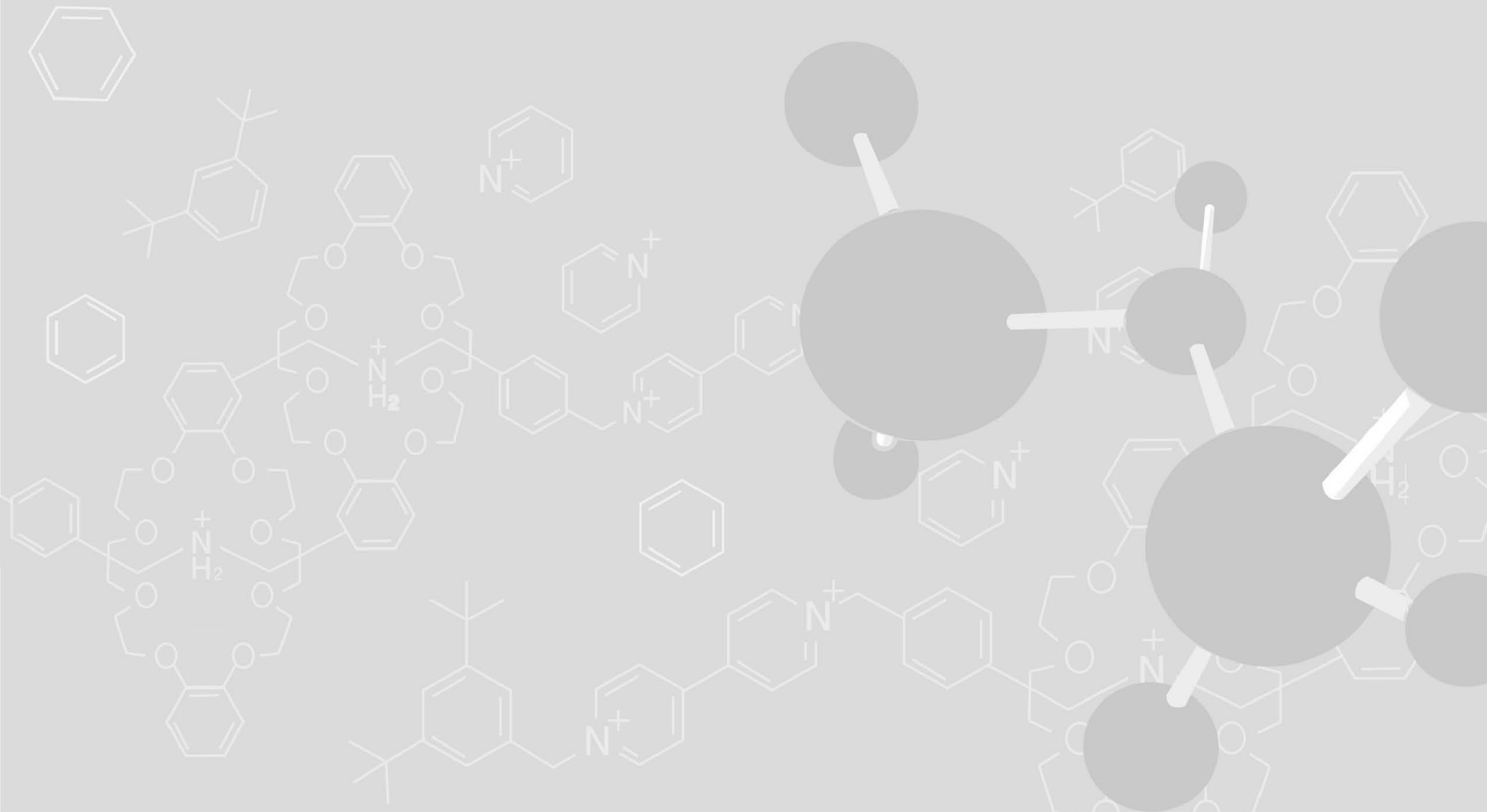
2020년 추계학술대회
연구논문 초록집

The Polymer Society of Korea

구두 발표 프로그램



기조강연장_10월 6일 (화)

기조강연

PL-1 (10:00-10:40) **좌장: 윤호규**
전기차 파트너, 리튬이온전지
김명환, LG화학

제1회장_10월 6일 (화)

콜로이드 및 분자조립 부문위원회 (I)

Organizer: 심태섭(아주대), 이효민(POSTECH)

1L1-1 (13:00-13:25) **좌장: 임재훈**
Perspectives on the Environmentally Friendly InP-based Quantum Dots for Display Applications
장은주, 삼성전자

1L1-2 (13:25-13:50)
Diffusion and Energy Balance of a Brownian Particle in an Active Bath
박혁규, 박진태, UNIST/IBS

1L1-3 (13:50-14:15)
Functional Epoxide Monomers: From Self-Assembled Degradable Micelles to Hydrogels
김병수, 연세대학교

1L1-4 (14:15-14:40)
Complete Encapsulation of Sulfur in Porous Carbon: A Key Process for High-performance Lithium-sulfur Batteries
문준혁, 서강대학교

1L1-5 (15:00-15:25) **좌장: 이효민**
Graphene-templated Growth of Conjugated Molecules for Organic Electronics
조길원, 포항공과대학교

1L1-6 (15:25-15:50)
Colloidal Interactions at or Near Fluid-fluid Interfaces
박범준, 경희대학교 국제캠퍼스

1L1-7 (15:50-16:15)
Functional Ion Gels: Promising Electrolyte Platforms for Electrochemical Applications
문홍철, 서울시립대학교

1L1-8 (16:15-16:40)
Liquid Crystal Emulsion with Lasing Application
윤동기, 한국과학기술원

제2회장_10월 6일 (화)

신진연구자 특별 심포지움 (I)

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

1L2-1 (13:00-13:25) **좌장: 홍성우**
Tailoring of Polymer Chains and Microstructure Characterization Using X-ray Scattering
박성민, 한국화학연구원

1L2-2 (13:25-13:50)
Interface Engineering for Efficient and Stable Perovskite Solar Cells
송슬기, 한국화학연구원

1L2-3 (13:50-14:15)
Synthetic Approaches to Semiconductive Polymers for Chemical Sensors
구병진, 단국대학교

1L2-4 (14:15-14:40)
Expanding the Properties and Utility of DNA-Engineered Nanoparticle Superlattices through Monodispersity and Metallization
오태곤, 한국과학기술연구원

1L2-5 (15:00-15:25) **좌장: 김용주**
Self-healing Soft Electronics: From Materials to Devices to Systems
강지형, 한국과학기술원

1L2-6 (15:25-15:50)
Interfacial Engineering in MOF-Polymer Hybrid Membranes for Efficient Gas Separations
지원석, 전남대학교

1L2-7 (15:50-16:15)
Multipolar Spatial Electric Field Modulation for Free form Electroactive Actuation
나준희, 충남대학교

1L2-8 (16:15-16:40)
Chemical Additives of Solution-Phase Ligand Exchange for Infrared Colloidal Quantum Dot Solar Cells
조제웅, 동국대학교

제3회장_10월 6일 (화)

고분자구조 및 물성

Organizer: 고현협(UNIST), 염봉준(한양대)

1L3-1 (13:00-13:25) **좌장: 고현협**
Artificial Multimodal Receptors Based on Ion Relaxation Dynamics
정운룡, 포항공과대학교

1L3-2 (13:25-13:50)
Molecular Doping and Nanostructuring of Conjugated Polymers for Thermoelectric Applications
장재영, 한양대학교

1L3-3 (13:50-14:15)
Bio-Inspired Smart Window
윤현식, 서울과학기술대학교

1L3-4 (14:15-14:40)
Multi-Functional Nanocomposites from Naturally Derived Materials: Conductive Melanin and Crystalline Nanocellulose
심봉섭, 인하대학교

1L3-5 (15:00-15:25) **좌장: 염봉준**
Ionovoltaic Analysis in Aqueous Systems
김연상, 서울대학교

1L3-6 (15:25-15:50)
DNA-Coated Janus Colloids
이기라, 조인성, 성균관대학교

1L3-7 (15:50-16:15)
Strain Tunable Optical Microlens Arrays with Deformable Wrinkles for Spatially Coordinated Image Projection on Security Substrate
홍석원, 부산대학교

1L3-8 (16:15-16:40)
3D Nanostructured PDMS for Functional Applications
전석우, 한국과학기술원

제4회장_10월 6일 (화)

고분자가공/복합재료

Organizer: 임성갑(KAIST), 장세규(KIST)

1L4-1 (13:00-13:25) **좌장: 임성갑**
Thermally Stable and High-efficient Porous Polymers for Application to Battery Separator
강상욱, 상명대학교 화학에너지공학과

1L4-2 (13:25-13:50)
Development of Hydrocarbon-based Membrane Materials and Structural Effect of Hydrophobic Block on the Chemical Stability for Redox Flow Battery
이장용, 한국화학연구원

1L4-3 (13:50-14:15)
고성능 기체분리를 위한 기능성 다공성 고분자
배태현, 한국과학기술원

1L4-4 (14:15-14:40)
Intrinsically Microporous Polymers for Advanced Separation Processes
고동연, KAIST

1L4-5 (15:00-15:25) **좌장: 고동연**
나노복합 재료를 이용한 포장재 개발
김진호, (주)상보

1L4-6 (15:25-15:50)
콜로이드 SiO_2와 Polyimide 복합재료를 이용한 저유전 하이브리드 필름 제조 및 특성
윤여성, 장은진, 문동준, 오미혜, 한국자동차연구원

1L4-7 (15:50-16:15)
How and What to Use of Rheometer in Material Development and Polymer Processing
김명호, 한남대학교

1L4-8 (16:15-16:40)
Morphological Evolution of Commercial PAN-based Carbon Fibersin Oxidation
이성호, 한국과학기술연구원

제5회장_10월 6일 (화)

고분자 이론 및 시뮬레이션

Organizer: 손정곤(KIST), 허수미(전남대)

1L5-1 (13:00-13:25) **좌장: 허수미**
Self-Assembly in Charged Polymeric Mixtures: Equation-of-state and Field Approaches
조준한, 단국대학교

1L5-2 (13:25-13:50)
Polymer Loop Formation in Glass-Forming Liquid
성봉준, 서강대학교

1L5-3 (13:50-14:15)
Description of Flow In Soft Glassy Materials by the Soft Glassy Rheology (SGR) Model
박준동, 숙명여자대학교

1L5-4 (14:15-14:40)
Role of Solvation on Diffusion of Ions in Diblock Copolymers: Understanding the Molecular Weight Effect Through Modeling
서영미, LG화학 기술연구원

1L5-5 (15:00-15:25) **좌장: 손정곤**
Electrostatic Bending of Intrinsically Rigid DNA by Binding with a Cationic Nanoparticle: Application to the Brownian Motor
김준수, 이화여자대학교

1L5-6 (15:25-15:50)
Enabling Predictive Molecular Simulations of Polymer Electrolytes for Next Generation Energy Storage Devices
손창윤, 포항공과대학교

1L5-7 (15:50-16:15)
Self-assembly Simulation of Architecture Controlled Copolymers in Solution
김용주, 국민대학교

1L5-8 (16:15-16:40)
Single Chain in Mean Field (SCMF) Simulation of Flexible and Semiflexible Polymers
김재업, 울산과학기술원

제6회장_10월 6일 (화)

Biomedical Polymers Division (I) (English)

Organizer: Dong-Wook Han (Pusan Natl. Univ.), Yong-kyu Lee (KNUT), Seung Yun Yang (Pusan Natl. Univ.)

1L6-1 (13:00-13:25) **Chair: In Kyu Park**
Heme Oxygenase 1-targeted Drug Delivery Systems for Acute Myeloid Leukemia Therapy
Seok-BeomYong, Jaehyun Kim, Yong-Hee Kim*, Department of Bioengineering, Hanyang University; *Department of Bioengineering, Hanyang University/Institute for Bioengineering and Biopharmaceutical Research, Hanyang University

1L6-2 (13:25-13:50)
Targeted Cancer Therapy Using PDT-based Self-assembled Nanoparticles that can be Selectively Activated in Tumors by Visible-light
박주호, 건국대학교

1L6-3 (13:50-14:15)
Human BBB Model for Study for BBB Penetration of Drugs
박태은, 울산과학기술원(UNIST)

1L6-4 (14:15-14:40)
Secretory Production of Recombinant Proteins Using ABC Transporter in Gram Negative Bacteria
안정훈, 한국과학영재학교

1L6-5 (15:00-15:25) **Chair: Se Heang Oh**
Smart Wearable Devices for Ubiquitous Healthcare Applications
한세광, 포항공과대학교

1L6-6 (15:25-15:50)
Endosome-triggered Ion-releasing Nanoparticles as Therapeutics to Enhance the Angiogenic Effcacy of Human Mesenchymal Stem Cells
방석호, 성균관대학교

1L6-7 (15:50-16:15)
Polymer Based Functionalized Microfluidic Cell Chips for In-situ Monitoring of Cell Culture and Drug Efficacy
양성윤, 충남대학교

1L6-8 (16:15-16:40)
Orally Active Heparin Conjugate Augments Drug Distribution and Alleviates the Immunosuppressive Microenvironment by Promoting Tumor Perfusion
Jeong Uk Choi, Chonnam National University

제7회장_10월 6일 (화)

자동차 파워트레인/샤시용 고분자 재료

Organizer: 최치훈(현대자동차), 이춘수(현대자동차)

1L7-1 (13:00-13:25) **좌장: 최치훈**
PT샤시/차체외판용 플라스틱 부품 동향 및 미래차 소재 기술 이슈
황덕형, 김석환, 현대자동차

1L7-2 (13:25-13:50)
탄소섬유를 적용한 고강성 배터리 케이스 개발
김도형, 최현진, 김권택, 오애리, 정찬호, 서하정, LG하우시스

1L7-3 (13:50-14:15)
수소저장시스템적용 복합소재 경량화 프레임 개발
박균범, 동희산업

1L7-4 (14:15-14:40)
연료전지자동차의 플라스틱 수소 이송관에 관한 연구
오현옥, 부국산업(주) 연구소

1L7-5 (15:00-15:25) **좌장: 이춘수**
내열안정성이 우수한 POLYAMIDE 소재
정헌규, 코오롱플라스틱

1L7-6 (15:25-15:50)
엔지니어링 플라스틱의 최신 해석 기술 동향
제형호, BASF

1L7-7 (15:50-16:15)
나노 소재를 이용한 자동차 연료 증발가스 투과 방지 단층플라스틱 소재 개발
김상엽, 류동열*, 권보림*, BYK Korea(신일화학공업 기술고문); *신일화학공업

1L7-8 (16:15-16:40)
Forming Two- and Three-Dimensional Network Polymers for Energy Applications
백종범, 울산과학기술원

제8회장_10월 6일 (화)

분자전자 부문위원회 (I)

Organizer: 박상혁(공주대), 오진우(부산대), 윤명한(GIST)

1L8-1 (13:00-13:25) **좌장: 김경곤**
Highly Strong and Conductive Acid-spun Carbon Nanotube Fibers
구본철, 한국과학기술연구원

1L8-2 (13:25-13:50)
Solution-based Patterned Synthesis of 2D Heterostructure and Its Application
이승기, 한국과학기술연구원

1L8-3 (13:50-14:15)
Development of Large-area Organic Photovoltaics for Indoor and Outdoor Applications
손해정, 한국과학기술연구원

1L8-4 (14:15-14:40)
A Reactive Polyurea Nanogel as a Solution-processable, Functional Nano-coating
박지웅, 남준식, 광주과학기술원

1L8-5 (15:00-15:25) **좌장: 손해정**
Strategies to Enhance Stabilities of Organic Photovoltaics
김경곤, 이화여자대학교

1L8-6 (15:25-15:50)
Simple All-Dip-Coating Processed Perovskite Materials for Efficient Perovskite Solar Cells
이재관, 조선대학교

1L8-7 (15:50-16:15)
Perovskite Solar Cells: Organic Hole-transport Materials and Tandem Structures with III-V
박희준, 한양대학교

1L8-8 (16:15-16:40)
Electrochemistry of Quaternary Ammonium Polybromide Droplets
장진호, 한양대학교

1L8-9 (16:40-17:20)
2021년 과학기술정보통신부 국책연구사업 소개 및 주요 이슈
이영국, 한국연구재단 국책연구본부 소재부품단

제9회장_10월 6일 (화)

Graduate Student Oral Session (I) (English)

Organizer: Jeong Jae Wie (Inha Univ.), Dong Ki Yoon (KAIST), Keun Hyung Lee (Inha Univ.)

1O9-2 (13:15-13:30) **Chair: Jeong Jae Wie**
Non-Volatile, Ultra-stretchable, Highly Transparent Ion Gels for the Next-Generation Skin-type Wearable Sensors
김용민, 문홍철, 서울시립대학교

1O9-3 (13:30-13:45)
Versatile Soft Robotic Web Inspired by Spider Web
송원준, 이영훈, 정연수, 유현재, 김만용*, 김호영, 선정윤, 서울대학교; *음암중학교

1O9-4 (13:45-14:00)
Poloxamer for Extrusion-based 3D Printing of Hydrogels

Kusuma Betha Cahaya Imani, 윤진환, 부산대학교

1O9-5 (14:00-14:15)
Dual-functional Alginate Crosslinker: Independent Control of Crosslinking Density and Cell Adhesive Properties of Hydrogels via Separate Conjugation Pathways
최초롱, 김선태, 차채녕, 울산과학기술원

1O9-6 (14:15-14:30)
Silver Fractal Dendrites for Highly Sensitive and Transparent Positive Temperature Coefficient Polyacrylate Thermistors
김종윤, 이윤구, DGIST

1O9-7 (14:30-14:45)
Soft Hydrogel-based Ion Conducting Artificial Tongue for Astringency Perception
염정희, 최아영, 임성동, 이영수, 나상윤, 고현협, 울산과학기술원

1O9-8 (14:45-15:00)
Preparation of Polymeric Core-shell Microparticles for the Detection of Formaldehyde
윤가영, 김양수, 인제대학교

1O9-9 (15:10-15:25) **Chair: Younsoo Kim**
Linearity and Sensing Band Controlled Pressure Sensor by Designated Electrodes
정찬호, 김태일, 성균관대학교

1O9-10 (15:25-15:40)
Structure and Relaxation Dynamics for Complex Coacervate Hydrogel of ABA Triblock Copolymer
김정민, 허태영, 최수형, 홍익대학교

1O9-11 (15:40-15:55)
Eco-Degradable and Flexible Clay-DMSO Nano-composites as a Solid-State Ionic Conductor
이승현, 심봉섭, 인하대학교

1O9-12 (15:55-16:10)
Organic Solvent Nanofiltration via Ultrathin Membranes Synthesized with Initiated Chemical Vapor Deposition (iCVD)
최지훈, 고동연, 한국과학기술원

1O9-13 (16:10-16:25)
Tuning Ultramicroporosity of Carbon Molecular Sieve (CMS) Membrane with Electron Beam Irradiation
오반석, 고동연, 한국과학기술원

1O9-14 (16:25-16:40)
Phase Behavior of 6-arm Star (PMMA-*b*-PS)$_6$ in Thin Films
박소영, 김진곤, 포항공과대학교

1O9-15 (16:40-16:55)
Sub-10 nm Perpendicular Lamellae of Fluoro-Acrylic Block Copolymer Films and Electric Field Induced Directed Assembly
조성준, 전승배, 김휘수, 류두열, 연세대학교

제10회장_10월 6일 (화)

대학원생 구두발표 (I)

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

1O10-1 (13:00-13:15) **좌장: 전석진**
Microplatelet-Reinforced Structural Polymer Composites Based on Design Principle of Nacre
지동환, 김재윤, 성균관대학교

1O10-2 (13:15-13:30)
Preparation of PEI Modified Carboxymethyl Cellulose Nano-fibril Beads as Superadsorbent for Cr(VI) Removal
박진석, 김정규, 김윤진, 방준식, 곽효원, 서울대학교

1O10-3 (13:30-13:45)
A Chemical-Receptor Functionalizable Interpenetrating Polymer Semiconductor Nano-networks for Outstanding Chemodetection with Remarkable Sensitivity, Selectivity and Recovery
권혁민, 김재희, 박한울, 고푸른산, 황해중, 김도환, 한양대학교

1O10-4 (13:45-14:00)
Highly Durable Fuel Cell Catalysts Using Crosslinkable Block Copolymer-Based Carbon Particles with Ultralow Pt Loadings
이영준, 최주혁, 이현주, 김범준, KAIST

1O10-5 (14:00-14:15)
A Highly Self-healable Elastomer Based on Urea Oligomer with Excellent Mechanical Properties and Outstanding Long-term Storage Stability
최기원, 김진실*, 이서윤, 강정순, 김기승*, 박희정**, 홍성우*, 고민재, 한양대학교; *한국생산기술연구원; **단국대학교

1O10-6 (14:15-14:30)
Consecutive Phase Separation of Cholesteric Liquid Crystals in Emulsion Drops for Photonic Capsules with Multiple Photonic Bandgaps
박시훈, 이상석*, 김신현, 한국과학기술원; *한국과학기술연구원

1O10-7 (14:30-14:45)
Fabrication of Cation-π Interacted Graphene Hydrogels for Highly Robust Supercapacitors
한임경, 김연수, 포항공과대학교

1O10-8 (14:45-15:00)
Universal Three-dimensional Crosslinker for All-photopatterned Electronics
김민제, 이명재*, 강문성**, 김봉수***, 조정호, 연세대학교; *고려대학교; **서강대학교; ***UNIST

1O10-9 (15:10-15:25) **좌장: 이동윤**
Peptidomimetic Antimicrobial PEGtides: A Modular Approach to Combat Bacteria
김민성, 문원식, 정우혁*, 이준희, 조가영, 권지수, 안동준*, Robert J. Mitchell, 김병수**, 울산과학기술원; *고려대학교; **연세대학교

1O10-10 (15:25-15:40)
Dual-crosslinked Chitosan Aerogel for Wound Dressing Prepared by Non-acid Condition
고은주, 김형섭, 건국대학교

1O10-11 (15:40-15:55)
Hyaluronan Microgel as a Local Controlled Protein Delivery Carrier
이시민, 박기동, 손주영, 아주대학교

1O10-12 (15:55-16:10)
A Dry Room-free Enabled by Functional Separator Membrane for High-current-density Lithium-ion Batteries
손혜빈, 박수진, 유승민*, 포항공과대학교; *울산과학대학교

1O10-13 (16:10-16:25)
Effect of the Solubility Parameter of the Solvent on the Film-forming Behavior and Polymer Aggregation of the Conjugated Polymer
권은혜, 박영돈, 인천대학교

1O10-14 (16:25-16:40)
3D Printable Alginate/Silk Fibroin Hydrogel with Enhanced Cytocompatibility and Dimensional Stability via Photocrosslinking
김은우, 박원호, 충남대학교

1O10-15 (16:40-16:55)
Microfluidically-Designed Smart Microcapsules for NIR-Triggered Chemo-Photothermal Therapy
김지원, 한상훈, 김신현, KAIST

기조강연장_10월 7일 (수)

상암고분자상 수상기념강연

PL-2 (10:00-10:40) **좌장: 나창운**
A 30 Year Journey in Organic Photonics: From Potential to Reality
김장주, 서울대학교

한화고분자학술상 수상기념강연

PL-3 (10:40-11:20) **좌장: 김윤희**
Arylene Based Ion Conductive Polymer Electrolyte Membranes for Li Secondary Batteries and Fuel Cells
김덕준, 성균관대학교

제1회장_10월 7일 (수)

콜로이드 및 분자조립 부문위원회 (II)

Organizer: 심태섭(아주대), 이효민(POSTECH)

2L1-1 (13:00-13:25) **좌장: 이주형**
Self-assembly of Nanoparticles to Fabricate Optical Structures Inspired from Nature
오진우, 부산대학교

2L1-2 (13:25-13:50)
User-interactive 3D Touchless Sensing Displays with Block Copolymer Self Assembly
박철민, 강한솔, 박태현, 한효원, 연세대학교

2L1-3 (13:50-14:15)
Functional Building Blocks for Molecular Engineering of Polynorbornenes from Ring-Opening Metathesis Polymerization
임지우, 경희대학교

2L1-4 (14:15-14:40)
Assembly and Hybridization of Plasmonic Nanoparticles for Catalysis, Optoelectronics and Theragnosis
김동하, 이화여자대학교

2L1-5 (15:00-15:25) **좌장: 심태섭**
Structure and Kinetics of Micelles Based on Bottlebrush Block Copolymers in Selective Solvent
차국헌, 서울대학교

2L1-6 (15:25-15:50)
Design of Smart Material from Colloidal/Molecular Self-Assembly via Liquid Crystalline Soft Template
김영기, 포항공과대학교

2L1-7 (15:50-16:15)
Supramolecular Two-dimensional Materials as Biofunctional Modulators
김용주, 고려대학교

2L1-8 (16:15-16:40)
Interfacial Assembly of Amphiphilic Photonic Tiles
김신현, 한국과학기술원

제2회장_10월 7일 (수)

신진연구자 특별 심포지움 (II)

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

2L2-1 (13:00-13:25) **좌장: 김용주**
Structure Engineering of Polymer Dielectric Films for Multifunctional Triboelectric Devices
김민수, 고현협, 울산과학기술원

2L2-2 (13:25-13:50)
Functional Separator Membrane Based on Phase Separation Method for Use in Energy Storage Devices
송우진, 충남대학교 유기재료공학과

2L2-3 (13:50-14:15)
Directed Self-assembly of Block Copolymer Thin Film with Vertical Lamellae by Applying Filtered Plasma and Repeated Shear Stress
오진우, 손정곤, 한국과학기술연구원

2L2-4 (14:15-14:40)
Fabrication of Phospholipid- and Block Copolymer-based Artificial Sensory Organ Arrays on Chips
한원배, 고려대학교

2L2-5 (15:00-15:25) **좌장: 홍성우**
High-Performance and Stable Nonfullerene Acceptor-Based Organic Solar Cells for Indoor to Outdoor Light
박성민, 안형주*, 김지영, 손해정, 한국과학기술연구원; *포항가속기연구소

2L2-6 (15:25-15:50)
1D Hypo-Crystals: Crystallization of Stereo-Irregular Polymers with Entropy Diluent
심재현, 강영종, 한양대학교

2L2-7 (15:50-16:15)
Low-temperature Solution-processed Soluble Polyimide Gate Dielectrics: From Molecular-level Design to Electrically Stable and Flexible Organic Transistors
박현진, 김윤호, 원종찬, 한국화학연구원

2L2-8 (16:15-16:40)
Spatiotemporal Proximity Crosslinking by Light Activation (Spotlight) for in vivo Interactome Mapping
강명균, 서울대학교

제3회장_10월 7일 (수)

고분자 합성: 기초 합성에서 첨단 소재까지

Organizer: 김병수(연세대), 김정곤(전북대)

2L3-1 (13:00-13:25) **좌장: 김병수**
Precise Synthesis of Block Copolymers Containing Triphenylamine via Living Anionic Polymerization and Their Applications
강범구, 숭실대학교

2L3-2 (13:25-13:50)
Development of Organic Semiconducting Materials for Solar Cell Devices
장성연, 울산과학기술원

2L3-3 (13:50-14:15)
Development of High Peroformance New Semiconducting Materials
김윤희, 경상대학교

2L3-4 (14:15-14:40)
Alkyl Side-Chain Engineering of Non-Fullerene Acceptors for Large-Area Organic Solar Cells
임은희, 경기대학교

2L3-5 (15:00-15:25) **좌장: 김정곤**
Study on Synthesis of Polyisocyanates from 1994
이재석, 광주과학기술원

2L3-6 (15:25-15:50)
Molecular Weight Distribution of Polystyrenes Prepared by Reversible Deactivation Radical Polymerization
백현종, 부산대학교

2L3-7 (15:50-16:15)
Molecularly Engineered Redox-regulating Biopolymers for Nanomedicines
이동원, 전북대학교

2L3-8 (16:15-16:40)
Effective Design of Polymer Matrix for MOF Based Toxic Chemical Detoxification System
서진영, 백경열, 한국과학기술연구원

제4회장_10월 7일 (수)

유무기 양자소재 및 응용기술

Organizer: 정소희(성균관대), 이도창(KAIST)

2L4-1 (13:00-13:25) **좌장: 강문성**
In Situ Sol-Gel Synthesized Siloxane-Encapsulated Quantum Dot Resin for Color Converters in Display Applications
배병수, 한국과학기술원

2L4-2 (13:25-13:50)
Highly Bright and Narrow Emission from InP-based Quantum Dots
장효숙, 장은주, 원유호, 김용욱, 삼성종합기술원

2L4-3 (13:50-14:15)
Ultrathin Flexible Optoelectronic Devices for Wearable/Implantable Applications
최문기, 울산과학기술원(UNIST)

2L4-4 (14:15-14:40)
Surface Modification of Quantum Dots with Cross-linkable Polymer Ligands
방준하, 고재완, 고려대학교

2L4-5 (15:00-15:25) **좌장: 임재훈**
양자점 고분자 복합체의 다양한 응용 기술 동향
한철종, 박경원, 이정민, 한국전자기술연구원

2L4-6 (15:25-15:50)
Experimental Studies on the Photophysics of Single Fluorescent Emitters
이광걸, 한양대학교 물리학과

2L4-7 (15:50-16:15)
Understanding Surface-Ligand Interactions of All-Inorganic Cesium Lead Halide Perovskite Nanocrystals
우주영, 임성남, 송신애, 김기영, 김시형, 한국생산기술연구원

2L4-8 (16:15-16:40)
Colloidal Quantum Dots of Fully-inorganic Cesium Lead Halide Perovskites for Photovoltaic Applications
김영훈, DGIST

2L4-9 (16:40-17:05)
Efficient Colloidal Quantum Dot:Organic Hybrids Solar Cells
이정용, 한국과학기술원(KAIST)

제5회장_10월 7일 (수)

Korea-Taiwan Joint Symposium: Advanced Polymer Science and Engineering (English)

Organizer: Moon Sung Kang (Sogang Univ.), Younsoo Kim (POSTECH)

2L5-1 (13:00-13:25) **Chair: Younsoo Kim**
Synthesis and Hydrogelation of Polypeptide-Based Polymers
Jeng-Shiung Jan, Xuan-You Shen, Chen-Chi Tang, Department of Chemical Engineering, National Cheng Kung University

2L5-2 (13:25-13:50)
In Situ Forming Hydrogels with Tunable Mechanics for Biomedical Applications
차채녕, 울산과학기술원

2L5-3 (13:50-14:15)
Fabrication of Photocurable and Elastomeric Poly(glycerol sebacate)-*co*-Poly(ethylene glycol) Hydrogels
Yi-Cheun Yeh, Institute of Polymer Science and Engineering, National Taiwan University

2L5-4 (14:15-14:40)
Highly Conductive Polymer Gel Electrolytes for Deformable Thin-film Devices
이근형, 인하대학교

2L5-5 (15:00-15:25) **Chair: Keun Hyung Lee**
Advanced Energy Conversion and Storage Devices Using Double Comb

Copolymers
박정태, 건국대학교

2L5-6 (15:25-15:50)
Influences of Structure Defects on the Performances of Solution-Processed OFET
Chien-Lung Wang, Yi-Fan Huang, Kuan-Yi Wu, Chou-Ting Hsieh, Department of Applied Chemistry, National Chiao Tung University

2L5-7 (15:50-16:15)
PIMS-Based Nanoporous Polymer Membrane: How Small Can We Go?
서명은, KAIST

2L5-8 (16:15-16:40)
Macroscopic Geometry-Dominated Orientation of Symmetric Microwrinkle Patterns and Their Applications
Han-Yu Hsueh, Department of Material Science and Engineering, National Chung Hsing University

제6회장_10월 7일 (수)

의료용 고분자 부문위원회 (II)

Organizer: 한동욱(부산대), 이용규(한국교통대), 양승윤(부산대)

2L6-1 (13:00-13:25) 좌장: 황승림
Cancer-specific Prodrug Nanoparticles for Cancer Targeting Therapy
김광명, Korea Institute of Science and Technology (KIST)

2L6-2 (13:25-13:50)
Lectin-Janus Nanoparticles for the Exosome-mediated Diagnosis of Metastatic Pancreatic Cancer
최종훈, 최용현, 중앙대학교

2L6-3 (13:50-14:15)
Vapor-phase Synthesized Functional Polymer Films for Conformal Modification of the Biochip Surfaces
임성갑, KAIST

2L6-4 (14:15-14:40)
Applications of Hyaluronic Acid Particles for 3D Cell Culture and Tissue Regeneration
강선웅, 박경환, 허강무*, 안전성평가연구소; *충남대학교

2L6-5 (15:00-15:25) 좌장: 이용규
Highly Stretchable Self-healing Co-polymeric Gel Controlled by Molecular Interactions Between Acrylic Acid and Methyl Methacrylate
노인섭, 서울과학기술대학교

2L6-6 (15:25-15:50)
Enabling Technology of Cell-derived Extracellular Matrix for Advanced Tissue Repair
하상수, 김인걸*, 최동훈**, 박귀덕, Center for Biomaterials, Korea Institute of Science and Technology/Division of Bio-Medical Science and Technology, KIST School, University of Science and Technology (UST); *Department of ENT, Seoul National University Hospital; **Cardiology Division, Severance Cardiovascular Hospital, Yonsei University

2L6-7 (15:50-16:15)
Multiscale Biomimetic Approaches for Regulation of Cell Function and Tissue Regeneration
김장호, 전남대학교

2L6-8 (16:15-16:40)
Sustained Release of Reactive Oxygen Species via *in situ* Cross-linking Gelatin Hydrogels Attenuates Tonsil-derived Mesenchymal Stem Cells Senescence by Redistribution of Glucose-regulated Protein
박윤신, 충북대학교

제7회장_10월 7일 (수)

기능성 고분자

Organizer: 곽효원(서울대), 윤현석(전남대)

2L7-1 (13:00-13:25) 좌장: 윤현석
Mechano- and Electro-Active Nanocapsules and Elastomeric Patches
박치영, DGIST

2L7-2 (13:25-13:50)
Wearable Multimode Sensors Using Textile Structure for Detecting Human Body Signals
박종진, 전남대학교

2L7-3 (13:50-14:15)
Conducting Polymer-based Stimuli-responsive Smart Fluids
이승애, 건국대학교

2L7-4 (14:15-14:40)
Fabrication of Highly Conductive Polymer Hybrid Nanomaterials for High Performance Flexible Radio-frequency Antenna Application
신근영, 숭실대학교

2L7-5 (15:00-15:25) 좌장: 곽효원
Shape Control of Cellulose Nanofiber Hydrogels
현진호, 서울대학교

2L7-6 (15:25-15:50)
Nanofiber-Based Flexible Transparent Composite Electrodes for Wearable Electronics
김병석, 이승희, 고태훈, 전북대학교

2L7-7 (15:50-16:15)
A Low Cost Cationic Selective Ion-exchange Membrane for Rechargeable Zinc Batteries
이병선, 단국대학교 고분자시스템공학부 파이버융합소재전공

2L7-8 (16:15-16:40)
Thermo-responsive Polymeric Materials for Water Treatment Application
강 효, 동아대학교

제8회장_10월 7일 (수)

분자전자 부문위원회 (II)

Organizer: 박상혁(공주대), 오진우(부산대), 윤명한(GIST)

2L8-1 (13:00-13:25) 좌장: 우상혁
Recent Progress and Challenges of Fiber Dye-sensitized Solar Cells
송명관, 최진우, 재료연구소

2L8-2 (13:25-13:50)
High-Resolution Patterning of Metal Nanowire Based Electrodes for Flexible and Stretchable Electronic Devices
이윤구, 대구경북과학기술원

2L8-3 (13:50-14:15)
Influence of Acceptor Type and Polymer Molecular Weight on the Mechanical and Photovoltaic Properties of Polymer Solar Cells
김범준, 한국과학기술원

2L8-4 (14:15-14:40)
플렉서블 소자 응용을 위한 초박형 컬러 구현 및 위조방지필름
송영민, 광주과학기술원

2L8-5 (15:00-15:25) 좌장: 송영민
High-detectivity Organic Photodetectors by Development of Novel Conjugated Polymers
정인환, 국민대학교

2L8-6 (15:25-15:50)
Evaporation Driven Surface-Templated Supraparticle Synthesis
우상혁, 중앙대학교

2L8-7 (15:50-16:15)
Next-Generation Neural Interfaces: From Flexible Optoelectronic Fibers to Nanomaterials
박성준, 한국과학기술원

2L8-8 (16:15-16:40)
Synthesis of Nanoarchitectured Functional Materials from Polymers for Emerging Applications
김정훈, 국민대학교

제9회장_10월 7일 (수)

Graduate Student Oral Session (II) (English)

Organizer: Jeong Jae Wie (Inha Univ.), Dong Ki Yoon (KAIST), Keun Hyung Lee (Inha Univ.)

2O9-1 (13:00-13:15) Chair: Se Gyu Jang
Single-Cation Two-dimensional Formamidium Lead Halide Perovskite Films: Fabrication and Study of Optical Properties
NGUYEN MINH DUONG, 강영종, 한양대학교

2O9-2 (13:15-13:30)
Crystal Engineering of Azobenzene-based Organic Dye for Paintable Metallic Luster
임석인, 김대윤*, 정광운, 전북대학교; *한국과학기술원

2O9-3 (13:30-13:45)
Nanofiber Based Multifunctional Filter Platform Using Metal-Organic Frameworks (MOFs) Decorated Fe-doped TiO2 Nanorod Composites
김동연, 윤기로, 한국생산기술연구원

2O9-4 (13:45-14:00)
Viscosification of Nanoparticle Dispersion via Modulation of the Hydrogen Bonding Mode
신이삭, 서명은, 한국과학기술원

2O9-5 (14:00-14:15)
Dual Responsive PdNPs-SBA-15-PNIPAM/PMAA as a Versatile and Heterogeneous Green Nanocatalyst for the Suzuki-Miyaura Coupling

Reactions in the Aqueous Medium
안난두 모한, 박성수, 제롬 피터, 안주 마리아 토마스, 하창식, 부산대학교

2O9-6 (14:15-14:30)
In situ Deprotection of Polymeric Binders for Solution-Processible Sulfide-based All-Solid-State Batteries
이지은, 최장욱, 차국헌, 서울대학교

2O9-7 (14:30-14:45)
Sulfonated Poly(arylene ether ketone) Impregnated Porous PTFE Electrolyte Membranes with Ultra-low Vanadium Ion Permeability for Vanadium Redox Flow Battery
안연호, 김덕준, 성균관대학교

2O9-8 (14:45-15:00)
Pushing the Band Gap Envelope of Quasi-Type II Heterostructures to Blue: ZnSe/$ZnSe_{1-x}Te_x$/ZnSe Spherical Quantum Wells
이학준, 장준혁*, 이승현*, 윤상민*, 허성필*, 배완기*, 서울대학교; *성균관대학교

2O9-9 (15:10-15:25) **Chair: Dong Ki Yoon**
3-Dimensional Display through a Selective Plasticization and Nondisruptive Origami of Polymer Substrate
김기관, 김영민, 유성광, 장훈수, 고흥조, 광주과학기술원

2O9-12 (15:55-16:10)
Fabrication of Fiber Optoelectronic Devices via Conformal Transfer of Inkjet-printed Carbon Nanotube Microelectrodes for Smart Wearable E-textile Applications
김형준, 강태형, 이현정, 임정아, 한국과학기술연구원

2O9-13 (16:10-16:25)
Unique Polymorph of P3HT by Brønsted Acid Doping for Highly Conductive and Stable Organic Thermoelectric via Solution Mixing
서의현, 김상범, 정영제, 장재영, 한양대학교

2O9-14 (16:25-16:40)
Noise-Restrained Detection and Fast Response via a Non-Fullerene Acceptor for Stable Operation of Organic Photodiode
장웅식, 조재상, 김병기, 임지현, 김민수, 김진영, 왕동환, 중앙대학교

2O9-15 (16:40-16:55)
Long-term Retention and Low Power OTFT-NVMs with Hydroxyl Group Charge Trapping Layer via Ultrathin iCVD Dielectric
이창현, 박관용, 최준환, 김민주, 조병진, 임성갑, KAIST

2O9-16 (16:55-17:10)
Novel Injectable Nitric Oxide Releasing Hydrogel Accelerate M2 Macrophage Polarization for Wound Healing Applications
Dieu Linh Tran, 박기동, Le Thi Phuong, Ajou University

제10회장_10월 7일 (수)

대학원생 구두발표 (II)

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

2O10-1 (13:00-13:15) **좌장: 고현협**
Mechanochemically and Electrochemically Responsive Nano-Capsules Tailored with Metal-Phenolic complexes
최경현, 박치영, 대구경북과학기술원

2O10-2 (13:15-13:30)
Morphology Control via Strategic Halogen Substitution Achieving High-performance Small-molecule Based Tandem Solar Cells Exceeding 15% Efficiency
류승운, 박상아, 정우택, 김성룡, 송창은*, 이종철*, 박태호, POSTECH; *KRICT

2O10-3 (13:30-13:45)
High-Resolution Patterning of Quantum Dots via Azide-Containing Hole Transporting Polymeric Ligand
고재완, 장준혁*, 정병국*, 정준영, 박성남, 최동훈, 배완기*, 방준하, 고려대학교; *성균관대학교

2O10-4 (13:45-14:00)
Destruction of Toxic Chemicals Using Amine Functionalized Polymer and Metal-organic Framework Catalyst
서진영, 이정현*, 백경열, KIST; *고려대학교 화공생명공학과

2O10-5 (14:00-14:15)
Nanostructured Natural Melanin Composites with Tunable Multifunctional Properties
엄태식, 심봉섭, 인하대학교

2O10-6 (14:15-14:30)
On-site Fabrication of Injectable Biodegradable ^{131}I-Labeled Microgels for Local Radiotherapy
김소담, 임상구, Ajeesh Chandrasekharan, 성금용, 이태욱, 이유진*, 김근영**, 최성용*, 양승윤, 부산대학교; *한양대학교; **부산대학교병원

2O10-7 (14:30-14:45)
Wet-spun Carbon Nanotube Fiber for Flexible Thermoelectric Generators
박경태, 박종래*, 김희숙, 한국과학기술연구원; *서울대학교

2O10-8 (14:45-15:00)
Vertical Organic Synapse Expandable to 3D Crossbar Array
최용석, 조정호, 연세대학교

2O10-9 (15:10-15:25) **좌장: 손정곤**
Magnetic Actuation of Anisotropically Designed Micropillar Arrays
박정은, 전지수, 원수경, 위정재, 인하대학교 첨단소재연구실

2O10-10 (15:25-15:40)
Highly Ordered and Oriented Water Soluble Semiconducting Polymer Using a DNA Template
한문종, 윤동기, KAIST

2O10-11 (15:40-15:55)
An Efficient Route to Carbon Nanotube/Polymer Gels with Controlled Porosity
이상혁, 윤현석*, 전남대학교 대학원 고분자공학과; *전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

2O10-12 (15:55-16:10)
Synthesis of Photocurable Resins Based on Engineering Thermoplastic for Biocompatible Stereolithography 3D Printing Process
정재환, 이동현, 단국대학교 고분자공학과

2O10-13 (16:10-16:25)
Synthesis and Characterization of Biocompatible Copolymers Containing Plant-Based Cardanol and Zwitterionic Groups for Antifouling and Bactericidal Coating Applications
김진석, 이종찬, 이시영, 서울대학교

2O10-14 (16:25-16:40)
Conjugated Polymer Framework via Interfacial Knoevenagel Condensation: Covalent Self-Assembly from 0D Particle to 2D Film
오민택, 이택승, 충남대학교

2O10-15 (16:40-16:55)
Dissipative Particle Dynamics Simulation of Bottlebrush Copolymers: Effect of Brush Configuration and Crosslinking of Backbone Chain
권상우, 김용주*, 이원보, 서울대학교; *국민대학교

제1회장_10월 8일 (목)

신진연구자 특별 심포지움 (III)

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

3L1-1 (09:30-09:55) **좌장: 김용주**
Chiral Nanomaterials: Design Strategies and Their Properties
염지현, 카이스트

3L1-2 (09:55-10:20)
Designing Disruptive Organic Electrode Materials for Next-Generation Organic Batteries
권지언, 박수영*, 한국과학기술연구원; *서울대학교

3L1-3 (10:20-10:45)
Insights on the Optoelectric Properties of Perovskite Semiconductors via Transient Photoconductivity
임종철, 충남대학교

3L1-4 (10:45-11:10)
Synergistically Integrated Membranes and Ionomers for High Performance High Temperature Fuel Cells
이성수, 한국과학기술연구원

3L1-5 (11:10-11:35)
근적외선 광전변환을 위한 콜로이달 퀀텀닷/유기 반도체 앙상블 구조
백세웅, 고려대학교 화공생명공학과

3L1-6 (11:35-12:00)
Self-assembly of Dendronized Brush Block Copolymers in Emulsion for Color-Switchable Photonic Ellipsoids
구강희, 충남대학교

제2회장_10월 8일 (목)

Mechanochemical Approach to Polymers

Organizer: 김병수(연세대), 김정곤(전북대)

3L2-1 (09:30-09:55) **좌장: 김병수, 김정곤**
Polymerization in Ball Mills - From Linear Polymers to Porous Polymer Frameworks
Sven Grätz, Lars Borchardt, Faculty of Chemistry and Biochemistry, Ruhr-University Bochum

3L2-2 (09:55-10:20)
Fluorescence "turn-on" Upon Activating Mechanochemically Responsive Polymers
Yu-Hsuan Tung, Hao-Chun Chang, Chia-Chih Chang, Department of Applied Chemistry, National Chiao Tung University

3L2-3 (10:20-10:45)
Facile Mechanochemical Synthesis of Sustainable and Recyclable Network Polyurethanes Using a Biomass-Derived Furan Diol
김현우, 윤영성, 양지원, 차인환, 송창식, 성균관대학교

3L2-4 (10:45-11:10)
Ball Milling Prompted Atom Transfer Radical Polymerization in the Solid-State
조홍열, Christopher W. Bielawski*, 기초과학연구원 다차원탄소재료 연구단; *기초과학연구원 다차원탄소재료 연구단/울산과학기술원

3L2-5 (11:10-11:35)
Mechanochemical Degradation of Amorphous Polymers with Ball-Mill Grinding
Gregory Peterson, Yejin Hwang*, Tae-Lim Choi, Seoul National University; *Inha University

제3회장_10월 8일 (목)

신진연구자 특별 심포지움 (IV)

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

3L3-1 (09:30-09:55) 좌장: 홍성우
Polymer Systems with Network Structure and Their Applications
이진현, 인하대학교

3L3-2 (09:55-10:20)
Study on the Antibacterial Performance of Zinc Oxide and Silver Nanowire Films
김지현, 마준비, 이승훈, 김창수, 재료연구소(KIMS)

3L3-3 (10:20-10:45)
Artificial Photosynthesis: Learning from Nature
황동렬, 한남대학교

3L3-4 (10:45-11:10)
Passivating Defect Sites of Perovskite Materials to Improve Device Stability
김 민, 전북대학교

3L3-5 (11:10-11:35)
4차 산업혁명 시대를 위한 사물인터넷 소자와 3D 기능성 재료
김봉훈, 숭실대학교

3L3-6 (11:35-12:00)
Strategies for Manufacturing Eco-friendly Lignocellulosic Biosorbent and Improving Their Heavy Metal Removal Capacity
곽효원, 서울대학교

제4회장_10월 8일 (목)

차세대 기능성 고분자젤과 응용

Organizer: 김연수(POSTECH), 염봉준(한양대)

3L4-1 (09:30-09:55) 좌장: 염봉준
Gel Electrolytes: A Soft Route to All-solid-state Batteries
이상영, 울산과학기술원

3L4-2 (09:55-10:20)
Protein-based Adhesive Hydrogels for Regenerative Medicine and Drug Delivery Applications
차형준, Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH)

3L4-3 (10:20-10:45)
Biomimetic Hydrogels for Regenerative Medicine
조승우, 연세대학교

3L4-4 (10:45-11:10) 좌장: 김연수
Adhesive Hydrogels for Soft Tissue Mimicking and Transdermal Drug Delivery
김재윤, 성균관대학교

3L4-5 (11:10-11:35)
Mechanically Reinforced Highly Stretchable Hydrogels and Their Applications
윤진환, 부산대학교

3L4-6 (11:35-12:00)
Stretchable Ionics - Current & Future
선정윤, 서울대학교

제6회장_10월 8일 (목)

전력산업분야 고분자 복합소재 개발 및 응용

Organizer: 장세규(KIST)

3L6-1 (09:30-09:55) 좌장: 장세규
전력산업분야 고분자 복합소재 개발 및 응용
이중범, 한전 전력연구원

3L6-2 (09:55-10:20)
탄소섬유 전구체를 이용한 투명 전극 및 고전도성 도선 구현 연구
조한익, 건국대학교 미래에너지공학과

3L6-3 (10:20-10:45)
Carbon-Copper Composite Wires for High Performance Electrical and Mechanical Cables
배수강, 한국과학기술연구원

3L6-4 (10:45-11:10)
스마트 전기소재·부품을 위한 e-나노소재 응용기술
이건웅, 한국전기연구원

3L6-5 (11:10-11:35)
전력기기 감시용 복합 소재 및 이를 적용한 하베스팅 소자
정순종, 신동진, 고중혁*, 한국전기연구원 전기재료연구본부; *중앙대학교 전기전자공학부

3L6-6 (11:35-12:00)
Interface-engineered Polypropylene Blends for High Voltage Power Cable Insulations
유승건, 이대호, 한국전기연구원

제7-1회장_10월 8일 (목)

대학원생 구두발표 (IV)

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

3O7-1 (09:30-09:45) 좌장: 전석진
Preparation of Porous Silicon Carbonitride Ceramics with Micro-/Meso-/Macropore Using Branched Structured Polysilazane as Precursor and Freeze Casting Method
허태환, 곽영제, 숭실대학교

3O7-2 (09:45-10:00)
3D Bioprinted Gelatin-methacrylate Hydrogels Containing Poly(lactic-co-glycolic acid) Nanofiber Fragments
이혜영, 고윤제, 권오형, 금오공과대학교

3O7-3 (10:00-10:15)
Luminescence Enhancement of Upconversion Nanoparticle Sensitized Perovskite Quantum Dots in Metal-insulator-metal Configuration under NIR Excitation
김민주, 김영지, 고형덕*, 현가담, 김동하, 이화여자대학교; *한국과학기술연구원

3O7-4 (10:15-10:30)
Planar Color Display Boards Detecting Local Environmental Changes
손동완, Muhammad Umar*, Sara Arif*, 김성환*, 김명웅, 인하대학교; *아주대학교

3O7-5 (10:30-10:45)
Electrical Conductivity of Polymer Composites Highly Filled with Carbon Nanotube
장지운, 김성훈, 김성룡*, 한양대학교; *전북대학교

3O7-6 (10:45-11:00)
Study on the Mechanical Characteristics of Injection Molded Glass Fiber-reinforced Polyamide 66 Composites for the Application of Automotive Lightweighting
구권모, 김양수, 김경건*, 정재흠*, 김영길*, 인제대학교 나노융합공학부; *대흥알앤티

3O7-7 (11:00-11:15)
Improved Network Formation in Polyelectrolyte Complex Hydrogels via Suppression of Micellization
한지훈, 김연수, 포항공과대학교

3O7-8 (11:15-11:30)
Inverted Cylinder Structures from AB/AC Diblock Copolymer Blends with Hydrogen Bonding
강석원, 김진곤, 포항공과대학교

3O7-9 (11:30-11:45)
Food Waste-driven N-doped Carbon Dots: Applications for Fe^{3+} Sensing and Cell Imaging
안정빈, 김형섭, 건국대학교

3O7-10 (11:45-12:00)
Multicolor, Transparent, Design-it-Yourself (DIY) Electrochemical Displays Based on Oxidatively Tuned Ion Gels
이재경, 문홍철, 서울시립대학교

제7-2회장_10월 8일 (목)

대학원생 구두발표 (V)

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

3O7-11 (09:30-09:45) 좌장: 안석균
Implementation of Bottlebrush Polymer in Inducing Perpendicular Orientation of High-x Block Copolymers on Thin Film

김기현, 김민철, 방준하, 고려대학교

3O7-12 (09:45-10:00)
Intervertebral Disc Regeneration Using Stem Cell/Growth Factor-Loaded Porous Particles with a Leaf-Stacked Structure
김민지, 이진호*, 김준수**, 김호용, 이희천**, 변준호***, 이재훈**, 김나현****, 오세행, 단국대학교; *한남대학교; **경상대학교; ***경상대학교병원; ****안전성평가연구소

3O7-13 (10:00-10:15)
Cloaking Protein Shield Zr-MOF Delivery Platform for Targeted Nanomedicine
오준용, 유자형*, 울산과학기술원; *울산과학기술원 자연과학부

3O7-14 (10:15-10:30)
Anti-counterfeiting Application of Chiral Photonic Crystals Made of Aligned Helical Liquid Crystal Structures
박원기, 윤동기, 한국과학기술원

3O7-15 (10:30-10:45)
Dissipative Particle Dynamics Simulation of Self-assembly of Thin Film of Diblock Copolymers and Nanoparticles under Soft Confinement
남정용, 김용주*, 이원보, 서울대학교; *국민대학교

3O7-16 (10:45-11:00)
Thiol-Modified Cellulose Nanofibers Enabling Effective Functionalization Routes and the Adsorption of Heavy Metal Ions
안 솔, 김명웅, 이호익*, 인하대학교; *한국생산기술연구원

3O7-17 (11:00-11:15)
Understanding Marangoni Flow-driven Solidification of Polymer Semiconducting Films on an Aqueous Substrate
오승택, 이화성, 한양대학교 에리카캠퍼스

3O7-18 (11:15-11:30)
Growth Modeling of InAs Colloidal Quantum Dots in Continuous Process
박성민, 김태완, 정소희, 성균관대학교

3O7-19 (11:30-11:45)
Effect of Fiber and Matrix Modifications on Properties of Carbon Fiber/ABS Composites: Comparative Studies between SFT and LFT
김영은, 조동환, 금오공과대학교

3O7-20 (11:45-12:00)
Transparent, Water-stable, Cellulose Nanofiber-based Packaging Film with a Low Oxygen Permeability
김중권, 진정호, 울산대학교

제9회장_10월 8일 (목)

Graduate Student Oral Session (III) (English)

Organizer: Jeong Jae Wie (Inha Univ.), Dong Ki Yoon (KAIST), Keun Hyung Lee (Inha Univ.)

3O9-1 (09:30-09:45) **Chair: Youngjong Kang**
Soft Nanoliposomes as an Effective Drug Carrier in Breast Cancer
Tony Kiio, 박소연*, Keimyung University; *계명대학교 약학대학

3O9-2 (09:45-10:00)
Emulsion-based Synthesis of Semi-permeable Protocells Composed of Poly(N-isopropylacrylamide)-albumin Hybrid Amphiphiles
김진민, 오승수, 포항공과대학교

3O9-3 (10:00-10:15)
Sequestering ATP Inside Mitochondria by Nucleopeptide Induces Cancer Cell Apoptosis
최후연, 유자형, UNIST(Ulsan National Institute of Science and Technology)

3O9-4 (10:15-10:30)
ROS-responsive and PD-L1 targeted Thioketal Nanoparticles Triggered Mitochondrial-mediated Apoptotic Cell Death in Melanoma Model
Asmita Banstola, Simmyung Yook, College of Pharmacy, Keimyung University

3O9-5 (10:30-10:45)
Potentiated Local Immunomodulatory Effect of Uniformly Engineered Hybrid Stem Cell/Drug Depot Spheroids on Xeno-Source Pancreatic Islet Transplantation Outcomes
응웬티엔티앱, 박준형, 쉬레스타먼주, 팜탄텅, 박필훈, 김종오, 용철순, 육심명*, 정지헌, 영남대학교; *계명대학교

3O9-6 (10:45-11:00)
Activation of NK Cell Functionality by Coacervate-mediated Interleukin-15 Delivery
김영국, 김교범, 동국대학교

3O9-7 (11:00-11:15)
Copper-free Clicked Nanoclusters of Gold Nanoparticles and Quantum Dots for in vivo Real-time Imaging and Tumor Sensing
Vu Nguyen Oanh Pham, 신지운, Wei Mao, 이주원, 박재근, 이미소, 조완호, 유혁상, 강원대학교

3O9-8 (11:15-11:30)
Evaluation of EGFR Targeting Cetuximab Conjugated Temozolomide Loaded Poly(lactic-co-glycolic acid) Nanoparticles for the Treatment of Cancer
Ramesh Duwa, Simmyung Yook, College of Pharmacy, Keimyung University

3O9-9 (11:30-11:45)
Combination Therapy of Sustained Release Immune Modulatory Drug and PEGylation of Islets in Presence of Hydrogel for Treatment of Type 1 Diabetes Mellitus
Prakash Shrestha, Shiva Pathak*, Shobha Regmi*, 정지헌, Yeungnam University; *Standford University

3O9-10 (11:45-12:00)
Injectable Hydrogels Scavenging Reactive Oxygen Species for Wound Management and Tissue Repair
Phuong Le Thi, 박기동, 아주대학교

제10회장_10월 8일 (목)

대학원생 구두발표 (III)

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

3O10-1 (09:30-09:45) **좌장: 양승윤**
Tuning Interfacial Properties by Spontaneously Generated Organic Interlayers in Top-Contact-Structured Organic Transistors
최기헌, 이화성, 한양대학교 에리카

3O10-2 (09:45-10:00)
High Refractive Index Polymer (n>1.9) Synthesized by the Novel Process Using Elemental Sulfur, Termed Sulfur Chemical Vapor Deposition (sCVD)
장원태, 김도흥, 최건우, 임지우*, 임성갑, 한국과학기술원; *경희대학교

3O10-3 (10:00-10:15)
On-demand Disposable Yet Reliable Co-citrate Based Polymer for Wearable Sensor
김도관, 정용철, 한국생산기술연구원

3O10-4 (10:15-10:30)
($Zn_xAg_yIn_z$) S_2 Synthesis Mechanism and Various Ligand Effects According to Components
정희경, 정종진*, 한남대학교; *한남대학교 화학과

3O10-5 (10:30-10:45)
Wireless Smart Contact Lens for Diabetic Diagnosis and Therapy
김수경, 한세광, 포항공과대학교

3O10-6 (10:45-11:00)
Fabrication of Chemically Surface Modified Microcrystalline Cellulose Reinforced HDPE Composites and Their Mechanical Properties
홍서화, 박진환, 황석호, 단국대학교 고분자시스템공학부 고분자공학

3O10-7 (11:00-11:15)
Efficient Debundling of Few-walled CNTs by Donor-Acceptor Polymer for High Performance and Flexible Thermoelectric Power Generators
정재민, 서의현, 정용진*, 양한솔, 이택성, 장재영, 한양대학교; *한국교통대학교

3O10-8 (11:15-11:30)
AlGaN Light-Emitting Diodes with Localized Surface Plasmon Resonance Mediated by High Density Array of 40 nm Al Nanoparticles
이종원, 하경원, 박정현, 송현규*, 박재용, 이재용, 조용훈*, 이종람, 김진곤, 김종규, 포항공과대학교; *카이스트

3O10-9 (11:30-11:45)
Intramitochondrial Polymerization-induced Self-Assembly (Mito-PISA) Using Covalent Bond Controls Cancer Cell Necrosis
김상필, 유자형, 울산과학기술원

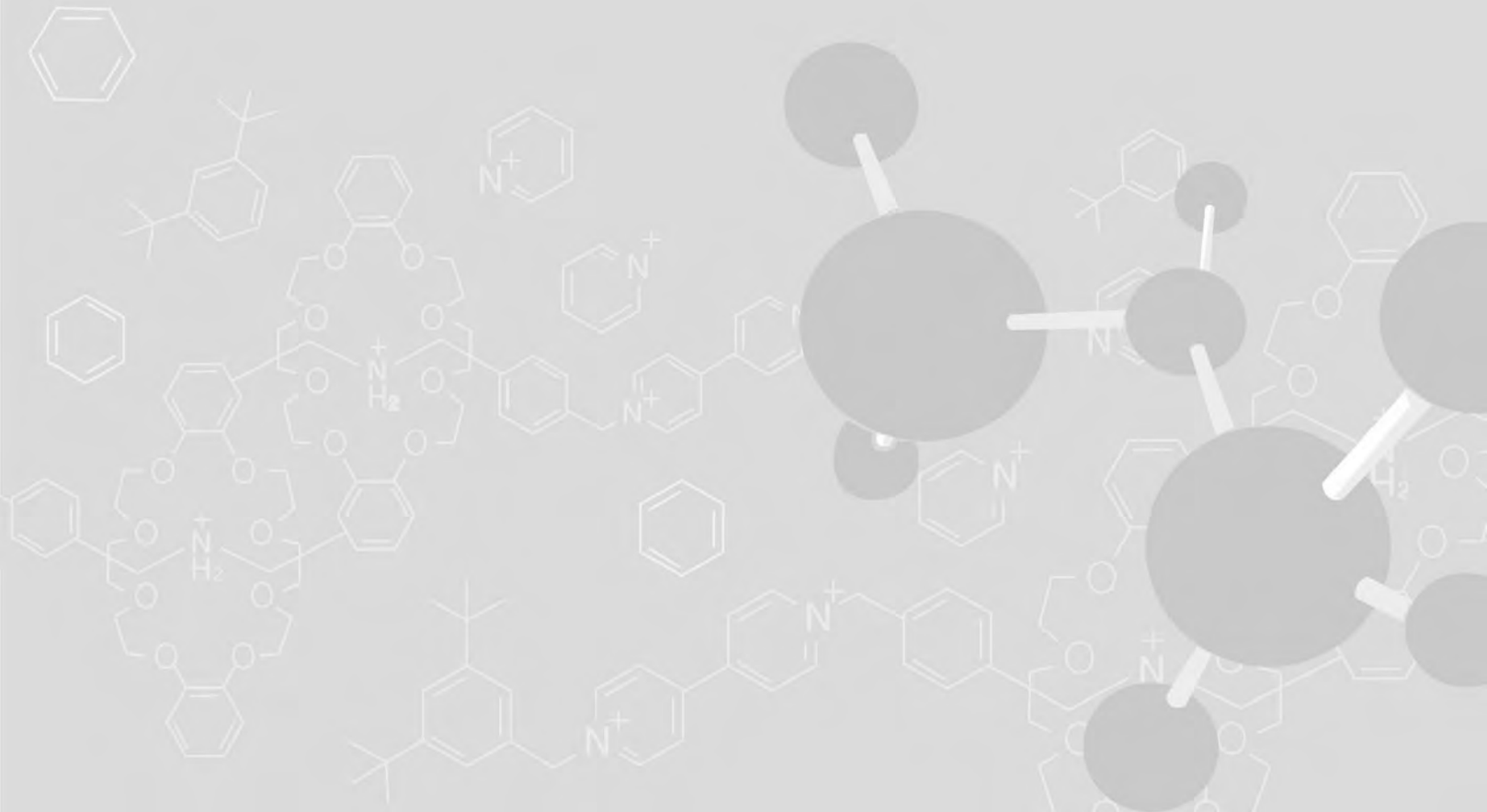
3O10-10 (11:45-12:00)
Realized Well-Defined Surface of InP Quantum Dot and Their Growth Control
김영식, 정소희, 성균관대학교

한국고분자학회
The Polymer Society of Korea

2020년 추계학술대회
연구논문 초록집

The Polymer Society of Korea

포스터 발표 프로그램



포스터 발표 (I)

기능성 고분자 (I)

1PS-1 Preparation and Application of Poly(N-isopropylacrylamide) Hydrogel Coated Dip-Pen Nanolithography, Probe via E-beam Irradiation
황태순, 김경민*, 임정혁*, 곽효빈*, 한국교통대학교 나노고분자공학과; *한국교통대학교

1PS-3 Waste Cotton-derived Porous Carbon Textiles as Electrode Materials for Supercapacitors
황아름, 이병민, 최재학, 충남대학교

1PS-5 Adhesive Behavior of Polyelectrolyte Hydrogel Bonded to Concrete Surfaces
황세영, 나양호, 한남대학교

1PS-7 Structural Stability, Electric Properties of Polyimide Thin Films Introduced with MXene
황규현, 정영규, 충남대학교

1PS-9 Surface Sealable Poly(ε-caprolactone) (PCL) Hollowed Nanoparticles and On-Demand Pore Generability for Easy Loading and NIR Light-Triggered Opening System for Drug Release
홍상기, 현동준, 문건대*, 안형주**, 박주향, 김다인, 서호준, 김혜지, 경북대학교; *한국생산기술연구원; **포항가속기연구소

1PS-15 Versatile Metal/Carbon Nanohybrid Electrocatalysts Created Using Biomass Mold
허은서, 윤현석*, 전남대학교 대학원 고분자공학과; *전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

1PS-17 Surface Morphologies and Wetting Properties of Porous Layer-by-layer Film Prepared Using Polyelectrolyte Mixture of Two Average Molecular Weights
허예진, 김주영, 성충현, 동의대학교

1PS-19 SERS-based Multiple Detection Bioassay Platform with Shape-coded PEGDA Hydrogel Microparticles
함정우, 고원건, 김혜원, 김지영, 안수정, 연세대학교

1PS-21 Perovskite Nanocrystals in Block Copolymer Photonic Crystal Films for Dual-Responsive Anticounterfeiting
한효원, 오진우, 박철민, 연세대학교

1PS-23 Polypropylene-Based Nanocomposites with High Mechanical and Dielectric Strength for High-Voltage Application
한진아, 이대호, 유승건, 한세원, 박효열, 안명상, 김인성, 한국전기연구원

1PS-25 Built-in Polymerized Elastomer Electrolytes for Highly Stable Li Metal Batteries
한정훈, 이승훈*, 이경빈*, 이영준, 이승우*, 김범준, KAIST; *Georgia Institute of Technology

1PS-27 Preparation and Chemical Resistances of UV-cured Resins Based on Siloxane Acrylate Oligomer
공민선, 전유성, 이연주, 노화정, 한윤수, 대구가톨릭대학교

1PS-29 Preparation and Physical Properties of Irradiation-curable Resins for Applications to Glass Slimming Process
전유성, 공민선, 이연주, 한윤수, 대구가톨릭대학교

1PS-31 Thiourea-based Chemical Actuator Using Photo Induced Fluoride Generation and Amplification
하성균, 송창식, 성균관대학교

1PS-33 Microfluidic Fabrication of Polyacrylic Acid Hydrogel Microspheres Toward Calcium Sensing
탄하오, 위나라, 홍효진, 박수영*, 경북대학교 응용화학공학과; *경북대학교 고분자공학과

1PS-37 Study on the Water Purification Using Graphene Oxide for Eliminating Microplastics, COD, and Bacteria
최지호, 한국외국어대학교

1PS-39 Vapor-Phase Synthesis of High-k, Ultrathin Polymer Dielectric with Molecular Thin, Hydrophobic Skin Layer for Extremely Stable Organic Thin-Film Transistor (OTFT) Operation
최준환, 임성갑, KAIST

1PS-41 Flexible and Low-cost Solid-State-Supercapacitor Based on Poly(vinyl alcohol)-based Nanocomposite Polymer Electrolytes
최준영, 최우혁, 인하대학교

1PS-43 NIR-triggered Photodynamic Therapy and Bioimaging Based on Multi-shell Structured Upconversion Nanoparticles
최종선, 김소연, 충남대학교

1PS-45 Design of Surface Modified Magnetic Nanoparticles for Biosensor Application
최종선, 김소연, 충남대학교

1PS-47 Morphology, Rheological and Thermo-Mechanical Properties of TLCP/PCT Blends Fabricated by Melt-compounding
최은지, 정영규*, 충남대학교; *충남대학교 유기소재섬유시스템공학과

1PS-49 EIS-based Biosensor to Measure the Cortisol with PEDOT: PSS/MXene Electrode
최용우, 유필진, 성균관대학교

1PS-51 Liquid Crystal Elastomers with Slide-Ring Polyrotaxane Cross-linkers
최수빈, 김빛가람*, 서지훈*, 안석균, 부산대학교; *고려대학교

1PS-53 Polyaniline (PANI)-based Textile pH Sensor for Monitoring of Chronic Wounds
최민영, 구형준, 이민지*, 김수영, 소주희*, 서울과학기술대학교; *한국생산기술연구원

1PS-55 Compressible Mesoporous Polymer Monoliths for the Selective Removal of Oils from Water
채지애, 김형우, 전남대학교

1PS-57 Tuning of Volume Phase Transition of Thermo-responsive Ionogels Depending on Ionic Liquids
진우진, Bernard Timothy, 윤진환, 부산대학교

1PS-59 Tandem Interactive Sensing Display De-convoluting Dynamic Pressure and Temperature
진우경, 김의혁, 박철민, 연세대학교

1PS-61 Studies and Synthesis Poly(biphenyl piperidine) Membranes by Super Acid Copolycondensations for PEMFC
진레이, 류태욱, 파이즈아메드, WEI ZHANG, 윤수진, 김대호, 이용훈, 장호현, 김환기, 건국대학교

1PS-63 Fabrication of Transparent Anti-Fogging and Self-Cleaning Coating on Greenhouse Film
주성환, 이찬민, 이준영, 황기섭, 한국생산기술연구원

1PS-65 Programmable Photoresponsive Main-chain Liquid Crystal Elastomers Prepared by a Two-stage Thiol-acrylate Reaction
조은혜, Luu, 박수영, 경북대학교

1PS-67 Efficient Conduction of Nonconjugated Small-Molecule Organic Radicals
조예린, 유일환, 고재형, 김대윤, 손대원*, 주용호, 한국과학기술연구원 전북분원; *한양대학교

1PS-69 Facile Preparation of Polyethyleneimine-Coated Microgel Capsules via Schiff Base Formation for Removal of Heavy Metal Ions
조승현, 장민철, 전남대학교

1PS-71 바이오파울링 저감을 위한 초소수성으로 처리된 수처리용 나노다공성 polyvinylidene fluoride(PVDF)분리막의 제조
조슬기, 문강민, 오준균, 단국대학교

1PS-73 Dielectric Behavior of Polyimide Aerogel Films with Controlled Pore Structure
조문정, 이대호, 한세원, 박효열, 유승건, 한국전기연구원

1PS-75 Fabrication of Super Liquid-repellent and Transparent Glass Surfaces with Antifouling Properties
조동익, 이한나, 오준균*, 단국대학교; *단국대학교 고분자공학과

1PS-77 Phase Separated Hydrogels with Embedded Microgels to Improve Shrinking and Re-swelling
정태훈, 김재영, 김연수, 포항공과대학교

1PS-79 Enhancement of Anti-biofouling Properties of Polypropylene Membrane via Bioinspired $CaCO_3$ Coating and Hydrophilic Graft Polymerization
정주현, 송상하, 오준균, 단국대학교

1PS-81 Synthesis and Characterization of Thienoquinoline-Based Conjugated Polymer Donors for Organic Photovoltaics
정재경, 황도훈, 부산대학교

1PS-83 Visualization of Strain Sensor by Structural Color of Block Co-polymer
정영두, 박철민, 연세대학교

1PS-85 Multifunctional Role of MoS_2 in Preparation of Composite Hydrogels: Radical Initiation and Cross-Linking
정송아, 이경민*, 김형우, 전남대학교; *서울대학교

1PS-87 Remote-Controllable Liquid Crystal Physical Gels Based on Photo-responsive Supramolecule with Electro-optical Properties
정다영, 정광운, 전북대학교

1PS-89 Long Term Durability Evaluation of Thermotropic Liquid Crystalline Polyester-based Nanocomposites for Automotive Applications
전하빈, 정영규, 충남대학교

1PS-91 Solid Electrolyte Membrane Based on Poly(arylene ether sulfone)-g-Poly(ethylene glycol) with Various End Groups for Lithium-ion Battery
전진천, 김덕준, 성균관대학교

1PS-93 Programmable Microtextures by Programming Magnetic Actuation of Polymer Composites Microarray
전지수, 박정은, 원수경, 위정재, 인하대학교

1PS-95 Preparation of Thermoresponsive Core-shell Nanoparticles with PNIPAM
전민욱, 김태동, 김 윤, 한남대학교

1PS-97 Functional Poly(2-alkyl-2-oxazoline)-based Stimuli-responsive Hydrogel
전민우, 장우동, 연세대학교

1PS-99 Designing Ionic Liquids for Stabilizing Lithium Metal Batteries
장진하, 강지형, 한국과학기술원

1PS-101 Enhancement of Electrochemical Properties of Cathode in Lithium Ion Batteries by Using Poly(triethylene glycol methyl ether methacrylate-co-methyl methacrylate)
장지혜, 한미정, 석정돈, 김영진*, 한국화학연구원; *충남대학교

1PS-103 Shape-Transformable and Electrical & Mechanical Self-Healing Electroluminescence Displays Using Viscoelastic Polymer Composite
장지혜, 이승원, 박철민, 연세대학교

1PS-105 Kinetic Control of Polymorphic Superstructure for Tuning Optical Properties
장준화, 정광운, 전북대학교

1PS-107 The Fabrication of Coatable E-type Polarizer by Photopolymerization of Perylene-based Reactive Mesogens
임민우, 정광운, 전북대학교

1PS-109 Preparation and Properties of Silicone Hydrogel Contact Lenses Using Thiol-ene "Click" Reaction
이호준, 곽기섭, 김효진*, 경북대학교; *대구테크노파크 나노융합실용화센터

1PS-111 Thiol-Functionalization of Cellulose Nanofiber for Heavy Metal Removal
이호익, 한국생산기술연구원

1PS-113 Dual Functionalization of Hexagonal Boron Nitride Allotropes Using Pyrene-tethered Poly(4-vinyl-pyridine)
이혁중, 박철민, 연세대학교 신소재공학과

1PS-115 Analysis and Characterization of Catechol Lipid Based Natural Lacquers According to the Types of Catechol Lipid Molecules
이한나, 김동영, 이보라, 이연희, 이상수, 임정아, 한국과학기술연구원

1PS-117 Anti-Biofouling Performance of Low-Density Polyethylene Films by Photografting Modification with a Fluoromonomer
이한나, 오준균, 조동익, 단국대학교 고분자공학과

1PS-119 Synthesis and Characterization of Activated N-doped Carbon Aerogel for Lithium Sulfur Battery
이하영, 권용구, 인하대학교

1PS-121 Electrochemical Transducers Based on Graphene Nanohybrids and Their Application to Biocide Detection
이하늬, 윤현석*, 전남대학교 Alan G. MacDiarmid 에너지연구소; *전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

1PS-123 Self-assembled Block Copolymer Non-volatile Structural Color through Thermal Cross-linking for Optical Data Storage
이창은, 박철민, 어홍규, 김태빈, 연세대학교

1PS-125 Liquid Crystalline Vitrimers with Poly(ether-thiourea) Bonds
이진형, 김동균*, 김용석*, 안석균, 부산대학교; *한국화학연구원

1PS-127 코팅소재 응용을 위한 바이오매스 기반 생분해성 고분자 경화소재 개발
조계용, 권영제, 이지하, 조수현, 김은영, 정수진, 김하진, 부경대학교

1PS-129 Synthesis and Preparation of Low Dielectric Polyimide Having Excellent Adhesion Property
이지원, 박노균*, 김현철*, 김윤호*, 고민재**, 최성룡***, 원종찬*, 한국화학연구원/한양대학교; *한국화학연구원; **한양대학교; ***ABC나노텍

1PS-131 Self-Healing Protective Coating Corresponding to Crack-Growth
이지선, 이준서, 안현수, 정찬문, 연세대학교

1PS-133 Preparation of Polymer-encapsulated Liquid Metal Droplets
이준서, 이지선, 안현수, 정찬문, 연세대학교

1PS-137 Multifunctional Hybrid Scaffold with bECM/Mg(OH)$_2$ and PDRN-BMP2 Nanocomplex Using Human Fetal MSCs for Bone Regeneration
이준규, 김다슬*, 허 윤, 김태형*, 한동근, 차의과학대학교; *중앙대학교

1PS-139 Synthesis and Properties of Thermoplastic Polyurethane for Crash Pad
이주홍, 허필호, 권충렬, 민진규, 원종찬, 배지홍, 부산대학교

1PS-141 Cross-linked Composite Separator for High Performance Lithium-ion Batteries with Enhanced Safety
이제남, 송진광, 송승원*, 유지상, 전자부품연구원; *(주)제라브리드

1PS-143 Effect of Polyimide-based Composite Binder for the Lithium Sulfur Batteries
이제남, 김동범, 우상길, 유지상, 전자부품연구원

1PS-145 Stimuli-Responsive Conformational Transformation of KLA Peptide for Selective Cytotoxicity
이정훈, 오은택, 이한울, 김지원, 김하경, 박헌주, 김철희, 인하대학교

1PS-147 습식방사 및 불균일계 비누화를 통한 PVA/MMT 복합섬유의 제조 및 특성 분석
이정언, 염정현, 양성백, 경북대학교

1PS-149 용융원심방사를 이용한 PVB 나노 섬유 제조 및 특성 분석
이정언, 염정현, 양성백, 경북대학교

1PS-151 A Highly Elastic and Stretchable Polymer Gel for Quantum Dots-based Light Emitters
이운한, 조혜미, 윤현석*, 전남대학교 대학원 고분자공학과; *전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

1PS-153 The Urea Structure in Which Fluorosulfonyl Isocyanate was Introduced into Methacryl that was Applied to Lithium Ion Batteries with PEGDMA by Photopolymerization and Radical Polymerization
이용훈, 류태욱*, 진레이*, WEI ZHANG*, 윤수진*, 김대호*, 장호현*, 김환기*, 건국대학교 글로컬캠퍼스; *건국대학교

1PS-155 Patterning Technique of Silver Nanowire Electrodes for Flexible and Transparent Photodetector
이영수, 엄두승*, 임성동**, 고현협, 울산과학기술원; *세종대학교; **옥스포드대학교

1PS-157 Preparation of Non-porous Alginate-based Hydrogel Crosslinked via Diels-Alder Click Chemistry for Drug Release Application
이시윤, Sonita Afrita Purba Siboro, 조성우, 임권택, 부경대학교

1PS-159 Chitosan-based Dual pH and Thermal Responsive Polyelectrolyte Hydrogel for Colon Targeted Controlled Drug Delivery: Effect of Crosslinker Type on Drug Loading and Kinetics Release
이시윤, Hoang Thi Huong, 박한솔, 임권택, 부경대학교

1PS-161 The Novel Carbazole-based Polyimide as the Hole Transporting Material for Optoelectronic Application
이시윤, Tu Thi Kieu Trang, 박찬, 임권택, 부경대학교

1PS-163 Synthesis of Reduced Graphene Oxide Compunds for Improved Photothermal Effect and Photodynamic Effect
이승화, 김소연, 충남대학교

1PS-165 Design of Self-healable, Stretchable, Electro-active Tough Hydrogel for Soft Robotics Using Graphene Oxide
이승화, 최종선, 김소연, 충남대학교

1PS-167 Non-volatile Resistive Random Access Memory Based on Aromatic Polyimide Containing Anthracene Moiety
이승현, 최주영, 진승원, 박형주, 최윤제, 김담비, 정찬문, 연세대학교

1PS-169 Fabrication of the Nitrogen Doped Nano-onion Hybrids with Fe_2O_3 for the Efficient Oxygen Reduction Reaction in the Zinc-air Battery
이승연, 김동은, 김창근, 중앙대학교

1PS-171 Tough Self-healing Polymer System Based on Metal-Ligand Interactions
이수현, 강구민, 강지형, 카이스트

1PS-173 Surface-functionalized Micro-fluidic Chip for Monitoring of Drug Efficacy Toward Mammalian Cells
이수진, 양성윤, 충남대학교

1PS-175 Tough, Transparent Ionic Conductor with Multivalent Cation
이선우, 강지형, KAIST

1PS-177 Two-dimensional Titanium Carbide (MXene) Electrode Polymer Light-Emitting Diode under Alternating-Current Operation
이석영, 박철민, 김의혁, 진우경, 연세대학교

1PS-179 Cancer Specific Fluorescence Imaging Using Folate-Alginate Nanoparticles
이사라, 배채원, 김창헌, 박예철, 정한나, 이강원, 서울대학교

1PS-181 Low Shrinkage, High Porosity Polyimide Composite Aerogels Containing Silica Nanoparticles
이동익, 김혜선, 김승현, 인하대학교

1PS-183 Synthesis and Characterization of Polyimides Containing Phosphorus Groups
이동익, 김혜선, 김승현, 인하대학교

1PS-185 Influence of Fluorination on the Charge Transport Property and Air Stability
이도영, 이해랑, 조영준*, 정아영**, 이정호*, 이상면*, 주세훈*, 곽상규*, 양창덕*, 오준학, 서울대학교; *UNIST; **포항공과대학교

1PS-187 Effect of Silane Content in Acrylic Polymer Binder with High Transparency, Good Shear Strength and Water Resistance for Protecting Phosphorescent Material
이규혁, 임홍섭, 이주홍, 권충렬, 배지홍, 허필호, 부산대학교

1PS-189 Synthesis and Characterization of Polymeric Nanoparticles Based on Polystyrene-block-Poly(4-vinylpyridine)
이강혁, 김 윤, 김태동, 한남대학교

1PS-191 Characterization and Synthesis of Thienopyrroledione Derivatives Based Polymer Donors for Organic Solar Cells
이강인, 황도훈, 부산대학교

1PS-193 Plasmonic Microcylinders for Direct Raman Detection of Target Small Molecules in Pristine Samples
윤지원, 이건호, 김신현, 한국과학기술원

1PS-195 Synthesis of Blending Membranes by Florosulfonyl Imide and Sulfonic Acid Based Polymers for Proton Exchange Membranes Fuel Cell
윤수진, 류태욱, 진레이, Ahmed Faiz, WEI ZHANG, 김대호, 이용훈, 장호현, 김환기, 건국대학교

1PS-197 Efficient Electron Transport in Radical Polymers through Mixed Ionic and Electronic Conduction
유일환, 전대영*, Bryan Boudouris**, 주용호*, 한국과학기술연구원 전북분원; *한국과학기술연구원; **Department of Chemistry, Purdue University

1PS-199 Synthesis and Characterization of Photo-curing Acryl-polyurethane through Optimizing of Viscosity and UV Condition
원종찬, 정석훈, 민진규, 이규혁, 배지홍, 허필호, 부산대학교

1PS-201 Nanoporous Membrane Prepared with Ultra-thin Films of Polymer Ternary Blends
우경식, 양성윤, 충남대학교

1PS-203 Effect of Amplitude of Ultrasonic Waves in Emulsification for Lacquer Thin Film with Improved Characteristics
오효준, 박민주, 김하연, 황준호, 이은지, 광주과학기술원

1PS-207 Graphical Encoding of Oil@Hydrogel Core-Shell Microcapsules
오윤진, 이상민, 김신현, KAIST

1PS-209 Sustainable Adhesive Thermosets: Preparation, Reuse, and Signal-Induced De-Bonding
오유리, 김형우, 전남대학교

1PS-211 Modular Protective Nanoporous Polyurea Network Membranes for Enzymatic Catalysis
오왕석, 박지웅*, 광주과학기술원; *광주과학기술원 신소재공학부

1PS-213 Photo-responsive Wringing Gel Fabricated from Azobenzene-based Asymmetric Gelator
오민택, 정광운*, 전북대학교 공과대학; *전북대학교

1PS-215 해양 유출 기름 방제를 위한 생분해성 Polycaprolactone(PCL) 흡착제 연구
엄준혁, 박세진, 김현구, 남창우, 전북대학교

1PS-217 Chiral Photonic Crystal Film Based on Thermal-responsive Cholesteric Liquid Crystal
양승철, 정광운, 전북대학교

1PS-219 Charge Carrier Recombination Analysis of Organic Solar Cells Based on Lewis Acid Doped PTB7-Th:PCBM
알렘 아라야 메레사, 김선주, 중앙대학교

1PS-221 Ultra-microporous Carbon-based Materials as Efficient CO_2 and Methylene Blue Adsorbents
아딜라, 박수진, 인하대학교

1PS-223 Facile Synthesis of Heteroatom-doped Microporous Carbons by Potassium Salts Activation
아딜라, 박수진, 인하대학교

1PS-225 Solvent Free Synthesis of Microporous Carbons for Enhanced CO_2 Adsorption
아딜라, 박수진, 인하대학교

1PS-227 Colorimetric Sensing of Barium Ion in Water Based on Polyelectrolyte-Induced Chemical Etching of Silver Nanoprisms
심현보, 김문호, 부경대학교

1PS-229 Tissue-adhesive Sealant Using Natural Polymer
심소현, 나양호, 한남대학교

1PS-231 Fluorinated Covalent Organic Polymers for High Performance Sulfur Cathodes in Lithium-Sulfur Batteries
신혁수, 김도윤*, 김현진, 김지헌*, 차국헌, Cafer T. Yavuz*, 최장욱, 서울대학교; *카이스트

1PS-233 Eco-Friendly Colored Ink from Bio-Based Oriental Lacquer
신주영, 임가현*, 김효진*, 노유진*, 임호선*, 숙명여자대학교; *숙명여자대학교 화공생명공학부

1PS-235 Effects of High-energy Beam Irradiation on the Properties of Polymer/ Silane Hybrid Aerogels
신재환, 김선주, 중앙대학교

1PS-237 High-Performance, Self-Powered Multimodal Sensors via Ferroelectric Polarization
신영은, 손소담, 신형준, 고현협, 울산과학기술원

1PS-239 Synthesis of Dopamine-Incorporated Thiourea Polymers and Their Applications
송선구, 하성균, 하채연, 김현우, 송창식, 성균관대학교

1PS-241 Superhydrophobically-Modified Nanoparticles Embedded Dual-Functional Low-Density Polyethylene Film for Antibacterial and Self-Cleaning Properties
송상하, 정주현*, 오준균, 단국대학교 고분자공학과; *단국대학교

1PS-243 The Synthesis of Photosensitive Polyimide Using Various Groups for Application of Semiconductors
송광식, 박성만, 김영랑, 김영훈, 허윤정, 백정주, 장기철, 이효선, 배근열, 최경호, 신교직, 한국생산기술연구원

1PS-245 Multifunctional Elbow and Knee Pad Sensor System Using Carbon Ink
손경철, 안다혜, 김준서, 박상기, 조유장, 정재선, 최형섭, 박종진, 전남대학교

1PS-247 Formation of Functional Coating Layers Derived from Fluorine-modified Polysilazane and Their Coating Properties
백정주, 신교직, 최경호, 배근열, 이효선, 허윤정, 장기철, 김영훈, 송광식, 박성만, 김영랑, 한국생산기술연구원

1PS-249 Highly Porous Oxime-functionalized Lyocell-based Cellulose Droplets and Their Filter Applications
백승엽, 박수영, 경북대학교

1PS-251 Design of 3D Printing Materials Based Photoactivating Acryl-polyurethane to Add Flexible Functionality to Exquisite Structures
배지홍, 원종찬, 정석훈, 민진규, 이규혁, 허필호, 부산대학교

1PS-253 Construction of Heat Radiating Material with High Effective Heat Transfer Channel Using PS-PMMA Diblock Copolymer
배소연, 박찬수, 조남주, 부산대학교

1PS-255 Preparation of Carbon-Based Aerogels Embedded with Transition Metal Oxide for Lithium-Sulfur Battery Applications
반유정, 권용구, 인하대학교

1PS-257 Preparation of Highly Self-healable Polyurethane Using Polyols with Blocky Segments of Imide Methacrylate
박희정, 이동현, 홍성우*, 단국대학교; *한국생산기술연구원

1PS-259 Pd Nanoparticle Immobilized BIJEL Catalytic Membrane Using Phenolic Ligands
박태정, 유필진, 성균관대학교

1PS-261 Antifreeze Block Polymers
박진경, 모두미타파텔, 정병문, 이화여자대학교

1PS-263 Block Copolymer/Tannic Acid Hydrogel
박종민, 박은숙, 이해신, 서명은, 한국과학기술원

1PS-265 Development of Polymer Net for Low Sulfur Fuel Oil (LSFO) Remediation at Low Temperature
박세진, 엄준혁, 김현구, 남창우, 전북대학교

1PS-267 Precise Particle Growth Control of Electrospray-synthesized Polysilazane Films for Improvement of Hydrophobic Properties
박성만, 신교직, 최경호, 배근열, 이효선, 장기철, 백정주, 허윤정, 김영훈, 송광식, 김영랑, 한국생산기술연구원

1PS-269 Fabrication and Optimization of Conductive Paper Based on Screen-printed Polyaniline/Graphene Patterns for Nerve Agent Detection
박서린, 장혜지*, 조성훈, 영남대학교; *영남대학교 화학공학부

1PS-273 Surface Modification of Silica Micro-particles and Application for Release Coating
장주은, 송예슬, 박금환, 한국전자기술연구원

1PS-275 Transfer Method of Amorphous Alloy Thin Layer by Using Hydrophobic Surface
송예슬, 장주은, 박금환, 한국전자기술연구원

1PS-277 Fabrication and Electrochemical Properties of Carbon Nanofibers Derived from Polyimide and Lignin
박규태, 정영규, 충남대학교

1PS-279 Multiresponsive Hydrogels via Surface Modification with Spiropyran-conjugated Polymer Network
바돈 이사벨 웬, 문선정, 임희정, 김호중, 조선대학교

1PS-281 Study for Lubricating Properties of Norbornene-Based Bottle-Brush Polymers Synthesized by ROMP and RAFT
문휘현, 송창식, 성균관대학교

1PS-283 The Double Comb Copolymer Lithium Ion Polymer-gel Matrix
문주용, 이재연, 박정태, 건국대학교

1PS-285 염수 조건하에서 폴리우레탄 표면의 개질을 통한 유해 박테리아 오염 방지에 관한 연구
문강민, 조슬기, 오준균, 단국대학교

1PS-287 Microflow Reactor Process을 이용한 Nanoparticles 합성 및 크기 제어
류한나, 김 윤, 김태동, 한남대학교

1PS-289 Development of Chitosan-based Hydrogels Embedded with Poly (N-isopropylacrylamide) Nanogels for Thermoresponsive Controlled Drug Delivery
데미발레스, 정우경, 김호중, 조선대학교

1PS-291 Characterization of Silicon Alloy Anode with Alginate Binder for Li-ion Batteries
노미소, 최재학, 김성수, 지상구, 충남대학교

1PS-293 플라스틱 식품 보관 용기 표면의 적용 가능한 기능성 세라믹 나노복합체 제조
남유준, 김성준, 금혜리, 네오플램

1PS-295 Preparation and Optical Properties of Charge Transfer Type Dye-dispersed Fluorescent Polyimide Films
김희상, 곽기섭, 경북대학교

1PS-297 Synthesis of ABA-type Block Copolymers with Highly Enhanced Self-healing Ability
김혜진, 박희정, 홍성우*, 이동현, 단국대학교; *한국생산기술연구원

1PS-299 Fabrication of Polymer Particles with Controllable and Sophisticated Structures for High Immobilization of Noble-metal Nanoparticles
김혜지, 현동춘, 안형주*, 문건대**, 박주향, 서호준, 김다인, 홍상기, 경북대학교; *포항가속기연구소; **한국생산기술연구원

1PS-301 Microporous Organic Polymers: A Synthetic Platform for Atomic-Level Engineering of Heterogeneous Carbocatalysts
김혜지, 김형우, 전남대학교

1PS-303 Array of Gold Nanoelectrodes from Nanoporous Block Copolymer Films for Electrochemical Sensing
김혜선, 이동익, 김승현, 인하대학교

1PS-305 Tuning the Properties of Ionic Elastomer by Molecular Enigneering of Ionic Liquid
김현준, 강지형, 한국과학기술원

1PS-307 Solid-State Synthesis of Biomass-Derived Network Polyurethanes and Their Vitrimer Properties
김현우, 송창식, 성균관대학교

1PS-309 Fabrication of Core-shell Structured $ZnFe_2O_4$/PANI Particles and

Their Suspension Dual Response under Electromagnetic Field
김현민, 최형진, 인하대학교

1PS-311 폴리올레핀 기반 자성 흡유제를 이용한 기름 유출 회복 방안
김현구, 박세진, 엄준혁, 남창우, 전북대학교

1PS-313 Preparation of Silver Nanowire-SBR Composite Conductive Materials Using a Cross-linkable Multifunctional Dispersant
김한영, 권민호, 박용해*, 백현종, 부산대학교; *공주대학교

1PS-315 Determination of the Hydrogenation State of Benzene by the Thermally Induced Phase Separation of Poly(ethersulfone)s
김태형, 여병욱, 이진희, 박제영, 김상율, KAIST

1PS-319 Highly Transparent Polymeric Film Based on Colorless Fluorinated Polyimide with Excellent Mechanical Properties for Flexible Displays
김태용, 이예진, 문경민, 고민재*, 홍성우, 한국생산기술연구원; *한양대학교

포스터 발표 (II)

의료용 고분자 부문위원회

2PS-1 *In Situ* Crosslinked Chitosan/Poly(ethylene Glycol) Hybrid Hydrogel with Controllable Physicochemical Properties
황진영, 정하영, 박기동, Le Thi Phuong, 황보경희*, 배진우*, 아주대학교; *(주)제노스

2PS-2 S-Nitrosoglutathione-Releasing Mineralized Nanoparticles Enhance Anticancer Activities of Arsenite by Reversing Drug Resistance
황원태, 이상천*, 정서영, 이경태, 민경현**, 이홍재*, 경희대학교 나노의약생명과학과; *경희대학교 치과대학; **전북대학교 약학과

2PS-3 Oral GLP1 Gene Delivery by Bile Acid Based Non Viral Gene Delivery Carrier to Treat Type II Diabetes Mellitus
황용화, 김민준, 오정주, 이승아, 이용규, 케이비바이오메드

2PS-4 Surface Modification of Silicon Implant and Effect of Nanopattern on Fibrosis Suppression
최주환, 이화정, 함정우, 고원건, 연세대학교

2PS-5 Healing Effect of Oxygen-releasing Biomaterials for Wound Model
최정연, 홍경식*, 임정욱*, 한국생산기술연구원; *경북대학교

2PS-6 Three-dimensional Double-layered Hydrogel Based Stem Cell Co-culture System for Enhanced Cardiovascular Tissue Regeneration
최연정, 국윤민*, 김영환**, 임광범**, 방석호**, 이강원, 서울대학교; *한국과학기술연구원; **성균관대학교

2PS-7 Enhanced Cellular Uptake of Surface-Functionalized Polymer Nanoparticles
최수임, 이근용, 한양대학교

2PS-8 Design of Biodegradable Iodinated Polymeric Nanoparticle as CT Contrast Agents
최민규, 안철희, 서울대학교

2PS-9 Polymeric Sonosensitizer Nanoparticles for *in situ* Cancer Vaccination
주혜연, 엄우람, 고혜원, 박재형, 성균관대학교

2PS-10 The Hybrid Hydrogel for Sustained Release and Extended Half-life: Albumin Affibody-Conjugated Injectable Gel with Albumin-Conjugated Urate Oxidase for the Treatment of Hyperuricemia
조진환, 권인찬*, 광주과학기술원; *광주과학기술원 신소재공학부

2PS-11 Tuning Surface Functionalities of Sub-10 nm-Sized Nanocarriers to Target Outer Retina in Designing Intravitreal Drug Delivery Agents for Age-Related Macular Degeneration
정혜연, 김보람, 김윤경, 한국생명공학연구원

2PS-12 Ultrasound-Mediated Enhanced Drug Delivery and Targeted Imaging by Using Microbubble-Self-Aggregate Complex
정인재, 문형원*, 이학중*, 안철희, Research Institute of Advanced Materials (RIAM), Department of Materials Science and Engineering, College of Engineering, Seoul National University; *Department of Radiology, Seoul National University, College of Medicine and Seoul National University Bundang Hospital

2PS-13 Transdermal Delivery of Up-conversion Dye Using HA-based Nanoparticles
정우엽, 박정민, 최혜은, 이도혜, 김재혁, 김기수, 부산대학교

2PS-14 Supramolecular Injectable Hyaluronate Hydrogels for Cartilage Tissue Regeneration
정상훈, 한세광, 포항공과대학교

2PS-15 Enhancement of ROS Quantum Yield of Photosensitizer by Chemiluminescence Resonance Energy Transfer for Photodynamic Cancer Therapy
전주은, 유동길, 박재형, 성균관대학교

2PS-16 Biodegradable Polymer-based Radiopaque Micropaticles for Transarterial Chemoembolization
전성익, 제환준*, 안철희, Research Institute of Advanced Materials (RIAM), Department of Materials Science and Engineering, College of Engineering, Seoul National University; *Department of Radiology, Seoul National University College of Medicine, Institute of Radiation Medicine, Seoul National University Medical Research Center, Clinical Research Institute, Seoul National University Hospital

2PS-17 Bone Cancer Targeting Nano-aggregates Prepared from the Self-assembled Polyaspartamide Graft Copolymers for pH Sensitive DOX Delivery
임철원, 김덕준, 성균관대학교

2PS-18 Calcium-binding Near-infrared Fluorescent Nanoprobe for Bone Tissue Imaging
임용근, 김현정*, 김진원*, 박경순, 중앙대학교; *고려대학교 구로병원

2PS-19 폴리비닐알콜 나노섬유 내부에서의 산화질소방출 나노 입자 분포 연구
임도현, 곽영우, 남창우, 전북대학교

2PS-20 Adipocyte-targeting Gas-generating Poly(lactic-*co*-glycolic acid) Nanoparticles
한영경, 이혜원, 이근용, 한양대학교

2PS-21 Fabrication and Evaluation of in situ Biodegradable Pullulan Hydrogels as an Injectable Hemostatic Agent
이혜영, 곽동민, 김현서, 이승욱*, 권오형, 금오공과대학교; *VISION SCIENCE CO., LTD.

2PS-22 Catechol-modified Poly(allylamine) Hydrogels with Self-healing and Adhesive Properties
이지나, 이수연, 박원호, 충남대학교

2PS-23 Optimization of the Preparation Parameters of Escitalopram Loaded PLA/PLGA Microspheres for Sustained Release
이주화, 김혜민, 김보연*, 신병철*, 박정숙**, 충남대학교/한국화학연구원; *한국화학연구원; **충남대학교

2PS-24 Development of Enhanced Cancer Theranostics Based on Perfluorocarbon Loaded Nanosensitizers
이정진, 이기라, 박재형, 성균관대학교

2PS-25 Fabrication of Antigen Associated Poly(lactic-co-glycolic acid) Nanoparticle for House Dust Mite Allergy
이윤복, 강예영, 공민선, 김서영, 이현종, 이예린, 가천대학교

2PS-26 Polydimethylsiloxane (PDMS) Changes in Physical Properties of Polymer Brushes Depending on the Difference in Average Molecular Weight
이승희, 정종진*, 한남대학교; *한남대학교 화학과

2PS-27 Fabrication of Nanofibrous Patch Functionalized with Catechol for Wound Healing
이소윤, 권미나, 김기수, 부산대학교

2PS-28 Chlorin-e6 Conjugated Polydopamine Capped Gold Nanoparticles for Synergy Effect By Combining PDT and PTT
이미소, Wei Mao, 이주원, 박재근, PHAM NGUYEN OANH VU, 조완호, 유혁상, 강원대학교

2PS-29 Bioreducible Polymers with Fluorinated Arginine-graft for Efficient Gene Delivery Systems
이미겸, 정소희, 김태일, 서울대학교

2PS-30 Silk Fibroin Microspheres Prepared in Macromolecular Crowding Conditions
안혁주, 양세준, 이기훈, 서울대학교 농림생물자원학부

2PS-31 Development of pH-responsive Polymeric Nanocarrier for Delivery of Methotrexate to Rheumatoid Arthritis
윤 빈, 전주은, 박재형, 성균관대학교

2PS-32 Development and Characterization of Propolis Extract, Camellia Oil Extract, Oil Soluble Licorice Extract Encapsulated Polymeric Micelle Nanoparticle Material
안주영, 조선행*, 김채진**, 박나래***, 이은희****, 한국화학연구원/고려대학교; *한국화학연구원; **한국화학연구원/중앙대학교; ***한국화학연구원/충남대학교; ****고려대학교 약학대학

2PS-33 Oral Delivery of Parathyroid Hormone Using Bile Acid Transport System
안정만, 이동윤, 이용규*, 한양대학교; *한국교통대학교

2PS-34 In Vitro Photodynamic Effects of Dectin-1 Receptor Targeted-photoactivatable Nanoagents on Atherogenic Cells
안재원, 김진혁, 박경순, 중앙대학교

2PS-35 Injectable and Self-healing Fmoc-diphenylalanine (Fmoc-FF) Hydrogels for Sustained Drug Release
심재민, 강지선, 조연주, 윤석일, 상명대학교

2PS-36 Substrate-Independent Antibacterial Coatings by Zwitterionic L-DOPA
신현민, 조우경, 충남대학교

2PS-37 Optimization of the Preparation and Characterization of Tannylated-Albumin Nanoagent
송영준, 정성윤, 김진혁, 박경순, 중앙대학교

2PS-38 The pH-Responsiveness of Metal-Phenolic Network-Coated Polymeric Nanoparticles for Targeted Cancer Therapy
송석호, 신정민, 박재형, 성균관대학교

2PS-39 Dual-crosslinked Silk Fibroin Hydrogel for Regeneration of Articular Cartilage
배수빈, 박원호, 충남대학교

2PS-40 Design and Synthesis of Methylene Malonate Compound for Liquid Embolic Material
박지호, 안철희, 서울대학교 재료공학과

2PS-41 Injectable Shear-thinning Hydrogels Induced by Host-Guest Interaction

as the Chemoembolization Agents
박지슬, 박기동, 이효진, 전여진, Phuong Le Thi, 아주대학교

2PS-42 Gene Delivery and Drug Delivery Study Based on Synthesized Biodegradable and Biocompatible Polyurethane Double Emulsion Nanoparticles
박수용, 정일두*, 부산대학교; *부산대학교 고분자공학과

2PS-43 Effects of Electron-beam Irradiation and Poly Ethylene Glycol (PEG) Contents on Porous Polysaccharide Based Coating for Interventional Medical Devices
박세게, 김자록, 최동윤, 이동윤*, 유승화**, 한국생산기술연구원; *경북대학교; **전북대학교

2PS-44 Synthesis and Characterization of Thermoresponsive Hollow - Shell Polymeric Nanocapsules Based on Colloidal Silica
박수용, 정일두*, 이유진*, 부산대학교; *부산대학교 고분자공학과

2PS-45 Development of Glutathione Depleting Pro-oxidants for Oxidative Anticancer Therapy
박미란, 정은경, 신현빈, 이영종, 이동원, 전북대학교

2PS-46 Micropattern-based Multichannel Nerve Conduit with Stem Cell Recruitment Ability
박도연, 김수현, 한국과학기술연구원

2PS-47 The Preparation and Evaluation of Apigenin Nanoparticles for Antioxidant
박나래, 조선행*, 안주영**, 김채진***, 구태성, 이재휘***, 신병철*, 충남대학교; *한국화학연구원; **고려대학교; ***중앙대학교

2PS-48 Hypoxia Targeting Smart Nanoconstructs with Dual Photothermal Cancer Therapy and T1 MRI Imaging
몬 달, 이용규*, 한국교통대학교; *Department of Green Bio Engineering, Korea National University of Transportation

2PS-49 Adhesive and Tough Hydrogel Based on Mussel-Inspired Copolymer
나행요, 손정선, 최재곤, 조선대학교

2PS-50 Sustained Release Characterization of Donepezil-loaded PLGA Microspheres Addition to Glycolic Acid as a Release Retardant
김혜민, 이주화, 김보연*, 신병철*, 박정숙**, 충남대학교/한국화학연구원; *한국화학연구원; **충남대학교

2PS-51 Interaction of Protein with a Modified Drug Conjugate
나행요, 손정선, 조선대학교

2PS-52 Dual-crosslinkable Self-healing Hydrogel for 3-D Bioprinting
김현승, 문창욱, 노현호, 이근용, 한양대학교

2PS-53 Fabrication of Biomass-based Anti-Microbial Carbon Composites PU Foam Dressings for Functional Wound Healing
김현서, 고윤제, 신인해, 조동환, 박원호*, 권오형, 금오공과대학교; *충남대학교

2PS-54 The Drug Loading/Releasing Capability of Glutathione-responsive Peptide Amphiphile Vesicles Controlled by Positionable Disulfide-bridges
김하연, 김인혜, 황준호, 이은지, 광주과학기술원

2PS-55 Fabrication of Gas-generating Polymer Micelles for Fat Reduction
김충구, 이근용, 한양대학교 생명공학과

2PS-56 Synthesis and Properties of Novel Multiple-hydroxy Polyaspartamide and Its Cross-linked Gels
김지흥, 문종렬, Dat Quoc Dang, 성균관대학교

2PS-57 Tannin-based Nanoformulation for Stabilization of Paclitaxel in Aqueous Medium
김지연, 홍선기, 대구경북과학기술원

2PS-58 근적외선 조사에 의해 산화질소 방출 제어가 가능한 폴리도파민 코팅 연구
김수현, 정환희, 예영신, 남창우, 전북대학교

2PS-59 Development of Antifouling Coatings Using Diverse Polymers and the Comparative Study
김수연, 박상정, 서현지, 김선희, 조우경, 충남대학교

2PS-60 Develpment of Multi-functional NK Cell Coating Materials for Enhanced Anti-cancer Efficacy
김성준, 김교범, 동국대학교

2PS-61 Barium Titanate Nanoparticles/Hyaluronate-Rose Bengal Conjugate for Noninvasive Photochemical Tissue Regeneration
김성종, 한세광, 포항공과대학교

2PS-62 Treatment of Riboflavin Phosphate to a Collagen Matrix and Effects of Blue Light Irradiation
김서영, 강예영, 이윤복, 공민선, 강연태, 이현종, 가천대학교

2PS-63 Development of Cell Spheroid System Based on Porous Microparticles for Cell Survival and Bone Regeneration
김민지, 정영조*, 이진호*, 오세행, 단국대학교; *한남대학교

2PS-64 Enhancement in Tissue Adhesion of Catechol-modified Hyaluronic Acid Hydrogels by Tannic Acid Treatment
곽민아, 홍보민, 박원호, 충남대학교

2PS-65 Guiding Tissue Regeneration of Rabbit Bone Defects Using Silk Fibroin-Poly(glycolic acid) Hybrid Scaffolds Fabricated by Electrospinning and 3D Printing Techniques
곽동민, 고영광, 권오형, 금오공과대학교

2PS-66 Fabrication of Injectable Hydrogel via Visible Light-crosslinkable Furfuryl-modified Gelatin
공민선, 강예영, 이윤복, 김서영, 임새빈, 이현종, 가천대학교

2PS-67 Catalase-immobilized Syringes to Create Oxygenated Hydrogels for Boosting Wound Healing
강전일, 박경민*, 인천대학교; *인천대학교 생명공학부

2PS-68 Preparation of Biodegradable Poly(lactic-co-glycolic acid) Micro/Nanoparticles for Vaccination
강예영, 김서영, 김재학, 공민선, 이윤복, 이현종, 가천대학교

2PS-69 Cytotoxicity and Potential Applicability of Polyethyleneimine-coated Eu_2O_3 and Dy_2O_3 Nanoparticles as X-ray CT Contrast Agents
강문성, 이석현, 이지은, 김춘태, Timur Sh. Atabaev*, 한동욱, 부산대학교; *Nazarbayev University

2PS-70 Surface-triggering in situ Gelation (STIG) Technology for Individual Encapsulation of Therapeutic Cells
Tung Pham, Phuong Le Tran, Jee-Heon Jeong, Yeungnam University

2PS-71 Post-transplantation Tracking of the Pancreatic Islets by Magnetic Resonance Imaging Using Iron Oxide Nanoparticles Loaded Tissue-adhesive Microparticles
Phuong Tran, Tung Pham, Jee-Heon Jeong, Yeungnam University

분자전자 부문위원회

2PS-72 Reverse Offset Printed Silver Nanowire Electrodes with Large-Area and Fine Micro-Patterning
황인국, 김종윤, 박규태, 이윤구, 대구경북과학기술원

2PS-73 Stabilization of Quantum Dots in Water/Alcohol by Ligand Exchange
황대호, 황동렬, PREM PRABHAKARAN, 한남대학교

2PS-74 Stability Cesium Lead Halide Perovskite Quantum Dots Obtained by Amino Acid Mediated Synthesis
홍수진, 이광섭, PREM PRABHAKARAN, 김경주, 한남대학교

2PS-75 3D-Printed Sugar Scaffold for High-Precision and Highly-Sensitive Active and Passive Wearable Sensors
호동해, 홍판욱*, 한중탁**, 김상연***, 권석준****, 조정호, 연세대학교; *성균관대학교; **KERI; ***한국과학기술교육대학교; ****KIST

2PS-76 Enhancement-mode OECTs with a Large Volumetric Capacitance
허성민, 권지민, 노용영, 포항공과대학교

2PS-77 Synthesis, Electrochemical and Photophysical Properties of Nitrogenous Heterocyclic Green Fluorophores
허선형, 우한영, 고려대학교

2PS-78 Synthesis and Characterization of a Wide-bandgap Polymer Based on Perfluorinated and Alkylthiolated BDT with a Deep HOMO Level for Organic Photovoltaics
함효빈, 김희수*, 황도훈*, 강인남, 가톨릭대학교 성심교정; *부산대학교

2PS-80 High-Performance Near-Infrared Circularly Polarized Light-Sensing Organic Phototransistors with Conjugated Polymer Layer and Cholesteric Liquid Crystal Network Film for Optoelectronic Encryption
한혜미, 이유진*, 정재승, 한재훈, 주현수, 안석균*, 임정아, 한국과학기술연구원; *부산대학교

2PS-81 Photomultiplication-type Organic Photodetectors with Fast Response Time Enabled by the Controlled Charge Trapping Dynamics of Quantum Dot Interlayer
한세교, 최욱진, 이한솔, 조길원, 포항공과대학교

2PS-82 Slot-Die Coated Organic Solar Cells with Improved Device Performance and Stability by Introduction of Unusual Additive
한나라, 허윤정*, 김동유, 광주과학기술원; *한국생산기술연구원

2PS-83 High Performance All-Polymer Solar Cells with 11.66% Efficiency and Long-Term Stability by Employing Novel π-Conjugated Donor Polymer with Nonhalogenated Green Solvent
타바마니 구굴라한트, 성경민, 박형진, 제갈영순*, 진성호, 부산대학교; *경일대학교

2PS-84 Highly Efficient and Stable Hybrid Perovskite Solar Cells by Introducing Novel IDTT-based Small Molecule Additive
최현태, 류승운, 이대환, 민지현, 윤선희, 박태호, 포항공과대학교

2PS-85 Visco-Poroelastic Ionic Pump Based Mechanical Selective Sensor
최한빈, 권혁민, 김도환, 한양대학교

2PS-86 Fluorene-based Organic Hole Transporting Material for Improved Stable Perovskite Solar Cell
최정민, 비라 무루간 아리부니티, 도영주, 라자라파티 두르가 가야뜨리, 제갈영순*, 진성호, 부산대학교; *경일대학교

2PS-87 Controlling Random Configuration of Thiophene Units for Mechanically Stable Solar Cells
최예림, 박상아, 이대환, 정우택, 윤선희, 박태호, 포항공과대학교

2PS-88 Ancillary Ligand Effects on Heteroleptic Ir(III) Dye in Dye-Sensitized Photocatalytic CO_2 Reduction: Aryl-Substitution on Bipyridine Ligand

and Its Control on Catalytic Performance
최민수, 이대한, 나수원, 최성한, 김철훈, 조대원, 박종진, 강상욱, 손호진, 고려대학교

2PS-89 Facile and Microcontrolled Blade Coating of Organic Semiconductor Blends for Unialxial Crystal Alignment and Reliable Flexible Organic Field-Effect Transistors
최건오, 김경훈*, 안태규, 한국교통대학교; *포항공과대학교

2PS-90 Synthesis of Donor-Acceptor Polymer for Transistors and Gas Sensors
천형진, 김윤희, 권순기, 정용진*, 성민재, 안태규*, 김세현**, 전인하*, 경상대학교; *한국교통대학교; **영남대학교

2PS-91 Sorting of Large-diameter Semiconducting Carbon Nanotubes for Near-infrared Phototransistors
지동섭, 정학순, 김순효, 권지민, 노용영, 포항공과대학교

2PS-92 Flexible and Enhanced Performance of Thermoplastic Polyurethane Based Triboelectric Nanogenerator
주현서, 이주혁, 대구경북과학기술원

2PS-93 Coplanar Floating Gates Connected with Ionic Bridges for Remote Gating Graphene Transistors
조현우, 강문성, 서강대학교

2PS-94 Sputtered Metallic Glass Thin Film Electrodes for Flexible Strain Sensors and Organic Photovoltaics
조재상, 장웅식, 박금환*, 왕동환, 중앙대학교; *전자부품연구원

2PS-95 Flexible and Semi-transparent Organic Electrochemical Transistors Based on Ultra-thin Au-PEDOT: PSS Hybrid Electrode for Human Skin Electronics
조일영, 김건우, 김영석, 윤명한, 광주과학기술원

2PS-96 Novel Random Terpolymers Composed of Benzodithiophene, Benzodithiophene-4,8-dione and Difluorobenzothiadiazole Units for High-Performance Polymer Solar Cells
정현우, 유경화, 이윤구, DGIST

2PS-97 Improving the Mechanical Properties of Fluorinated NDI-based Conjugated Polymer via Forming Short-range Ordered Segments
정우택, 류승운, 민지현, 김성룡, 박태호, POSTECH

2PS-98 An Oligomer Semiconductor with an Asymmetric End Group for Solution-processed OFETs
정영헌, 김윤희, 이민조*, 이민정, 정선영*, 정용진*, 안태규*, 경상대학교; *한국교통대학교

2PS-99 Regioregularity Effect of Chlorine Substituted Conjugated Copolymers on Charge Transport In Organic Field-effect Transistors
정세인, 조용준*, 양창덕*, 조길원, 포항공과대학교; *울산과학기술원

2PS-100 Small-Molecule Electrolytes as a Cathode Buffer Layer for High Performances Polymer Solar Cells
정미진, SABRINA AUFAR SALMA, 이준호, RAHMATIA FITRI BINTI NASRUN, 손동환, 아날리아 도라지오 컬만, 김주현, 부경대학교

2PS-101 Water/Ethanol Processable N-type Semiconducting Polymers for High Mobility Electrolyte-gated Transistors
정다현, 김민제*, 이승진, 김영웅, 조정호*, 김범준, KAIST; *연세대학교

2PS-102 Enhanced Device Performance Using Quinoxaline-based Polymer Donors by Thiophene Bridge Engineering for NFA Solar Cells
Vellaiappaillai Tamilavan, 장소영, 이성범, 김주현, 진영읍, 박성흠, 부경대학교

2PS-103 Synthesis and Characterization of Fluorinated Donor Polymer Organic Solar Cells Materials
임효진, 우한영, 고려대학교

2PS-104 Triazine-based Porous Organic Polymers for Building Electron Transport Pathways in Perovskite Solar Cells
임지현, 김민성*, 장웅식, 박진균*, 왕동환, 중앙대학교; *한국외국어대학교

2PS-105 Intrinsic Mobility-Strain Relationship in Flexible Organic Semiconductor Crystals via Hall Effect and Raman Spectroscopy
임재민, 한송연, 김수진, 정유정, 최현호, 경상대학교

2PS-106 Percolation-Limited Dual Charge Transport in Vertical p-n Heterojunction Schottky Barrier Transistors
임동언, 조새벽, 조정호, 연세대학교

2PS-107 Ultra-Low Power Electrochemical Heat Shutters Based on Diffusion-controlled Electrochromic Behaviors
인예령, 김용민, 이유정*, 김세현*, 이승우*, 문홍철, 서울시립대학교; *영남대학교

2PS-108 Synthesis and Characterization of Photo-Responsible LCEs Containing Hockey-stick-shaped Mesogen
이혜기, 최이준, 김학린*, 금오공과대학교; *경북대학교

2PS-109 Microporous-pyramid Patterned Hybrid Structure Based Highly Sensitive Triboelectric Nanogenerators
이철재, 이주혁, 대구경북과학기술원

2PS-110 Semiconducting Polymers with Sulfur-Containing Heterocycles and Their Phototransistor Characteristics
이철연, 문예진, 박지수, 이새봄, 이웅기, 김화정, 김영규, 경북대학교

2PS-111 Tuning Interfacial Properties with the Dipole Moment of Conjugated Polyelectrolytes
이준호, 손동환, 정미진, SABRINA AUFAR SALMA, 아날리아 도라지오 컬만, RAHMATIA FITRI BINTI NASRUN, 김주현, 부경대학교

2PS-113 Design and Synthesis of Narrow Bandgap Nonfullerene Acceptors for Low Energy Loss Near-Infrared Organic Solar Cells
이재원, 오필건*, 충남대학교; *부경대학교

2PS-114 Fluorinated Organic-Inorganic Hybrid Polymer Gate Dielectrics for High Performance Metal Oxide Thin-Film Transistors
이일금, 엽하경*, 김나혜**, 김주영**, 김세현*, 남수지, 한국전자통신연구원; *영남대학교; **강원대학교

2PS-115 Polyimide Interfacial Layers for Organic Solar Cells with Polymer: Nonfullerene Bulk Heterojunction Layers
이웅기, 김도한, 서주역, 이철연, 이수용, 이새봄, 박지수, 김화정, 김영규, 경북대학교

2PS-116 3차원 Direct-Ink-Writing을 위한 고전도성 나노복합체 잉크 및 유연/인쇄 전극 제조기술
이영재, 백강준, 부경대학교

2PS-117 ETL 표면 평탄도 개선 및 inkjet printed QD EML이 적용된 inverted QLED 소자 특성 연구
이영우, 정용철, 한국생산기술연구원

2PS-118 Photovoltaic Performance of Solid State Dye-sensitized Solar Cells with Poly(3-hexylthiophene) as Hole Transporting Material
김진아, 오다현, 이연주, 권영환*, 한윤수, 대구가톨릭대학교; *대구대학교

2PS-119 Water/Ethanol-Soluble NDI-Based Polymer Acceptors for Eco-Friendly and Air-Stable All-Polymer Solar Cells
이승진, 김영웅, Ziang Wu*, 이창연, 오승진, Nguyen Thanh Luan*, 이준복, 정다현, Kai Zhang**, Fei Huang**, Taek-Soo Kim, 우한영*, 김범준, KAIST; *고려대학교; **South China University of Technology

2PS-120 Introducing Neutral Layer Design to Supressed Deformation in Stretchable Display
이수안, 신준혁, 최수석, 포항공과대학교

2PS-121 High Efficiency Perovskite Solar Cell with a Defect-passivating Organic Hole-transport Material
이세욱, 이종민, 박상혁*, 박흔준, 한양대학교 유기나노공학과; *공주대학교 화학과

2PS-122 Quinoxaline-based Polymers with Strong Electron-Withdrawing Cyano Groups for Photovoltaic Applications
이석우, 정미진, 김주현, 장동욱, 부경대학교

2PS-124 The Study on Photovoltaic Properties of Fluorine-Substituted Quinoxaline-Based Conjugated Polymers
이석우, 정미진, 김주현, 장동욱, 부경대학교

2PS-125 Universal 3D-crosslinker for Solution-processed Electronics
이명재, 김봉수*, 고려대학교; *울산과학기술원

2PS-126 Highly Efficient Porphyrin-Driven CO_2 Reduction via Hetero-Collisional Electron Transfer Route between Homogeneous Porphyrin and TiO_2 Semiconductor
이대한, 최민수, 나수원, 최성한, 김철훈, 강상욱, 손호진, 고려대학교

2PS-127 User-Interactive Thermotherapeutic Stretchable Strain Sensor Based on Thermochromic Property
이기원, 이시영, 조길원, POSTECH

2PS-128 Electron Injection Process of Porphyrin Dye into Heterogeneous TiO_2/Re(I) Photocatalyst
이대한, 최민수, 백창현, 최성한, 신재윤, 김철훈, 박종진, 강상욱, 손호진, 고려대학교

2PS-129 Effects of Electron Withdrawing Pendant Groups on Thiophene Backbone-based Polymers for Organic Thin-film Transistors
이규민, 정문기*, 강진현*, 정인환*, 장재영, 한양대학교; *국민대학교

2PS-130 Reasearch of New Anthracene Cored Molecules for Efficiency Enhancement Layer (EEL) in Blue Fluorescent Organic Light Emitting Diodes (OLEDs)
이경석, 천형진*, 임형철**, 김미경***, 김장주**, 김윤희*, 경상대학교 유기반도체 재료연구실; *경상대학교; **서울대학교; ***삼성디스플레이

2PS-131 Achieving High Jsc by Reducing Optical Interference Effects in PbS Colloidal Quantum Dots Solar Cells
윤선희, 최현태, 임세영, 최예림, 박태호, 포항공과대학교

2PS-132 Effects of Substitution on Photovoltaic Performance in Benzothiadiazole-Based NIR-absorbing Small-Molecule Acceptor Solar Cells
윤남선, 송창은, 이행근, 이종철, 문상진, 신원석, 이상규, 한국화학연구원

2PS-133 Simple Modification of Alternating Copolymer Donor with Complementary Light Harvesting for High Performance All-Polymer Solar Cells
유호선, 마부수, 김건우, 김택수, 김범준, KAIST

2PS-134 Breath-Figure Molding of Polymer Transistors to Implement Low Power, Flexible, and Highly Selective NO_x Sensors
유성훈, Henok Hetachew Girma*, 심규민, 윤성원**, 안상혁, 박종목*, 공호열*, 정대성, 포항공과대학교; *Research Center for Green Fine Chemicals, Korea Research Institute of Chemical Technology; **KIST

2PS-135 A Multifunctional Aromatic Polythiourea Gate Insulator with Dual Cross-linking Network for Organic Field-effect Transistors
유성미, 박현진, 원종찬, 김동균, 김윤호, 한국화학연구원

2PS-136 Morphology Optimization for High-performance Ternary Organic Solar Cells Using Non-halogenated Solvent
유경화, 정현우, 이윤구, DGIST

2PS-137 High-performance Dual Hybrid Perovskite Photodetectors Utilizing Graphenes and Gold Nanostars
원유상, 이윤호*, 박승영**, 문정호***, 하재환***, 이정훈, 노준석***, 고현협****, 오준학, 서울대학교; *삼성디스플레이; **KRICT; ***포항공과대학교; ****울산과학기술원

2PS-138 A Novel Synthetic Strategy of Thienothiophene-benzotriazole-based Polymers for Field-effect Transistor Applications
오종규, 조요한*, 김철환*, 안태규*, 이지훈*, 장재영, 한양대학교; *한국교통대학교

2PS-139 The Impact of Controlled Side Chains on the Morphology, Molecular Orientation of Small Molecule Based Photovoltaic Devices
오소라, 송창은, 이행근, 이종철, 신원석, 이상규, 한국화학연구원

2PS-140 Zn1-XMgXO-based Electron Transport Layer to Promote Charge Balance for Quantum Dot Light-emitting Diodes
여상민, 이도창, 한국과학기술원

2PS-141 Backbone Tuning of Diketopyrrolopyrrole-Based Copolymer Semiconductors for High-Performance Thin Film Transistors
양희창, 김윤희*, 인하대학교; *경상대학교

2PS-142 Influence of 3D Morphology on the Performance of All-polymer Solar Cells Processed Using Environmentally Benign Nonhalogenated Solvents
안평강, 이은지*, 김봉수, 울산과학기술원; *광주과학기술원

2PS-143 Dopant-Enhanced Ordering and Conductivity of Solution-Processed Semiconducting Polymer Thin Films
양희창, 인하대학교

2PS-144 Facile Photo-crosslinking System for Polymeric Gate Dielectric Materials toward Solution-processed Organic Field-effect Transistors: Role of Crosslinker in Various Polymer Types
안태규, 권혁진*, 정용진, 한국교통대학교; *포항공과대학교

2PS-145 Deep-Blue Phosphorescent Organic Light-Emitting Diodes with Excellent External Quantum Efficiency up to 24% with CIEy Value of 0.08
아티싼 마헤쉬와란, 박호열, 제갈영순*, 진성호, 부산대학교; *경일대학교

2PS-146 Surface Modification of CdSe Quantum Dot Floating Layers in Light-responsive Organic Flash Memory
안태규, 김재영, 이지훈, 정용진, 한국교통대학교

2PS-147 Synthesis and Characterization of IDTT Derivatives for Organic Solar Cell
아날리아 도라지오 컬만, SABRINA AUFAR SALMA, 정미진, RAHMATIA FITRI BINTI NASRUN, 손동환, 이준호, 김주현, 부경대학교

2PS-148 Improved Contact Properties of Spray-Coated AgNWs Source and Drain Electrodes in Oxide Thin-Film Transistors
안태규, 정선영, 정용진, 한국교통대학교

2PS-149 Colloidal Synthesis of Cu_2BaSnS_4 (CBTS) for Hole Transport Layer Applications of Organic Photodiode
심규민, 정대성*, 대구경북과학기술원; *포항공과대학교

2PS-150 Effect of Structural Modulation of Polymeric 3rd Component on the Performance of Polymer Solar Cells
신인수, Vellaiappillai Tamilavan, 김단비, 양현석, 정윤경*, 정중현, 이보람, 김주현**, 손세모***, 박성흠, Department of Physics, Pukyong National University; *School of Biomedical Engineering, Inje University; **Department of Polymer Engineering, Pukyong National University; ***Department of Graphic Arts Engineering, Pukyong National University

2PS-151 Three-dimensional Artificial Skin Device with Self-healing and Tactile Sensing Functionality
신우현, 김준섭, 최희주, 김희성, 이희정, 정경운, 한국기계연구원 부설 재료연구소(KIMS)

2PS-152 Hybrid Organic Photovoltaic Cells Integrated with Liquid Contact Triboelectric Nanogenerator for Energy Harvesting
손선영, 유동현, 김동성, 정성준, 포스텍

2PS-153 Photovoltaic Properties of A-D-A Small Molecule-based on Indacenodithieno [3,2-b]thiophene with Chromone Derivative for Organic Solar Cells
손동환, 아날리아 도라지오 컬만, SABRINA AUFAR SALMA, 정미진, 이준호, RAHMATIA FITRI BINTI NASRUN, 김주현, 부경대학교

2PS-154 Highly-Efficient Phosphorescent Organic Light-Emitting Diodes with Horizontal Oriented Iridium(III) Complexes
손선영, 전현진*, 안형주**, 정성준, 권순기***, 김윤희*, 포스텍 창의IT융합공학과; *경상대학교 화학과; **포항가속기연구소; ***경상대학교 나노신소재공학부

2PS-155 The Substituent-Effect of Deep-Blue Phosphorescent N-Heterocyclic Carbene (NHC) Ir(III) Complexes and the Application in OLED Devices
백창현, 나수원, 최민수, 김진형, 조대원, 강상욱, 손호진, 고려대학교

2PS-156 Synthesis of Highly Fluorinated Polymer Photoresist for Photo-patterning of Organic Light Emitting Diode (OLED) Displays
박춘희, 이진균, 인하대학교

2PS-157 Photophysical Properties of Structural Isomers of N-Heterocyclic Carbene Iridium(III) Complexes Derived from Xylene Substitution
백창현, 나수원, 이대한, 윤보선, 조대원, 강상욱, 손호진, 고려대학교

2PS-158 Elucidating Important Roles of Polymer Donor Aggregation in Blend Morphology and Device Performance of Different Types of Non-Fullerene Polymer Solar Cells
박진수, 최나연, 이창연, 이승진, 하종운*, 황도훈*, 김범준, KAIST; *부산대학교

2PS-159 Synthesis of New Donor-Acceptor Copolymer for Organic Thin Film Transistor (OTFT)
박지현, 김윤희, 권순기, 경상대학교

2PS-160 Design and Synthesis of Imidazole Coupled Diphenylamine Derivatives as Hole-transport Materials for Perovskite Solar Cells
박종호, 박상혁, 공주대학교

2PS-161 Cross-Linked Polymer Semiconductor-Based OFET Sensors for Direct Detection of Organic Solvent
박종민, 이무열*, 김형준**, 정관영***, 한아름***, 곽상규***, 김범준**, 오준학, 서울대학교; *KIST; **KAIST; ***UNIST

2PS-162 친환경 양자점 InAs 기반 고효율 고안정성 태양전지 소자 연구
박영상, 배성용*, 박성민**, 김태완**, 최효성*, 김영훈***, 정소희**, 한국과학기술원; *한양대학교; **성균관대학교; ***대구경북과학기술원

2PS-164 Breath Figure Patterned Light Extraction Structures for High Performance Organic Light-Emitting Diodes
박성빈, 한주원, 주철웅*, 이종희**, 김용현, 부경대학교; *한국전자통신연구원(ETRI); **한밭대학교

2PS-165 Green-Solvent-Processable Hole Transport Polymers with Lead-Capturability in Perovskite Solar Cells
박상아, 이준우, 최현태, 이대환, 최예림, 김성룡, 박태호, POSTECH

2PS-166 Surface Modified Fullerene Electron Transport Layers for Stable and Reproducible Flexible Perovskite Solar Cells
민지현, 최경원, 최현태, 임세영, 윤선희, 박태호, 포항공과대학교

2PS-167 The Surface Modification of CdS Photocatalyst by Inorganic Ions for the Improvement of CO_2 Reduction
로 반, 이도창, 한국과학기술원

2PS-168 Highly Efficiency Green Ir(III) Complexes with External Quantum Efficiency Over 20% in Green Solvent Processed Phosphorescent Organic Light-Emitting Diodes
라자 쿠마레즌, 박호열*, 아티싼 마헤쉬와란*, 제갈영순**, 진성호*, 부산대학교 화학소재학과; *부산대학교; **경일대학교

2PS-169 Doping or Mixing: Role of Monovalent Metal Iodide in Two-Dimensional Perovskite Transistor
노유진, HUIHUI ZHU, AO LIU, 고지영, 최태수, 노용영, 포항공과대학교

2PS-170 친환경 수성 콜로이드를 이용한 열전소자의 제작
남건희, 하재언, 심혜륜*, 정대성*, 대구경북과학기술원; *포항공과대학교

2PS-171 Influence of Bulky Substituents on the Photophysical Properties of Homoleptic Iridium(III) Complexes
나수원, 백창현, 최민수, 김진형, 조대원, 강상욱, 손호진, 고려대학교

2PS-172 Design of Deep Blue Thermally Activated Delayed Fluorescence Materials
김희재, PREM PRABHAKARAN, 황동렬, 한남대학교

2PS-173 One-dimensional Organic Artificial Multi-synapses Enabling Electronic-textile Neural Network for Wearable Neuromorphic Applications
강민지, 함성길*, 장성훈*, 장진곤*, 왕건욱*, 김태욱, 전북대학교; *고려대학교

2PS-174 Smart Contact Lens with Silver Nanowire Sensor for Continuous Intraocular Pressure Monitoring
김태연, 한세광, 포항공과대학교

2PS-175 C70-based Aqueous-Soluble Fullerene Acceptor for Eco-Friendly Polymer Solar Cells with Water Composition-Tolerant Performance
김창균, 강현범, 최나연, 이승진, 김영권, 김진우, 우한영*, 우즈앙*, 김범준, 한국과학기술원; *고려대학교

2PS-176 Decoupling Critical Parameters in Large-range Crystallinity Controlled Polypyrrole-based Organic Electrochemical Transistors
김지환, Zubair Ahmad, 김영석, 김원빈, 안형주*, 이재석, 윤명한, 광주과학기술원; *포항가속기연구소

2PS-177 Synthesis of Naphthalene-Diimide (NDI) Based N-Type Small Molecules for Organic Field-Effect Transistors
김지현, 김윤희, 권순기, 하연희, 오정규*, 박세진**, 안태규**, 장재영*, 경상대학교; *한양대학교; **한국교통대학교

2PS-178 Doping-dedoping Interplay for Fine Patterning/Stacking of All-polymer Optoelectronic Devices
김주희, 정대성, 포항공과대학교

2PS-180 Improved Light Extraction Efficiency in Organic Light-Emitting Diodes Using Phase-Separated Polymer Films
김정하, 홍주희, 한주원, 박성빈, 김용현, 부경대학교

2PS-181 Synthesis of Carbazole Based p-Type Polymers for Indoor Photovoltaics
김정아, 이원호, 금오공과대학교

2PS-182 Artificial Synaptic Tactile Transistor Based on Hydrogen Bond-Triggered Ion Pump
김윤아, 김주성, 권혁민, 정윤선, 김도환, 한양대학교

2PS-183 Effect of Low Molecular Weight Fraction on Charge Transport Behavior of Conjugated Polymers
김승현, 박상식, 조용준*, 양창덕*, 조길원, 포항공과대학교; *울산과학기술원

2PS-184 Enhanced Endurance in Organic Electrochemical Neuromorphic Transistors Based on Polythiophene Containing Protonating Groups for Spiking Neural Network Computing
김수진, 정재승*, 장호원**, 주현수*, 임정아*, 한국과학기술연구원/서울대학교; *한국과학기술연구원; **서울대학교

2PS-185 Analysis and Prediction of Perovskite Solar Cells Database
김수진, 박재성, 최우진, 이재흥, 한국화학연구원

2PS-186 Improvement of Ionic Gel's Thermal Stability, Stretchable and Self-healable Properties through an Ionic Side Chain
김성룡, 이준우, 박상아, 류승은, 정우택, 박태호, POSTECH

2PS-187 Metal-doped Nickel Oxide Thin Film Electrodes for High Performance Electrochromic Supercapacitors
김선영, 윤태용, 유경수, 문홍철, 서울시립대학교

2PS-188 Synthesis and Characterization of Circularly Polarized Light-emitting Liquid Crystalline Fluorene-based Compounds with Chiral Alkyl Groups
김서영, 최이준, 유창재*, 김재훈*, 금오공과대학교; *한양대학교

2PS-189 Highly Stretchable, High-Mobility, Free-Standing All-Organic Transistors Modulated by Solid-state Elastomer Electrolytes
김보미, 김도환*, 김봉수, 울산과학기술원; *한양대학교

2PS-190 Carbon-carbon Decoupling Reaction Rate Enhancement by Cation-pi Interaction of Cation-coordinated Graphitic Carbon Nitride
김민수, 이도창, 한국과학기술원

2PS-191 용액공정을 이용한 유기발광다이오드(OLED) 개발
김민경, 김민지, 엄태식, 홍익대학교

2PS-192 강유전성 고분자 블렌드를 이용한 유기박막태양전지 개발
김문규, 김지훈, 이 솔, 엄태식, 홍익대학교

2PS-193 PVC Gel-based Skin-attachable Single Layer Triboelectric Nanogenerator and Position Sensor
김대영, 이주혁, 대구경북과학기술원

2PS-194 SnO_2 Electron Transport Bilayer for Highly Efficient Planar Perovskite Solar Cell
김기웅, 신성식*, 이경진**, 서장원*, 한국화학연구원/충남대학교 응용화학공학과; *한국화학연구원; **충남대학교 응용화학공학과

2PS-195 Red-Green InP/ZnSeS/ZnS QD Incorporated Color Filters for UHD Liquid Crystal Displays
김경주, 최신일, 고윤혁, PREM PRABHAKARAN, 이광섭, 한남대학교

2PS-196 New Triad-Type, Multi-Functional Compatibilizers for Enhancing Device Efficiency and Thermal/Mechanical Stabilities of Polymer Solar Cells
김건우, 이영웅*, 우한영*, 김범준**, 마부수**, 김진석**, 박진수**, 이승진**, Thanh Luan Nguyen*, 송명**, 김택수**, KAIST; *고려대학교; **한국과학기술원

2PS-197 Fluorinated Organic-Inorganic Nanohybrid Sol-Gel Derived Gate Dielectrics for Ultra-Flexible and Electrical Stable Organic Electronics
권혁진, 백용화, 염하경*, 김나혜**, 홍지수, 박용환**, 박찬언, 김주영**, 김세현*, 포항공과대학교; *영남대학교; **강원대학교

2PS-198 유기전계효과트랜지스터 특성 향상을 위한 광파에 의한 고분자 반도체의 결정 구조 변화와 전하 이동 특성 개선 연구
권미정, 백강준, 부경대학교

2PS-199 Ultrasensitive and Transparent Piezoresistive Force Sensor Based on Spike-Stimulated Dendritic Networks
구지우, 이윤구, 대구경북과학기술원

2PS-200 Synthesis of Fluorinated Alternating Copolymer and Photolithographic Characterization under High Energy Electron-beam and EUV Radiation
구예진, 이진균, 인하대학교

2PS-201 Nano-crack Formation on the Micro-structure for Piezo-resistive Pressure Sensor with High Linearity and Flexibility
고현주, 김성원*, 조길원*, 이승구, 울산대학교; *포항공과대학교

2PS-202 Realization of Hysteresis-Free Two-Dimensional Perovskite Transistors at Room-Temperature
고지영, HUIHUI ZHU, AO LIU, 노유진, 노용영, 포항공과대학교

2PS-203 Optical Anisotropy in InP/ZnS Core/Shell Nanotetrapods
고성준, 이도창, KAIST

2PS-204 Noise-Tolerant Optical Sensors via Junction Engineering of Organic Photodiodes
강민균, Syed Zahid Hassan*, 정대성*, 대구경북과학기술원; *포항공과대학교

2PS-205 Phenylethylammonium Iodide Induced Interface Engineering and Surface Passivation for Efficient and Stable Perovskite Solar Cells
Yuanyuan Zhang, 박성흠, 김주현, 이보람, 정윤경*, 양현석, Pukyong National University; *Inje University

2PS-206 Poly[(9,9-bis(3′-((*N*,*N*-dimethyl)-*N*-ethylammonium)-propyl)-2,7-fluorene Derivatives as Interfacial Layer in Polymer Solar Cell
SABRINA AUFAR SALMA, 정미진, RAHMATIA FITRI BINTI NASRUN, 아날리아 도라지오 컬만, 손동환, 이준호, 김주현, 부경대학교

2PS-207 Cathode Modification of Polymer Solar Cells by Introducing Conjugated Polyelectrolytes with Diverse Acid Derivatives
RAHMATIA FITRI BINTI NASRUN, 이준호, SABRINA AUFAR SALMA, 정미진, 손동환, 아날리아 도라지오 컬만, 김주현, 부경대학교

2PS-208 Air-processable and Stable Perovskite Planar Solar Cells with Base-Layered 2 Dimensional Perovskite
Pesi Mwitumwa Hangoma, 김단비*, 정윤경**, 이보람*, 김주현***, 박성흠*, Pukyong National University; *Department of Physics, Pukyong National University; **Department of Biomedical Engineering, Inje University; ***Department of Polymer Engineering, Pukyong National University

2PS-209 Lead-free Layered-perovskite Transistors
HUIHUI ZHU, 노용영, Pohang University of Science and Technology

2PS-210 Intra Molecular Charge Transfer from Phenanthro-Imidazole Based T and Y Shaped Donor-Acceptor Molecules
Eswaran Kamaraj, 박상혁, Kongju National University

2PS-211 Stretchable Transparent Conductive Biopolymers with Embedded Silver Nanowires
Anky Wibowo, 박성빈, 한주원, 김용현, 부경대학교

2PS-212 Anomalous Absorption of Electromagnetic Waves by 2D Transition Metal Carbonitride Ti3CNTx (MXene)
Aamir Iqbal, 구종민, Korea Institute of Science and Technology

2PS-213 Molecule Charge Transfer Doping for p-Channel Solution-Processed Copper Oxide Transistors
AO LIU, 노용영*, Pohang University of Science and Technology; *Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH)

기능성 고분자 (II)

2PS-214 UV Reactive Self-healing Polymer with Water Repellency Property and Coating Process
김진호, 오명건, 이강택*, 이선종, 한국생산기술연구원; *연세대학교

2PS-215 Facile Fabrication of Polyaniline Films with Hierarchical Porous Networks for Enhanced Electrochemical Activity
김지혜, 구형준, 소주희*, 김성곤**, 최종훈***, 서울과학기술대학교; *한국생산기술연구원; **전북대학교; ***중앙대학교

2PS-216 Colorimetric Detection for Organic Solvent in Water Using Microfluidic System
김지영, 김세민, 지유진, 고원건, 연세대학교

2PS-217 Highly Purified MSC-derived Exosome Isolation Methods for Attenuating Inflammatory Cells
김준용, 임원규, 박천권*, 한동근, 차의과학대학교; *성균관대학교

2PS-218 PP-g-MAH 및 EOR-g-MAH 첨가가 polypropylene/kenaf 펠프 복합체의 상용성 및 충격강도에 미치는 영향
김준석, 김상윤, 김연철, 공주대학교

2PS-219 Conductive Inks Using Modified PVB with Improved Dispersibility and Adhesion
김준서, 안다혜, 손경철, 박상기, 조유장, 최민석, 차석준, 박종진, 전남대학교

2PS-220 Vascularized Cardiac Tissue Network by a Direct Patterning via a 3D Bioprinter
김주란, 한국생산기술연구원

2PS-221 Fabrication of Conductive Overcoating Layer Based on Hybrid Composites to Improve the Stability of Flexible Transparent Conductive Films
김정민, 이진근*, 조원석*, 조한결*, 김영노*, 이홍주*, 김중현*, 연세대학교; *연세대학교 화공생명공학과

2PS-222 Acaricidal Effects of Eugenol-encapsulated Cellulose Acetate Nanofibers Against Dermatophagoides Farinae via Emulsion Electrospinning
김주란, 한국생산기술연구원

2PS-223 Functional Polyimide Binder for High-nickel, High-voltage Cathode Materials of Lithium Rechargeable Batteries
김정동, 정현민, 박준우, Azimov Farkhod, 박수빈, 송승완*, 금오공과대학교; *충남대학교

2PS-224 Highly Efficient and Sustainable Alginate/Carboxylated Lignin Hybrid Beads as Adsorbent for Cationic Dye Removal
김정규, 박진석, 방준식, 김윤진, 곽효원, 서울대학교

2PS-225 Sensing and Memorising Liquids Information with Polarity-interactive Ferroelectric Sound
김의혁, 박철민, 연세대학교

2PS-226 폐가죽 추출 단백질 가수화물/폴리비닐알코올 복합 수지 제조 및 자력증강제 적용 연구
김은지, 백인규, 윤영호*, 한국신발피혁연구원; *(주)기룡산업

2PS-227 Carbon Nanotubes-in-polymer Nanofibers with a Long-range Ordered Structure
김유경, 윤현석*, 한국소방산업기술원; *전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

2PS-228 Hydrogel Encapsulation System for Aquaculture of Marine Organism
김원혁, 나양호, 한남대학교

2PS-229 Influence of Wettability on Glass Transition Temperature on the Interface of Polymer Core-shell Nanoparticle Films
김용수, 이찬민*, 이준영*, 황기섭*, 한국생산기술연구원/성균관대학교; *한국생산기술연구원

2PS-230 광학적 안정성을 증진시킨 옥사디아졸 형광체를 이용한 나노구조제어체의 면역형광표지법을 위한 연구
김완서, 김형준, 공주대학교

2PS-231 Improvement of Absorption Properties by Formation of Surface Pores Using Chemical Blowing Agent
김예린, 남현구, 곽영제, 숭실대학교

2PS-232 Enhanced Photocatalytic Activity of Ce-doped β-Ga_2O_3 Nadnofiber Films Fabricated by Electrospinning Method
김영훈, 허윤정, 백정주, 장기철, 송광식, 박성만, 배근열, 이효선, 신교직, 최경호, 한국생산기술연구원

2PS-233 Icephobic-coating Characteristics of Polymers with Controlled Modulus
김영석, 천지민, 김진환, 정진영, 조보경, 한국전자기술원

2PS-234 A Highly Self-healable Heterocyclic Elastomer Synthesized Using Cage-shaped Adamantane with Outstanding Mechanical Properties
김영경, 문경민, 전혜련, 홍평화, 홍성우, 한국생산기술연구원

2PS-236 Multiple Enzyme Immobilization Using Heat-sensitive Polymeric Nanocarrier for Enhanced Cascade Reaction
김승균, 권인찬*, 광주과학기술원; *광주과학기술원 신소재공학부

2PS-237 Durable Sulfur Cathode via an Elastic Chitosan Network Designed for Fast-Charging Lithium-Sulfur Batteries
김수찬, 조미숙, 이영관, 성균관대학교

2PS-238 Enhancement in Soil Moisture Retention Using Hydrophilic Hydrogel with Homogeneous Network Structure
김성민, 나양호, 한남대학교

2PS-239 Influences of Nanoparticles on Ion Conduction in Poly(lithium acrylate)-based Solid Polymer Electrolytes (SPEs)
김선호, 최우혁, 인하대학교

2PS-240 Synthesis and Characterization of New Self-polishing Copolymers
김서일, 황도훈, 부산대학교 화학과

2PS-243 Investigations on Diketopyrrolopyrrole (DPP) and Isomeric Fluorinated-Benzothiadiazole-based Polymers
김부영, 전정담, 송지은, 이정훈, 동서대학교

2PS-244 pH-Responsive Polymer-coated Silica-titania Hollow Nanoparticles for Controllable Drug Release
김보미, 정의석, 이승애, 건국대학교

2PS-245 A Reversible Near-Infrared Fluorescence Photoswitch Based on Diarylethene-Crosslinked Nanoclusters for Live Imaging
김보람, 정혜연, 김윤경, 한국생명공학연구원

2PS-246 Heat Radiating Polyurethane Composite Using Modified Boron Nitride to Enhance Flame Retardancy
김민규, 조남주, 이창록, 부산대학교

2PS-247 Thin Film Nanocomposite Reverse Osmosis Membranes Containing Schiff Base Network-1 Having Improved Separation Performance
김문현, 정경화, 서희란, 이종찬, 서울대학교

2PS-248 Preparation and Bio-application of Polyphenolic Tannic Acid-containing Polyelectrolyte Nano-films
김민규, 이수진, 윤지원, 양성윤, 충남대학교

2PS-249 pH and Acid Type-responsive Self-assembled Colorimetric Film of Block Copolymer Photonic Crystals
김동현, 이찬민, 이준영, 황기섭, 한국생산기술연구원

2PS-250 The Biocompatible Neural Interface Coated with Heparin/Substance P-conjugated PLCL Promotes Neuronal Development and Limits Astrogliosis
김동학, 김수현*, 고려대학교; *한국과학기술연구원

2PS-251 Non-precious Metal Hybrid Hydrochar from Hydrothermal Carbonization for High Level Electrochemical Performance for the Oxygen Reduction Reaction
김동은, 이승연, 김창근, 중앙대학교

2PS-252 Surface Modified Magnetic Particles Removing Nitrogen Organic Compounds in Ultra Pure Water System
김동민, 이강택*, 이선종, 한국생산기술연구원; *연세대학교

2PS-253 Single-Ion Conductive Divalent Acrylic Fluorosulfonylimide Based Polymer Electrolyte with High Conductivity for Li-ion Batteries
김대호, 류태욱, 진레이, 윤수진, WEI ZHANG, 이용훈, 장호현, 김환기, 건국대학교

2PS-254 Synthesis of Water- and Humidity-Responsive Liquid Crystal Elastomers and Their 4D Printing
김금비, 궈위엔항, 허성현, 배재희, 안석균, 부산대학교

2PS-255 Fabrication of Thiophene Derivatives Electrolyte for All Solid Polymer Secondary Battery
권현주, 음율, 조남주, 부산대학교

2PS-256 High Performance and Eco-friendly Polyurethane Using Isosorbide as Chain Extender of Hard Segment Part
권충렬, 이주홍, 민진규, 원종찬, 배지홍, 허필호, 부산대학교

2PS-257 Fabrication and Electrochemical Characterization of MXene/Poly (ether amide)-Derived Hybrid Carbon Nanofibers for Supercapacitor Electrode Materials
권영승, 정영규*, 충남대학교; *충남대학교 유기재료공학과

2PS-258 General Method for the Production of Hydrogel Droplets from Uniformly Sized Smart Shell Membranes
권소정, 박수영, 경북대학교

2PS-259 Photochromic Dye Sensor with TiO_2 Impacting Nitrogen Oxide Controlling VOCs in the Air
권미연, 김주혜, 한국생산기술연구원

2PS-260 A Simple Demonstration of Reversible Transformation between the Programed 2D Structures and 3D Actuators
구자현, 정광운, 전북대학교

2PS-261 Study on the Photocatalyst Effect of Digital Image Screen with Hybrid TiO_2-SiO_2
권미연, 김주혜, 한국생산기술연구원

2PS-262 Infiltrating Gel Polymer Electrolytes into the Electrodes for Improving Electrode-Electrolyte Interface
구민국, 김파도, 김현준, 송은석, 김성곤, 전북대학교

2PS-263 Memorizable Gas Sensor Based on Amine-Functionalized Semiconducting Polymer Gel for Retention of Cumulative Gas History
고푸른산, 권혁민, 김재희, 박한울, 김도환, 한양대학교

2PS-264 Electromagnetic Interference Shielding Effectiveness of Single-walled Carbon Nanotube Films
고재형, 유일환, 김태욱*, 이동수, 주용호, 김남동, 배수강, 이승기, 최재원**, 이상석, 한국과학기술연구원; *전북대학교; **경상대학교

2PS-265 Study of Cell Movement and Proliferation by the Control in Physical and/or Chemical Properties of the Substrate
고은서, 양성윤, 충남대학교

2PS-266 Microstructures and Electrochemical Properties of Bicomponent Nanofibers Consisting of PAN/Lignin-derived Carbon Nanofibers and $LaMnO_3$ Nanofibers
강하은, 정영규*, 충남대학교; *충남대학교 유기소재섬유시스템공학과

2PS-267 Performance Optimization of Polymer Photovoltaic through Immiscible Ternary Blends
강진현, 김준호, 정인환, 국민대학교

2PS-268 Reinforcing Cellulosic Hydrogels
강지선, 심재민, 조연주, 윤석일, 상명대학교

2PS-270 Biocompatible Tissue Adhesive Using Double-network Concept
강은지, 나양호, 한남대학교

2PS-271 Ag-chitosan Nano-composite Layered Paper Sensor by Surface-enhanced Raman Spectroscopy
강유리, 형지우, 노혜란, 서울과학기술대학교

2PS-272 Improvement of Gas Adsorption Efficiency of Fragile Porphyrin Based MOFs
강승욱, 설규민, 강찬우, 최은영, KSA of KAIST

2PS-274 Uniaxially Oriented Liquid Crystal Polymer for Redox-Responsive Smart Window
강동규, 정광운, 전북대학교

2PS-275 Improved Performance of Single Ion Conducting Polymer Electrolyte Based on Polystyrene with an Additive of Lithium Salt for Lithium-ion Batteries
WEI ZHANG, Ahmed Faiz, 진레이, 류태욱, 윤수진, 김대호, 이용훈, 장호현, 김환기, 건국대학교

2PS-276 High Conductive and Stretchable Thermoplastic Polyurethane (TPU)-Silica Nanoparticles for Electrical Double Layer Supercapacitor
Puji Lestari, 최우혁, Inha University

2PS-277 Mechanically Reinforced Ionogels of Double Network Structure
Hiep Dinh Xuan, Bernard Timothy, 김도완, 윤진환, 부산대학교

2PS-278 High Performance Organic Field-effect Transistor through P3HT/EEG Channel Flexible Nanocomposite
류승완, 이경진*, 한국화학연구원/충남대학교; *충남대학교

2PS-279 Electrically Conductive and Water-stable Melanin-polymer Composite
김선우, 심봉섭, 인하대학교

2PS-280 Colloidal Origami Using Liquid Crystal Polymeric Shells
김대석, Teresa Lopez-Leon*, 부경대학교; *UMR Gulliver 7083 CNRS, ESPCI Paris Tech, PSL Research University

포스터 발표 (III)

유무기 양자소재 및 응용기술

3PS-1 III-V Semiconductor Colloidal Quantum Dots
함동효, 허성필, 박지수, 정동주, 임재민, 배완기, 성균관대학교

3PS-2 Colloidal Semiconductor Nanocrystals for Solar Energy Conversion
정병국, 배완기, 김선호, 박정우, 성균관대학교

3PS-3 Stabilizing Cubic-Phase of Perovskite Quantum Dots in Photovoltaics

via Low-Temperature-Processed Electron Transporting Layer
임세영, 박태호, 김영훈*, 최종민*, 포항공과대학교; *대구경북과학기술원

3PS-4 Upconversion Nanoparticles/Hyaluronate-Rose Bengal Conjugate Complex for Noninvasive Photochemical Tissue Bonding
이기범, 한슬기, 포항공과대학교

3PS-5 Nanopatterning of Perovskites Templated in Self-assembled Block Copolymer Films Enhancing Photoluminescence and Environmental Stability
오진우, 한효원, 박철민, 연세대학교

3PS-6 Light-Emitting Electrochemical Cells with Polymer-blended InP/ZnSeS Quantum Dot Active Layer
박상준, 강문성, 양지혜, 서강대학교

3PS-7 Two-Dimensional Magnetic Semiconductors for Spintronic Devices Applications
김현호, 금오공과대학교

3PS-8 Phenethylammonium-Stabilized $CsPbI_3$ Perovskite Quantum Dots Enable Stable and Efficient Photovoltaics
김지건, 고민재, 김영훈*, 한양대학교; *DGIST

3PS-9 Semi-interpenetrating Diphasic Network of CdSe Tetrapod Nanocrystal and P3HT Polymer Semiconductor with Balanced Ambipolar Transport
김승한, 박한나, 강문성, 서강대학교

콜로이드 및 분자조립 부문위원회

3PS-10 Helical Assembly of Au Nanoparticles in 1D Nanocylinders Confirmed by 3D Transmission Electron Microscopy
황준호, Ke Wang*, Jiangping Xu*, Jintao Zhu*, 이은지, 광주과학기술원; *Huazhong University of Science and Technology

3PS-11 Fabrication of Flexible and Bendable Surface Enhanced Raman Scattering (SERS) Substrate Exhibiting Constant Performance at Strained Condition via AuNPs Monolayer Assembled on Wrinkled PDMS
호정원, 유성수, 유필진, 성균관대학교

3PS-12 Iron Gall Ink-Inspired Supramolecular Complex of Fe^{3+} and Tannins for Black Hair-Dyeing
한상영, 홍석표, 강은혜, 최인성, KAIST

3PS-13 Preparation of PEGlated Conjugated Polymer Nanoparticles
팜티투이동, 박주현, 이다빈, 정상원, 전예지, 신용훈, 알렉스, Chung-Ang University

3PS-14 Enhanced Stability of $FAPbBr_3$ Nanoparticle-Polymer Composite Films
최효린, 강영종, 한양대학교

3PS-15 Thermal Control of Mechano-Responsive Property at LDPE Organogel
최진우, 강영종, 한양대학교

3PS-16 Fabrication of Thermoresponsive Hydrogel and Conjugated Polymer Composites
최인혁, 전석진, 금오공과대학교

3PS-17 Thermo-Responsive Microcapsules with Tunable Molecular-Size-Selective Permeation
최예훈, 전석진*, 김신현, KAIST; *금오공과대학교

3PS-18 Investigation on Surface Chemistry of InP-based Quantum Dots During Shell Growth Reaction
최영호, 임재훈, 성균관대학교

3PS-19 Preparation of Docetaxel Loaded Nanoparticles Using a Coaxial Turbulent Jet Mixer
정세희, 임종민, 순천향대학교

3PS-20 Optical Chirality Induced by Chiral Peptide Assembly
전나영, 김하연, 이은지, 광주과학기술원

3PS-21 Effect of Phenolic Acids on the Temperature Sensitivity of Self-assembled Nanospheres Containing Poly(ethylene imine) and (Phenylthio)acetic Acid
자 오, 김진철, 강원대학교 의생명과학대학

3PS-22 Sub-Band Gap Operation Mechanism of InP Quantum Dot-Based Light-Emitting Diodes
이현준, 정병국*, 배완기*, 이도창, 임재훈*, 한국과학기술원(KAIST); *성균관대학교(SKKU)

3PS-23 Suppression of Exciton Quenching in All-inorganic Quantum Dot Light-emitting Diode Through Nickel Oxide Surface Treatment
이태민, 이도창, KAIST

3PS-24 In situ Polymerization of Melanin Nanoparticles in Hydrogel Bilayers for Controlled Photothermal Effect Toward Programmable Actuation
이채원, 심태섭, 아주대학교

3PS-25 Reconfigurable Periodic Liquid Crystal Defect Array via Application of Electric Field
이창재, 윤동기, 한국과학기술원(KAIST)

3PS-26 Cadmium-free Colloidal Nanocrystal Quantum Dots (QDs) for Selective Bacterial Cell Killing
이일송, 이도창, 한국과학기술원

3PS-28 Effect of Isopropyl Alcohol (IPA) on Tin Oxide (SnO_2) Nanoparticle (NP) Suspension and Dried Film for Electron Transport Layer (ETL) of Solar Cell
이승연, 명진석*, 함동석*, 이재흥*, 김영진**, 최우진*, 한국화학연구원/충남대학교; *한국화학연구원; **충남대학교

3PS-29 All-water-based Solution Processes for Metallic Electrodes on Various Substrates and Their Applications
이성민, 오인혁, 장석태, 중앙대학교

3PS-30 Inkjet-printed Low-cost Colorimetric Tickets for TNT Detection in Contaminated Soil
이명구, 유해욱*, 임성현, 이기라, 성균관대학교; *국방과학연구소

3PS-31 Increasing Photocatalytic Efficiency by Photothermal Effect
이다빈, 박주현, 팜티투이동, 정상원, 전예지, 신용훈, 알렉스, 중앙대학교

3PS-32 Free Energy Analysis of Commensurability-driven Block Copolymer Self-assembly
윤현수, 최흥균, 공주대학교

3PS-33 Synthesis of Heterostructured Semiconductor Nanocrystals by Cation Exchange
윤다은, 이도창, KAIST

3PS-34 Fabricating Transparent Electrode Based on Grid-patterned Silver Nanowires
유진선, 엄홍식, 장석태, 중앙대학교

3PS-35 Facile Route to Highly Stable $CH_3NH_3PbBr_3$ Quantum Dots with High Production Yields and Their Optoelectronic Applications
양한솔, 장재영, 노성훈, 서의현, 정재민, 오종규, 이경호, 한양대학교

3PS-36 A Palladium Catalyzed Di-pendant Substituted Conjugated Polymer (CP) with Styrene Back Bone for Enhanced Thermal, and Optical Property
알렉스, 박주현, 이다빈, 정상원, 전예지, 신용훈, 팜티투이동, 중앙대학교

3PS-37 A Twisted Stack of Aligned Gold Nanowire Arrays from a Repetitive Tilted Transfer of Block Copolymer Thin Films
신민경, 오진우*, 손정곤*, 염봉준, 한양대학교; *한국과학기술연구원

3PS-38 Uniaxial Orientation of Semiconductor Nanorods for High Outcoupling-factor Light-emitting Devices
신도중, 이도창, 한국과학기술원

3PS-39 Synthesis of Silica Nanoplatelets with Controllable Wettability Using β-Sheet Structured Polypeptide Templates
성민철, 김진웅, 성균관대학교

3PS-40 Synthesis of Amphiphilic Silica Nanoplatelets via Surface Initiated ATRP for Effective Stabilization of Pickering Emulsion Drops
서복기, 성민철, 김진웅, 성균관대학교

3PS-41 Dynamical Changes Induced by Perovskites ($BaTiO_3$) in Ionic Liquid Lithium Ion Battery
박안성, 김용주*, 이원보, 서울대학교; *국민대학교

3PS-42 Effects of Vegetable Oils as Carrier Liquids on Mg-doped Silica/Titania Hollow Nanoparticles-based Electrorheological Fluids
박소희, 김세문, 이승애, 건국대학교

3PS-43 Bilayer Dichroic Films Using LIquid Crystalline Polymer for Various Optical Applications
박건형, 윤동기, 한국과학기술원 나노과학기술대학원

3PS-44 Orientation Control of Supramolecular Columns by Photo-thermal Laser Heating on Graphene Light Absorbing Layer
박강호, 진형민*, 권기옥**, 김장환, 윤해주***, 한규효, 윤태영, 김상욱, 정희태, KAIST; *한국원자력연구원; **한국생산기술연구원; ***삼성디스플레이

3PS-45 Photonic Janus Balls with Optical, Magnetic, and Density Anisotropy for Dynamic Structural-Color Tuning
남성경, 김종빈, 한상훈, 김신현, 한국과학기술원

3PS-46 In-situ Interfacial Coacervation of Silica Nanoplatelets with Polymers for Production of Structrually Stable Macroemulsion Drops
김하정, 박대환, 성민철, 김진웅, 성균관대학교

3PS-47 Self-assembly of Icosahedral Cluster and Its Photonic Properties
김철호, 박상혁*, 김신현*, 이원보**, 문준혁, 서강대학교; *KAIST; **서울대학교

3PS-48 Novel Synthesis Method of Perovskite Quantum Dots with Improved Colloidal Stability via Split-Ligand Re-Precipitation Technique
김진영, 김병기, 장웅식, 왕동환, 중앙대학교

3PS-49 Macroporous Photonic Hydrogels for Encryption of Structural-Color Patterns
김종현, 김종빈, 김신현, KAIST

3PS-50 All-Hydrogel Supercapacitor from Integration of Agar/Activated Carbon Composite Gels with Agar Hydrogel
김종식, 심태섭, 아주대학교

3PS-51 유해물질 제거가 가능한 습도 변색성 스마트 윈도우
편승범, 김정연, 조은철, 한양대학교 화학공학과

3PS-52 Fabrication of Highly Crystallized Multi-Pathways Poly(3-hexylthiophene) (P3HT) Thin Films
김용재, 전환진*, 정희태, 한국과학기술원; *한국산업기술대학교

3PS-53 PDMS Based Liquid Contactable Colorimetric Sensor Array for Bacteria

Discrimination
김영민, 이명구, 신동인, 임성현, 이기라, 성균관대학교

3PS-54 Eutectic Crystallization of Binary Colloidal Fluids in Double-Emulsion Drops for Dual Photonic Stopbands
김영건, 박상혁, 김신현, 한국과학기술원

3PS-55 PLGA Hollow Nanoparticles for Selective Targeting Liver Macrophage
김언지, 이승우, 남기범, 이재빈, 이옥상, 이지영, 박진규, 이동윤, 경북대학교

3PS-56 Ultrathin Hydrogel Skin Encapsulated 3D Nanoporous Plasmonic Chips for Toxic Small Molecular Analysis in Complex Fluids
김선호, 박성규*, 김신현, KAIST; *재료연구소

3PS-57 Near-unity Photoluminescence Quantum Yield of Quantum Dots with Thick and Continuously Graded Shell
김병재, 이현준*, 임재훈, 성균관대학교; *KAIST

3PS-58 Designing Multicolor Patterns of Plasmonic Metasurfaces via Colloidal- and Photo-Lithography
김민정, 김종빈, 김신현, KAIST

3PS-59 Hierarchical Self-assembly of Block Coplymers Templated by Colloidal Crystals
김동환, 최홍균, 공주대학교

3PS-60 Thermal Tunning of Colloidal Array in Microcapsules from Crystalline to Glassy Packing
김도은, 박상혁, 김신현, 한국과학기술원

3PS-61 Reentrant Graphene/Carbon Nanotube-Melamine Micro-cellular Foam Electrode for Stretchable Lithium Metal Batteries
김나연, 손정곤*, 염봉준, 한양대학교; *한국과학기술연구원

3PS-62 Core-Position Controlled CdSe/CdS Heterostructure Nanorod for Efficient Photocatalytic Hydrogen Generation
김귀민, 이도창, 한국과학기술원

3PS-63 Changes in Colloidal Properties of Graphene Oxide by Mild Thermal Annealing
김건웅, 김소연, 울산과학기술원

3PS-64 Effect of Various Metal Doping on the Electroresponse of Ecoresorbable Smart Fluids
권혁준, 김성진, 이승애, 건국대학교

3PS-65 Solubility and Crystallization of PMMA with Chain Stretching Agent at Room Temperature
권예진, 강영종*, 한양대학교; *한양대학교 자연과학대학 화학과

3PS-66 Ultra-dense (~20 Tdot/in2) Nanoparticle Array from an Ordered Supramolecular Dendrimer Building Block Containing a Metal Precursor
권기옥, 한국생산기술연구원

3PS-67 Dielectrophoretic Behavior of Janus Particles and Biomolecule- Conjugated Janus Particles
Kubra Akyildiz, 구형준, 이민지*, 최종훈**, 김교범***, Seoul National University of Science and Technology; *한국생산기술연구원; **중앙대학교; ***동국대학교

3PS-68 Upper Critical Solution Temperature Behavior of (Phenylthio)acetic Acid and Poly(ethyleneimine) Mixture and Their Temperature- dependent Release from Monoolein Cubic Phase
Wenting Long, 김진철, 강원대학교 의생명과학대학

3PS-69 Formation of Fluorescent One-dimensional Structures from Trigonal Molecules
Pyae Myat Phyo Thu, 박용해, 한민아, Kongju National University

3PS-70 Solar-driven H_2 Evolution from Photo-reforming of Biomass with Colloidal Quantum Dots
Nian fang Wang, 이도창*, KAIST; *Department of Chemical and Biomolecular Engineering (BK21+ Program), KAIST Institute for the NanoCentury, Korea Advanced Institute of Science and Technology(KAIST)

3PS-71 An Approach of a Recently Developed Material: 2D Mn2C (MXene)
Ngoc Bao Tran, 강영종, Hanyang University

3PS-72 Solvent-dependent Modification in Morphologies of Molecular Assemblies
Khin Moe Lwin, 박상혁, 한민아, Kongju National University

고분자합성 (I)

3PS-73 Hydrogels Synthesized Using Copolymer-Tethered Lignin
황환민, 손동완, 김명웅, 인하대학교

3PS-74 Synthesis and Preparation of Solid Polymer Electrolytes Based on Anion-Trapping Boron Moieties and Polysiloxane for Lithium Ion Batteries
홍동기, 백지훈*, 김상완, 이종찬, 서울대학교; *한국화학연구원

3PS-75 Determination of Amine Derivatives by Color Difference from Stilbene-modified Silica Beads
하태화, 이승우, 강인수, 영남대학교 화학공학부

3PS-76 Thiourea-based Nanoporous Membranes Using Spinodal Decomposition and Their Applications
하채연, 하성균, 송창식, 성균관대학교

3PS-77 Effect of Chain Substitution of Mussel-inspired Dopa Acrylamides on Oxidation Mechanism and Their Surface Functionalization
카루빠사미 가네쉬, 서성백*, 부산대학교; *부산대학교 바이오소재과학과

3PS-78 Removal of Copper(II) Ions by Hyperbranched Poly(amidoamine) Microparticles
최호중, 강인아, 김상율, 한국과학기술원

3PS-79 Solvent-less Surface Coating Using Organic/Inorganic Hybrid Ladder-like Poly(silsesquioxane)
최민혁, 우한영*, 이성수**, 백경열**, KIST/고려대학교 화학과; *고려대학교 화학과; **한국과학기술연구원

3PS-80 A Comparison of Different Methods to Synthesize Polyimide Powders for Application to Compression Moulding
진승원, 최주영, 박형주, 이승현, 최윤제, 김담비, 정찬문, 연세대학교

3PS-81 Solid-State Emissive Metallo-Supramolecular Assemblies Based on N-Acylhydrazone
조혜진, 송창식, 김현우, 성균관대학교

3PS-82 Living Anionic Polymerization of Styrene Derivatives Containing Adamantylimino Group
조웅현, 강범구, 숭실대학교

3PS-83 Optimization of 3,4-Epoxycyclohexylmethyl-3',4'-Epoxycyclohexane Carboxylate (ECC) Synthesis Process
조연주, 강지선, 심재민, 윤석일, 상명대학교

3PS-84 Synthesis of Cyclohexanedimethanol Pitch Based Plasticizer and Its Application to Poly(vinyl chloride) Fabrication
조민철, 강종구, 강민경, 리종위, 김광언, 배진영, 성균관대학교

3PS-85 Catalysis for ATRP Using Organic Photo-catalysts and Visible-light Irradiation
박경수, 조민기, 백지수*, 이은성*, 손경선, 충남대학교; *포항공과대학교

3PS-86 Bromine-Induced Polymerization of Ethynylpyridines
김태형, 진성호*, 심상연**, 박종욱***, 임권택****, 김상율, 제갈영순*****, 한국과학기술원; *부산대학교; **강릉원주대학교; ***경희대학교; ****부경대학교; *****경일대학교

3PS-87 Fully Polyester-Based Thermoplastic Polyurethanes
정재언, 김 일, 부산대학교 고분자공학과 고분자합성연구실

3PS-88 Modification of a Polyacetylene Polyelectrolyte via the Ion-exchange Reaction of Precursor Polymer Using Sodium Tetraphenylborate
제갈영순, 진성호*, 박종욱**, 심상연***, 임권택****, 경일대학교; *부산대학교; **경희대학교; ***강릉원주대학교; ****부경대학교

3PS-89 Synthesis and Chiral Self-assembly of Core-extended Triarylamine Derivatives
정성욱, 박창준*, 김동휘, 김상율, KAIST; *삼성전자

3PS-91 Self-Assembly of Two-Tailed Tadpole-Shaped Amphiphilic Copolypeptides
전수현, 김 일, Rimesh Augustine, Nagendra Kalva, 부산대학교 고분자공학과 고분자합성연구실

3PS-92 Synthesis of Acrylated Vegetable Oil and UV-Curing Properties
장성욱, 류상욱*, 충북대학교; *충북대학교 공업화학과

3PS-93 Bulky Alkyl Chain Optimization for High Performance Polymer Solar Cell
임종진, 이근대, 박성수, 이원기, 진영읍, 부경대학교

3PS-94 Synthesis of Nonionic Surfactants Based on Hyper-Branched Polyglycidol
임유정, 김 일, 부산대학교 고분자공학과 고분자합성연구실

3PS-95 Variation of Characteristics of D-A Structure OPV Using Phenazin and BDTT with Alkyl Chain Variation
임종진, 이근대, 박성수, 이원기, 진영읍, 부경대학교

3PS-96 생분해성 고분자의 마이크로파티클 제조와 약물전달시스템 응용
임원택, 이선준, 고영수, 공주대학교

3PS-97 A Novel D-A Alternating Copolymers Based on Fluorinated Phenazine
임종진, 이근대, 박성수, 이원기, 진영읍, 부경대학교

3PS-98 가지형 Poly(ε-caprolactone-co-glycolide) 합성과 구조분석연구
임원택, 지영현, 고영수, 공주대학교

3PS-99 Effects of Various Types of Polar Dispersants on the Properties of Silica/SBR Compounds
임승호, 권용록, 김정수, 홍석주, 김하은, 장영욱*, 김동현, 한국생산기술연구원; *한양대학교

3PS-100 Compatibility and Hydrolytic Behaviors of Polylactide Isomer/Poly (butylene succinate) Mixtures by the Langmuir Technique
임동혁, 비샬가반데, 김가연, 이봉, 진영읍, 이원기, 부경대학교

3PS-102 Synthesis and Properties of Block Copolymers of Enantiomeric Polylactide and Biopolyester
임동혁, 이승재, 비샬가반데, 진영읍, 이원기, 부경대학교

3PS-103 Synthesis of Poly(acrylic acid)-co-Poly(glycidyl methacrylate) Binders for Silicon Anodes in Lithium Ion Batteries
이효철, ANJALI NAGAPADI PREMAN, 안석균, *Pusan National University

3PS-104 Effect of Norbornenyl Comonomer Design on Dynamic Covalent Polymerization with Chalcogenide Hybrid Inorganic/Organic Polymer Resins

이홍찬, 권민호, 이서희*, 전흥배*, 오민철, Jeffrey Pyun**, 백현종, 부산대학교; *광운대학교; **University of Arizona

3PS-105 Synthesis and Properties of Imide-linkage Photocyclodimerizable Mesogen Compounds
이진은, 곽기섭, 경북대학교

3PS-106 Open-to-air RAFT Polymerization on Surface Under Ambient Conditions
김청수, 조수정, 이지훈, 조우경, 손경선, 충남대학교 화학과

3PS-107 Synthesis and Characterization of Mechanophore for Mechanical Stimuli-responsive Polymer
이지은, 가재원, 최재학*, 한국화학연구원; *충남대학교

3PS-108 Synthesis of Furan-based Polyurethanes with Photo-degradability via Curtius Rearrangement
이주현, 송창식, 성균관대학교

3PS-109 Tunable Silica/Graphene Composite Based Hierarchical Closed-cellular Structure
이제현, 유필진, 성균관대학교

3PS-110 Harnessing Semifluorinated Backbone in the Heterograft Copolymer by Sequential Grafting-through/Grafting-from Polymerizations
이정현, Gérald Lopez*, Bruno Améduri*, 서명은, 한국과학기술원; *Institut Charles Gerhardt Montpellier, CNRS, ENSCM, Universite' de Montpellier

3PS-111 Reversible Addition-Fragmentation Chain-Transfer (RAFT) Dispersion Polymerization of Block Copolymer Nano-objects in Presence of Solvophilic Macro-RAFT Agent in Ethanol/Epoxy Resin Mixture
이은호, 김경호, 이원주*, 서봉국*, 백현종, 부산대학교; *한국화학연구원

3PS-112 Synthesis and Analysis of Polyimides Having with Different Position in Aniline Moieties
이유정, 이승우*, 신요섭*, 영남대학교; *영남대학교 화학공학부

3PS-113 Alkoxy side group을 포함하는 열방성 액정 공중합체의 합성, 용융 방사 및 섬유의 열처리 효과
이원준, 우현준, 민병길, 장진해, 금오공과대학교

3PS-114 Synthesis and Properties of UV-curable Polyurethane Acrylates with Reactive Silicones
이원기, 이승재, 임동혁, 이 봉, 진영읍, 부경대학교

3PS-115 Fabrication of PAN-based Carbon Fibers Containing PAA-grafted CNTs
이용표, 임정혁, 김경민, 한국교통대학교

3PS-116 Synthesis and Properties of Aromatic Copolyesters with a Ionic Liquid
이아름, 신종찬, 김정민, 이민재, 군산대학교 화학과

3PS-117 Synthesis of Novolac-coated Superabsorbent Polymer (SAP) for Antibacterial Property
이시영, 백지훈*, 서희란, 궁찬영, 조경화, 김진석, 김상완, 육진솔, 이종찬, 서울대학교; *한국화학연구원

3PS-118 Synthesis of Comb-Branched Polyethers Using Double Metal Cyanide Catalyst
이수정, 김 일*, 부산대학교; *부산대학교 고분자공학과 고분자합성연구실

3PS-119 Synthesis and Properties of PVDF Grafted Copolymer from Polyfluorene-Based Polymer
이세진, 이진균, 인하대학교

3PS-120 Synthesis of Hyperbranched Poly(glycidol carbonate) Polyols Using Double Metal Cyanide Catalysts
이민웅, 김 일*, 부산대학교 고분자공학과 고분자합성연구실; *부산대학교 고분자공학과

3PS-121 Synthesis and Self-assembly of pH-Responsive Poly(4-hydroxystyrene)-*b*-Poly(*N*-vinylamine) Diblock Copolymer by RAFT Polymerization
윤준혁, 김상율, 김태형, KAIST

3PS-122 Synthesis of Melamine-formaldehyde Resin with Hierarchical Porous Structure by High Internal Phase Emulsion Polymerization and Solvent-assisted Curing
윤영록, 강인아, 김상율, 한국과학기술원

3PS-123 Alternating Ring-opening Copolymerization of Epoxide and Anhydride Using a Chromium Complex with a Sterically Demanding Amino Triphenolate Ligand
유호균, 배대영*, 임현기, 이은성*, 손경선, 충남대학교; *포항공과대학교

고분자가공/복합재료

3PS-124 Three-dimensional Graphene/transition Metal Alloys from Gelatin-Based Hydrogel for Zinc Air Battery
황종하, 장지현, 울산과학기술원

3PS-125 Development of Resin Formulation with High Mechanical Strength for Projection 3D Printing
황보현우, 전석진, 금오공과대학교

3PS-126 FeSiAl@metal Core Shell Composite with Electromagnetic Interference Shielding
홍준표, Pradeep Sambyal, 황승상, 구종민, 한국과학기술연구원

3PS-127 Analysis of Thermal Degradation Energy for Liquid Crystalline Epoxy Using Linear Polymerization
현하늘, 조승현, 숭실대학교

3PS-128 Mechanically Controlled Rheological Properties of Epoxy Composite via Introduction of Ultrasonic Disperser Techniques
허윤정, 김영훈, 백정주, 장기철, 송광식, 박성만, 배근열, 이효선, 최경호, 신교직, 한국생산기술연구원

3PS-129 Adhesion Behavior of Catechol-Incorporated Silicone Elastomer on Metal Surface
허 윤, 문준수, 방준하, 고려대학교

3PS-130 천연섬유의 종류별 폴리프로필렌/천연섬유 복합체의 물성 및 냄새에 대한 금속 산화물 영향
한석환, 정혜원, 김연철, 공주대학교

3PS-131 친환경 바이오매스 기반 탄소저감형 합성목재 개발
한동헌, 오승주, 염주선, 정다은, 배진우, 한국기술교육대학교

3PS-132 실란 커플링제 처리에 의한 소수화가 PP/CNF 복합체의 물성에 미치는 영향 연구
한석환, 송재헌, 김연철, 공주대학교

3PS-133 High-Performance Sodium Metal Hybrid Capacitors Based on Metal Anode and Capacitive Cathode
하 손, 강동혁, 윤영수, 고려대학교

3PS-134 Three-dimensional Carbonaceous Network with In-situ Formed Metallic Cobalt for Energy Storage Application
티와리 아준 프리차스, 김학용, 전북대학교

3PS-135 Electrospray Preparation of Hierarchically Structured Fe_3O_4 for Long-term Stability of High Performance and Long-term Stability of Magnetorheological Fluids
최준석, 서용석, 서울대학교

3PS-136 Direct Growth of Ultrathin ZIF-8 Membrane on Graphene Nanoribbon Treated Polymeric Support for Hydrogen/Hydrocarbon Separation
최은지, 김대우, 연세대학교 화공생명공학과

3PS-137 Preparation of LaF_3/Polyimide-Based PolyHIPEs Nanocomposite Foam with Low Dielectric Constant *via* Pickering High Internal Phase Emulsions
최윤제, 최주영, 진승원, 박형주, 이승현, 김담비, 정찬문, 연세대학교

3PS-138 Development of Ceramic 3D Printing Materials Based on Zirconia and Acrylic Photo-curable Resin
최유라, Nguyen The Manh, Lương Nguyen Dai Triet, Huynh tan Thai, 이민찬, 조남철, 순천향대학교

3PS-139 Graphene Oxide Liquid Crystal by Controlling the Amount of Diamine Vapor for Fabricating Gas Resistant Coating
최승은, 김성수*, 김대우, 연세대학교 화공생명공학과; *한국과학기술연구원

3PS-140 Transparent Conductive Reduced Graphene Oxide/Nickel Sulfide Flexible Thin Film
최슬기, 박희경, 정진주, 김재훈, 이정수, 조선대학교

3PS-141 Analysis of Microplastic Fibers Released from the Various Fabrics Through Washing
최솔아, 권미연, 박명자*, 김주혜, 한국생산기술연구원; *한양대학교

3PS-142 Carboxymethyl Cellulose/MMT Bionanocomposites Modified with Imidazolium-POSS
진희경, 박성수, 하창식, 부산대학교

3PS-143 Capacitance of MnO_2 Micro-Flowers Decorated CNFs in Alkaline Electrolyte and Its Bi-Functional Electrocatalytic Activity toward Hydrazine Oxidation
지성민, 김학용*, 전북대학교 나노소재연구실; *전북대학교

3PS-144 자동차 내장재의 VOCs 방출 특성 및 저감방안 연구
조하니, 박장석, 대한솔루션

3PS-145 PNIPAM-PDMS Composite Coating Layers Having Rapid Temperature-responsive Surface Transition
조윤호, 이종휘, 중앙대학교

3PS-146 $CoMn_3O_4$ and Fe_2O_3 Metal Oxides Coated Polyimide-based Carbon Fibers as Cathode and Anode Materials for Wire-type Supercapacitor Applications
조영훈, 고태훈, 정용식, 김학용, 김병석, 전북대학교

3PS-147 Engineering Methods of Drug Crystals by Porous Nucleation Plates
조승빈, 이종휘, 중앙대학교

3PS-148 Effects of Plasma Treated CVD Graphene on Crystallinity, Thermal, and Mechanical Properties of Polyketone
조성훈, 이준섭*, 장혜지**, 영남대학교; *가천대학교 신소재공학과; **영남대학교 화학공학부

3PS-149 Properties Prediction of Plastic Compounds by Machine Learning and Data Mining
조남정, 박재성, 이재흥, 최우진, 한국화학연구원

3PS-150 Palladium Alginate Polymer Beads for Transfer Hydrogenation of Ketones
제롬 피터, 아난두 모한, 안주 마리아 토마스, 하창식, 부산대학교

3PS-151 The Effect of Nickelocene on in-situ Growth of MWCNTs in SiCN Ceramics

포스터 프로그램

정혜림, 곽영제, 허태환, 숭실대학교

3PS-152 Fabrication and Characterization of High-filler-load Graphite/Polystyrene Composites
정현오, 임홍진, 정광운*, 장세규, 한국과학기술연구원; *전북대학교 고분자나노공학과

3PS-153 Ultra-low Pt Loading on Small-Sized Carbon Support Fabricated Using Emulsion Polymerization for Proton Exchange Membrane Fuel Cell
정한빛, 최주혁, 이준호, 이영준, 이현주, 김범준, KAIST

3PS-154 Highly Porous Carbon Structure Using Nanocellulose Derived from Marine Biomass as an Alternative Supercapacitive Material
정진주, 김재훈, 박희경, 최슬기, 이정수, 조선대학교

3PS-155 Enhancing the Mechanical Properties of Alginate/Polyacrylamide Double Network Hydrogels by Incorporating Cellulose Nanocrystals
정지훈, 엄영호, 부경대학교

3PS-156 High-performance Stretchable Conductive Adhesives Based on Silver Flakes and Multi-walled Carbon Nanotubes in Elastomer
정지인, 김희숙, 윤호규*, 고영표, 한국과학기술연구원; *고려대학교

3PS-157 Facile Synthesis of Metal Nanocrystals Embedded Hydrogel Beads and Their Application
정재환, 김문호, 부경대학교

3PS-158 나노셀룰로스 FRP(Fiber Reinforced Plastic)가 적용 된 친환경 농업용 전기차 대면적 외장재 제조 기술 개발
정용일, 전경수, 이민지, 민경배, 한국섬유기계융합연구원

3PS-159 Highly Efficient, 1D Structure Bi-functional Electrocatalyst Based on Co Atoms with Ultralow Ru Nanoclusters for Overall Water Splitting in Acidic Electrolyte
정예빈, 안성훈, 조선대학교

3PS-160 Enhanching the Mechanical Performances and Durability of Composite Polymer Electrolytes with Cellulose Nanocrystals
정민웅, 엄영호, 부경대학교

3PS-161 내충격성 및 내마찰성이 우수한 UHMWPP를 이용한 복합소재 개발
정도연, 이종수, (주)KOPLA

3PS-162 Thermal and Mechanical Properties of Silica-filled Epoxy Molding Compound for Fan Out Wafer Level Packaging
정대영, 서흔영, 윤호규, 고려대학교

3PS-163 진동감쇄 플라스틱 복합소재 개발
정도연, 이종수, (주)KOPLA

3PS-164 Fabrication and Characterization of Multifunctional Carbon Dots Embedded Keratin/Poly(Vinyl Alcohol) Nanofiber Membranes
정다운, 오자 구넨드라프러사드, 윤홍진*, 국윤수**, 김홍관*, 서민강**, 박미라, 우석대학교; *FITI시험연구원; **한국탄소융합기술원

3PS-165 Fabrication of Closed-Packed and Highly Aligned Boron Nitride Nanotube/Polymer Complexes
전상우, 김태환, 강신현*, 최정철, 전북대학교; *(주) 퀀텀캣

3PS-166 Preparation and Photoluminescent Assessment of Carbon Quantum Dots Incorporated Keratin/Polyvinyl Alcohol Hydrogels
정다운, 오자 구넨드라프러사드, 박미라, 우석대학교

3PS-167 A Study on the Cellulose Nanofiber (CNF) Sheet Fabrication for Application to Secondary Cell Separator
전경수, 이민지, 민경배, 정용일, 한국섬유기계융합연구원

3PS-168 Metal 3D 프린팅용 필라멘트 개발
장희수, 장타오, 조민기, 강호종, 단국대학교

3PS-169 Comparative Studies on Polyurethane Composites Filled with Polyaniline and Graphene for DLP-Type 3D Printing
장혜지, 조성훈*, 영남대학교; *영남대학교 화학공학부

3PS-170 Correlation between Morphological and Electrical Characteristics for High Current Generation: Methylammonium Lead Halide Solubility Control in Perovskite Photovoltaics
김병기, 장웅식, 조재상, 왕동환, 중앙대학교

3PS-171 Synthesis and Properties of PI-silica Composites Containing Silane Coupling Agent
장시훈, 박준철, 임다정, 박진경, 박수일*, 박노형, 한국생산기술연구원; *연세대학교

3PS-172 Multimodal Sensing with a Three-Dimensional Piezoresistive Structure
임희연, 김봉훈, 숭실대학교

3PS-173 Wet-spinning of Boron Nitride Nanotube Liquid Crystal for Multifunctional Polymeric Composite Fibers
임홍진, 김영경, 김홍식, 장세규, 한국과학기술연구원

3PS-174 Improved Thermal and Mechanical Properties of Epoxy Networks with Polyurethane Using Polyhedral Oligomeric Silsesquioxane (POSS) as Crosslinking Agent
임주희, 임정혁, 김경민, 한국교통대학교

3PS-175 Properties of EBA Composites Filled with Multi Walled Carbon Nanotubes and Carbon Blacks
임도현, 정대영, 남채윤, 윤호규, 고려대학교

3PS-176 Effect of the Type of Hardener and Curing Condition on Mechanical Properties of DGEBA/Amine Epoxy
인준서, 강영정*, 이영철*, 고려대학교; *한국생산기술연구원

3PS-177 Enhanced Impact Strength and Toughness of Polyamide 6,6 - Micro-crystalline Cellulose Composites via Hydrogen-bonding
이희은, 김용주, 이재경, 위정재, 인하대학교

3PS-178 Eco-friendly Air Filter with High Filtration Efficiency and Low Pressure Drop
이한비, 최원산*, 한밭대학교; *한밭대학교 화학생명공학과

3PS-179 Microstructure, Thermal and Mechanical Characterization of Poly (lactic acid) Composites Reinforced with Aramid Scrap Powder
이지수, 정영규, 충남대학교

3PS-180 Synthesis of Self-Healing Shape Memory Vitrimers for the Application of Direct Ink Writing 3D Printing Process
이주호, 권용구, 인하대학교

3PS-181 Fabrication of Silane-grafted Graphene Oxide and Its Effect on the Structural, Thermal, Mechanical, and Hysteretic Behavior of Polyurethane
이주형, 현지은, 김성훈, 한양대학교

3PS-182 Study on Impact Resistance, Wear Resistance and Crystallization Kinetics of Polypropylene Modified by Complex Crosslinkers
이종인, 배진우, 남병욱, 한국기술교육대학교

3PS-183 Preparation and Properties of Carbon Nanotube (CNT)/Nylon 12 Film
이재혁, 서영석, 박노형, 한국생산기술연구원

3PS-184 Effect of Poly(butyl acrylate) on Poly(lactic acid)/Poly(butylene adipate-co-terephthalate) as Compatibilizer
이재빈, 남기범, 김언지, 이욱상, 이지영, 김도영, 서관호, 이동윤, 경북대학교

3PS-185 The Influence of KOH Activation Temperature on the Microporosity of N-doped activated Carbon Material and Their Supercapacitve Behaviors
이의원, 박수진, 인하대학교

3PS-186 알콕시 곁사슬을 포함하는 열방성 액정고분자/organoclay의 합성 및 특성
이원준, 우현준, 민병길, 장진해, 금오공과대학교

3PS-187 Optimization of the Pore Structure of Petroleum-based Activated Carbons/Tubular Polypyrrole Composites with Enhanced Electrochemical Performance as Supercapacitor Electrode
이의원, 박수진, 인하대학교

3PS-188 Improved Dispersion of Cellulose Nanofibers (CNFs) in Polypropylene Based Composites by Using a Various Dispersant
이영재, 황준성, 권미경, 김현철, 정상원, 이세근, 이성준, DGIST

3PS-189 Synthesis and Characterization of Porous and Functional Polyimide with Inorganic Nanosphere Separator for Lithium-Sulfur Cell
이영동, 권용구*, 인하대학교; *인하대학교 고분자공학과

3PS-190 Morphology and Electrical Conductivity of Carbon Foams via High Internal Phase Emulsion Templating by Polypyrrole-Coated CNTs
이송희, 신홍희, 김선겸, 이성재, 수원대학교

3PS-191 Mechanical Properties and Bioactivity of Polyetheretherketone Composites with Modified Hydroxyapatite and Modified Carbon Fiber
이상운, 전인성, 조재영, 서울대학교

3PS-192 Binodal, Wireless Epidermal Electronic Systems with In-Sensor Analytics for Neonatal Intensive Care
이 봄, 김봉훈, 숭실대학교

3PS-193 40vol% 이상 고함량 수산화인회석 혼합 레진의 3D 프린팅을 위한 광경화 시스템 연구
이민지, 전경수, 민경배, 정용일, 한국섬유기계융합연구원

3PS-194 Epoxy Toughing for Semiconductor Encapsulation Material : Acrylic Block Copolymers Based on Poly(methyl methacrylate) and Poly (butyl acrylate)
이민규, 신범수*, 김수현*, 나창운*, KCC/전북대학교; *전북대학교

3PS-195 Effect of Carboxymethylated Cellulose Nanofiber on the Tensile Strength of Polyacrylamide Hydrogel
이동한, 현진호, 서울대학교

3PS-196 Fabrication of Cellulose Nano Fibers as Compatible Reinforcements for Polypropylene Composites
이동은, 이승준, 박규환, HDC현대EP

3PS-197 A New Droplet Based Stretchable Substrate with High Modulus Resolution and Stretchable Stability via Simultaneous Curing
이대환, 임세영, 최예림, 민지현, 박태호, 포항공과대학교

3PS-198 Fabrication of Porous PDMS/Au Composites for Solar-based Thermoelectric Power Generation
이건석, Iseki Tissasera, 김유빈, 유성일, 부경대학교

3PS-199 Liquid Crystalline Phase Behavior of Hydrophilic Gold Nanoparticles Induced By Pluronic Triblock Copolymer
윤영진, 장종대*, 김태환, 전북대학교; *한국원자력연구원

3PS-200 고분자전해질연료전지(PEMFC)용 수직정렬된 PTFE 나노섬유 기반 고내구성 강화복합전해질막
윤기로, 한국생산기술연구원

3PS-201 Manufacture of Polymeric Foam and Evaluation of Properties Under Various Conditions Using Supercritical Fluids

유용환, 이승준, 박규환, 현대EP

3PS-202 Spray-able Polyurethane 차음재 수지 조성물에 따른 고주파 소음에 대한 차음 성능 향상 연구
유민지, 김상민, 박장석, ㈜대한솔루션

3PS-203 점토 광물을 이용한 열방성 액정고분자 나노복합재료의 합성과 특성연구
우현준, 이원준, 민병길, 장진해, 금오공과대학교

3PS-204 Acid Functionalized Carbon Nanofibers Decorated with Mn Doped TNTs Nanocomposites for Lithium Adsorption and Recovery from Aqueous Media
우루즈, 박수진, 인하대학교

3PS-205 Carbon Supported TiO_2 Nanofiber as an Electrode Material for Supercapacitors
오자구넨드라프러사드, 권오훈*, 박용완*, 박미라, 우석대학교; *ECO융합섬유연구원

3PS-206 Acetic Acid-mediated Melamine-modified Carbons: Influence of Activation Conditions on Textural Features and CO_2 Adsorption Performance
우루즈, 박수진, 인하대학교

3PS-207 Ion-exchange Mediated Assembly of Ag_3VO_4 Nanoparticles in Polyacrylonitrile Nanofibers
오자구넨드라프러사드, 박미라, 우석대학교

3PS-208 Cellulose-derived Nitrogen-doped Carbons for Improved Textural Features and Enhanced CO_2 Uptakes
우루즈, 박수진, 인하대학교

3PS-209 Development of Impact Resistant and High-forming PLA/PBAT Blends for 3D Printers and Filaments for 3D Printers
오승주, 배진우, 남병욱, 한국기술교육대학교

3PS-210 New Approach for Fabricating Flexible Polymer Substrate with Hihgly Uniform High-curvature Structures
오상아, 전환진, 한국산업기술대학교

3PS-211 열가소성기반 UD Tape를 이용한 도어 임팩트빔 제조 및 강도에 관한 연구
오미혜, 윤여성, 문동준, 김경철*, 정우철*, 김화남**, 한국자동차연구원; *(주)캠스; **지금강(주)

3PS-212 Fluidity Improvement of Polyamides by Adding Hyperbranched Additives
안성현, 박승규, 유영재, 한국화학연구원

3PS-213 Ceramic Coating Reinforced by Amine-abundant Natural Polymeric Nanofibers and Its Properties
신은애, 김계현, 정제영, 이상봉, 이창기, 한국생산기술연구원

3PS-215 프로브카드 미세니들 고정을 위한 펀칭필름 레이저홀가공기술 개발
송신애, 김기영, 임성남, 한국생산기술연구원

3PS-216 Polymer/Inorganic Nanohybrid Membrane on Lithium Metal Electrode: Effective Control of Surficial Growth of Lithium Layer and Its Improved Electrochemical Performance
손희상, 광운대학교

3PS-217 Core-shell Structured $BaTiO_3$@SnO_2 Microsphere Composite as Li-ion Battery Anode with Enhanced Electrochemical Performance
손희상, 광운대학교

3PS-218 Hybrid of Ag Nanowires and Doped Graphene for the Transparent Conductor with Enhanced Conductivity
손희상, 광운대학교

3PS-219 Bimetallic Porous Material with Enhanced Catalytic Performance
손희상, 광운대학교

3PS-220 The Porous Carbon-Polymer-Sulfur Composite: Novel Li-S Battery Cathode with Enhanced Performance
손희상, 광운대학교

3PS-221 Monolithic 1D Nickel-based Catalytic Electrode with 2D Graphene Oxide for Efficient Hydrogen Production by Reconstruction of Interfacial Mass and Charge Transfer
손홍진, 안성훈, 조선대학교

3PS-222 Fabrication of PA6/MXene/rGO Nanocomposite for Enhancement of Mechanical and Thermal Properties
손나래, 류현민, 박지은, 이관희, 윤근병, 경북대학교

3PS-223 Engineering the Hierarchical Heterostructures of Zn-Ni-Co Nanoneedles Arrays@Co-Li-LDH Nanosheets Core-Sheath Electrodes for Hybrid Asymmetric Supercapacitor with High Energy Density and Excellent Cycle Stability
성재경, Jiwan Acharya*, 고태훈, 서민강**, 길명섭***, 김학용, 김병석***, 전북대학교; *전북대학교 BIN 융합공학과; **한국탄소융합기술원; ***전북대학교 유기소재파이버공학과

3PS-224 Effect of Resin Impregnation in Carbon Fiber/ABS LFT Pellets on Residual Fiber Length and Mechanical Properties of Carbon Fiber-reinforced Composites
서지한, 조동환, 금오공과대학교

3PS-225 Preparation and Properties of Carbon Nanotube (CNT)/Polyimide (PI) and Modified CNT/PI Composite Film
서영석, 장시훈, 이재혁, 박노형, 한국생산기술연구원 휴먼융합연구부문

3PS-226 Multifunctional UV-curable Two Dimensional hBN/Polyurethane Acrylate Nanocomposite Coatings
비샬가반데, 임동혁, 김병욱, 진영읍, 이원기, Pukyong National University

3PS-227 Ultra High Voltage Cable Semi-conductivity PP Compound Processing Techniques with Sufficient Dispersion for Actual Production Line
배환철, 김동훈, 기술연구소

3PS-228 Highly Transparent UV-curable Nylon 6 Nanofiber Reinforced Polyurethane Acrylate Nanocomposite
비샬가반데, 임동혁, 김병욱, 김가연, 진영읍, 이원기, Pukyong National University

3PS-230 The study on Mechanical and Electrical Properties of Vitrimer Filled with Non-covalently Functionalized MWCNT/PristineGNP Hybrid Filler
배성호, 윤호규, 고려대학교

3PS-231 The Effect of Interparticle Distance on the Fracture Behavior of Rubber Toughened Polyamide 12
배석영, 이민규, 조재영, 서울대학교

3PS-232 Porous Polymers for Effective Passive Radiative Cooling
박초연, 정은진, 유영재, 한국화학연구원

3PS-233 Toughening of Polylactide (PLA) by in-situ Reactive Compatibilization with Isosorbide Containing Copolyester
박창규, 장동진, 김성훈, 한양대학교

3PS-234 Preparation and Characterization of Acryl-polyurethane Foam Composites Improved Flame Retarding Properties with Various Flame Retardants
박준철, 박노형, 장시훈, 한국생산기술연구원

3PS-235 Removal of Microplastics via Tannic Acid-mediated Conglobulation
박준우, 서성백*, 부산대학교 생명자원과학대학 바이오소재과학과; *부산대학교 바이오소재과학과

3PS-236 Fabrication of Metal-nanofiber Web-structured Films for Robust Transparent Electrodes by Polymer Coating
박종명, 전환진, 한국산업기술대학교

3PS-237 Evaporative Crystallization of Poly(lactic acid) in Presence of Polyphenols
박예진, 이종휘, 중앙대학교

3PS-238 Cellulose Nanofibril (CNF)-polymer Composite : Effects of Surface Modification on Thermal and Mechanical Properties
박예림, 서영수, 세종대학교

3PS-239 폴리아미드계 복합소재의 유동성 개선을 위한 첨가제의 합성 및 분석
박승규, 안성현, 유영재, 한국화학연구원

3PS-240 Photothermal Conversion-based Solar Oil Evaporation for Fast Cleanup of BTX
박 솔, 최원산, 한밭대학교

3PS-241 Hydrogel-Templated Transfer-Printing of Conductive Nanonetworks for Wearable Sensors on Topographic Flexible Substrates
박성진, 이현정, 강태형, 장호찬, 최동원, 김순우, 문지희, 임정아, 이기영, 한국과학기술연구원

3PS-242 난연특성이 향상된 EG/PU 복합 foam의 제조 및 평가
박상현, 박준철, 장시훈, 박노형, 한국생산기술연구원

3PS-243 Ozonization of Single-walled Carbon Nanotubes on Mechanical Properties of Carbon Fiber-reinforced Epoxy Composites
박상진, 박수진, 인하대학교

3PS-244 Beyond Nanoscale Crack Based Sensors: Sensitivity, Durability and Visualization for Physiology Detection
박병학, 김태일, 성균관대학교

3PS-245 Effect of Blend Ratio on Thermal Properties and Fracture Toughness of Epoxy/Polyetherimide Composites
박상진, 박수진, 인하대학교

3PS-246 Effect of Polished Cross-section on the Mechanical and Thermal Properties of Large-tow Carbon Fiber/Vinyl Ester Composites Filled with Aluminum Hydroxide and Halloysite Nanoclay Produced by Pultrusion Process
박병수, 조동환, 금오공과대학교

3PS-247 Effect of Amine-grafted Surface Treatment on Mechanical Properties of Graphite Nanofibers/Epoxy Nanocomposites
박상진, 박수진, 인하대학교

3PS-248 Directed Patterning of Quantum Dots Using Chemically Modified Surface for Light Emitting Diodes
민수홍, 마서영, 이동현, 단국대학교

3PS-249 칡을 활용한 셀룰로오스 나노 피브릴 제조 및 특성 관찰
민경배, 전경수, 이민지, 정용일, 한국섬유기계융합연구원

3PS-250 MXene (Ti3AlC2) Incorporated Polyimide Hybrid Composite Films
문하람, 옌 융주, 하창식, 부산대학교

3PS-251 Modified MXene (Ti3C2) Filled PA6 Nanocomposites for Enhancement of Mechanical and Thermal Properties
류현민, 손나래, 박지은, 이관희, 윤근병, 경북대학교

3PS-252 Synthesis of Catechol-Functionalized Silsesquioxane for Enhancing Cohesive and Adhesive Forces of Epoxy Adhesive
노지영, 임정혁, 김경민, 한국교통대학교

3PS-253 Electrochromic Properties of WO_3-decorated Nanofiber-based Highly Flexible, Transparent and Twistable Electrode Materials
노재현, 곽채송*, 고태훈, 이기태, 김병석, 전북대학교; *한국전자기술연구원

3PS-254 Preparation of Si/C/N/Fe Magnetic Ceramics Derived from Iron Oxide and Polysilazane with Different Carbon Group
남현구, 허태환, 곽영제, 숭실대학교

3PS-255 The Study on the Effect of Crystallinity at the Dielectric Breakdown Strength According to the Cooling Rate for Insulating Layer of Cable
남채윤, 임도현, 윤호규, 고려대학교

3PS-256 Functionalized Graphene Oxides/Cellulose Nanocrystals Hybrid Fillers Incorporated PVA Films
남정민, 정지인, 진형준, 인하대학교

3PS-257 Effect of Solution Shearing Method for Organic Semiconductors
남기범, 김세현*, 이동윤, 경북대학교; *영남대학교

3PS-258 Carbon Quantum Dots Incorporated Keratin/Polyvinyl Alcohol Hydrogels: Preparation and Photoluminescent Assessment
김효주, 김학용, 전북대학교

3PS-259 Effects of Cellulose Nanocrystals on the Mechanical and Rheological Properties of Biodegradable Poly(butylene succinate)
김효정, 엄영호, 부경대학교

3PS-260 Performance Study of Polymeric Dense Membrane with a Hydrophilic Additive for Energy Efficient Air Conditioning
김효선, 서영수, 세종대학교

3PS-261 Effect of Boron Nitride Nanotubes on Mitigating Shuttle Effect of Lithium-Sulfur Battery
김홍식, 임홍진, 전영시*, 장세규, 한국과학기술연구원; *전남대학교 화학공학부

3PS-262 Diurnal Solar Evaporator Based on Thermosensitive Hydrogels
김호연, 이종휘, 중앙대학교

3PS-263 Enhancement of Proliferative Effects of Basic Fibroblast Growth Factor with Hyaluronic Acid Hydrogel by Light-induced Thiol-ene Reaction
김혜원, 이현종*, 고원건, 최주환, 김현지, 연세대학교; *가천대학교

3PS-264 Synthesis and Characterization of Poly(imide siloxane) Composites Containing Ladder-like Poly(methacryloxypropyl) Silsesquioxane (LPMS)
김태은, 임정혁, 김경민, 한국교통대학교

3PS-265 Dynamic Properties under Cyclic Strain Test in Conductive Polymer Nanocomposites for Stretchable Electrodes
김태곤, 최지영, 박지원, 이성재, 수원대학교

3PS-266 Novel Wide Viewing Optical Films Based on Double-Shell Layered Nanoparticles with Gradient Refractive Index Surface
김준형, 박윤국, 윤준식, 손인태*, 이준협**, 명지대학교; *서울대학교 [코팅기반 화학공정 센터]; **숭실대학교

3PS-267 Cellulose nanofiber slurry를 이용한 polypropylene/CNF 복합체 제조와 다중압출이 CNF 분산 및 응집에 미치는 영향
김준석, 박소연, 김연철, 공주대학교

3PS-268 Influence of Polymer and Metal Ion During Drowning Out Crystallization Process of Polyphenols
김정은, 이종휘, 중앙대학교

3PS-269 Fabrication of Nanocellulose Derived from Marine Biomass and Its Application for Biodegradable Polymer Composite with Enhanced Physical Property
김재훈, 정진주, 박희경, 최슬기, 이정수, 조선대학교

3PS-270 Improved Tensile Strength of Bacterial Cellulose/Poly(vinyl alcohol) Double Network Structures
김재환, 최준식, 현진호, 서울대학교

3PS-271 Study on Thermal and Electrical Properties of the Liquid Crystalline Epoxy (LCE) with CNP, CNT and Hybrid Nanofillers
김재우, 임도현, 남채윤, 윤호규, 고려대학교

3PS-272 A Study on Electromagnetic Interference Shielding Effectiveness Performance of Nickel-plated Polyester Nonwoven Fabrics
김윤섭, 박수진, 인하대학교

3PS-273 Superhydrophobic and Superhydrophilic Solar Oil Evaporators for Cleanup and Collection of BTX
최원산, 김상헌, 김예진, 한밭대학교 화학생명공학과

3PS-274 A Study of the Electromagnetic Interference Shielding Effectiveness of Nickel-cobalt Plated Carbon Fibers/Epoxy Composites
김윤섭, 박수진, 인하대학교

3PS-275 Enhancement of Electrical and Dispersion Properties of MWCNT in PEDOT:PSS by Non-covalent Functionalization
김영주, 한미정, 강영종*, 한국화학연구원; *한양대학교

3PS-276 Investigation on Rheological Properties of Boron Nitride Nanotube Liquid Crystals
김영경, 임홍진, 박성준*, 장세규, 한국과학기술연구원; *전북대학교 고분자나노공학과

3PS-277 Moisture-powered Tensile Carbon Nanotube Composite Actuator
김시형, 한국생산기술연구원

3PS-278 Mechanically Guided Post-Assembly of 3D Electronic Systems
김시몬, 김봉훈, 숭실대학교

3PS-279 Poly(N-isopropylacrylamide)/Gallium Composite Films Prepared by Melt-Crystallization Based Methods
김수연, 이종휘, 중앙대학교

3PS-280 The Moisture Barrier Film Using Thermal Epoxy Resin and Atomic Layer Deposition
김성희, 이준영, 최명수, 성균관대학교

3PS-281 Electromagnetic Interference Shielding Performance of MXene-Decorated Cellulose Papers and Cotton Fabrics
김수연, 정영규, 충남대학교

3PS-282 Interfacial Properties of Graphitic Carbon Nitride/Nanodiamond Composites Toward Synergistic Improvement of Photocatalytic Degradation of Organic Contaminants
김성황, 박수진, 인하대학교

3PS-283 Effect of Dry-ozonized Graphitic Nanofibers on Interfacial Properties of Carbon Fibers-reinforced Composites
김성황, 박수진, 인하대학교

3PS-284 Thermal and Mechanical Properties of Nickel Plated Basalt Fiber-reinforced Composites
김성황, 박수진, 인하대학교

3PS-285 Effect of Microcrystalline Cellulose on the Fracture Toughness of Epoxy Nanocomposites
김성황, 박수진, 인하대학교

3PS-286 Synthesis of Nanomaterials via Low-demensional Polymer Templates
김상준, 한국화학연구원

3PS-287 Edge-Propylene Graphitic Nanoplatelets as a Reinforcement for Polypropylene
김민희, 전인엽, 원광대학교 창의공과대학 화학융합공학과

3PS-288 Morphology Control and Corresponding Performance of Nitrogen Doped Hollow Carbon Nanocage Assisted Co_9S_8@MoS_2 for Overall Water Splitting
김민준, 유필진, 성균관대학교

3PS-289 Improvement of Compatibility and Impregnation for PA6/Carbon Fiber Thermoplastic Composites
김민석, 이승준, 박규환, HDC현대EP

3PS-290 Preparation of Thermoplastic Starch/Poly(butylene adipate-co-terephthalate) Blend with Maleic Anhydride as Compatibilizer
김문수, 김태희, 서관호, 경북대학교

3PS-291 Biomass-derived Bulk Catalyst Electrodes Embedding Nitrogen-coordinated Cobalt Species on Miscanthus x Giganteus for Hydrogen Production by Water Splitting
김동현, 안성훈, 박예은, 조선대학교

3PS-292 친환경 열가소성 PP 절연소재의 기계적/전기적 특성
김규남, 현대EP

3PS-293 자동차 판넬 부품의 경량화를 위한 복합소재 연구
김광섭, 이재용, 김승호, 덕양산업

3PS-294 Extremely Fast Electrochromic Supercapacitors Based on Mesoporous Wo_3 prepared by Evaporation-Induced Self-Assembly
김건우, 최예정, 김진곤, 포항공과대학교

3PS-295 전기자동차용 복합소재 배터리팩 커버 개발
김광섭, 박찬호, 김성지, 덕양산업

3PS-296 Anti-scratch and Anti-fingerprint Hard Coating for Foldable Cover Window
김강한, 정용철, 한국생산기술연구원

3PS-297 에너지 흡수율 향상을 위한 카울크로스바 최적화 연구
김광섭, 이재용, 곽성복, 이동기, 덕양산업

3PS-298 Effect of Fiber-Matrix Interface on the Properties of Epoxy Composites Consisting of Carbon Fibers Coated with PEI-modified MWCNT by Ultrasonic Process
김가영, 조동환, 금오공과대학교

3PS-299 Glycolysis of Polyethylene Terephthalate under Microwave Irradiation with Ethylene Glycol and Zinc Acetate
권혁준, 박재중*, 이찬민*, 이준영*, 황기섭*, 한국생산기술연구원/연세대학교; *한국생산기술연구원

3PS-300 Graphene Functionalization for Crosslinking with SBR Matrix Using Polymer Dispersant
권민호, 양지연, 김한영, 한종훈*, 백현종, 부산대학교; *전남대학교

3PS-301 Synthesis of Polymer-grafted Hydroxyapatite Nanofiber for Improving Mechanical Properties and Dispersion in Polylactic Acid Composite
고한승, 이상운, 조재영, 서울대학교

3PS-302 Three Dimensional Porous Binary Metal Oxide Networks for High Performance Supercapacitor Electrodes
고태훈, 김병석, 전북대학교

3PS-303 Ring-shaped Titanium Nitride Broadband Absorber of Visible Light with Multiple Patterning of Colloidal Lithography
고명철, 김준, 김진곤, 포항공과대학교

3PS-304 Preparation and Mechanical Properties of Epoxy/Hollow Microsphere Composites for Cryogenic Conditions
강영정, 이영철, 한국생산기술연구원

3PS-305 Edge-Styrene Grafted Graphitic Nanoplatelets as Reinforcing Additive to Polystyrene
강영아, 전인엽, 원광대학교 창의공과대학 화학융합공학과

3PS-307 Graphitic Pyropolymer-Based Nanosubstrate for Rechargeable Mg Metal Batteries
강동혁, 하 손, 윤영수, 고려대학교

3PS-308 Ultrathin Thermoconductive and Electrically Insulating Exfoliated Graphene Fluoride Paper for High-performance Thermal Management Materials
Vu Minh Canh, Nhat Anh Thi Thieu, Mani Dineshkumar, 김준범, 정태형, 김성룡, Korea National University of Transportation

3PS-309 A Comparative Study on the Nanoinclusion Effect of MoS_2 Nanosheets and MoS_2 Quantum Dots on the Fracture Toughness and Interfacial Properties of Epoxy Composites
Shahina Riaz, 박수진, Inha University

3PS-310 Reduced Graphene Oxide Grafted with Amine-functionalized NiO/ZnO for Advanced Attenuation of Electromagnetic Wave
QUYEN VU THI, 손대원, Hanyang University

3PS-311 Enhanced Thermal and Mechanical Properties of Epoxy Composites at Ultra-low Loading of Functionalized MoS_2 Nanosheets
Shahina Riaz, 박수진, Inha University

3PS-312 Lightweight MXene/CNT Aerogel for Electromagnetic Interference Shielding
Pradeep Sambyal, 구종민, Korea Institute of Science & Technology

3PS-313 Epoxy Composites with Functionalized Tungsten Disulfide Nanoplatelet Additives
Shahina Riaz, 박수진, Inha University

3PS-314 Vertical Alignment of Copper Nanowires Network and the Effect of Copper Nanowires Aspect Ratio on the Thermal Conductivity of Epoxy Composites
Nhat Anh Thi Thieu, 김성룡, Vu Minh Canh, Mani Dineshkumar, 정태형, 김준범, 한국교통대학교

3PS-315 Mussel-Inspired Synthesis of Heterogeneous Metal Nanoparticles as Efficient Photocatalyst
Maulida Zakia, Merreta Noorenza Biutty, Farris Hilmyafif Elli, 유성일, Pukyong National University

3PS-316 Ag-modified Graphene Oxide Reinforced Electrospun Polyurethane Nanofibers with Antibacterial Performance
Bishweshwar Pant, 정선준*, 박미라, 우석대학교; *전북대학교

3PS-317 Silver Nanoparticles Embedded Polyurethane Nano-Fiber/Net Structured Membrane via One-step Electrospinning
Bishweshwar Pant, 박용균*, 박미라, 우석대학교; *전주비전대학교

3PS-318 Sound Absorption and Insulation Properties of Electrospun Nylon-6 and Polyurethane Nanofibre Mats
이은정, 신혜경*, Bishweshwar Pant**, 박미라**, 지리산한지; *전주대학교; **우석대학교

3PS-319 Mechanical and Optical Properties of Cyclic Butylene Terephthalate/Nylon-6,6 Composites
김승근, 권오훈*, 박용완*, 문승찬**, Bishweshwar Pant***, 박미라***, 지리산한지; *ECO융합섬유연구원; **나눔; ***우석대학교

3PS-320 Improved Tribological Properties of TPEE/EEG Nanocomposite through Extrusion Molding
류승완, 이경진*, 한국화학연구원/충남대학교; *충남대학교

포스터 발표 (IV)

전력산업분야 고분자 복합소재 개발 및 응용

4PS-1 Fabrication and Characterization of Acrylic Polymer Binders Used in Temperature Sensitive Paints
이현지, 김예진, 정서현, 임보규, 정유진, 박종목, 황도훈*, 공호열, 한국화학연구원; *부산대학교

4PS-3 Enhancement of Oxidative Stability of PEM Fuel Cell By Introduction of HO• Radical Scavenger in Nafion Ionomer
보단공딘, 김덕준, 성균관대학교

4PS-5 바나듐 레독스 흐름 전지를 위한 저가 고품질 복합막개발
김대환, 허양일*, ㈜에너지공조/전남대학교; *전남대학교

차세대 기능성 고분자젤과 응용

4PS-7 Application of Separator to Lithium-ion Batteries through Amphiphilic Polymer
이재연, 문주용, 박정태, 건국대학교

4PS-9 Enlarging Out-of-plane Deformation of Active Actuating Multilayer Structure with Analytical Studies Using Electroactive Polymer
신준혁, 이수안, 최수석, 포항공과대학교

4PS-11 Microfluidic Fabrication of Highly Stretchable Soft Strain Sensor Based on Natural Rubber
람 뚜옛 니, 김도완, 윤진환, 부산대학교

4PS-13 Adaptive Solar Control Smart Window Films Comprising Thermo-responsive Hydrogels
김보경, 김도완, 윤진환, 부산대학교

고분자구조 및 물성

4PS-15 Mechanically Robust and Thermally Stable Electrochemical Devices Based on Star-Shaped Random Copolymer Gel-Electrolytes
황희동, 김진곤, 포항공과대학교

4PS-17 Isothermal Crystallization of PHBHx Using IRRAS and 2D-COS
황명원, 박연주, 정영미, 강원대학교

4PS-19 Biodegradation Behavior of Poly(butylene succinate) with Accelerated Degradation Environment
현유진, 오수빈, 진형준, 인하대학교

4PS-21 Shape Effect of Magnetic Particle on Magnetorheological (MR) Properties and Sedimentation Stability
한상석, 서용석, 서울대학교

4PS-23 Antifreeze Hydrogel with Reversibility Based on the Hydrogen Bonding Moiety
최제원, 김세영, 최수형*, 차국헌, 서울대학교; *홍익대학교

4PS-25 Mechanical Properties of Internally Plasticized Styrene-co-Methacrylic Acid Copolymers
김준섭, 최인화, 조선대학교

4PS-27 High-Performance Gel Electrolytes Based on Copolymer Gelators with Random Configuration
최원영, 김용민, 문홍철, 서울시립대학교

4PS-29 Physical Properties Controlled Vitrimers for FDM 3D Printing
최선희, 박성민*, 한국화학연구원/고려대학교; *한국화학연구원

4PS-31 다공성 골드 박막을 이용한 트립신 감지용 분자각인 전도성 고분자 전기합성 및 전기화학적인 센서 특성평가
최두영, 박진영, 경북대학교

4PS-33 A Novel Window Cover Film Based on Functional Polyimide with Fluorinated Urea Oligomer for Flexible Displays
최기원, 김태용*, 김용주, 전혜련*, 황성연, 고성연, 홍성우*, 고민재, 한양대학교; *한국생산기술연구원

4PS-35 Designable Building Blocks for 3D Hierarchical Collective Structures via Residual Stress Engineering
조웅비, 위정재, 인하대학교

4PS-37 Adsorbed-Layer Dependent Lamellar Orientation and Order-to-Disorder Transition Behavior of PS-b-P2VP Copolymers
조승연, 류두열, 김영식, 이우섭, 연세대학교

4PS-39 Mechanical Properties of Nylon 6/Poly(ethyl acrylate-co-acrylic acid) (PEAA) Blends
김준섭, 정윤관, 조선대학교

4PS-41 Self-Assembly of Conjugated Polymers in Solution Using a Non-Solvent Vapor Approach for Organic Field-Effect Transistors
정강훈, 장민철, 전남대학교

4PS-43 Electrically Conductive and flexible Cellulose Nanofiber/Poly(3,4-ethylenedioxythipohene) Composites
전소희, 심봉섭, 인하대학교

4PS-45 카르복시메틸셀루오스로부터 용융 염을 이용한 전기이중층 커패시터용 다공성탄소 재료 제조
장형석, 이병민*, 윤제문**, 최재학*, 충남대학교; *충남대학교 고분자공학과; **동의대학교 신소재공학부

4PS-47 Improvement of Stretchability and Contact Charging by Hollow Sphere-embedded PDMS
장준호, 이주현, 김진곤, 포항공과대학교

4PS-49 Enhanced Molecular Ordering and Charge Transport of P3HT Nanowire Films via Solvent-Vapor Annealing
장민구, 장민철, 전남대학교

4PS-51 Microbial Degradation(Inherent Biodegradability) Test and Evaluation on 3,4-dichloroaniline
장기철, 박성만, 송광식, 김영훈, 김영랑, 백정주, 허윤정, 이효선, 배근열, 신교직, 최경호, 한국생산기술연구원

4PS-53 하전 고분자의 사슬 구조 변화와 그 혼합물의 상거동 관계 연구
자오밍거, 장신위에, 조준한, 단국대학교 고분자공학과

4PS-55 Synthesis of Electroconductive Polydopamine with High Conductivities of by Electrochemical Method
이현정, 심봉섭, 인하대학교

4PS-57 Aligned Nanostructure of Nafion Membrane by Micromolding in Microcapillaries
이현승, 배인성, 한남대학교

4PS-59 Study on Phase Transition of Poly(N-propargylamide)s Depending on Solvent and Temperature
이진은, 곽기섭, 경북대학교

4PS-61 Highly Efficient and Mechanically Robust Polymer Solar Cells Using Polymer Acceptor Additive
이진우, 마부수, 정다현, 김택수, 김범준, KAIST

4PS-63 Changes in Structure and Property of Polycarbonate through Accelerated Photodegradation Test and the Effects of Adding Benzotriazole-based UV Absorbers
이정현, 김동환, 여영우, FITI시험연구원

4PS-65 Three-dimensional Continuous Curvature Design Based on Spatio-temporal Stress Analysis on Locally Actuated Shape Morphing Polymer Film by Thermal Stimulus
이재원, 최준찬, 안수민, 이종혁*, 원수경*, 이재경*, 위정재*, 김학린, 경북대학교; *인하대학교

4PS-67 Contactless Construction of Multi-functional and Transparent 3D Architectures by Patterned Adhesives
이재경, 원수경, 박정은, 위정재, 인하대학교 첨단소재연구실

4PS-69 Modulation of Ion Gel Properties Using Side Chain Crystallization in Random Copolymers
이연배, 김희인, 김상원, 인하대학교

4PS-71 Microneedles Combined with Hair Growth Factors
최다혜, 조수진, 이승준, 서원대학교

4PS-73 Preparation and Characterization of Biodegreable Gelatin Microspheres via Free Fall Microdroplets Technique
황의주, 한청수*, 이승준, 서원대학교; *(주)케이런

4PS-75 Fabrication of Biocompatible Micro-Patterned PET Film via UV Imprint Lithography Technique
정민희, 육지호, 이승준*, 인하대학교; *서원대학교

4PS-77 Effect of Artemisia Extract on Stability in Cubic Phase Gel Formulation
구민지, 김범기, 유종완*, 이승준, 서원대학교; *(주)베이바이오텍

4PS-79 리튬 이차전지 Si-alloy 음극용 폴리에테르이미드 바인더의 열처리 온도에 따른 전기화학특성 평가
이병민, 노미소*, 홍성권*, 김성수, 최재학, 충남대학교; *충남대학교 고분자공학과

4PS-81 Synthesis and Analysis of Hexagonally Packed DNA-like Double Helical Phase (H2) with A_1BA_2C Tetrablock Terpolymer
윤형건, 김진곤, 포항공과대학교

4PS-83 Effects of Concentration and Dispersion of Nanoparticles on Orbital Maneuver of Multiple Magnetic Soft Robots
원수경, 박정은, 이재용*, 전지수, 김용주, 김진곤*, 위정재, 인하대학교; *포항공과대학교

4PS-85 비스페놀 A 폴리카보네이트의 광 열화거동을 고려한 물성 예측 시뮬레이션 및 사용 환경을 고려한 최적 설계 가이드 수립
오정택, 송민우, 김형섭*, FITI시험연구원; *건국대학교

4PS-87 Achieving Highly Ordered Nanoparticles Structures in Dense Polymer/Nanoparticle Solution
오솔미, 김소연, UNIST

4PS-89 Dual Crosslinkable Methylcellulose/Chitosan Oligomer Composite Hydrogels
여용호, 박원호, 충남대학교

4PS-91 2D Aligned Pore Formation of Formaldehyde Imprinted Polymer Using Hard Lithography Technique and Its Sensing Characterization
양진철, 박진영, 곽기섭, 경북대학교

4PS-93 Order to Order Transition from Cylindrical to Lamellar Microdomain upon Heating for Linear Tetrablock Copolymer
안성현, 김진곤, 포항공과대학교

4PS-95 Neutral-Layer-Free Directed Self-Assembly of Block Copolymer in Trench Using Capillary Force-Induced Meniscus
신진용, 김봉훈, 숭실대학교

4PS-97 전자선 가교에 의한 전선용 폴리올레핀계 컴파운드의 물성 변화에 관한 연구
신재환, 이병민*, 박종석**, 최재학*, 충남대학교; *충남대학교 고분자공학과; **한국원자력연구원

4PS-99 Lyotropic Phase Behavior of Amphiphilic Random Copolymer in Aqueous Solution
신민중, 서명은, 한국과학기술원

4PS-101 Phase Behavior of AB/AC Binary Blend Having Complementary Hydrogen Bonding
신나리, 김진곤, 포항공과대학교

4PS-103 Effect of Surface Structuring on Molecular Imprinting Polymer Film and Recognition Properties
시범민, 박진영, 경북대학교

4PS-105 Entropy-Driven Assembly Behavior of Nanoparticles within Emulsion-Evaporative Block Copolymer Particles
쉬 멍, 윤홍석, Kin Liao*, 김범준, 한국과학기술원; *Khalifa University

4PS-107 Octadecylamine을 이용하여 아마이드화 시킨 PSMA 공중합체에 의한 아스팔텐 분산성 향상
김준섭, 송기철, 조선대학교

4PS-109 알리파틱 폴리케톤/나일론 6 블렌드의 혼화성에 관한 연구
권흥구, 손영곤, 공주대학교

4PS-111 Polystyrene-based Multiblock Copolymer Membrane for High Density of Ion Channel in PEMFCs
서홍대, 권후근*, 배인성, 한남대학교; *한남대학교 화학과

4PS-113 Importance of Tuning Aggregation Behaviors of BDT-based Polymers for Achieving Additive- and Annealing-Free High-Performance All-Polymer Solar Cells
서수덕, 김진석, 김범준, 한국과학기술원(KAIST)

4PS-115 Single-Step Production of Doubly Re-entrant Microstructures through Reaction-Diffusion Photolithography for Omniphobic Surfaces
배형한, 김종빈, 김신현, 한국과학기술원

4PS-117 The Study of Regioregularity Driven Liquid-crystalline Phase Transition
박현정, 김형준, 김범준, KAIST

4PS-119 Study on Phase Transition of PNiPAAm-co-PEG Hydrogel by 2D IR Correlation Spectroscopy
박연주, 김민경*, 황명원*, 정영미*, 강원대학교 강원방사선융복합연구지원센터; *강원대학교 화학과

4PS-121 하이드로차/셀룰로오스 나노 섬유 기반 고성능 수처리 분리막 제조 및 염료 제거능 평가
박세원, 김형섭, 건국대학교 공과대학 화학공학부

4PS-123 Dynamic Mechanical Properties of PLA and Sulfonated Polystyrene (SPS) Ionomer Blends
김준섭, 박상희, 조선대학교

4PS-125 할로이사이트 나노튜브/셀룰로오스 복합 필름 기반 고감도 산화 탄소나노튜브 가스 센서 성능평가 및 고찰
박상현, 김형섭*, 건국대학교; *건국대학교 화학공학부

4PS-127 Hierarchical Helical Array of Ferroelectric Polymer
박민주, 황준호, 장예주, 이은지, 광주과학기술원

4PS-129 Interpretation of Polydiacetylene Nanosome-based Carriers: Internanosomal Behaviors, Endocytosis and Enhanced Fluorescence
박규하, 조성무, 서성백*, KAIST 한국과학기술연구원; *부산대학교

4PS-131 Synthesis of Silica Nanoparticles Tethered with Fluorophore-Attached Polymer Brush
박강희, 팽기욱*, 김명웅, 인하대학교; *성균관대학교

4PS-133 Optimizing Marangoni-driven Patterning in Polymer Thin Film
민성배, 김현정, 마세연, 김채빈, 부산대학교

4PS-135 Bioinspired Architectures of Cellulose Nanocomposites with Clay and Chitosan
문성민, 심봉섭, 인하대학교

4PS-137 Ionoelastomer Junctions Between Polymer Networks of Fixed Anions and Cations
김형준, Ryan Hayward*, KAIST; *University of Massachusetts Amherst

4PS-139 End-on Orientation of Poly(3-alkyl thiophene)s by Microphase Separation of Lamellar Forming Amphiphilic Diblock Copolymer
김필곤, 우도경, 김진곤, 포항공과대학교

4PS-141 Rheological Observation on the Phase Transition Change of Cellulose Solution According to HNT Addition
김태호, 김형섭*, 건국대학교 나노 바이오 시스템 연구실; *건국대학교 화학공학부

4PS-143 Development of Reversibly Light-responsive BCP Particle by Introducing Photo-responsive Surfactants
김진우, 윤홍석, 구강희*, 이영준, 이준혁**, Kin Liao***, 김범준, KAIST; *MIT; **한국생산기술연구원; ***Khalifa University

4PS-145 Properties and Microstructural Variation in a Complex Polylactic Acid/ Polypropylene Blending System
김종우, 민병각, 한국교통대학교

4PS-147 Directed Self-Assembly of Metal Nanoparticles Induced by Soft Line Patterns
김영규, 이동현, 단국대학교

4PS-149 A Study of UV-cured Optical Clear Adhesives (OCAs) with Rheological Analysis
김아란, 현 규*, 최우진**, 이재흥**, 한국화학연구원/부산대학교; *부산대학교; **한국화학연구원

4PS-151 UV경화형 폴리우레탄 아크릴레이트와 실리카 나노입자를 이용한 초발수 및 초발유 스프레이 코팅
김수현, 이승구, 울산대학교

4PS-153 Effective Control of Domain Orientations in Block Copolymer Thin Films Using the Air-Water Interfacial Layer of Short Block Copolymers
김성은, 김동협, 김소연, 울산과학기술원

4PS-155 Improved Plasmonic Properties of Highly Conductive Polymers Confined in Nanopores
김상훈, 김진곤, 포항공과대학교

4PS-157 키틴 나노 섬유/셀룰로오스 나노 결정 혼합 분산액의 액정 거동 및 복합 필름 제조
김민형, 김형섭*, 건국대학교 유기나노시스템공학과 나노바이오시스템 연구실; *건국대학교 화학공학부

4PS-159 Enhanced Conductivity Network of Transparent PEDOT:PSS Electrode by Alcoholic Solvent Post-treatment Process Improved PCE (%) of Organic Photovoltaics
김민수, 장웅식, 김선주, 왕동환, 중앙대학교

4PS-161 Universal Interfacial Control through Polymeric Nanomosaic Coating to Control Domain Orientations in Block Copolymer Thin Films
김동협, 김소연, UNIST

4PS-163 A Highly Self-Healable Heterocyclic Elastomer Based on Isosorbide Oligomer with Excellent Surface Hardness
김기승, 김진실, 문경민, 홍평화, 최기원*, 고민재*, 홍성우, 한국생산기술연구원; *한양대학교

4PS-165 Self-healing of Sulfonated Poly(ether ether ketone)/PVA-CBA Membrane for Proton Exchange Membrane Fuel Cell
곽병진, 배인성, 한남대학교

4PS-167 Tensile Properties of Bisphenol-A Polycarbonate (BPA PC) Ultra-thin Films
강연주, 최우진*, 이재흥*, 홍성권**, 한국화학연구원/충남대학교; *한국화학연구원; **충남대학교

4PS-171 Melanin-like Nanoparticles for Multimodal Synergistic Therapy of Cancer
Busra Ozlu, 심봉섭, Inha University

고분자합성 (II)

4PS-173 Removal of Hexavalent Chromium from Wastewater by Using Nanoengineered Polypeptides
엄건희, 김 일, 부산대학교 고분자공학과 고분자합성연구실

4PS-175 Synthesis and Photovoltaic Properties of D-π-A Type Polymers Containing the Oxadiazole Side Chains of Diketopyrrolopyrrole (DPP) Acceptor Central Unit with Different Donor Units
심 용, 김태동, 한남대학교

4PS-177 Investigation of Chain Sequence of Polyphenylene Sulfide Copolymers and Monomer Reactivity in Melting Sulfur Polymerization Condition
심규원, 정현민, 이재훈*, 최성민, 금오공과대학교; *구미전자정보기술원

4PS-179 Synthesis and Characterization of Ionic Polyurethanes Based On Pyrrolidinium Ionic Liquid Monomers
신종찬, 이민재, 군산대학교

4PS-181 Thermal Conductivity Analysis of Phase-Separated Polyimide Film Containing Amorphous Boron Nitride
신요섭, 이승우, 강인수, 영남대학교 화학공학부

4PS-183 Synthesis of Super-Hydrophobic Monomer Based Polymeric Micelles for pH-Responsive Drug Delivery Systems
손일오, 김병수, 연세대학교

4PS-185 Octadecylamine-grafted Partially Unzipped Carbon Nanotubes (PUCNT-C18) Incorporated Thin-film Nanocomposite (TFN) Reverse Osmosis (RO) Membrane with High Separation Performance
서희란, 공새롬, 정경화, 김문현, 이종찬, 서울대학교

4PS-187 Anionic Polymerization of Isoprene and Functionalization by Thiol Derivatives
서정희, 류상욱, 충북대학교

4PS-189 Optimization of PEDOT:PSS Linearity by Sequential Addtion Process
배소영, 김중현, 이홍주, 김영노, 연세대학교

4PS-191 Synthesis and Evaluation for Cross-linkable Organic/Inorganic Hybrid Polymer via Quaternization
박희경, 최슬기, 김재훈, 정진주, 이정수, 조선대학교

4PS-193 Synthesis of Chemical Sensors Based on Azobenzene and Detection of Heavy Metal Ions
박효진, 이승우, 이유정, 영남대학교 화학공학부

4PS-195 Preparation and Properties of Protective Material for Electronic Device Based on Crosslinked Poly(imide-siloxane)
박형주, 최주영, 진승원, 이승현, 최윤제, 김담비, 정찬문, 연세대학교

4PS-199 Synthesis of Vinyl Terminated Poly(dimethyl-co-methylvinyl) Siloxane (VPDMS-co-VPVMS)
박연희, 강호종, 권수미, 김재옥, 단국대학교

4PS-201 Metal-Free Synthesis of Poly(Carbonate Ester)-Based Thermoplastic Elastomers
박상우, 김 일, 부산대학교 고분자공학과 고분자합성연구실

4PS-203 Glycolysis Reactivity of Glycols for Chemical Recycling of Copolyesters
민 주, 정현민, 이진석, 호린, 금오공과대학교

4PS-205 Synthesis and Characterization of Gel Polymer Lithium Ion Battery Containing Lithium Salt Using Thermal Curing Method
류태욱, 윤수진, 진레이, WEI ZHANG, 김대호, 이용훈, 장호현, 김환기, 건국대학교

4PS-207 Synthesis and Characterization of Cyclic, Hyperbranched and Graft Polymers Using a Sulfoxide-based Vinyl Protected Macroinimer
도주혁, 김동우, 김연지*, 이하나*, 전흥배*, 백현종, 부산대학교; *광운대학교

4PS-209 Near-Infra Red Shielding Effect of PAni:PSS Particles According to Acid Dopant Difference
도민석, 임소은, 박찬일, 김중현, 연세대학교

4PS-211 Polymerization of Polyacrylonitrile (PAN) Copolymers Containing Methyl Acrylate (MA) and Itaconic Acid (IA) as Comonomer for PAN Carbon Fiber Precursor
노지영, 임정혁, 김경민, 한국교통대학교

4PS-213 Polybenzimidazole Composite Membranes Having Imidazole Functionalized Graphene Oxide Showing High Proton Conductivity and Improved Physicochemical Properties
김혜진, 김정환, 김기현*, 한주성, 고태윤, 이종찬, 서울대학교; *경상대학교

4PS-215 Synthetic Approach to Produce Poly(ester-amide)s Using Bio-based Diols for Engineering Plastics
김형준, 김무송, 안철희, 서울대학교

4PS-217 Silica Dispersibility and Its Correlationship with Properties of Silica/SBR Compounds Using Cellulose Dispersant
김하은, 임승호, 권용록, 홍석주, 김정수, 김동현, 한국생산기술연구원

4PS-219 Functionalization of Poly(2-ethynylpyridinium bromide) via Copper-catalyzed Azide-alkyne Click Chemistry
김태형, 김상율, 제갈영순*, KAIST; *경일대학교

4PS-221 Effects of CNT-COOH on the Stabilization of Polyacrylonitrile Copolymers
김태은, 임정혁, 김경민, 한국교통대학교

4PS-223 Efficient Synthesis of the Ag-Hollow Spherical Porous Polymer with Excellent Catalytic Effect on Dye Degradation
김지수, 쑹원리앙*, 김 일, 부산대학교; *부산대학교 고분자공학과 고분자합성연구실

4PS-225 멤브레인용 투명 폴리이미드/PVA 블렌드 필름의 특성 연구
김종원, 장진해*, 금오공과대학교; *금오공과대학교 고분자공학과

4PS-227 폴리이미드와 PVA 블렌드를 이용한 무색 투명 멤브레인 필름의 특성 연구
김종원, 장진해*, 금오공과대학교; *금오공과대학교 고분자공학과

4PS-229 The Enhancement of the Liquid Permeability of Biomass-based Superabsorbent Terpolymer
김정수, 한국생산기술연구원

4PS-231 유해물질 발생 저감을 위한 자동차 선루프용 친환경 폴리우레탄 수지 제조 및 특성 연구
김은지, 백인규, 김창겸*, 한국신발피혁연구원; *(주)대진에스앤티

4PS-233 Highly Transparent Polyimide Film Synthesized Using Fluorinated Amide-Imide Oligomer for Flexible Displays
김용주, 최기원, 김태용*, 노아현, 전혜련*, 이예진*, 홍성우*, 고민재, 한양대학교; *한국생산기술연구원

4PS-235 Colorless and Thermostable Poly(amide-imide)s with Controlled CTE
김성종, 김상율, 변태준, 이병용, 한국과학기술원

4PS-237 Solid-Phase Colorimetric Sensing Platform for Bromide ions Based on a Tough Hydrogel Embedded with Silver Nanoprisms
김상헌, 우희철, 김문호, 부경대학교

4PS-239 자동차 헤드라이닝 내장재 저밀도 기재 개발에 대한 연구
김상민, 조하니, 박장석, 대한솔루션

4PS-241 Structure-Property Relationships of 3D-Printable Chain-Extended Block Copolymers with Tunable Elasticity and Biodegradability
김령일, 이성수, 이정현*, 황승상, 한국과학기술연구원; *고려대학교

4PS-243 Supramolecular Chirality of Triphenylamine Derivatives Having Multiple Hydrogen Bondings
김동휘, 김상율, 정성욱, 한국과학기술원

4PS-245 Sulfoxide-base Vinyl Protection in ATRP Inimers
김동우, 도주혁, 강유영*, 김연지*, 전흥배*, 백현종, 부산대학교; *광운대학교

4PS-247 Simple Preparation of Porous Polystyrene Microparticles in Ternary Mixtures and Their Application as Catalyst Support
김대환, 김문호, 부경대학교

4PS-249 Molecular Weight Distribution of Two Living Chains in Polystyrene Prepared by Nitroxide Mediated Polymerization
김경호, 이지은, 박미림, 이서희*, 장태현**, 전흥배*, 백현종, 부산대학교; *광운대학교; **포항공과대학교

4PS-251 Controlled Photooxidation of PyridiniumAcylhydrazones to1,3,4-Oxadiazoles by Inclusion Complexation with Cucurbit[7]uril
김경수, 김현우, 송창식, 성균관대학교

4PS-253 A Low-temperature Cross-linked Polyimide Gate Insulator for Thin Film Transistors Using a (Hydroxymethyl)benzoguanamine as a Cross-linker
김경민, 유성미*, 김윤호*, 안 택, 경성대학교; *한국화학연구원

4PS-255 Preparation and Thin Film Properties of a Novel Polyimide/Tetrafluorophthalate Attached $BaTiO_3$ Namocomposite for Solution Processable High k Dielectric

김경민, 안 택, 경성대학교

4PS-257 The Changes of Absorption Behaviors in Superabsorbent Copolymers Using Polycation Salts
권용록, 임승호, 홍석주, 김하은, 김정수, 장영욱*, 김동현, 한국생산기술연구원; *한양대학교

4PS-259 Synthesis of Carboxylic Acid Bearing Polyethers by Monomer-Activated Anionic Ring-Opening Polymerization
권기환, 김민성*, 이상호**, 김병수, 연세대학교; *UNIST; **한국화학연구원

4PS-261 Ion-Electron Conductive Cross-Linked Polymer Coated Cathode for Lithium-Sulfur Battery
궁찬영, 정다운, 이종찬, 서울대학교

4PS-263 Iterative Convergent Synthesis of Large Cyclic Polymers and Block Copolymers with Discrete Molecular Weights
구모범, 이슬우, 이정민, 김경택, 서울대학교

4PS-265 Uniaxial Orientation of Reactive Mesogens for Anisotropic Heat Managing Materials
고혜윤, 정광운, 전북대학교

4PS-267 Synthesis and Properties of Photoisomerizable Azobenzene Side-Chain Polymers for Green and Red Color Rewritable Hologram
강혜주, 이예원, 가재원, 한국화학연구원

4PS-269 LLDPE 중합용 Ziegler-Natta 촉매연구
강현성, 허승현, 고영수, 공주대학교

4PS-271 Preparation of Porous Polymers via Solvent-Assisted Curing
강인아, 윤영록, 김상율, KAIST

4PS-273 Synthesis and Properties of PBO for Positive Photo Resist According to Various End Cappers
강인수, 신요섭, 이승우, 영남대학교

4PS-275 Injectable, Biocompatible Conjugated Catechol Chitosan Hydrogels with Iron Inducement and EDTA Treatment at Different Conditions
Quang Nguyen Ngoc, 손대원, Hanyang University

4PS-277 Synthesis of Ag－Ag2S Nano－Heterostructures and Their Application for Dye Photodegradation
Pradyasti Astrini, 김대환, Biutty Merreta Noorenza, 유성일, 김문호, 부경대학교

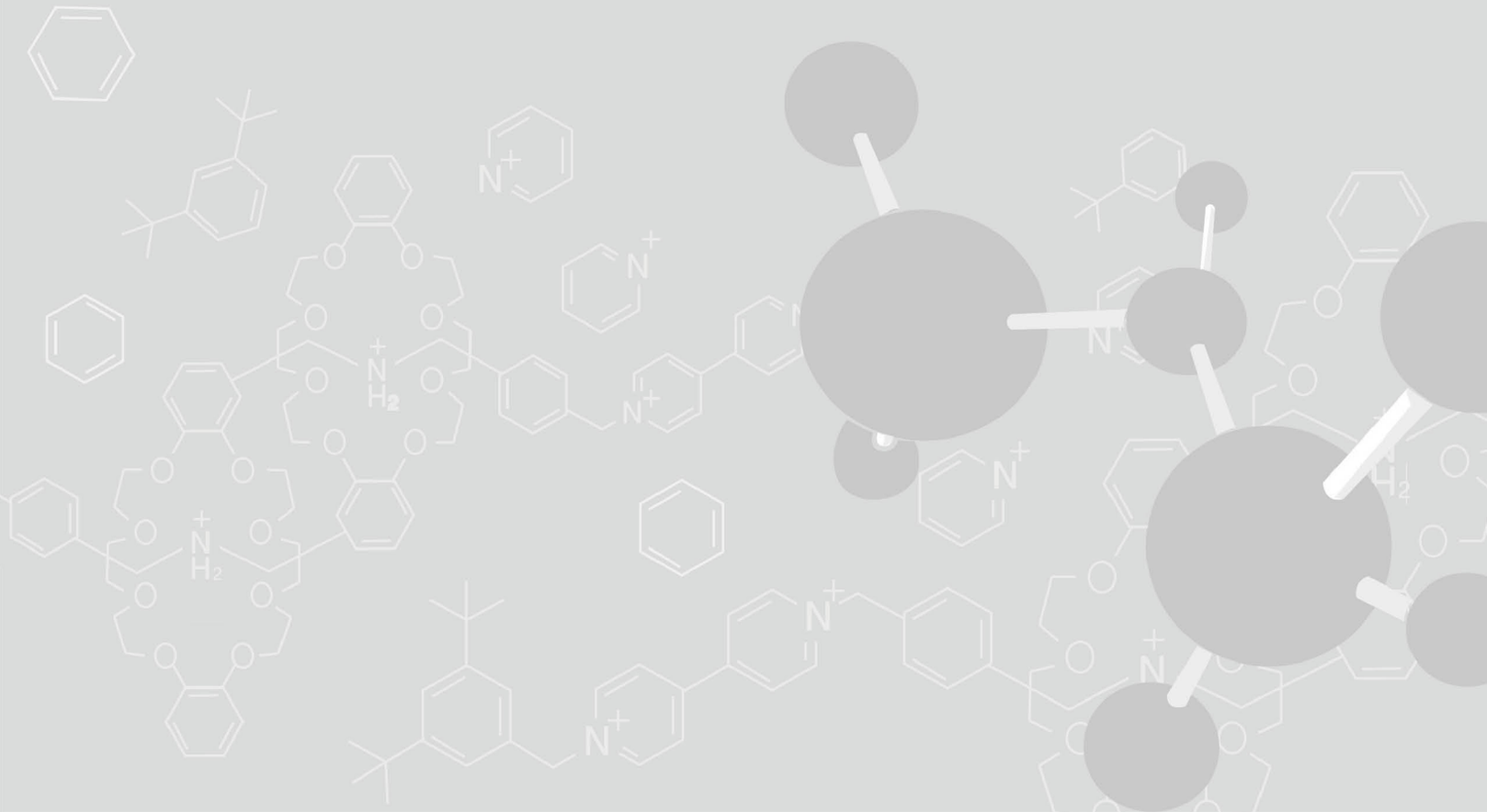
4PS-279 Synthesis and Electrochemical Characterization of Three-dimensionally Crosslinked Copolymer Binders for Silicon-based Lithium Ion Battery Anodes
ANJALI NAGAPADI PREMAN, 손진하, 안석균, Pusan National University

2020년 추계학술대회

연구논문 초록집

The Polymer Society of Korea

초록_ 구두 발표



기조강연 | Plenary Lecture

기조강연장 [10월 6일(화)]

PL-1 김명환 (Myung Hwan Kim) (10:00–10:40)

1976-1980 서울대학교 공업화학과 (학사)
1980-1982 한국과학기술원 화공과 (석사)
1982-1985 ㈜럭키 중앙연구소 고분자연구부문
1985-1990 미국 University of Akron 고분자공학과 (박사)
1990-1992 ㈜유공 고분자연구소 신소재개발팀장
1992-현재 ㈜LG화학 전지사업본부 CPO

전기차 파트너, 리튬이온전지

김명환† LG화학

1991년 일본 Sony에 의해 상품화 된 리튬이온전지는 초기에는 3C(Camcorder, Cellular Phone, Notebook PC) 용으로 주로 사용되었으나 지금은 전기차, ESS(Energy Storage System) 등, 우리 사회의 에너지/환경 문제를 해결하는 Solution으로서 주목 받고 있다. 지구가 처한 환경 문제의 심각성에 따른 각 국 정부의 규제/지원 강화, 기술 발전에 따라 1회 충전 후 운행할 수 있는 주행거리의 대폭 향상, 그리고 생산성 증대에 따른 꾸준한 배터리 가격 하락의 결과로 전기차 시장이 급격히 확대 되고 있다. 최근 Major Car OEM 들이 본격적으로 전기차 출시를 예고하고 있어, 2030년에는 전기차 배터리 시장이 1400 GWh에 달할 것이라는 전망이다. 가까운 미래에 태양 에너지 활용도가 높아지고 자율주행자동차의 등장 및 Car Sharing이 활성화 됨에 따라 내연기관에서 전기차로의 변환이 더욱 빨라질 것이며, 에너지 공급원으로서 리튬이온전지 기술은 더욱 중요해질 전망이다.

콜로이드 및 분자조립 부문위원회 (I) | Division of Colloid & Molecular Assembly (I)

제1회장 [10월 6일(화)]

Organizer: 심태섭(아주대), 이효민(POSTECH)

1L1-1 장은주 (Eunjoo Jang) (13:00–13:25)

1993 포항공과대학교 화학공학과 (학사)
1995 포항공과대학교 화학공학과 (석사)
1998 포항공과대학교 화학공학과 (박사)
1999-2000 University of Ottawa 화학과 (Post-Doc.)
2000-현재 삼성종합기술원 (Fellow)

Perspectives on the Environmentally Friendly InP-based Quantum Dots for Display Applications

장은주† 삼성전자

For the commercial next generation QD display, there is an urgent need to prepare environmentally friendly QDs that show high efficiency and better color purity. From this perspective, a strategy for tuning the wavelength and spectral width to optimize the brightness and color space agreement will be discussed. The critical parameters affecting photophysical properties, such as InP core uniformity, the thickness and shape of the ZnSe shell, the electron/hole distribution, surface dangling defects, oxidative phase, and the stacking faults, should be carefully examined. The qualitative and quantitative analytical methods are important to understand the nature of the ligands on the QDs for various applications. For further development of QD-LED displays, it is required to prepare more efficient and stable green and blue-emitting QD by passivating interface defect structures and to understand of the degradation mechanisms.

1L1-2 박혁규 (Hyuk Kyu Pak) (13:25–13:50)

1985 부산대학교 물리학과 (학사)
1992 Pittsburgh 대학교 물리학과 (박사)
1992-1993 Duke 대학교 물리학과 (Post-Doc.)
1994-1995 Kansas State 대학교 물리학과 (Post-Doc.)
1995-2014 부산대학교 물리학과 교수
2014-현재 UNIST 물리학과 교수

Diffusion and Energy Balance of a Brownian Particle in an Active Bath

박혁규†, 박진태 UNIST/IBS

Particles kicked by external forces to produce mobility distinct from thermal diffusion are an iconic feature of the active matter problem. Understanding this is central to the problem of swimming bacteria, active colloidal particles, and even catalytic enzymes. Here, we map this onto a minimal model for experiment and theory covering the wide time and length scales of usual active matter systems. A particle diffusing in a harmonic potential generated by optical trap is kicked by programmed forces that arrive at random intervals. The model's generic simplicity allows us to find conditions for which displacements are Gaussian (or not), how diffusion is perturbed (or not) by kicks, and quantifying energy dissipation to maintain the non-equilibrium steady state. A further advantage is that active and thermal forces are varied independently as is impossible to achieve in most physical systems.

1L1-3 김병수 (Byeong-Su Kim) (13:50–14:15)

1999 서울대학교 화학과 (학사)
2001 서울대학교 화학과 (석사)
2007 University of Minnesota 화학과 (박사)
2007-2009 MIT 화학공학과 (Post-Doc.)
2009-2018 UNIST 화학과 조교수, 부교수
2018-현재 연세대학교 화학과 부교수

Functional Epoxide Monomers: From Self-Assembled Degradable Micelles to Hydrogels

김병수† 연세대학교

본 발표에서는 다양한 기능성 에폭시 단량체의 합성과 이를 기반한 폴리에테르 블락공중합체의 합성과 응용에 대한 두 가지 대표적인 예시를 제시하고자 한다. 첫째로, 자기조립된 마이셀을 이용한 약물전달의 응용에서 다양한 생물학적인 자극에 의한 고분자 구조 및 물성의 변화와 이에 따른 약물 방출 속도를 제어하는 것은 아주 중요한 연구분야이다. 이에 본 연구에서는 생분해성 폴리에테르 마이셀의 합성을 위한 4가지 기능성 에폭시 단량체의 합성과 이들의 자기조립된 블락공중합체의 약물 방출 속도 제어에 관한 주제를 소개하려고 한다. 둘째로, 반응후 기능화 방식에 의한 ABA 형식의 삼중블락공중합체의 합성과 이를 이용한 자극민감성 자기치유 가능한 하이드로젤의 활용 가능성에 대해서 논의하려고 한다.

1L1-4 문준혁 (Jun Hyuk Moon) (14:15–14:40)

1999 고려대학교 화학공학과 (학사)
2005 한국과학기술원 생명화학공학과 (박사)
2005-2007 University of Pennsylvania (Post-Doc.)
2007-2008 삼성종합기술원 전문연구원
2014-2015 Harvard University (Visiting Scholar)
2008-현재 서강대학교 화공생명공학과 교수

Complete Encapsulation of Sulfur in Porous Carbon: A Key Process for High-performance Lithium-sulfur Batteries

문준혁† 서강대학교

Lithium-sulfur batteries rely on the reaction of sulfur to lithium sulfide or vice versa. For the cathode of a lithium-sulfur battery, it is highly required to completely contain sulfur in the porous carbon. This is to minimize the loss of lithium polysulfide due to its high solubility in the electrolyte. However, the relatively low affinity between sulfur and carbon makes it difficult for sulfur to penetrate completely into the porous structure of carbon, so a strategy is needed. As a way to tackle this, we suggest engineering a porous structure. By using a polymer colloid sacrificial template, pores are formed in the spherical CNT assembly, which improves the capillary action. In addition, we introduce the control of the interfacial energy of a solution containing sulfur. This is obtained by adding a solution having high compatibility with carbon to the sulfur-solution. Finally, we present the coating of metal compound nanoparticles with chemical affinity with sulfur on the carbon surface. The complete and uniform encapsulation of sulfur by each of these methods immediately improves the performance of the lithium-sulfur battery; we analyze the influence of the sulfur loading on the electrochemical reaction.

1L1-5 조길원 (Kilwon Cho) (15:00–15:25)

1980, 1982 서울대학교 공업화학 (학사, 석사)
1986 Akron대학교 고분자과학 (박사)
1987-1988 IBM연구소 연구원
1988-현재 포항공과대학교 화학공학과 교수
2011-현재 소프트일렉트로닉스 글로벌프론티어연구단 단장
2016 한국고분자학회 회장

Graphene-templated Growth of Conjugated Molecules for Organic Electronics

조길원† 포항공과대학교

Molecular orientation, crystallite size and lattice disorders in organic semiconductor (OSC) thin films determine the transport of electrons or excitons in the OSC thin films, and thus the performance of organic or graphene-OSC hybrid electronic devices. It has been shown that the control of the properties of OSC thin films can be achieved by using graphene as a growth template because the interaction between OSC molecules and graphene affects the molecular orientation and diffusivity of the OSC molecules on graphene. In this talk, the assembly mechanism of OSC molecules on graphene template will be discussed. In particular, the effects of various factors, such as surface contamination, doping, and roughness of graphene template, on the growth OSC thin films will be discussed. Lastly, I will present the application of the OSC thin films grown on graphene template in high-performance organic thin film transistors, organic photovoltaics, and graphene-OSC hybrid electronic devices.

1L1-6 박범준 (Bum Jun Park) (15:25–15:50)

2002 한양대학교 화학공학과 (학사)
2004 한양대학교 화학공학과 (석사)
2010 델라웨어대학교 화학공학과 (박사)
2010-2013 펜실베니아 대학교 화학공학과 (Post-Doc.)
2013-현재 경희대학교 화학공학과 조/부교수
2019-현재 Editor, Macromolecular Research

Colloidal Interactions at or Near Fluid−fluid Interfaces

박범준† 경희대학교 국제캠퍼스

Optical laser tweezers have been utilized to quantitatively measure the interaction forces and microrheological properties and to carry out structural manipulation in various soft matter systems, such as biological systems, polymer/biopolymer, and colloidal suspensions. In general, the reflection and refraction of a laser beam at the interface between an object and a fluid medium generate optical forces that can drive the object toward the beam focus. Using the optical laser tweezer apparatus, we investigate physical properties of various colloidal systems, e.g., interactions between polymeric particles in a low dielectric constant medium, critical electrolyte concentrations for colloid adsorption to fluid–fluid interfaces, and aspect ratio–controlled capillary forces between ellipsoidal particles at an oil–water interface.

1L1-7 문홍철 (Hongchul Moon) (15:50–16:15)

2007 POSTECH 화학공학과 (학사)
2012 POSTECH 화학공학과 (박사)
2012-2013 POSTECH 고분자연구소 (Post-Doc.)
2013-2015 University of Minnesota 화학공학과 (Post-Doc.)
2015-2019 서울시립대학교 화학공학과 조교수
2019-현재 서울시립대학교 화학공학과 부교수

Functional Ion Gels: Promising Electrolyte Platforms for Electrochemical Applications

문홍철† 서울시립대학교

Polymer gel electrolytes (PGEs) have been widely utilized in diverse applications including energy storage devices, e-skins, electrolyte gated transistors, and electrochemical displays. In particular, ion gels composed of room temperature ionic liquids (ILs) and copolymers are considered as promising high-performance PGEs, owing to their outstanding ionic conductivity, high capacitance, negligible vapor pressure, tunable mechanical robustness, and good solution processability. However, a trade-off between two important characteristics to evaluate electrolyte performance, ionic conductivity and mechanical property, is inevitable. Therefore, we proposed a simple but effective strategy for achieving mechanically robust, highly conductive ion gel platforms. In addition, we functionalized these ion gels through various approaches. We successfully demonstrated solution processable, low-voltage, flexible electrochemical displays and sensors using the functional ion gels.

1L1-8 윤동기 (Dong Ki Yoon) (16:15–16:40)

2001 연세대학교 화학공학과 (학사)
2003 카이스트 생명화학공학과 (석사)
2007 카이스트 생명화학공학과 (박사)
2007-2009 삼성전자 반도체연구소 책임연구원
2009-2011 미국 U. of Colorado 물리학과 (Post-Doc.)
2011-현재 카이스트 나노과학기술대학원 조교수, 부교수

Liquid Crystal Emulsion with Lasing Application

윤동기† 한국과학기술원

We present a structurally reversible smectic liquid crystal (LC) emulsion made of semi-fluorinated rod-type molecules in silicon oil, which is controlled by simple heating and cooling. Without adding any kind of additives, such as surfactants, polymers or emulsifiers, and without using any special tools, such as microfluidics or gas bubbling, the LC molecules spontaneously form monodisperse spherical and myelin-like structures upon cooling from the isotropic temperature. The LC emulsion can easily trap guest materials, providing a platform for repeatable and reliable switchable emulsification. For example, this interesting system enables to realize an on–off lasing system by confining fluorescent dyes in the LC droplets.

신진연구자 특별 심포지움 (I) | Young Polymer Scientists (I)

제2회장 [10월 6일(화)]

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

1L2-1 박성민 (Sungmin Park) (13:00–13:25)

2011 연세대학교 화학공학과 (학사)
2017 연세대학교 화공생명공학과 (박사)
2017-2019.08 Rensselaer Polytechnic Institute 화공과/화학과 (Post-Doc.)
2019.09-현재 한국화학연구원 선임연구원

Tailoring of Polymer Chains and Microstructure Characterization Using X-ray Scattering

박성민† 한국화학연구원

Precise Tailoring of polymer chains and characterization provide understanding on the role of the chemical structures onto physical behaviors of polymers. In this talk, labelled polystyrene with single ionic group from unique polymerization kinetic of 1,1-diphenylethylene (DPE) will be discussed. Single ionic group per chain was labelled into polystyrenes systematically using sequence controlled anionic polymerization. The microstructures were characterized using x-ray scattering, and critical role of functional group location in polymer chains on aggregation and fractal structure formation was investigated. In addition to this, thermal and viscoelastic properties of nearly perfect alternating copolymer of 1,1-diphenylethylene (DPE) and butadiene and its selectively hydrogenated polymers will be discussed.

1L2-2 송슬기 (Seulki Song) (13:25–13:50)

2011 서울시립대학교 화학공학과 (학사)
2017 POSTECH (박사, 통합과정)
2017-2018 Max-Planck-Institut für Kohlenforschung (Post-Doc.)
2018-현재 한국화학연구원 선임연구원

Interface Engineering for Efficient and Stable Perovskite Solar Cells

송슬기† 한국화학연구원

Perovskite solar cells have recently achieved high efficiency of more than 25% and are in the limelight as the next generation solar cells. Although currently showing relatively high efficiencies, much progress is still needed to reach theoretical efficiencies that are close to theoretical efficiencies of the Shockley-Queisser limit. In particular, for developing the extremely high efficient perovskite solar cells, engineering of interfaces with minimal recombination is important. Therefore, proper design and engineering of interfaces has become increasingly important in recent years and many studies have been published. There are many interfaces in the perovskite solar cells and if these carrier selection or separation interface is changed, changes in the interface characteristics can change the overall parameters that affect device efficiency. Here I would like to discuss the interface engineering and design strategy to achieve high efficient perovskite solar cells.

1L2-3 구병진 (Byungjin Koo) (13:50–14:15)

2012 서울대학교 재료공학부 (학사)
2017 Massachusetts Institute of Technology, Department of Materials Science and Engineering (Program in Polymers and Soft Matter) (박사)
2017-2020 University of California, Berkeley, Department of Chemistry (Post-Doc.)
2020-현재 단국대학교 고분자시스템공학부 조교수

Synthetic Approaches to Semiconductive Polymers for Chemical Sensors

구병진† 단국대학교

Semiconductive polymers have been incorporated in various optoelectronic devices and chemical sensor systems. In order to provide new functions, chemical modification of these polymers is necessary. In the first part, a facile way to modify poly (3-hexylthiophene) (P3HT) will be presented. The method employs a lithium–halogen exchange reaction on brominated P3HT, which generates more than 100 thienyl lithium species in a single polymer chain. The reactive thienyl lithiates can be quenched with a variety of electrophiles, generating derivatized P3HTs. Carbon nanotube–P3HT composites were fabricated for use in chemiresistive sensors. In the second part, functionalization of poly(phenylene ethynylene)s will be introduced. Specifically, through side-chain engineering, this functionalization generates emissive polymer aggregates (emissive excimers) at the air–water interface. The excimers can be transferred to glass substrates, which are responsive to selected volatile organic compounds (VOCs) via fluorescence changes induced by energy migration.

1L2-4 오태곤 (Taegon Oh) (14:15–14:40)

2013 University of Illinois at Urbana-Champaign (학사)
2013 University of Illinois at Urbana-Champaign (석사)
2019 Northwestern University (박사)
2019-현재 한국과학기술연구원 전문연구요원

Expanding the Properties and Utility of DNA-Engineered Nanoparticle Superlattices through Monodispersity and Metallization

오태곤† 한국과학기술연구원

With the advent of DNA-directed methods to form “single crystal” nanoparticle superlattices, new opportunities for studying the properties of such structures across many length scales now exist. Although DNA-programmed colloidal crystals consistently form thermodynamically favored Wulff shapes, the crystals are of size and shape polydispersity, a serious limitation for many applications. In addition, DNA hybridization is basically mutual hydrogen bonds which are sensitive to the environments (salt concentration, solvent, and temperature), and the weak linkage between particles limits in-depth characterizations and practical use of the DNA-assembled colloidal crystals. This presentation will discuss methods to overcome these problems for the DNA-engineered colloidal crystals to be synthesized more reliably; a density-layer approach with a quenching sublayer enhances the size and shape uniformity, and a post-synthetic treatment with Ag^{+} ions greatly increases the structural stability.

1L2-5 강지형 (Jiheong Kang) (15:00–15:25)

2012 서울대학교 화학과 (학사)
2014 동경대학교 화학 생물 공학부 (석사)
2017 동경대학교 화학 생물 공학부 (박사)
2017-2019 스탠포드대학교 화학공학과 (Post-Doc.)
2020-현재 KAIST 신소재공학과 조교수

Self-healing Soft Electronics: From Materials to Devices to Systems

강지형† 한국과학기술원

In this presentation, I will first show my approaches to toughen self-healable network to use for soft electronic applications. Second, I will talk about how to impart electronic functionalities to self-healable polymer network using nanomaterials. This approach is based on my recent finding that conductive nanostructured network can be reconstructed when it is surrounded by dynamic self-healing polymer matrix. Finally, I will show unexplored opportunities in interconnection technologies in soft electronics by the use of self-healable materials, which allow the users to design and construct their own electronics by simply cutting and pressing the robust, self-healable electronic modules. Through my presentation, I will cover from fundamental development of self-healing materials to their system level applications in soft electronics.

1L2-6 지원석 (Won Seok Chi) (15:25–15:50)

2010 연세대학교 화학공학과 (학사)
2015 연세대학교 화공생명공학과 (박사)
2015-2016 연세대학교 산업기술연구소
2016-2017 University of California, Berkeley Chemical and Biomolecular Engineering
2017-2019 Massachusetts Institute of Technology, Chemical Engineering
2019-현재 전남대학교 고분자융합소재공학부 조교수

Interfacial Engineering in MOF-Polymer Hybrid Membranes for Efficient Gas Separations

지원석† 전남대학교

Metal-organic framework (MOF) nanoparticles have been incorporated into a polymer matrix to form hybrid membranes. The hybrid membranes offer a significant improvement in gas separation performance and stability compared to a pure polymeric membrane. However, interfacial defects are often formed, resulting in non-selective void spaces between polymer and MOFs in the hybrid membranes. As a result, the interfacial defects reduce gas separation performance (i.e., selectivity) and stability. To address this concern, this study shows a remarkable technique, which is interfacial engineering between the polyimide matrix and MOF nanoparticles, to theoretically design the hybrid membranes. This talk will provide the interfacial design method, material, and transport characterization for MOF-polymer hybrid membranes.

1L2-7 나준희 (Jun-Hee Na) (15:50–16:15)

2004 충남대학교 정보통신공학부 (학사)
2006 서울대학교 전기컴퓨터공학부 (석사)
2006-2008 삼성전자 LCD총괄 연구원
2012 서울대학교 전기컴퓨터공학부 (박사)
2012-2015 Polymer science & engineering, University of Massachusetts Amherst (Post-Doc.)
2015-2016 Apple Inc. (Senior Engineer)
2016-현재 충남대학교 융복합시스템공학과/전기전자통신공학교육과 부교수

Multipolar Spatial Electric Field Modulation for Freeform Electroactive Actuation

나준희† 충남대학교

Electroactive hydrogels that exhibit large deformation in response to an electric field have received significant attention as a potential actuating material for soft actuators and artificial muscle. To implement complex movements, a pre-program, such as a hinge and a multilayer pattern, is usually required for the actuator in advance. Here, we propose a reprogrammable actuating method and sophisticated manipulation by using multipolar three-dimensional electric field modulation without pre-program. Through the multipolar spatial electric field modulator, which controls the polarity/intensity of the electric field in three-dimensions, complex 3D actuation of single hydrogels is achieved. We demonstrate soft robotic actuators, including basic bending mechanics in terms of controllability and reliability, and several 3D shapes having positive and negative curvature can easily be achieved in a single sheet, paving the way for continuously reconfigurable materials.

1L2-8 조제웅 (Jea-woong Jo) (16:15–16:40)

2009 서울대학교 재료공학부 (학사)
2015 서울대학교 재료공학부 (박사)
2012-2013 UMass Amherst 고분자공학과 방문연구원
2015-2016 KIST 광전하이브리드센터 (Post-Doc.)
2016-2018 토론토대학교 전기컴퓨터공학부 (Post-Doc.)
2018-현재 동국대학교 융합에너지신소재공학과 조교수

Chemical Additives of Solution-Phase Ligand Exchange for Infrared Colloidal Quantum Dot Solar Cells

조제웅† 동국대학교

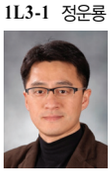
Colloidal quantum dot (CQD) is one of the effective infrared absorbing materials for photovoltaic applications. For this applications, original insulating ligands used for the synthesis of CQD should be replaced in order to obtain electrically conductive CQD solid films with reduced recombination of photo-generated charge carriers. Recently, solution-phase ligand exchange has been considered as a promising strategy to realize the homogeneous exchange of surface ligand and the minimized density of defects. However, current solution-phase ligand exchanges have still reported insufficient optoelectrical and photophysical properties of CQDs for achieving high performance infrared solar cells. In this study, the solution-phase ligand exchange methods have been modified by introducing various chemical additives. And then, the influences of chemical additives on the photovoltaic performances have been explored by fabricating infrared CQD solar cells.

고분자구조 및 물성 | Polymer Structure and Property

제3회장 [10월 6일(화)]

Organizer: 고현협(UNIST), 염봉준(한양대)

1L3-1 정운룡 (Unyong Jeong) (13:00–13:25)



1998 포항공과대학교 화학공학과 (학사)
2000 포항공과대학교 화학공학과 (석사)
2003 포항공과대학교 화학공학과 (박사)
2004-2005 Univ. Washington, Seattle, 화학과 (Post-Doc.)
2006-2014 연세대학교 신소재공학과 조교수/부교수
2015-현재 포항공과대학교 신소재공학과 교수

Artificial Multimodal Receptors Based on Ion Relaxation Dynamics

정운룡† 포항공과대학교

Human skin has different types of tactile receptors that allow distinguishing of mechanical stimuli and temperature. Here, we present a highly-deformable artificial multimodal ionic receptor design that can simultaneously detect thermal and mechanical information without signal coupling. Two variables are derived from the analysis of the ion relaxation dynamics; the charge relaxation time as a strain-insensitive intrinsic variable to measure absolute temperature, and the normalized capacitance as a temperature-insensitive extrinsic variable to measure the strain. We present a pixelated matrix of the multimodal receptors, called Ion-Electronic skin (IE-skin). IE-skin can determine the directions and magnitudes of forces, which recognizes various tactile motions (shear, pinch, spread, torsion, etc.). This ability is expected to help us understand the tactile sensing mechanisms in human skin.

1L3-2 장재영 (Jaeyoung Jang) (13:25–13:50)

2006 포항공과대학교 화학공학과 (학사)
2012 포항공과대학교 화학공학과 (박사)
2012-2014 시카고대학교 화학과 (Post-Doc.)
2014-2015 시카고대학교 제임스 프랑크 연구소 (Post-Doc.)
2015-2020 한양대학교 에너지공학과 조교수
2020-현재 한양대학교 에너지공학과 부교수

Molecular Doping and Nanostructuring of Conjugated Polymers for Thermoelectric Applications

장재영† 한양대학교

Recently, conjugated polymers have emerged as a new class of thermoelectric (TE) materials, opening new avenues for harvesting thermal energy by inexpensive and scalable routes. Here, I present 3 different approaches to improve the TE and mechanical properties of conjugated polymer-based TE materials: 1) molecular doping of conjugated polymers via simple solution mixing, 2) efficient debundling of few-walled CNTs by wrapping with conjugated polymers, and 3) nanostructuring of conjugated polymers in a thermoplastic elastomer matrix. The first two parts of this presentation will focus on how to improve the TE properties of the polymers and their composite films as well as the performance of flexible TE generators. In the last part, two novel designing strategies of TE materials will be introduced to realize self-healable and stretchable organic TE materials and to minimize the thermal resistance between the heat sources and the TE material.

1L3-3 윤현식 (Hyunsik Yoon) (13:50–14:15)

1996 서울대학교 화학공학과 (학사)
1998 서울대학교 화학공학과 (석사)
2004 서울대학교 화학공학과 (박사)
2004-2007 삼성전자 책임연구원
2008-2012 서울대학교 화학생물공학과 (Post-Doc.)
2012-현재 서울과학기술대학교 화공생명공학과 부교수

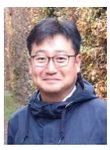
Bio-Inspired Smart Window

윤현식† 서울과학기술대학교

The camouflage of a squid use a transformable skin which have a capability to switch from transparent to opaque skins and vice versa. The mechanism is known that the muscle of a suqid can control the size of light absorption dyes. In this presentation, we demonstrate a new concept of smart window by mimicking the squid skin. We use magnetic nanoparticles dispersed within pyramidal structures and modulate the area of light absorption by chaning the position of the magnetic field. We show the change of transparency difference (ON/OFF ratio) by controlling the concentration of magnetic nanoparticles and the dispersive liquid and provide a simple model

to explain. In addition, we propose a better structure design for higher transmittance and demonstrate the performance by using 3D printing technology.

1L3-4 심봉섭 (Bong Sup Shim) (14:15–14:40)



1999	고려대학교 화학공학과 (학사)
2001	CJ제일제당 엔지니어
2009	미시간대학교 화학공학과 (박사)
2011	델라웨어대학교 (Post-Doc.)
2011-현재	인하대학교 화학공학과 부교수

Multi-Functional Nanocomposites from Naturally Derived Materials: Conductive Melanin and Crystalline Nanocellulose

심봉섭† 인하대학교

Natural systems utilize multifunctional biocomposites by a bottom-up assembly of nanomaterials for creating hierarchical multiphasic structures, while conventional man-made composites increase one functionality by sacrificing the others. Here, we introduce multifunctional nanocomposites from natural biomaterials, including high crystalline cellulose nanofibers and conductive melanin nanoparticles. Tunic cellulose nanofibers have shown high crystallinity, straight fibrous shape, and liquid crystalline alignments. Thus, their nanocomposites showed excellent optical, mechanical, and surface properties. On the other hand, naturally derived melanin nanoparticles are molecularly structured to possess finely tunable electrochemical conductivities, optical reflectivity, and casting shape stability with inherent biocompatibility. These composites can be used as key functional materials in emerging applications such as biotic-abiotic interfaces, implantable electronics, and eco-electronics.

1L3-5 김연상 (Youn Sang Kim) (15:00–15:25)

1995	서울대학교 화학공학과 (학사)
1997	서울대학교 화학공학과 (석사)
2002	서울대학교 화학공학과 (박사)
2002-2004	MIT(미국) 화학공학과 (Post-Doc.)
2004-2009	이화여자대학교 화학나노과학부 조교수
2009-현재	서울대학교 융합과학기술대학원 교수

Ionovoltaic Analysis in Aqueous Systems

김연상† 서울대학교

최근 물 흐름을 이용한 발전으로 댐을 이용하여 위치에너지를 기계적 에너지, 전기에너지로 순차적으로 전환하는 기존의 전통적인 수력발전과 다른 물 흐름의 기계적 에너지에서 직접 전기에너지로의 전환이 가능한 연구결과들이 보고되고 있으나, 그 원리에 대한 정확한 이해는 아직 부족한 편으로, 물 흐름 에너지 전환 응용에 대한 단편적인 연구결과들의 보고들이 주를 이루고 있다. 본 연구진은 이의 근본적인 원리가 물속에 존재하는 이온의 고체 계면에서 움직임 즉, ion dynamics에 기인한 현상으로 파악하고 있으며, 이를 "Ionovoltaic"이라는 새로운 학문적 키워드로서 정의하여 정립하고 있다. 본 발표를 통해 다양한 물 흐름에서 연속적으로 전기에너지가 전환되는 새로운 소자구조(Energy Harvestor)와 고체-액체 계면에서의 이온 거동에 의한 이온동력학이 에너지 전환에 중요한 구동원리임을 소개하려한다. 이를 통해 물 속의 다양한 이온 거동 및 생체물질을 모니터링 할 수 있는 센서를 제시하고, ionovoltaic 현상의 분석을 통해 고체/액체 계면에서의 ion-dynamics를 체계적으로 이해할 수 있음을 보여주고자 한다.

1L3-6 이기라 (Gi-Ra Yi) (15:25–15:50)

2003	카이스트 화학공학과 (박사)
2003-2004	UC Santa Barbara 화학공학과 (Post-Doc.)
2004-2006	LG화학기술연구원 선임연구원
2006-2009	한국기초과학지원연구원 선임연구원
2009-2012	충북대학교 공업화학과 조교수
2012-현재	성균관대학교 화학공학과 부교수

DNA-Coated Janus Colloids

이기라†, 조인성 성균관대학교

Colloidal Janus paticles serve as model systems to explore structure formation of particles with chemically heterogeneous surfaces such as proteins. While there are numerous computer studies, there are few experimental realizations due to a lack of means to produce such colloids with a well-controlled variable Janus balance. Here, we report a simple scalable method to precisely vary the Janus balance over a wide range and selectively functionalize one patch with DNA. We observe, via experiment and simulation, the dynamic formation of diverse superstructures: colloidal micelles, chains, or bilayers, depending on the Janus balance. Flexible dimer chains form through cooperative polymerization while trimer chains form by a two-stage process, first by cooperative polymerization into disordered aggregates followed by condensation into more ordered stiff trimer chains.

1L3-7 홍석원 (Suck Won Hong) (15:50–16:15)

2000	한국항공대학교 재료공학과 (학사)
2008	아이오와주립대 재료공학과 (박사)
2008-2010	일리노이주립대 재료공학과 (Post-Doc.)
2010-현재	부산대학교 광메카트로닉스공학과 교수

Strain Tunable Optical Microlens Arrays with Deformable Wrinkles for Spatially Coordinated Image Projection on Security Substrate

홍석원† 부산대학교

As a new concept in materials design, a variety of strategies have been developed to fabricate optical microlens arrays (MLAs) that enable the miniaturization of optical systems in micro/nanoscale, improving the characteristic optical performance with unique functionality. Here, we introduce a cost-effective and facile fabrication process in a large scale up to 15 inches via a sequential lithographic method to produce thin and deformable hexagonally arranged MLAs, consisting of polydimethylsiloxane (PDMS). Simple employment of oxygen plasma treatment on the prestrained MLAs effectively harnessed the spontaneous formation of highly uniform nanowrinkled structures on all over the surface of elastomeric microlenses. With strain-controlled tunability, unexpected optical diffraction patterns were characterized by the interference combination effect of the microlens and deformable nanowrinkles.

1L3-8 전석우 (Seokwoo Jeon) (16:15–16:40)

1993-2000	서울대학교 재료공학 (학사)
2001-2003	서울대학교 재료공학 (석사)
2003-2006	UIUC, Materials Science and Engineering (박사)
2007-2008	Columbia University (Post-Doc.)
2008-현재	한국과학기술원 신소재공학과 교수
2017-2020	한국과학기술원 석좌교수

3D Nanostructured PDMS for Functional Applications

전석우† 한국과학기술원

The intensive development of nanotechnologies offers a new route to construct sophisticated architectures of emerging soft electronics. Among the many classes of stretchable materials, nanostructured poly(dimethylsiloxane) (PDMS) has emerged as a vital building block based on its merits of flexibility, stretchability, and, more importantly, high degrees of freedom of incorporation with other functional materials. The artificially designed geometries play important roles in achieving the desired mechanical and electrical performances of devices and thus show great potential for applications in the fields of stretchable displays, sensors and actuators as well as in health-monitoring device platforms. Meanwhile, novel lithographic methods to produce stretchable platforms with superb reliability have recently attracted research interest. The aim of this talk is to comprehensively summarize the progress regarding nanostructured PDMS and their promising soft electronic applications.

고분자가공/복합재료 | Polymer Processing/Composites

제4회장 [10월 6일(화)]

Organizer: 임성갑(KAIST), 장세규(KIST)

1L4-1 강상욱 (Sang Wook Kang) (13:00–13:25)

2002	중앙대학교 화학공학과 (학사)
2008	서울대학교 화학생물공학부 (박사)
2009	MIT 화학공학과 (Post-Doc.)
2010-현재	상명대학교 화학에너지공학과 부교수

Thermally Stable and High-efficient Porous Polymers for Application to Battery Separator

강상욱† 상명대학교 화학에너지공학과

Nanopores in thermally stable polymer matrix were generated by utilizing wetting agents with water pressure without metal salts as additive. When specific polymer films fabricated with wetting agents as an additive was exposed to water pressure, nano-pores were generated and could be easily controlled by the pressure-strength. Actually, the chains became weakened in the portion of polymers since wetting agents wer surrounded by water molecules, resulting in plasticization for generating nano-pores. Thus, we succeeded in preparing the porous polymers with high porosity of 78%.

1L4-2 이장용 (Jang Yong Lee) (13:25–13:50)

2005	건국대학교 신소재공학과 (학사)
2007	건국대학교 신소재공학과 (석사)
2011	건국대학교 신소재공학과 (박사)
2011	한국화학연구원 (Post-Doc.)
2011-현재	한국화학연구원 분리막연구센터 책임연구원

Development of Hydrocarbon-based Membrane Materials and Structural Effect of Hydrophobic Block on the Chemical Stability for Redox Flow Battery

이장용† 한국화학연구원

Recently, as the most typical approach to overcome the limitations of Nafion IEMs, hydrocarbon-based alternative ionomers have attracted attention for VRFB. However, low oxidative stability is regarded as an obstacle to restrict commercial use of hydrocarbon-based ionomer membranes. Typically, hydrophilic blocks or hydrophilic moieties have been considered as the main reason on degradation of hydrocarbon-based ionomers, while the significance of hydrophobic moiety has been neglected in ionomers. Herein, four kind of poly(p-phenylene)s-based cation conducting polymeric membrane materials with different hydrophobic block structures were

successfully synthesized by Ni(0)-catalyzed coupling polymerization for investigating the effect of the hydrophobic block structure on durability of membrane in VRFB. Furthermore, we propose chemically stable hydrocarbon-based ionomer materials for VRFB.

1L4-3 배태현 (Tae-Hyun Bae) (13:50-14:15)

1999	서울대학교 생물자원공학부 (학사)
2001	서울대학교 생물자원공학부 (석사)
2010	Georgia Tech 화학생물공학부 (박사)
2013	UC Berkeley 화학과 (Post-Doc.)
2019	난양공대 (NTU) 화학생물공학부 조교수
현재	KAIST 생명화학공학과 부교수

고성능 기체분리를 위한 기능성 다공성 고분자

배태현† 한국과학기술원

We develop a facile strategy that converts a cost-effective porous organic polymer (denoted as PP), which is synthesized by Friedel-Crafts alkylation reaction of dichloro-p-xylene, into outstanding CO_2 adsorbents through one-step post-synthesis functionalization with polyamines. Among the adsorbents synthesized, PP-2-DETA and PP-2-TEPA show superior high CO_2 uptake capacities, excellent CO_2 selectivity over N_2, and appropriate Qst. Furthermore, the adsorbents show good CO_2 uptake capacity and excellent stability toward both water vapor and regeneration cycles under dynamic flow conditions. Meanwhile, amine-functionalized organic porous polymers were used as filler materials to yield mechanically stable composite membranes that possess good CO_2/CH_4 separation performance. Composite membranes that contain amine-functionalized fillers exhibited both superior mechanical strength and more effective adhesion to glassy Matrimid® Polyimide (PI) and polysulfone (PSf) polymers.

1L4-4 고동연 (Dong-Yeun Koh) (14:15-14:40)

2007	고려대학교 생명과학대학 (학사)
2013	KAIST 생명화학공학과 (박사)
2014-2017	Georgia Tech, School of Chemical and Biomolecular Engineering (Post-Doc.)
2017-현재	KAIST 생명화학공학과 조교수

Intrinsically Microporous Polymers for Advanced Separation Processes

고동연† KAIST

Advanced molecular separations using polymeric membrane materials have been recently focused on development of microporous, rigid polymers. These microporosity and rigidity, when combined properly, allows membranes to have high permeability and selectivity combination that can surpass the current upper bound for polymeric membranes. In this regard, polymer of intrinsic microporosity (PIM-1), has been extensively studied for its separation performance when challenged with a variety of gases and liquids. In this work, gas separation performances, physical aging, energy storage and continuous carbon utilization using PIM-1 hollow fiber will be discussed.

1L4-5 김진호 (Jinho Kim) (15:00-15:25)

2001	부경대학교 융합디스플레이공학 (학사)
2005	부경대학교 융합디스플레이공학 (석사)
2012	부경대학교 융합디스플레이공학 (박사)
2014-현재	㈜상보 CMS 사업본부 본부장 이사

나노복합 재료를 이용한 포장재 개발

김진호† (주)상보

여러 가지제품의 유통/보관 과정에서 제품의 내용물을 보호하고 장기 보존하기 위해서 다양한 포장재가 사용되고 있다. 유리, 종이, 금속, 플라스틱 중 플라스틱 등이 주로 사용되고 있으며, 그 중 포장재의 수요가 지속적으로 증가하고 있으며, 기체 차단 및 수분, 향기 등을 보존하기 위한 재료들도 많이 개발되고 있다. 특히 식품의 보존 기간을 늘리기 위해서는 산소나 수분을 차단하는 배리어 필름의 수요가 선진국을 위주로 성장하고 있다. 본 연구에서는 나노 복합재료를 이요한 투명 배리어 필름에 대해 소개한다.

1L4-6 윤여성 (Yeo Seong Yoon) (15:25-15:50)

1990	충북대학교 화학과 (학사)
1992	충북대학교 화학과 (석사)
2005	충북대학교 화학과 (박사)
1996-현재	한국자동차연구원

콜로이드 SiO_2와 Polyimide 복합재료를 이용한 저유전 하이브리드 필름 제조 및 특성

윤여성†, 장은진, 문동준 오미혜 한국자동차연구원

최근 5G 통신 및 자율주행 자동차 개발 등으로 많은 양의 정보 및 저손실 · 고속 데이터 전송 기술이 전자기기들의 요구 특성으로 부각 되고 있다. 특히 밀리미터파(mmWave) 대역의 적용 소재는 신호손실이 커지기 때문에 현재 통신에서 쓰이는 소재보다 유전체 손실이 적고 절연성이 우수하며 전도성이 좋은 소재가 필요하다. 본 연구에서는 유전손실이 적은 이미드 필름을 제조 하였다. 졸-겔 합성법을 이용하여 저유전 소재의 필러로 콜로이드 SiO_2를 합성 하였다. 합성된 콜로이드 SiO_2 와 PAA 수지를 혼합 후 Knife coater를 이용하여 필름을 제조 후 400 ℃에서 이미드화 시켜 SiO_2/PI 하이브리드 필름을 제조 하였다. 이미드화 과정을 FT-IR를 이용하여 확인 하였으며, 인장, 형태학적 관찰 및 저유전율 등 물리적 특성을 관찰 하였다. SEM을 관찰 하여 제조된 콜로이드 SiO_2 입자와 PI와 계면사이에 기공이 형성되어 유전율에 영향을 주는 것을 확인 하였으며, 사용된 PI의 유전율은 3.56, 하이브리드 필름의 유전율은 2.96으로 유전율이 낮아짐을 확인하였다.

1L4-7 김명호 (Myung Ho Kim) (15:50-16:15)

1982-1987	서울대학교 화학공학과 (학사)
1987-1989	서울대학교 화학공학과 고분자공학 (석사)
1995-1999	스티븐스 공과대학 고분자공학 (박사)
2009-현재	한남대학교 교수
2010-현재	MKE 대표
2015-현재	SPE Korea 회장

How and What to Use of Rheometer in Material Development and Polymer Processing

김명호† 한남대학교

Recently, rheological measurement and analysis are quite freqently used in material development and production area, such as material characterization, quality control, laboratory analogy and design purpose. F.E.A.R. rheometry (Fast, Easy, Accurate, and Reliable) is a good terminology stand for modern rheological development. Especially screw rheometer is good rheometer to measure shear viscosity and viscoelastics. High accuracy and repeatability of shear viscosity measurement and relaxation time measurement in processing shear rate range are two important feature of this rheometer. Comparison among various rheometer will be dealt in depth and practical application of rheological values are most important in this presentation.

1L4-8 이성호 (Sungho Lee) (16:15-16:40)

1996	중앙대학교 화학공학과 (학사)
1996-1999	㈜한화 사원
2001	Louisiana State University 화학공학과 (석사)
2007, 2008	Clemson University 화학공학과 (박사, Post-Doc.)
2008-2009	LS전선 ㈜ 중앙연구소 책임연구원
2009-현재	한국과학기술연구원 탄소융합소재연구센터장

Morphological Evolution of Commercial PAN-based Carbon Fibers in Oxidation

이성호† 한국과학기술연구원

PAN기반 탄소섬유는 고강도의 기계적 물성을 가지고 있으며, 고분자 수지, 금속 또는 세라믹 매트릭스를 사용하여 탄소섬유 강화 복합재 형태로 항공 우주용, 자동차 산업, 일반 산업용 및 토목/해양 구조물에서 강화 재료로 사용되고 있다. 탄소섬유 기반의 복합소재가 우주용 구조재료로 사용될때는 발사 시의 극심한 가속도 조건, 산화성 등의 극한 환경조건을 견뎌내야 하기 때문에 기지소재는 고분자가 아닌 내열성 소재를 사용한다. 그러므로 복합재료를 주로 구성하고 있는 탄소섬유의 내열성 및 산화성이 복합소재에 영향을 미칠 것이며 초고온 내열성 복합재료의 내열, 내산화성을 향상시키기 위해서는 탄소섬유의 기계적 물성과 미세구조에 따라 산화 거동을 확인하는 연구가 필요하다. 본 연구에서는 상용 탄소섬유의 산화 저항성과 구조적 안정성 및 산화 후 탄소섬유의 형태를 관찰하고자 하였다. 본 실험에서는 TORAY사의 T300J, T700S, T800S, T1000G 탄소섬유를 사용하였다.

고분자 이론 및 시뮬레이션 | Theory and Simulation of Polymeric Materials

제5회장 [10월 6일(화)]

Organizer: 손정곤(KIST), 허수미(전남대)

1L5-1 조준한 (Junhan Cho) (13:00-13:25)

1987	서울대학교 섬유공학과 (학사)
1989	서울대학교 섬유공학과 (석사)
1990-1991	KIST 고분자공정실 위촉연구원
1995	U of Texas at Austin 화학공학과 (박사)
1995-1996	U of Akron 고분자과학과 (Post-Doc.)
1996-현재	단국대학교 고분자공학과 교수

Self-Assembly in Charged Polymeric Mixtures: Equation-of-state and Field Approaches

조준한† 단국대학교

Understanding of systems containing charged polymers are of central importance in modern polymer science due to their abundance in nature. One of the possible efforts is to employ a reliable and amenable theory. Starting with the classical Voorn-Overbeek theory, there are several more choices in this direction such as RPA, self-consistent field, and integral equation theories. The first 3 theories assume system to be incompressible in most cases. In contrast, the integral equation theory provides a continuous-space equation of state. Through Edwards's Gaussian thread approach, we formulate a field theory in connection with the equation of state to describe inhomogeneity in weakly charged polymeric systems, where temperature and pressure are taken as two equal control variables. Some salt-free mixtures of polyelectrolytes or charged amphiphiles with varying chain architectures are given to discuss the responses of those systems to temperature and pressure.

1L5-2 성봉준 (Bong June Sung) (13:25–13:50)

1999 서울대학교 화학과 (학사)
2001 서울대학교 화학과 (석사)
2006 University of Wisconsin–Madison (박사)
2007 University of Wisconsin–Madison (Post–Doc.)
2007-현재 서강대학교 화학과 조교수, 부교수, 교수

Polymer Loop Formation in Glass–Forming Liquid

성봉준† 서강대학교

Recent single molecule experiments showed that the cell cytoplasm, a factory of biochemical reactions, should be glass–like: the diffusion of proteins cell cytoplasm is, especially, slow, heterogeneous and sometimes non–ergodic. The effects of such intriguing glassy diffusion on the kinetics of biochemical reactions in biological systems remain elusive. In this talk, we present extensive molecular dynamics simulations and Langevin dynamics simulations to investigate the kinetics of polymer loop formation in Kob–Anderson (KA) glass–forming liquid as a model system. We show that the loop formation kinetics is influenced significantly by the dynamic heterogeneity in glass–forming liquids. The dynamic heterogeneity of KA liquid affects the rate constant (krxn) of the loop formation and leads to the identical fractional dependence of krxn on η_s. This suggests that the dynamic heterogeneity of cell cytoplasm would influence the biochemical reaction significantly.

1L5-3 박준동 (Jun Dong Park) (13:50–14:15)

2006-2010 서울대학교 화학생물공학부 (학사)
2010-2016 서울대학교 화학생물공학부 (박사)
2016-2019 University of Illinois at Urbana–Champaign (Post–Doc.)
2019-2020 금오공과대학교 화학공학과 조교수
2020-현재 숙명여자대학교 화공생명공학부 조교수

Description of Flow in Soft Glassy Materials by the Soft Glassy Rheology (SGR) Model

박준동† 숙명여자대학교

A large class of soft glassy materials including polymer and colloid demonstrate intriguing rheological features under flow and deformation condition. The complex rheological behavior of soft glassy materials is attributed to glassy dynamics resulted from structural disorder and metastability. In this presentation, the Soft Glassy Rheology (SGR) model that has been developed to describe the rheology of soft glassy materials is briefly introduced and some rheological phenomena of soft glassy materials, such as elastic to viscoplastic transition and Bauschinger effect, will be discussed in terms of glassy dynamics and local strain distribution change.

1L5-4 서영미 (Youngmi Seo) (14:15–14:40)

2010 서울시립대학교 화학공학과 (학사)
2012 서울시립대학교 화학공학과 (석사)
2017 The Ohio State University 화학공학과 (박사)
2018-현재 LG화학 기술연구원 책임연구원

Role of Solvation on Diffusion of Ions in Diblock Copolymers: Understanding the Molecular Weight Effect Through Modeling

서영미† LG화학 기술연구원

Salt–doped diblock copolymers, which are composed of conducting and robust blocks, have been considered as potential solid battery electrolytes. In such systems, ions conduct through the conducting phase typically made of poly(ethylene) oxide while the other phase provides robustness. The polymeric systems have been of particular interest due to their unique behavior such that ionic conductivity increases while the polymer molecular weight increases. In this study, we explored the cause of such phenomenon using a coarse–grained molecular dynamics. While the ion distribution especially apart from the polymeric interfacial area has been treated as a key factor for the explanation, our model indicated the ionic agglomeration plays a key role. Taking an advantage of the coarse–grained model, the ion–polymer and ion–ion interaction were tuned to represent various generic conditions, and a trend line was obtained between the ion diffusion constants and the degree of the ion agglomeration.

1L5-5 김준수 (Jun Soo Kim) (15:00–15:25)

2002 서울대학교 화학과 (학사)
2004 서울대학교 화학과 (석사)
2009 미국 위스콘신주립대 화학과 (박사)
2009-2011 미국 노스웨스턴대학교 의생명공학과 (Post–Doc.)
2011-현재 이화여자대학교 화학나노과학과 조교수/부교수

Electrostatic Bending of Intrinsically Rigid DNA by Binding with a Cationic Nanoparticle: Application to the Brownian Motor

김준수† 이화여자대학교

We design a DNA–based Brownian motor for directional transport of positively charged nanoparticles along a single, long double–stranded DNA (dsDNA) with elaborately designed flexibility variation. To prove its realization, we first investigate the bending of intrinsically rigid dsDNA by binding with a cationic nanoparticle, using the coarse–grained molecular dynamics simulations. An electric charge of the nanoparticle and the sequence–dependent flexibility of dsDNA are varied to elucidate the competitive effects of intrinsic rigidity of dsDNA and electrostatic interactions between charged dsDNA and a nanoparticle. We prove that the nanoparticle wrapped around by dsDNA rolls over the dsDNA towards more flexible region of the dsDNA. This work suggests that dsDNA molecules with elaborately designed flexibility variation can be used as a molecule–scale guide for spatial and dynamic control of nanoparticles for future applications.

1L5-6 손창윤 (Chang Yun Son) (15:25–15:50)

2005 서울대학교 화학과 (학사)
2011 서울대학교 화학과 (석사)
2017 위스콘신–매디슨 대학교 화학과 (박사)
2017-2020 캘리포니아공과대학 화공학과 (Post–Doc.)
2020-현재 포항공과대학교 화학과 조교수

Enabling Predictive Molecular Simulations of Polymer Electrolytes for Next Generation Energy Storage Devices

손창윤† 포항공과대학교

Solid state polymer electrolytes are rapidly emerging materials to replace the flammable organic electrolytes widely used in industrial lithium ion batteries. Extensive efforts have been made to understand the mechanisms and to optimize the ion transport properties, which are strongly coupled to the solvent/polymer dynamics. In this talk, I'll present our ongoing efforts to enable predictive molecular simulations of ionic liquids and polymer electrolytes. Two major advances will be highlighted – the development of predictive multi–scale force field based entirely on first–principle calculations, and new simulation algorithms to treat surface polarization and proper thermal equilibrium in polarizable MD simulations. New physical insights will be discussed, which includes polarization effects on the ion adsorption at air/water and water/electrode interfaces, ion correlation in organic electrolytes, formation of ionic liquid crystals, as well as conformational dynamics in IL–polymer mixtures.

1L5-7 김용주 (YongJoo Kim) (15:50–16:15)

2005-2008 포항공과대학교 신소재공학과 (학사)
2008-2013 MIT 재료공학과 (박사)
2013-2014 KAIST 재료공학과 (Post–Doc.)
2014-2019 KAIST KI 나노융합연구소 연구조교수
2020-현재 국민대학교 신소재공학부 조교수

Self–assembly Simulation of Architecture Controlled Copolymers in Solution

김용주† 국민대학교

Copolymer particles have drawn significant attention as designing functional soft materials and building blocks for colloidal superstructures. Conventional methods for the fabrication of polymeric particles are based on the mechanical deformations which are either expensive and/or improper for large–scale productions. In this study, we suggest the novel methods in controlling size and shape of copolymer particles by controlling copolymer architecture in solution self–assembly. By using computer simulation, we designed complex micelles and vesicles. Detailed underlying physics are followed with experimental verification. We believe that our novel strategy will open a new possibility of designing nano–sized soft particles for the functional materials design.

1L5-8 김재업 (Jaeup Kim) (16:15–16:40)

1998 KAIST물리학과 (학사)
2005 Columbia University 물리학과 (석/박사)
2005-2006 Columbia University 화학공학과 (Post–Doc.)
2006-2009 University of Reading 물리학과/수학과 (Post–Doc.)
2009-2013 UNIST 기계및신소재공학부 조교수, 부교수
2014-현재 UNIST 자연과학부 물리학과 부교수

Single Chain in Mean Field (SCMF) Simulation of Flexible and Semiflexible Polymers

김재업† 울산과학기술원

Single chain in mean field (SCMF) simulation is a recently emerging theoretical framework allowing polymer chains to move under quasi–instantaneously updated self–consistent fields. In this talk, I will explain SCMF simulation of homopolymers and block copolymers using various chain models. The results are quantitatively compared with those of discrete chain self–consistent field theory (DCSCFT). The free energy calculated by thermodynamic integration and the stress calculation enables us to find the equilibrium block copolymer morphologies with high accuracy. With these tools, we systematically show that DCSCFT serves as an intermediate step between SCMF simulation and SCFT. We adopted angle dependent bond potential to simulate semiflexible polymers using bead–spring and freely–jointed chain models. It turns out that the lamellar domain has a tendency to align perpendicular to the surfaces when the chain stiffness is high.

Biomedical Polymers Division (I) (English)

제6회장 [10월 6일(화)]

Organizer: Dong-Wook Han (Pusan Natl. Univ.), Yong-kyu Lee (KNUT), Seung Yun Yang (Pusan Natl. Univ.)

1L6-1 김용희 (Yong-Hee Kim) (13:00-13:25)

1983 서울대학교 약학대학 (학사)
1985 서울대학교 약학대학원 (석사)
1992 Univ. of Utah, Pharmaceutics (박사)
1992-1994 Univ. of Utah, Pharmaceutics (Post-Doc.)
1997-2003 용인송담대학교 총장
2005-현재 한양대학교 공과대학 생명공학과 교수

Heme Oxygenase 1-targeted Drug Delivery Systems for Acute Myeloid Leukemia Therapy

Seok-Beom Yong, Jaehyun Kim, Yong-Hee Kim[1,†] Department of Bioengineering, Hanyang University; [1]Department of Bioengineering, Hanyang University/Institute for Bioengineering and Biopharmaceutical Research, Hanyang University

Acute myeloid leukemia (AML) is hematological malignancies with high mortality, and chemotherapy and bone marrow transplantation are available, and recently challenged with immunotherapy. Heme oxygenase 1 (HO1)-mediated cytoprotection has been demonstrated as a chemo-resistant mechanism in AML, and recently reported as an immune checkpoint molecule in tumor myeloid cell. In here, HO1-targeted drug delivery systems are developed for AML therapy. Firstly, human CD64-targeted single chain antibody fusion protein sR9 was complexed with HO1-targeting siRNA (siHO1). In human AML-bearing orthotopic model, sR9-mediated siHO1 delivery enhances chemotherapeutic effect of daunorubicin. Secondly, HO1-inhibitor-loaded nanoparticle (T-hNP) was prepared and modified for active targeting of AML. In human AML xenograft model, combination of T-hNP with daunorubicin shows dual chemo- and immuno-therapeutic effect.

1L6-2 박주호 (Jooho Park) (13:25-13:50)

2009 서울대학교 약학과 (약학사)
2016 서울대학교 약학과 (약학박사)
2016 서울대학교 종합약학연구소 선임연구원
2016-2020 한국과학기술연구원 의공학 (Post-Doc.)
2020-현재 건국대학교 바이오융합부 바이오의약학 조교수

Targeted Cancer Therapy Using PDT-based Self-assembled Nanoparticles that can be Selectively Activated in Tumors by Visible-light

박주호[†] 건국대학교

Among anti-cancer technology, the therapeutic effect of photodynamic therapy (PDT) in cancer treatment is highlighted due to high efficacy of PDT using reactive singlet oxygen. However, poor tissue penetration of light has limited the effectiveness of PDT in the clinic. Therefore, in this study, we newly have developed noble light-induced apoptosis activatable nanoparticles that consists of the photosensitizer (Ce6), caspase 3 cleavable peptide (DEVD), and monomethyl auristatin E (MMAE). Compared with conventional PDT based on high-energy irradiation, this novel PDT therapy uses lower-energy irradiation to induce apoptosis of cancer due to activation of caspase 3. As a result, the activation of MMAE in the Ce6-DEVD-MMAE nanoparticles amplified the cytotoxic effect at the tumor site. Therefore, This remarkable PDT-based therapeutic strategy can be used to treat various solid tumors.

1L6-3 박태은 (Tae-Eun Park) (13:50-14:15)

2011 서울대학교 동물생명공학 (학사)
2011-2015 서울대학교 동물생명공학 (석박사통합)
2015 서울대학교 농업생명과학대학 (Post-Doc.)
2015-2017 Wyss Institute at Harvard University (Post-Doc.)
2017-현재 UNIST 생명과학부 조교수

Human BBB Model for Study for BBB Penetration of Drugs

박태은[†] 울산과학기술원

Microfluidic biomimetic system represents a new avenue in a range of area in preclinical precision drug validation and new drug discovery. A patient's own cells could be adapted with induced pluripotent stem cell (iPSC) techniques to develop biomimetic system which emulates individual organ-level function. Here, I will discuss my recent research related to organ mimetics based on the stem cell technology and microfluidics. The 'organ-on-a-chip' and 'organoid' models of the human blood-brain barrier (BBB) are lined by iPSC-derived brain microvascular endothelium, primary human brain astrocytes and pericytes that recapitulate the high level of barrier function of the in vivo human BBB. The endothelium expresses high levels of tight junction proteins, multiple functional efflux pumps, and transcytosis pathways, which enable reliable monitoring of transport of drugs and therapeutic antibodies across the human BBB in vitro and screen the BBB permeable drugs.

1L6-4 안정훈 (Jung Hoon Ahn) (14:15-14:40)

1993 서울대학교 식품공학 (학사)
1995 KAIST 생명과학 (석사)
1999 KAIST 생명과학 (박사)
1999-2001 한국생명공학연구원 (Post-Doc.)
2002-현재 한국과학영재학교 교사, KAIST 생명과학 겸임교수

Secretory Production of Recombinant Proteins Using ABC Transporter in Gram Negative Bacteria

안정훈[†] 한국과학영재학교

The recombinant proteins have been synthesized inside the prokaryotic cells like *Escherichia coli* and extracted by breaking the cells. However, constructing a system which can secrete the recombinant proteins is far more efficient than breaking the cells. *Pseudomonas fluorescens* is an efficient platform for the secretory production of recombinant proteins. *P. fluorescens* has an ABC transporter secreting endogenous thermostable lipase (TliA) and protease, which can be exploited to transport recombinant proteins across the cell membrane. Various proteins have been tested for their secretion. The criteria of well-secreted and non-secreted proteins were protein isoelectric point (pI) value with negative charged proteins preferred for secretion. The ABC transporter system will provide greater convenience for the secretory production and purification of recombinant proteins in Gram-negative bacteria, such as *E. coli* and *Pseudomonas* species.

1L6-5 한세광 (Sei Kwang Hahn) (15:00-15:25)

1987-1996 KAIST 생명화학공학과 (학사, 석사, 박사)
2001-2002 Univ. of Washington (Post-Doc.)
2002-2005 Roche group, Chugai Pharm. Stage II 연구원
2012-2013 Harvard Medical School 방문교수
2019-현재 Stanford University 방문교수
2005-현재 포항공과대학교 신소재공학과 석천석좌교수, 국가과학기술자문위원, 삼성미래기술연구회원, 한국공학한림원 회원, 화이바이오메드 대표이사

Smart Wearable Devices for Ubiquitous Healthcare Applications

한세광[†] 포항공과대학교

We developed smart contact lens and smart wearable devices for both continuous diabetic monitoring and diabetic retinopathy therapy. Smart contact lens could measure tear glucose levels as a non-invasive alternative to the conventional blood glucose tests and deliver drugs from gold coated reservoirs for the treatment of diabetic retinopathy. On the basis of these results, we also developed a smart wearable device for highly sensitive glucose monitoring in sweat for clinically feasible diabetic diagnosis. A blue-tooth system could send data wirelessly allowing patients to check their diabetic diagnosis results on the mobile phones. Furthermore, we developed a NIR light emitting contact lens for the diabetic diagnosis and the treatment of diabetic retinopathy based on photobiomodulation. The retinal vascular hyper-permeability induced by diabetic retinopathy in rabbits was reduced to the statistically significant level by simply wearing the NIR light emitting contact lens.

1L6-6 방석호 (Suk Ho Bhang) (15:25-15:50)

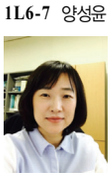
1999-2003 서울대학교 응용화학부 (학사)
2003-2008 서울대학교 화학생물공학부 (석박사통합)
2008-2014 한양대학교, 서울대학교, 워싱턴대학교 (St. Louis), 조지아텍 (Post-Doc.)
2014-2015 서울대학교 BK 조교수
2015-2019 성균관대학교 화학공학/고분자공학부 조교수
2019-현재 성균관대학교 화학공학/고분자공학부 부교수

Endosome-triggered Ion-releasing Nanoparticles as Therapeutics to Enhance the Angiogenic Efficacy of Human Mesenchymal Stem Cells

방석호[†] 성균관대학교

Here, we report that Fe ions delivered into stem cells (hMSCs) by bioreducible metal nanoparticles (NPs) enhance their angiogenic and cell-homing efficacy by controlling ion-triggered intracellular reactive oxygen species (ROS) and improve cell migration, while reducing cytotoxicity. Endosome-triggered iron-ion-releasing nanoparticles (ETIN) were designed to be low-pH responsive to take advantage of the low-pH conditions of endosomes for in situ iron-ion release. Treatment of hMSCs with ETIN significantly enhanced the expression of angiogenesis- and lesion-targeting-related genes and proteins. Transplantation of ETIN-treated hMSCs significantly enhanced angiogenesis and tissue regeneration in a wound-closing mouse model compared with those in untreated mice and mice that underwent conventional hMSC transplantation.

1L6-7 양성윤 (Sung Yun Yang) (15:50-16:15)



1993 이화여자대학교 화학과 (석사)
1995 KIST 응용과학연구부 연구원
2001 NYU Poly(舊Polytechnic Univ.) 화학화공과 (박사)
2003 MIT 재료공학과 (Senior Post Doc.)
2010 UC Berkeley 화학공학과 방문연구교수
2004-현재 충남대학교 고분자공학과/유기재료공학과 교수

Polymer Based Functionalized Microfluidic Cell Chips for In-situ Monitoring of Cell Culture and Drug Efficacy

양성윤[†] 충남대학교

We have studied various polymer and/or inorganic hybrid coatings for cell culture. In this papery, we present the work on fabrication of micro-fluidic chips for the study of an anticancer drug efficiency and toxicity of the drug-encapsulated hydrogel beads placed within a micro-channel of the device. In order to create efficient cell

culture environment as well as avoid the direct contact of the hydrogel beads to the cells, we utilized polyelectrolyte multilayer film modifying the surface of the micro-channels. In our previous studies, different behaviors of the cells were shown depending on the hydrophilicity, functional groups, and morphology of the coating surfaces. Based on the results, we applied the anti-fouling, biocompatible coatings for the microfluidic devices to culture cells effectively and tested real time drug efficiency. Our system may have a great potential in cell-based drug screening and some related biomedical applications.

1L6-8 최정욱 (Jeong Uk Choi) (16:15–16:40)

2006-2012 서울대학교 재료공학부 (학사)
2012-2019 서울대학교 약학대학 (석,박사)
2019-2020 서울대학교 약학대학 종합약학연구소 연수연구원
2020.09-현재 전남대학교 약학대학 조교수

Orally Active Heparin Conjugate Augments Drug Distribution and Alleviates the Immunosuppressive Microenvironment by Promoting Tumor Perfusion

Jeong Uk Choi† Chonnam National University

Formation of blood clots is common in solid tumors, however their impact on limiting tumor perfusion and drug distribution have not been well established. Here, this study verifies that tumor perfusion is highly limited by cancer-associated thrombosis (CAT), which results in restricted drug distribution and accelerated hypoxia. Administration of an oral heparin conjugate (STP3725) demonstrates prevention of CAT and improves tumor perfusion, potentiating the efficacy of gemcitabine/oxaliplatin by enhancing drug distribution. Furthermore, this decreases hypoxia-related cytokines and MDSCs while increasing the infiltration of effector lymphocytes, leading to transformation into an immune-supportive tumor microenvironment. Collectively, these findings establish a rationale for a new combination strategy of oral anticoagulation therapy with chemotherapy/immunotherapy, which can lead to substantial improvements of current approaches in the clinic.

자동차 파워트레인/샤시용 고분자 재료
Polymeric Materials for Automotive Powertrain & Chassis

제7회장 [10월 6일(화)]

Organizer: 최치훈(현대자동차), 이춘수(현대자동차)

1L7-1 황덕형 (Duck Hyoung Hwang) (13:00–13:25)

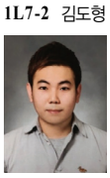
1997-2001 고려대학교 화학공학과 (학사)
2001-2003 고려대학교 화학공학과 (석사)
2003-2010 한국엔지니어링플라스틱 연구개발팀
2010-현재 현대자동차 연구개발본부 재료개발2실

PT샤시/차체외판용 플라스틱 부품 동향 및 미래차 소재 기술 이슈

황덕형, 김석환† 현대자동차

오늘날 자동차는 연비와 환경규제 강화로 인하여 경량화에 많은 노력을 기울이고 있다. 특히 차량에 있어 안전강화와 편의성 확대는 차량 중량을 늘어나게 하기 때문에 경량화의 필요성은 점점 커지고 있는 실정이다. 경량화의 방법에는 구조를 최적화 하거나, 제품 두께를 박육화 하는 방법 등이 있으나 이미 상당 부분 양산에 적용된 상태이다. 따라서 경량화 방법으로 가장 부각되는 것은 소재를 경량화하는 것이며, 특히 엔지니어링 플라스틱이나 플라스틱 복합소재를 적용하기 위한 연구개발이 활발한 상황이다. 본 발표에서는 기존 금속을 플라스틱화한 사례를 소개하고, 전기차나 수소연료전지차 등 미래차에 요구되는 플라스틱 재료 특성에 대해 소개하고자 한다.

1L7-2 김도형 (Do Hyoung Kim) (13:25–13:50)



2006-2012 한양대학교 기계공학부 (학사)
2012-2014 한양대학교 기계공학과 (석사)
2014-2018 한양대학교 기계공학과 (박사)
2018-2019 LG하우시스 경량화선행기술 PJT
2019-현재 LG하우시스 배터리케이스 PJT

탄소섬유를 적용한 고강성 배터리 케이스 개발

김도형†, 최현진, 김권택, 오애리, 정찬호, 서하정 LG하우시스

최근 지구 온난화로 인한 환경문제에 대응하기 위한 환경차 시장이 크게 확대되고 있는 추세에 따라, 전기차의 전비 향상에 대한 관심이 증대되고 있다. 이러한 이유로 전비를 효율적으로 향상시키기 위한 부품 경량화에 대한 요구가 크게 증대되고 있는데, 특히 전기차 무게의 약 30% 이상을 차지하는 연료시스템의 무게 절감에 대한 중요성이 대두되고 있다. 본 연구에서는 높은 비강성과 비강도를 갖는 탄소섬유/열경화성 플라스틱 복합소재를 사용하여 전기차 연료시스템을 구성하는 주요 부품인 배터리 하부 케이스를 경량화하는 연구를 수행하였으며 부품의 요구 성능을 만족시키기 위해 복합소재의 성형/조립공정 최적화 및 구조설계/해석이 수행되었다. 또한 제품의 안전 법규 상에 명시되어 있는 내화, 충돌, 진동 시험의 수행을 통하여 배터리 케이스의 구조 성능을 검증할 수 있었다. 최종적으로 본 연구를 통해 기존 스틸 하부 케이스 대비 약 40%의 무게가 절감된 복합소재 하부 케이스를 개발할 수 있었으며, 이러한 연구 결과가 국내의 경량 복합소재 전기차 부품 개발 시장 확대에 기여하기를 기대한다.

1L7-3 박균범 (Kyun Beom Park) (13:50–14:15)

2007 국민대학교 기계공학 (학사)
2007-2015 동희산업 연료탱크 설계
2016-현재 동희산업 연료시스템 선행개발팀 팀장

수소저장시스템적용 복합소재 경량화 프레임 개발

박균범† 동희산업

수소전기차의 효율을 향상시키기 위한 경량화 기술은 연료전지 차량설계 시 중요한 기준으로 요구되고, 경량화를 위해서는 자동차의 주요 구조를 이루는 샤시 경량화가 필요하다. 차체에 수소저장용기를 고정하는 역할을 하는 수소저장 프레임은 기존 스틸소재를 적용하여 증량 증가 및 부식문제를 일으킨다. 이러한 문제점을 해결하기 위해 탄소/유리섬유 복합소재를 활용하여 프레임의 경량화 및 기존 문제점을 극복하였다. 공정/원가 절감을 위한 일체와 성형 공법을 실현하였고, 연속섬유 복합소재 인서트 사출 공법을 도입하여 이종접합 문제를 개선하였다. 연속섬유 복합재 판재성형과와 단섬유 복합재 사출성형을 결합하여 제품의 언더컷 및 조립구조 적용, 강성확보, 파손모드 개선하였다. 결과적으로 기존 스틸 프레임 대비 40%의 중량 절감을 실현하였다.

1L7-4 오현옥 (Hyunok Oh) (14:15–14:40)

1993 동의대학교 산업공학과 (학사)
2004 동의대학교 산업공학과 (석사)
2014 울산대학교 산업공학과 (박사수료)
1993-현재 부국산업㈜ 연구소 책임연구원

연료전지자동차의 플라스틱 수소 이송관에 관한 연구

오현옥† 부국산업(주) 연구소

연료전지자동차의 수소이송관은 고압으로 압축된 수소를 고압 및 중.저압으로 변환하여 연료스택으로 이송하는 관으로 수소취성, 가스투과성, 압력 및 온도 등을 특성을 극복하기 위해 스테인레스강을 주로 사용한다. 이러한 스테인레스강은 상대적으로 원가 및 중량을 증가시키는 요인으로 작용한다. 본 연구는 수소를 이송하기 위한 중.저압 라인에 사용 중인 스테인레스강을 대체할 수 있는 플라스틱튜브로 수소에 대한 내화학성 및 가스 차단성, 압력, 외부 충격 및 열에 대한 저항력이 우수한 다층구조를 가진 플라스틱 튜브 개발에 관한 연구이다. 수소에 대한 내 화학성 및 취성문제를 해결하기 위해 수소와 직접 접촉하는 내층에는 불소계열 수지를 사용하고, 수소 투과성 차단을 위해 에틸렌비닐알코올 수지를 추가하여 압출하였다. 그리고 중. 저압을 극복하기 위해 압출 튜브위에 직조하였다. 또한, 외부로부터 충격 및 열 등을 보호하기 위해 프로텍터를 추가하였다. 완성된 시제품은 내부 및 외부시험을 실시하여 고객에 요구조건에 충족하였다.

1L7-5 정헌규 (Heon Kyu Jung) (15:00–15:25)

2006 충남대학교 화학공학과 (학사)
2009 충남대학교 화학공학과 (석사)
2009-현재 코오롱 플라스틱 연구1팀

내열안정성이 우수한 POLYAMIDE 소재

정헌규† 코오롱플라스틱

Polyamide(PA) 소재는 산업계에서 널리 사용되는 엔지니어링 플라스틱(엔프라) 소재이다. PA 소재 중 특히 PA6, PA66은 소재의 특성 상 자동차 부품용 소재에 사용이 많이 되고 있다. 특히 엔프라 수지 중 내열성이 우수하여 자동차 엔진 주변 부품의 내열안정성이 요구되는 부품에 주로 사용되고 있다. 현재 세계적인 환경이슈에 의해 자동차 연비, 효율을 높이는 노력들을 하고 있다. 엔진의 효율을 높이기 위해 자동차 엔진의 사이즈가 작아지면서 소재의 내열성은 더욱 커지고 있다. 따라서, 최근에 PA 소재의 내열성을 향상시키는 연구가 많이 이루어지고 있다. 본 발표자료에서는 PA의 내열성을 높이기 위해 사용되는 내열제들의 종류와 역할 및 그 성능에 대해 살펴보도록 하겠다. 또한 실제 산업계에서 진행되는 개발동향 및 시장동향에 대해 살펴보도록 하겠다.

1L7-6 제형호 (HyungHo Jae) (15:25–15:50)

2004 국민대학교 자동차공학 (석사)
2004-2010 한국바스프 EP 제품개발 해석팀
2010-현재 한국바스프 기능성 제품개발 해석팀장

엔지니어링 플라스틱의 최신 해석 기술 동향

제형호† BASF

최근 강화되는 환경 및 연비규제 기준으로 자동차 기술 개발 방향은 경량화 및 친환경 기술 개발에 역량을 집중하고 있으며 이러한 지속적으로 요구되는 경량화 및 친환경

자동차 개발을 위해, 금속대체 소재로 엔지니어링 플라스틱의 사용이 꾸준히 증가하고 있다 또한 다양한 용도에 따라 고강성을 위한 카본섬유강화, 고강도를 위한 유리섬유강화 및 방열 및 전자파 차단을 위한 열전도 플라스틱 등 다양한 요구 조건에 맞는 재료 개발이 활발하게 이루어 지고 있다. 이러한 재료 개발과 동시에 플라스틱의 제조공정 및 디자인 최적화의 토탈 솔루션이 함께 연구되고 있다. 특히 엔지니어링 플라스틱의 각종 보강제 에 따른 재료의 이방성 거동 예측은 설계 해석 분야에서 핵심이 된다. 본 발표에서는 다양한 보강재의 영향으로 인한 플라스틱 재료의 이방성 거동의 효과적이 예측 및 해석 사례에 대해 소개 하였다.

1L7-7 김상엽 (Sang Yup Kim) (15:50–16:15)

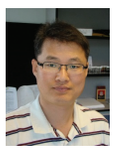
1993	계명대학교 화학과 (학사)
2001	미국 에크론대학교 고분자과학과 (석사)
2005	미국 플로리다대학교 재료공학과 (박사)
2006-2015	삼성전자 프린트 사업부
2015-2018	신일화학공업㈜ 연구소 개발이사
2018-현재	BYK KOREA 기술이사 및 신일화학공업 고문

나노 소재를 이용한 자동차 연료 증발가스 투과 방지 단층플라스틱 소재 개발

김상엽, 류동열[1,†], 권보람[1] BYK Korea(신일화학공업 기술고문); [1]신일화학공업

환경 오염에 대한 세계적인 규제 강화로 차량의 배기 가스와 휘발성 연료 누출에 대한 규제 또한 점차 강화되고 있다. 특히, 자동차의 연료튜브 및 Vapor 호스 등의 연료 시스템의 내연료 투과성의 향상 및 경량소재, 그리고 바이오 연료에 대한 친화성 등이 더욱 요구된다. 본 발표는 강화된 환경법규에 맞도록 발전해온 기존의 다층시스템이 갖는 층간 접착력 및 복잡한 성형 특성에 의한 고가의 성형 장비 등의 문제점을 해결한, 나노클레이 및 카본나노튜브 등의 나노소재를 이용한 연료 증발가스 투과 방지 단층플라스틱 소재에 대하여 소개하고자 한다.

1L7-8 백종범 (Jong-Beom Baek) (16:15–16:40)



1984-1991	경북대학교 응용화학과 (학사)
1991-1993	경북대학교 고분자공학과 (석사)
1994-1998	미국 에크론대학교 고분자과학과 (박사)
1998-2003	미국 공군연구소 고분자부 연구원
2003-2008	충북대학교 화학공학부 부교수
2008-현재	울산과학기술원 에너지및화학공학부 교수 및 창의연구단 단장

Forming Two- and Three-Dimensional Network Polymers for Energy Applications

백종범[†] 울산과학기술원

Stable organic network polymers have been designed and synthesized. They have uniformly distributed heteroatoms, holes with heteroatoms and transition metal nanoparticles in the holes. Their network structures were confirmed using various characterization techniques, including scanning tunneling microscopy (STM). Based on the stoichiometry of 2D layered network polymers, they were, respectively, designated C_2N, C_3N, C_4N, and M@C2N (M = Co, Ni, Pd, Pt, Ru). Their electronic and electrical properties were evaluated by electrooptical and electrochemical measurements along with density-functional theory (DFT) calculations. Furthermore, robust 3D cage-like organic network polymers have also been constructed and they show high sorption properties. The results suggest that these newly-developed 2D and 3D organic network polymers offer greater opportunities, from wet-chemistry to various device applications.

분자전자 부문위원회 (I) | Molecular Electronics Division (I)

제8회장 [10월 6일(화)]

Organizer: 박상혁(공주대), 오진우(부산대), 윤명한(GIST)

1L8-1 구본철 (Bon-Cheol Ku) (13:00–13:25)

1992	서강대학교 화학과 (학사)
1994	포항공과대학교 화학과 (석사)
2005	매사추세츠 주립대학교(UMass Lowell) Polymer Science and Plastics Eng. (박사)
2005-2008	UMass Amherst, Polymer Sci & Eng (Post-Doc.)
2009-현재	한국과학기술연구원(KIST) 선임/책임연구원

Highly Strong and Conductive Acid-spun Carbon Nanotube Fibers

구본철[†] 한국과학기술연구원

Although carbon nanotubes (CNTs) have outstanding properties, CNT fibers (CNTFs) have not yet reached that level.[1] To enhance mechanical and electrical properties of CNTFs, a few parameters including CNT length, aspect ratio, alignment, densification, and cross-linking should be considered and optimized.[2,3] One promising approach to enhance mechanical and electrical properties may be wet spinning and liquid crystalline spinning method using super acid.[4] Herein, I will present an effective way to make highly strong and conductive CNTFs. References (1) B.-C. Ku *et al.*, *Carbon Lett.*, **13**, 191 (2012). (2) Q. Li *et al.*, *Adv. Mater.*, 1902028 (2019). (3) B.-C. Ku *et al.*, *Carbon*, **118**, 413 (2017). (4) S.M. Kim *et al.*, *Small*, **13**, 1701131 (2017).

1L8-2 이승기 (Seoung-Ki Lee) (13:25–13:50)

2010	성균관대학교 재료공학 (학사)
2014	성균관대학교 신소재공학 (박사)
2014-2015	연세대학교 전기전자공학 (Post-Doc.)
2015-2016	RICE University (Post-Doc.)
2016-현재	한국과학기술연구원 선임연구원

Solution-based Patterned Synthesis of 2D Heterostructure and Its Application

이승기[†] 한국과학기술연구원

Transition metal dichalcogenide have been one of the most promising materials for post-silicon electronics and have attracted broad attention from academia as well as industry. In particular, the heterostructures of TMDs provide a wide range of building blocks with innovative electrical and optical properties, which was not observed from existing bulk materials. Here, the structure controllable synthesis of TMDs will be introduced by the solution-based partial thermolysis. The approach provides specific control of the structure of MoS_2 such as thickness, shape and interspacing, resulting in a well-aligned MoS_2 pattern. Especially, the laser-based local treatment enabled the generation of patterned MoS_2 (n-type) and WSe_2 (p-type) on a 4 in. wafer within several minutes under ambient conditions. As a proof of concept, we demonstrated a MoS_2-based FET, a skin-attachable motion sensor, and a MoS_2/WS_2-based heterojunction diode, showing the applicability to practical applications.

1L8-3 손해정 (Hae Jung Son) (13:50–14:15)

2000	성균관대학교 화학과 (학사)
2002	한국과학기술원 화학과 (석사)
2002-2004	삼성종합기술원 연구원
2005-2012	시카고대학교 (박사 및 Post-Doc.)
2012-2017	한국과학기술연구원 선임연구원
2017-현재	한국과학기술연구원 책임연구원

Development of Large-area Organic Photovoltaics for Indoor and Outdoor Applications

손해정[†] 한국과학기술연구원

For successful transfer of organic solar cell technology from lab-scale into cost effective products, high performing technology at small sizes should be realized at large scales; We need to study how the bulk heterojunction (BHJ) morphology is affected by mechanism of film generation and coating techniques. Furthermore, when considering potential applications of organic photovoltaic products in various environments, we should pursue researches to fully satisfy requirements for practical applications of organic solar cells under various indoor and outdoor illumination. In the presentation, we developed new conductive polymers for large-area solar cell technologies and studied effects of the active materials on mechanism of BHJ formation and photovoltaic performance in large areas. This presentation will provide rational guideline for developing materials and processing techniques to achieve high performing large-area organic photovoltaic device under various illumination environments.

1L8-4 박지웅 (Ji-Woong Park) (14:15–14:40)

1984-1989	서울대학교 공업화학과 (BS)
1989-1991	KAIST 화학과 (MS)
1991-1995	화학연구원 연구원
1995-2000	Polytech, Brooklyn (현 NYU Engineering) (Ph.D.)
2000-2004	MIT (Post-Doc.)
2004-현재	GIST 신소재공학부 교수

A Reactive Polyurea Nanogel as a Solution-processable, Functional Nano-coating

박지웅[†], 남준식 광주과학기술원

We demonstrate that three-dimensional polyurea network nanogels are versatile coating materials that coat an ultrathin organic network layer on the surface of nanoparticles by simple solution methods. Firstly, graphene oxides were coated with the polyurea network nanogel to yield a polyurea-graphene-polyurea sandwich-structured composite. The subsequent thermal treatment produced a composite with the same triple-layered architecture, which showed excellent performance as an electrocatalyst for the oxygen reduction reaction. Secondly, the nanogel coating containing photoactive moieties could be evenly coated onto titania particles to yield a highly active photocatalyst for the generation of hydrogen peroxide. The ability to cover the nanoscale features with nanometer-thick, instantly-setting, and irreversible coatings allows the preparation of new functional nanocomposites with stable performances. We discuss the potentials of the nanogel coatings further for different applications.

1L8-5 김경곤 (Kyung Kon Kim) (15:00–15:25)

1992	고려대학교 화학과 (학사)
1996	고려대학교 화학과 (석사)
2003	고려대학교 화학과 (박사)
2003-2006	Wake Forest Univ. & Yale Univ. (Post-Doc.)
2006-2012	한국과학기술연구원 태양전지센터
2012-현재	이화여자대학교 화학나노과학과 부교수, 교수

Strategies to Enhance Stabilities of Organic Photovoltaics

김경곤† 이화여자대학교

With rapid advances in the development of new conjugated polymers, non-fullerene acceptors, the power conversion efficiency (PCE) of organic photovoltaics (OPVs) has been increased over 17%. However, a major drawback for the commercialization of OPVs is their long-term stability under continuous operation. Especially, OPVs suffer from a rapid decrease in PCE during initial device operation, which is known as the "burn-in loss". It is considered that the origin of the burn-in loss is mainly related with the instability of the bulk heterojunction morphology and/or interface rather than the photooxidation of a photoactive layer. In this contribution, I would like to introduce strategies to enhance morphological and interfacial stability via constructing pure heterojunctions and a robust interfacial layer. [1] ACS applied materials & interfaces 2018, 10 (33), 27757-27763. [2] Advanced Materials Interfaces 2019, 1900213.

1L8-6 이재관 (Jae Kwan Lee) (15:25-15:50)

2000	서강대학교 화학과 (학사)
2004	포항공과대학교 화학과 (박사)
2006	㈜ 삼성SDI 중앙연구소 책임연구원
2009	UC Santa Barbara (Post-Doc.)
2011	호서대학교 그린에너지공학과 조교수
2019-현재	조선대학교 화학교육과 부교수

Simple All-Dip-Coating Processed Perovskite Materials for Efficient Perovskite Solar Cells

이재관† 조선대학교

Recently, organic-inorganic lead halide perovskite solar cells (PrSCs) have received intense attention from the scientific community because of their marvelous breakthrough power conversion efficiencies (PCEs) making them propitious surrogates to conventional silicon-based solar cells. Hence, an intense research has been devoted for the development of efficient fabrication methods for perovskite material layers in PrSCs. Herein, we present a facile, cost-effective, and environmentally benign approach to prepare efficient perovskite materials by simple all-dip-coating deposition. This process is in contrast to the conventional spin-casting approach with detrimental organic solvents. Notably, the perovskite materials fabricated from this process exhibited superior crystallinity, morphology, and coverage. Also, the $MAPbI_3$ perovskite formed via $Pb(NO_3)_2$ and PbI_2 undergoes additional ion-exchange reaction with unreacted $Pb(NO_3)_2$ even in the solid state, resulting in decomposition to PbI_2.

1L8-7 박희준 (Hui Joon Park) (15:50-16:15)

2002, 2004	서울대학교 재료공학부 (학사/석사)
2004-2007	LG전자 연구원/KIST 연구원
2012	University of Michigan-Ann Arbor (박사)
2012-2014	Intel Corporation, Senior Researcher
2014-2019	아주대학교 전자공학과 조교수/부교수
2019-현재	한양대학교 유기나노공학과 부교수

Perovskite Solar Cells: Organic Hole-transport Materials and Tandem Structures with III-V

박희준† 한양대학교

Solar cell device utilizing organometal halide perovskite material as light absorber has been highlighted as a next-generation solar cell technology. In this talk, various efforts on organic hole-transport layers to realize highly efficient and stable perovskite solar cell technology will be introduced (e.g. defect-passivation and photo-excitation). Moreover, our recent results about perovskite/III-V tandem cell approach will be mentioned.

1L8-8 장진호 (Jinho Chang) (16:15-16:40)

2007	한양대학교 화학과 (학사)
2019	한양대학교 화학과 (석사)
2014	The University of Texas at Austin 화학과 (박사)
2014-2015	The University of Illinois at Urbana-Champaign 화학과 (Post-Doc.)
2015-2018	성신여자대학교 화학과 조교수
2018-현재	한양대학교 화학과 조교수

Electrochemistry of Quaternary Ammonium Polybromide Droplets

장진호† 한양대학교

In this presentation, electro-analyses of electrochemically generated quaternary ammonium polybromides (QBr2n+1) on Pt ultramicroelectrode (UME) are introduced. (1) we report the electrochemistry of Br− electro-oxidation in MEPBr2n+1 droplets during their collision on Pt UME through the current transient method, and reveal that MEPBr2n+1 also plays a vital role as an electrochemical reaction medium for Br− electro-oxidation in the Br−/Br2 redox system. (2) we present Br- electro-oxidation in QBr2n+1 strongly depends on Q+, and Br- transfer from aqueous to QBr2n+1 is the important preceding step for Br- electrolysis during the collision of QBr2n+1 droplets on Pt UME. (3) we found ions transfer from water to QBr2n+1 droplets was important for Br−-electrolysis in QBr2n+1 droplets during their particle-impacts on Pt UME.

1L8-9 이영국 (Young Kuk Lee) (16:40-17:20)

1985	서울대학교 무기재료공학과 (학사)
1987	서울대학교 무기재료공학과 (석사)
1997	서울대학교 무기재료공학과 (공학박사)
1989-현재	한국화학연구원 책임연구원
2020-현재	한국연구재단 소재부품단장

2021년 과학기술정보통신부 국책연구사업 소개 및 주요 이슈

이영국† 한국연구재단 국책연구본부 소재부품단

2019년 핵심소재분야에 대한 일본의 수출제한조치이후 우리나라 소재 · 부품연구 장 · 단기 시행계획 재편성의 필요성이 학 · 연 · 산 · 관 전반에 걸쳐 절실하게 인식되었다. 이에 과학기술정보통신부와 한국연구재단은 소재분야전문가 집단과 기획회의를 진행하였고 소재 · 부품분야 국가연구사업의 새로운 청사진을 작성하였다. 본 발표에서는 과학기술정보통신부의 소재부품연구 사업 철학변화와 전문가 기획결과를 공유하고자 하며 큰 틀에서 과학기술정보통신부소관 소재 · 부품분야의 연구사업을 '기술자립형'과 '미래준비형'으로 구분하였다. 기술자립형에는 단기적으로 기술 확보가 필요한 '핵심전략품목' 개발 과제가 포함되며 과제의 수행방식으로는 '소재혁신선도프로젝트', '소재융합기술개발사업' 등이 있다. 미래준비형에는 중장기적인 관점에서 소재 · 부품분야 원천기술 확보를 목표로 진행되며 '미래소재디스커버리사업', '나노 · 미래소재기술개발' 사업 등이 포함된다. 결론적으로 정부는 작년 일본의 핵심소재수출제한 조치이후 핵심전략소재 개발의 필요성을 인식하여 2020년 이후 소재 · 부품 분야의 국가연구개발사업비는 매년 30% 이상 증가될 전망이며, 관련연구자들의 많은 관심과 참여가 필요하다고 판단된다.

Graduate Student Oral Session (I) (English)

제9회장 [10월 6일(화)]

Organizer: Jeong Jae Wie (Inha Univ.), Dong Ki Yoon (KAIST), Keun Hyung Lee (Inha Univ.)

1O9-2 김용민 (13:15-13:30)

Non-Volatile, Ultra-stretchable, Highly Transparent Ion Gels for the Next-Generation Skin-type Wearable Sensors

김용민, 문홍철† 서울시립대학교

For the next-generation wearable electronics, highly stretchable and deformable materials have received great attention. On the basis of the polymeric gelators [poly(methyl methacrylate-ran-butyl acrylate), PMMA-r-PBA] and ionic liquids (IL), nonvolatile, ultrastretchable and highly stable ionic sensory system is proposed. A systematically designed ion gel can be deformed and effectively dissipate applied strains due to the IL-insoluble components having low glass transition temperature (T_g). The resulting transparent ion gel was employed as the skin-type strain sensor, referred to as ionoskin, by simply attaching to a part of the body (e.g., finger, elbow, knee, or ankle), and various human movements were successfully monitored. The ionoskin renders the opportunity to achieve wearable ubiquitous electronics such as healthcare devices and smart textile systems.

1O9-3 송원준 (13:30-13:45)

Versatile Soft Robotic Web Inspired by Spider Web

송원준, 이영훈, 정연수, 유현재, 김만용[1], 김호영, 선정윤† 서울대학교; [1]음암중학교

Spiders use adhesive, stretchable, and translucent webs to capture their prey. However, sustaining the capturing capability of these webs can be challenging because the webs inevitably invite contamination, thus reducing its adhesion force. To overcome these challenges, spiders have developed strategies of using webs to sense prey and clean contaminants. Here, we emulate the capturing strategies of a spider with a single pair of ionic threads based on electrostatics. Our ionic spiderwebs completed consecutive missions of cleaning contamination on itself, sensing approaching targets, capturing those targets, and releasing them. The ionic spiderwebs demonstrate the importance of learning from nature and push the boundaries of soft robotics in an attempt to combine mutually complementary functions into a single unit with a simple structure.

1O9-4 Kusuma Betha Cahaya Imani (13:45-14:00)

Poloxamer for Extrusion-based 3D Printing of Hydrogels

Kusuma Betha Cahaya Imani, 윤진환† 부산대학교

There is an increased interest on 3D printing of hydrogels in recent years, as it has a high potential in the development of various fields, such as soft robotics and tissue engineering. One of the most highly studied materials to realize 3D printing of hydrogels is poloxamer, a triblock copolymers comprised of poly(propylene oxide) (PPO) hydrophobic central block and poly(ethylene oxide) (PEO) hydrophilic side blocks. Poloxamer is a promising material because of its amphiphilic nature, allowing a temperature controllable viscosity, an important characteristic of a 3D printing ink to maintain its structure upon deposition without blocking the nozzle. In this study, we added methacrylate groups into poloxamer 407 to crosslink the 3D printed structure. In addition, we improved the mechanical property and added conductivity to the system by incorporation of ionic bond and conductive filler. This system is highly feasible and can be further developed into real-life applications.

1O9-5 최초롱 (14:00–14:15)

Dual-functional Alginate Crosslinker: Independent Control of Crosslinking Density and Cell Adhesive Properties of Hydrogels via Separate Conjugation Pathways

최초롱, 김선태, 차채녕† 울산과학기술원

Alginate is an abundant natural polysaccharide widely utilized in various biomedical applications. Although physically-crosslinked alginate hydrogels are highly efficient to fabricate and able to maintain their natural chemical structure, it is difficult to control their physicomechanical and biological properties in a desirable range and manner. To overcome these challenges, we investigated to allow control over material properties as well as fabrication, and to serve cells adequate environments to proliferation. As it is difficult to apply various chemical reactions to alginate due to limited solubility in organic solvents, we rendered alginate by substituting the sodium counterions with tetrabutylammonium conterions and developed two different conjugation pathways. Multifunctional alginate with methacrylate and cell adhesion molecule shows controllable mechanical properties and cell adhesive properties.

1O9-6 김종윤 (14:15–14:30)

Silver Fractal Dendrites for Highly Sensitive and Transparent Positive Temperature Coefficient Polyacrylate Thermistors

김종윤, 이윤구† DGIST

Polymer thermistors for non-invasive temperature sensor are attracting attention because their several advantages including flexibility, conformability and biocompatibility. However, most polymer thermistors containing a high concentration of opaque filler still have issues such as low sensitivity, optical transparency and operational durability due to low electrical conductivity and inefficient hopping transport. I present a highly sensitive and transparent positive temperature coefficient (PTC) thermistor using silver fractal dendrites (AgFDs) and a polyacrylate has been demonstrated. It exhibits a superior PTC intensity ($\sim 10^7$) because of the high electrical conductivity of the AgFDs and the quantum tunneling effect resulting from their unique structures. Moreover, it shows excellent optical transparency, mechanical flexibility, and operational durability. Based on these characteristics, the thermistor was successfully demonstrated for real-time temperature monitoring of human body.

1O9-7 염정희 (14:30–14:45)

Soft Hydrogel-based Ion Conducting Artificial Tongue for Astringency Perception

염정희, 최아영, 임성동, 이영수, 나상윤, 고현협† 울산과학기술원

Recently, artificial tongues have been received intensive attention in industrial and medical fields. Here, we present flexible and ion-conductive hydrogel based artificial tongue for the detection of astringency. The hydrogel consists of polyacrylamide hydrogel, mucin protein and lithium chloride as analogues of salivary layer covering human tongue. Upon the exposure to the astringent tastants, astringency could be perceived thorough the morphological changes of the porous PAAm matrix. The microporous PAAm matrix is transformed into hierarchical micro/nanoporous structures due to the formation of hydrophobic mucin-tannin complexes, resulting in frictionless ion flow inside the hydrogel matrix. The sensor exhibits wide sensing range, high sensitivity within 10 s and high selectivity from other basic tastants. Finally, the artificial tongue can distinguish the degree of astringency in wines, tea, and fruits using a simple wipe-and-detection method.

1O9-8 윤가영 (14:45–15:00)

Preparation of Polymeric Core-shell Microparticles for the Detection of Formaldehyde

윤가영, 김양수† 인제대학교

Formaldehyde is one of the hazardous volatile organic compounds and is known to be a major cause of sick building syndrome. In this study, core-shell polystyrene (PS)/polyaniline (PANI) composite microparticles were prepared by applying the Swelling-Diffusion-Interfacial Polymerization (SDIPM) process. PANI was uniformly coated on the core PS particles and the prepared PS-PANI core-shell microparticles showed a high encapsulation efficiency. A formaldehyde detecting sensor was fabricated by coating the PS-PANI core-shell microparticles on the Interdigitated Electrodes (IDEs) device. The formaldehyde sensor showed not only an excellent sensitivity for 1~50 ppm of formaldehyde but also a manageable controllability. In addition, it showed a clear reversibility indicating that the sensor could be reused at least 3 times for the detection of formaldehyde.

1O9-9 정찬호 (15:10–15:25)

Linearity and Sensing Band Controlled Pressure Sensor by Designated Electrodes

정찬호, 김태일† 성균관대학교

The resistive type pressure sensor, which is mainly utilized in industry, has the advantages of being easy to manufacture, and of being hardly affected by external electromagnetic fields, unlike the capacitive type. However, the signal is not linear, and it is also difficult to measure a wide range of pressures. Therefore, before being utilized, the extracted nonlinear data need to be newly processed by computer. Herein, we present a resistive sensor that is capable of measuring a wide range of pressure of up to 4 MPa with constant linearity.[1] Controlled contact points between deformable structure and designed electrodes enabled this unique characteristic. Moreover, as well as the linear response in a sensor, differently designed sensors can selectively control the sensing pressure band, or act as an on/off switch by the sensor itself, without any digital computing process. Reference (1) C. Jeong *et al.*, *Adv. Mater.*, **31**, 1902689 (2019).

1O9-10 허태영 (15:25–15:40)

Structure and Relaxation Dynamics for Complex Coacervate Hydrogel of ABA Triblock Copolymer

김정민, 허태영, 최수형† 홍익대학교

Complex coacervation is a liquid-liquid phase separation when two oppositely charged polyelectrolytes are met in an aqueous solution. Since the complex coacervate are responsive to salt concentration and pH, it has been employed to bio-related industry. Hydrogels with coacervate domain can be prepared by simple mixing method of ABA and A'BA' triblock copolymer, where A and A' are oppositely charged blocks. Because of specific junction, the coacervate hydrogels have advantages involving self-healing and stimuli-responsiveness. In this study, the structure and rheological properties of the coacervate hydrogels were investigated by small-angle X-ray/Neutron scattering (SAX/NS) and rheometer. The relation between relaxation time and charged block length was observed by time-salt superposition principles. We found that the relaxation time has strong dependency with charged block length. Furthermore, the potentiality of 3D printing material was verified based on the short relaxation time.

1O9-11 이승현 (15:40–15:55)

Eco-Degradable and Flexible Clay-DMSO Nano-composites as a Solid-State Ionic Conductor

이승현, 심봉섭† 인하대학교

Solid-state electrolytes can alleviate the safety issues of chemical and thermal instabilities from liquid-state electrochemical systems. While a liquid provides seamless ionic transport between electrodes, a solid-state electrolyte needs to demonstrate comparable electrochemical performance to liquid electrolytes as well as mechanical robustness and flexibility. Here, we introduce the facile preparation of montmorillonite (MMT)/dimethyl sulfoxide (DMSO) nanocomposites, which show high ionic conductivities, mechanical strengths, and thermal stabilities by mimicking the layered structure of abalone shell. The mechanical strength with its molecularly confined structures and ionic conductivity at room temperature are confirmed by X-ray diffraction peaks, tensile test, and electrochemical impedance spectroscopy. Furthermore, its optical translucency and on-demand eco-degradability together make the composites unique materials with a wide range of solid-state electrochemical applications.

1O9-12 최지훈 (15:55–16:10)

Organic Solvent Nanofiltration via Ultrathin Membranes Synthesized with Initiated Chemical Vapor Deposition (iCVD)

최지훈, 고동연† 한국과학기술원

Separations of solutes in organic solvents are crucially important in chemical and pharmaceutical industry. Energy-efficient membrane-based separations can be an alternative to thermal separation such as distillation. Organic solvent nanofiltration (OSN) is a pressure-driven process that separates solute molecules with molecular weights of 200-1000 g mol^{-1} from organic solvents. However, most polymeric OSN membranes have poor organic solvent stability, and are easily dissolved especially for harsh polar aprotic solvents. The solubility of polymers in harsh polar aprotic solvents can have advantages in membrane fabrication, but the separation process for harsh solvents can only be used through post-treatment. In particular, harsh solvents are a more major issue in the pharmaceutical industry. In this work, the OSN composite membrane was fabricated using a solvent-free iCVD process and an organosilica polymer that has a hyper-crosslinking structure to provide excellent solvent stability.

1O9-13 오반석 (16:10–16:25)

Tuning Ultramicroporosity of Carbon Molecular Sieve (CMS) Membrane with Electron Beam Irradiation

오반석, 고동연† 한국과학기술원

The conventional separation process is energy-intensive because it requires phase change to separate one from another. Membrane-based separation process does not possess phase change but it separates the molecules by size, sorption and diffusion difference. Carbon molecular sieves (CMS) membranes are synthesized by pyrolyzing polymer precursors and it has shown high performance. The bimodal pore distribution reveals the characteristics of the CMS, which consists of a micropore (〈 2.0 nm) and ultra-micropore (〈 0.7 nm) that serves as molecular sieving. Ultra-micropore control has been studied to separate molecules with similar kinetic diameters. In this study, the electron beam is irradiated onto the 6FDA-based polyimide derived CMS films and fibers to tune the ultramicroporosity. Unusual performance was observed via permeability measurements to specific gas pairs. Raman spectroscopy, XPS and pressure decay analysis were utilized to elucidate its mechanism and structural change in CMS.

1O9-14 박소영 (16:25–16:40)

Phase Behavior of 6-arm Star (PMMA-*b*-PS)$_6$ in Thin Films

박소영, 김진곤† 포항공과대학교

To apply block copolymer (BCP) to nanolithography, vertically oriented microdomains in thin film are needed. When the chain architecture of BCPs was star shape, vertically oriented microdomains were obtained by using only thermal annealing. Here, we investigated the effect of the molecular weight (M) of 6-arm polymehylmethacrylate-block-polystyrene copolymers [(PMMA-*b*-PS)$_6$] on the orientation of nanostructure in thin films. At smaller M, parallel orientation of microdomains was observed. This

is because the entropic loss arising from the formation of vertical oriented microdomains is not large; thus the its orientation is greatly affected by a substrate. On the other hand, at larger M, the entropic penalty for parallel orientation becomes huge, resulting in vertical orientation. We also studied the film morphology depending on annealing temperature. When the film thickness of $(PMMA-b-PS)_6$ was 1 L_0, an interesting nanotubes were formed when annealing temperature was controlled.

1O9-15 조성준 (16:40–16:55)

Sub-10 nm Perpendicular Lamellae of Fluoro-Acrylic Block Copolymer Films and Electric Field Induced Directed Assembly

조성준, 전승배, 김휘수, 류두열† 연세대학교

Block copolymers (BCPs) self-assembly have attract the "bottom-up" approach lithographical applications by its districted properties of spontaneous nanoscale structures in long-range alignment with small feature down to 5 nm. We present a fluorine containing BCPs of polystyrene-*b*-poly(2,2,2-trifluoroethyl acrylate) (PS-*b*-PTFEA) which the Flory-Huggins interaction parameter (χ) is higher than the conventional polystyrene-*b*-poly(methyl methacrylate) (PS-*b*-PMMA). A neutralized substrate and top coat materials are applied where a sub-10 nm perpendicular lamellar morphology is observed with simple thermal annealing. The balanced interfacial interactions for the BCP films are tuned by overlaying neutral layers using the same monomer of the BCP with a fixed underlying neutral layer. We also demonstrate GISAXS experiment to confirm the orientation of perpendicular lamellae. Additionally, directed self-assembly (DSA) is induced by electric field resulting a long-range alignments.

대학원생 구두발표 (I) | Graduate Student Oral Session (I) (Korean)

제10회장 [10월 6일(화)]

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

1O10-1 지동환 (13:00–13:15)

Microplatelet-Reinforced Structural Polymer Composites Based on Design Principle of Nacre

지동환, 김재윤† 성균관대학교

Reinforced polymer composites have received attention due to high specific mechanical properties. Particulates or fibers as a reinforcement are widely used to improve the mechanical properties; however, the stiffness and toughness of the composite is still mutually exclusive. In our study, we suggest a way to achieve a combination of high mechanical properties (strength, stiffness, and toughness) for polymer composites by applying a design principle of nacre in a seashell. Nacre composed of a soft polymer matrix and stiff inorganic microplatelets (microsized tablets) in a layered structure shows unique fracture mechanisms such as an effective load transfer and fracture-resistance through a platelet pull-out and multiple cracking under tension. Inspired from that, we fabricated structural polymer composites reinforced with layered microplatelets. The composite showed well-balanced mechanical properties and outstanding fracture resistance with multiple cracking mechanism.

1O10-2 박진석 (13:15–13:30)

Preparation of PEI Modified Carboxymethyl Cellulose Nano-fibril Beads as Superadsorbent for Cr(VI) Removal

박진석, 김정규, 김윤진, 방준식, 곽효원† 서울대학교

The difficulty of nanocellulose processing into multidimensional materials restrict the wide and practical application of it. In this study, high performance bead type nanocellulose biosorbent was prepared using the chemically modified carboxy methylated cellulose nano-fibril (CMCNF). Thereafter, PEI was introduced to improve the Cr(VI) removal performance. CMCNF easily fabricated into bead formulation while unmodified CNF could not maintain its droplet shape. The PEI introduction was confirmed by FTIR, XPS, elemental analysis and positive surface charge conversion was elucidated through the zeta potential analysis. The PEI modification process significantly increased the Cr(VI) removal capacity of CMCNF by more than 700%, and as a result, PEI/CMCNF beads exhibited the excellent Cr(VI) adsorption capacity of 1300 mg/g.

1O10-3 권혁민 (13:30–13:45)

A Chemical-Receptor Functionalizable Interpenetrating Polymer Semiconductor Nano-networks for Outstanding Chemodetection with Remarkable Sensitivity, Selectivity and Recovery

권혁민, 김재희, 박한울, 고푸른산, 황해중, 김도환† 한양대학교

Chemosensor based on polymer semiconductors emerge a significant attention due to their low operating temperature and effective contact with target chemicals. However, their low sensitivity and selectivity, as well as slow recovery capability, are major drawbacks which should be improved. Herein, we demonstrate a functionalizable interpenetrating polymer semiconductor nano-networks (IPSNs), so that functional groups can be introduced by manipulating silanol groups of IPSNs. We anchored amine receptors as NO_2 gas moieties due to their high dipole moment interaction with the gas. Therefore, the amine-receptor functionalized polymer semiconductor nano-networks (NH_2-PSNs) possesses high sensitivity attributed to enhanced interactions with NO_2. Further, the recovery time was significantly improved because penetration of NO_2 was restricted by the NH_2 receptors introduced onto the surface. Consequently, our novel approach will provide a guidance for realization of practical chemodetection.

1O10-4 이영준 (13:45–14:00)

Highly Durable Fuel Cell Catalysts Using Crosslinkable Block Copolymer-Based Carbon Particles with Ultralow Pt Loadings

이영준, 최주혁, 이현주, 김범준† KAIST

Minimizing the use of platinum (Pt) catalysts in proton exchange membrane fuel cells (PEMFC) is essential, considering its high price and scarcity. Herein, we demonstrate novel catalysts for PEMFCs with high mass activity and durability, in which block copolymer-based carbon particles are loaded with an ultra-small amount of Pt. The mass activity measured after 30,000 cycles of single cell tests was 0.81 A mg^{-1}_{Pt} at 0.9 V, which is the highest performance reported to date. The newly developed catalyst yielded nearly the same power density as that of the commercial Pt/C, even with 1/20 of Pt usage. We developed the new strategy in which carbon particles were prepared by carbonizing crosslinked domain of block copolymer particles, resulting in uniform mesoporous carbon particles with ~25 nm pores. When Pt was deposited, thin carbon shells were formed encapsulating PtFe nanoparticles, catalyzing oxygen reduction reaction efficiently with high durability.

1O10-5 최기원 (14:00–14:15)

A Highly Self-healable Elastomer Based on Urea Oligomer with Excellent Mechanical Properties and Outstanding Long-term Storage Stability

최기원, 김진실[1], 이서윤, 강정순, 김기승[1], 박희장[2], 홍성우[1], 고민재† 한양대학교; [1]한국생산기술연구원; [2]단국대학교

We demonstrate a highly self-healable elastomer based on urea oligomer (shEUo) in this study. Acrylate-based polyol, urea oligomer with isocyanate groups at both ends, and crosslinker containing multiple isocyanate groups are blended and the resulting blended precursor is reacted to generate shEUO. As a reference, conventional urea-containing elastomer (cEU) is prepared through the traditional one-pot synthesis where urea groups are randomly distributed in cEU. Interestingly, the blended precursor of shEUo shows outstanding long-term storage stability at room temperature compared to that of cEU. In addition, shEUo exhibits better self-healing performances and mechanical properties than cEU or conventional elastomer without urea groups. This demonstrates that conventional elastomer can achieve both superior self-healability and mechanical properties by incorporating urea oligomer where multiple urea groups are serially connected.

1O10-6 박시훈 (14:15–14:30)

Consecutive Phase Separation of Cholesteric Liquid Crystals in Emulsion Drops for Photonic Capsules with Multiple Photonic Bandgaps

박시훈, 이상석[1], 김신현† 한국과학기술원; [1]한국과학기술연구원

Cholesteric liquid crystals (CLCs) construct a helical superstructure which exhibits photonic bandgap due to its periodic modulation of refractive index along the helical axis. Micro-compartments of CLCs make use of this photonic property for applications such as sensing, lasing, and optical barcoding. To provide enhanced functionality, the integration of distinct CLCs into a single microgranule can be performed. However, it is challenging to fabricate multishell structure of CLCs without a complicated microfluidics system. Here, we suggest a facile and spontaneous production of CLC multishells through liquid-liquid phase separation (LLPS). The multiplicity of emulsions is controlled from one to five by adjusting the initial composition of the ternary mixture. The chiral dopant is unevenly partitioned in CLC-rich layers in an odd yet expected manner during LLPSs. The resultant single microgranules embrace distinct stopbands in CLC-rich layers enabling dual-band-edge lasing.

1O10-7 한임경 (14:30–14:45)

Fabrication of Cation-π Interacted Graphene Hydrogels for Highly Robust Supercapacitors

한임경, 김연수† 포항공과대학교

Flexible supercapacitors are considerable interest as mobile power supply for future flexible electronics. In this regard, graphene hydrogels are considered promising flexible supercapacitors because they can exhibit both excellent electrical conductivity, flexibility and mechanical robustness. Here, we newly fabricated physically cross linked graphene hydrogels via cation-π interaction with zwitterionic imidazolium based polymers. We established facile and novel synthetic methods for fabricating cation-π interacted graphene hydrogels by using microwave irradiation which induces exfoliation of graphite and polymerization simultaneously. In this presentation, facile method to fabricating graphene hydrogels and their electrochemical performances will be discussed.

1O10-8 김민제 (14:45–15:00)

Universal Three-dimensional Crosslinker for All-photopatterned Electronics

김민제, 이명재[1], 강문성[2], 김봉수[3], 조정호† 연세대학교; [1]고려대학교; [2]서강대학교; [3]UNIST

All-solution processing of organic electronics requires multiple steps of patterning

and stacking of various device components. Here, we report the fabrication of highly integrated arrays of PTFTs and logic gates entirely through a series of solution processes. The fabrication is done using a 3D crosslinker in tetrahedral geometry containing four photocrosslinkable azide moieties, referred to as 4Bx. 4Bx can be mixed with a variety of solution-processable electronic materials and generate crosslinked network under exposure to UV. Fully crosslinked network film can be formed even at an unprecedentedly small loading, which enables preserving the inherent electrical and structural characteristics of host material. Because the crosslinked electronic component layers are strongly resistant to chemical solvents, micropatterning the layers at high resolution as well as stacking the layers on top of each other by series of solution processing steps is possible.

1O10-9 김민성 (15:10–15:25)

Peptidomimetic Antimicrobial PEGtides: A Modular Approach to Combat Bacteria

김민성, 문원식, 정우혁[†], 이준희, 조가영, 권지수, 안동준[1], Robert J. Mitchell, 김병수[2,†]
울산과학기술원; [1]고려대학교; [2]연세대학교

Despite their high potency, the widespread implementation and use of antimicrobial peptides is still challenging due to their low in vivo efficacy and productivity, and high hemolytic activity. Herein, we address these issues by employing a minimal approach to mimic the key amino acid residues present in antimicrobial peptides, such as lysine, leucine, and serine, on the highly biocompatible poly(ethylene glycol) (PEG) as a platform. We introduce a series of PEG-based peptides (PEGtides) using functional epoxide monomers, corresponding to each key amino acid. These PEGtides possessed highly potent bactericidal activities as well as controlled selectivity with respect to their hemolytic behavior. The critical role of the PEGtide microstructure in the selectivity was also thoroughly analyzed using coarse-grained molecular dynamic simulations. This modular approach shed a light on the design principles necessary for the further and future development of antimicrobial polymers.

1O10-10 고은주 (15:25–15:40)

Dual-crosslinked Chitosan Aerogel for Wound Dressing Prepared by Non-acid Condition

고은주, 김형섭[†] 건국대학교

Aerogel is a porous material used in various fields including biomedical engineering. Aerogel for wound dressing requires biocompatibility and structural stability, as well as high absorbency. Herein, chitosan-based aerogel for wound dressing was prepared by dual crosslinking in non-acid condition. Chitosan was dissolved in 1-butyl-3-methylimidazolium chloride (BmimCl). The hydroxyl groups were covalently crosslinked by epichlorohydrin (ECH) while the amino groups were ionically crosslinked by itaconic acid (IA). Each crosslinking of the aerogels was analyzed using FT-IR spectra and solid-13C NMR. The concentrations of ECH and IA significantly influenced on the water absorption capacity of the aerogel, with the highest swelling ratio of over 1200%. The aerogel showed low toxicity against human cells and good antibacterial function against Gram-positive and Gram-negative bacteria strains. The prepared aerogel shows potential as a wound healing matrix.

1O10-11 이시민 (15:40–15:55)

Hyaluronan Microgel as a Local Controlled Protein Delivery Carrier

이시민, 박기동[†], 손주영 아주대학교

Short half-life and fast clearance of protein drugs require frequent administration for therapeutic efficiency, causing physiological burdens and bacterial infections. In this study, a novel injectable protein loaded hyaluronic acid microgel (HA microgel) *via* thiol-ene click chemistry was developed to achieve the local sustained therapeutic effect. The crosslinking density (0.4~12.6 kPa) and gelation time (41~165 sec) could be controlled. The size of microgel by emulsification was controlled, exhibiting various protein loading efficiency (52.86 ~ 99.02%). Moreover, *in vitro* protein release profile from microgels could be significantly adjusted by their size and crosslinking density. The protein drug carrier showed cytocompatibility and the released protein exhibited drug efficacy. From the results, we can suggest a promising carrier as a controlled delivery carrier for a variety of therapeutic proteins. Acknowledgements: 2018M3A9B5021319, 2019R1A6A1A11051471

1O10-12 손혜빈 (15:55–16:10)

A Dry Room-free Enabled by Functional Separator Membrane for High-current-density Lithium-ion Batteries

손혜빈, 박수진[†], 유승민[†] 포항공과대학교; [1]울산과학대학교

The worldwide demands for sustainable energy sources and eco-friendly energy storage systems have been increasing, lithium-ion batteries (LiBs) are widely used for various applications such as smart devices, electric vehicles and energy storage systems. To meet the advancement of LiBs technology, various groups studied aging mechanism and degradation models in a battery. Among the degradation mechanism, hydrofluoric acid (HF) generation in the electrolyte due to decomposition reaction between moisture and $LiPF_6$ salt ($LiPF_6 \rightarrow LiF + PF_5$, $PF_5 + H_2O \rightarrow 2HF + PF_3O$) may influence on the battery performance. For this reason, the cell should be assembled in a dry room, which is expensive to maintain. I will present a functional separator membrane based on the HF scavenging ability for achieving high energy LIBs used for electrical vehicles, and I manufactured a pouch cell in the ambient air for the first time, the humidity is about 46%. I can see the possible to produce in the air system.

1O10-13 권은혜 (16:10–16:25)

Effect of the Solubility Parameter of the Solvent on the Film-forming Behavior and Polymer Aggregation of the Conjugated Polymer

권은혜, 박영돈[†] 인천대학교

Solvent-additive engineering is an effective strategy for producing organic semiconductors with high crystallinity. We investigate how the physicochemical properties of a additive solvent influence to the aggregation of a conjugated polymer and film-forming behavior. We chose alcohol-based polar solvents as a additive solvent that induce polymer aggregation. We demonstrated that the polarity of the solvent additive strongly affects its miscibility with the main solvent and the ability of the resultant mixed solvent to dissolve the poly(3-hexylthiophene); this solvation ability was related to the intermolecular force of the dipole−dipole interaction. Whereas, we found that during polymer film formation, the evaporation sequence and solvent composition play more influential roles than dipole−dipole interactions in determining the crystallinity of the resultant polymer film. We fabricated a highly crystalline P3HT film based organic field-effect transistor with enhanced charge mobility.

1O10-14 김은우 (16:25–16:40)

3D Printable Alginate/Silk Fibroin Hydrogel with Enhanced Cytocompatibility and Dimensional Stability via Photocrosslinking

김은우, 박원호[†] 충남대학교

3D 바이오프린팅은 복잡한 인체조직의 구조를 정확히 구현할 수 있어 환자 맞춤형 치료가 가능하기 때문에 조직공학 분야에서 활발히 연구되고 있는 새로운 기술이다. 바이오잉크는 세포와 고분자로 구성되며 3D 바이오프린팅에 필수적인 재료로, 그 특성에 따라 인쇄성, 젤화거동 및 세포친화성이 달라진다. 본 연구에서는 알긴산 유도체를 제조하여 광가교형 젤화를 유도하고, 세포친화성을 향상시키고자 실크 피브로인과 혼합하여 바이오잉크를 제조하였다. 저농도의 알긴산/실크 피브로인(Alg/SF) 바이오잉크를 3D 압출 프린팅에 사용하기 위해 먼저 알긴산을 이온가교시켜 점도를 증가시켰다. 또한, 고분자의 농도 및 종류에 따라 유변학적 및 기계적 특성을 비교분석하였다. 실크 피브로인은 β-시트를 형성함으로써 구조적 안정성을 향상시켰고 우수한 세포친화성을 보여주었다. 최종적으로, 광 기반 3D 바이오프린팅을 통해 구조적 안정성과 세포생존능 및 증식률을 관찰함으로써 조직공학으로의 적용가능성을 확인하고자 하였다.

1O10-15 한상훈 (16:40–16:55)

Microfluidically-Designed Smart Microcapsules for NIR-Triggered Chemo-Photothermal Therapy

김지원, 한상훈, 김신현[†] KAIST

Photothermal therapy has been employed to selectively kill cancer cells through localized heating. To enhance the therapeutic effect of cancer treatment, chemical drugs can combine with photothermal agents. However, production of therapeutic cargo containing highly concentrated drugs and photothermal agents with high stability and biocompatibility remains challenging. Herein, we report osmotic-pressure-controlled microfluidic approach to provide monodispersed microcapsules with high concentrated-encapsulation efficiency of drugs and polydopamine nanospheres for photothermal agent. Moreover, the shell membrane is composed of phase-change-material to control the permeability with sustained and stepwise manner by heating and cooling. These thermo-responsive microcapsules can release the drug by thermal stimulus and NIR laser irradiation for multiple times. We believe that this approach for advanced therapeutic microcapsule production is promising for cancer treatments.

상암고분자상 수상기념강연 및 한화고분자학술상 수상기념강연
Commemorative Lecture: Sangam Polymer Award & Hanwha Polymer Award

기조강연장 [10월 7일(수)]

PL-2 김장주 (Jang-Joo Kim) (10:00–10:40)

1977, 1980	서울대학교 화학공학과 (학사, 석사)
1987	stanford대학교 재료공학과 (박사)
1986-1987	SRI International (Post-Doc.)
1987-1996	한국전자통신연구원 선임/책임연구원
1997-2003	광주과학기술원 교수
2003-현재	서울대학교 재료공학부 교수

A 30 Year Journey in Organic Photonics: From Potential to Reality

김장주[†] 서울대학교

My lifetime research journey from late 1980s to 2020 in organic photonics will be presented, which spans from molecular electronics, polymer electro-optic modulators, switches and passive waveguide devices, organic light emitting diodes, organic solar cells and detectors and so on. Through this lecture, I would like to show that how the potential of organic photonics becomes the reality.

PL-3 김덕준 (Dukjoon Kim) (10:40–11:20)

1984	서울대학교 화학공학과 (학사)
1986	KAIST화학공학과 (석사)
1993	PURDUE대학교 화학공학과 (박사)
1993-1994	Lehigh대학교 화학공학과 (Post-Doc.)
1994-현재	성균관대학교 화학공학/고분자공학부 교수

Arylene Based Ion Conductive Polymer Electrolyte Membranes for Li Secondary Batteries and Fuel Cells

김덕준† 성균관대학교

Ion conductive poly(arylene ether ketone) (PAEK) and poly(arylene ether sulfone) (PAES) membranes were prepared in a variety of structures including cross-linked and graft and multi-block copolymers to enhance dimensional and mechanical stability as well as ion conductivity for application of secondary battery and fuel cell systems. In lithium secondary battery application, those were prepared in solid forms to be applied as a robust solid state electrolyte. In fuel cell application, proton conducting PAEK was modified with hygroscopic mesoporous conductors to lessen their dehydration in the low humid environment. The antioxidant toughening agent of cerium/organosiloxane polymer network (Ce/OSPN), was introduced to adjust the elongation and chemical stability of the membranes. Several essential properties of a series of of arylene based polymer electrolyte membranes and their precursors such as ion conductivity, fuel crossover, thermal and mechanical stability, and electrochemical performance were analyzed. Those properties were correlated with the phase separation behavior investigated employing SEM, TEM, and SAXS.

콜로이드 및 분자조립 부문위원회 (II) | Division of Colloid & Molecular Assembly (II)

제1회장 [10월 7일(수)]

Organizer: 심태섭(아주대), 이효민(POSTECH)

2L1-1 오진우 (Jin-Woo Oh) (13:00-13:25)

2003 한양대학교 화학과 (학사)
2005 한양대학교 화학과 (석사)
2009 한양대학교 화학과 (박사)
2010-2012 UC Berkeley (Post-Doc.)
2012-현재 부산대학교 나노에너지공학과 부교수
2017-현재 파지메타물질연구단 단장

Self-assembly of Nanoparticles to Fabricate Optical Structures Inspired from Nature

오진우† 부산대학교

The diverse and powerful functionality from nanostructures existing in nature attracts a lot of attention. However, most of the nanostructures in nature are stereostructured and poorly formed, sometimes arranged at low levels, making it difficult to imitate very accurately. Our M13 bacteriophage-based self-assembly approach can be good candidate to overcome those obstacles. M13 bacteriophages are very beneficial for self-assembly due to its geometrical consistency. In addition, it is possible to express various chemical functional groups on the surface protein of M13 bacteriophage through genetic engineering technology. Here we introduce various self-assembled nanostructures based on bacteriophage. By mimicking nature's strategies, we fabricated color films via simple self-assembly to be used as sensors and color pixels. Inspired from elaborate and complicated motion of human hand, we introduced bioinspired artificial palmer creases (APC) to achieve well-controlled wrinkle surface.

2L1-2 박철민 (Cheol Min Park) (13:25-13:50)

1992 서울대학교 섬유공학과 (학사)
1995 서울대학교 섬유고분자공학과 (석사)
2001 MIT 재료공학과 (박사)
2001-2002 Harvard 화학과 (Post-Doc.)
2002-현재 연세대학교 신소재공학과 교수
2014-2017 연세대학교 Underwood 특훈교수

User-interactive 3D Touchless Sensing Displays with Block Copolymer Self Assembly

박철민†, 강한솔, 박태현, 한효원 연세대학교

Self-assembled nanostructures resulting from block copolymers (BCPs) have gained a great attention not only because of the variety of nanostructures they can evolve but also because of the controllability of these structures by stimuli. An emphasis is made on the development of a 3D touchless sensing display based on multi-order reflection structural colors (SCs), solid-state photonic crystal (PC). Full-visible-range SCs are developed in a BCP PC consisting of alternating lamellae, one of which contains a chemically cross-linked, interpenetrated hydrogel network. The absorption of an ionic liquid into the domains of the interpenetrated network allows for further manipulation of SC by utilizing not only 1st-order but also 2nd- and 3rd-order photonic reflections, giving rise to unprecedented visible SCs arising from reflective color mixing. When the ionic liquid is used as an ink for printing via the localized swelling of the domains, various colored, programmed SC images are elaborated.

2L1-3 임지우 (Jeewoo Lim) (13:50-14:15)

2006 Princeton University 화학과 (학사)
2011 MIT 화학과 (박사, 유기화학)
2011-13 ㈜삼성토탈(현 한화토탈) 책임연구원
2013-2017 서울대학교 화학생물공학부 (Post-Doc.)
2017-현재 경희대학교 화학과 조교수

Functional Building Blocks for Molecular Engineering of Polynorbornenes from Ring-Opening Metathesis Polymerization

임지우† 경희대학교

Polymers from ring-opening metathesis polymerization (ROMP) of norbornene derivatives have backbone structures which are distinct from those prepared from radical or anionic polymerizations. The unique backbone structure, along with the high functional group tolerance of various ROMP initiators, make ROMP polymers interesting targets for molecular engineering and self-assembly investigations. We have recently developed various functional monomers, such as photoreactive monomers, bifunctional monomers having heterocyclic cores, and semifluorinated monomers having up to 34 fluorine atoms per monomer, as building blocks for molecular engineering of polynorbornenes from ROMP. Herein, the design principles of the monomers, along with their synthesis and polymerization are presented. Self-assembly of block copolymers from these monomers are discussed, including star-shaped polynorbornenes prepared from core-first strategies involving multifunctional norbornenes.

2L1-4 김동하 (Dong Ha Kim) (14:15-14:40)

1991 서울대학교 섬유공학과 (학사)
1996 서울대학교 섬유고분자공학과 (석사)
2000 서울대학교 섬유고분자공학과 (박사)
2000-2003 매사츄세츠대학교 고분자공학과 (Post-Doc.)
2003-2005 막스플랑크 고분자연구소 (Post-Doc.)
2006-현재 이화여자대학교 화학나노과학과 조교수, 부교수, 교수

Assembly and Hybridization of Plasmonic Nanoparticles for Catalysis, Optoelectronics and Theragnosis

김동하† 이화여자대학교

Plasmonics has been recognized as a promising platform that may premise the advance of diverse functional materials and devices. A comprehensive approach for the design and synthesis of multifunctional hybrid nanomaterials has been systematically performed to seek their potential applications as key elements in green nano- and bio-technology. Of the numerous methodologies to achieve these goals, we integrate plasmonic nanostructures into the elements of multidisciplinary subject areas. The hot carriers and near-field enhancement induced by localized surface plasmon resonance excitation are the key parameters that are responsible for the enhanced performances. In this presentation we provide a concise overview of the fundamental principles of plasmonics and engineering protocols of plasmonic nanoparticles for catalytic, optoelectronic and theragnosis systems.

2L1-5 차국헌 (Kookheon Char) (15:00-15:25)

1981 서울대학교 화학공학과 (학사)
1983 한국과학기술원(KAIST) 화학공학과 (석사)
1989 미국 스탠포드대학교 (박사)
1989-1990 IBM Almaden Research Center (Visiting Scientist)
1991-현재 서울대학교 화학생물공학부 교수
2010-2017 Intelligent Hybrids 창의연구단장
2017-현재 서울대학교 공과대학장

Structure and Kinetics of Micelles Based on Bottlebrush Block Copolymers in Selective Solvent

차국헌† 서울대학교

We present structural and dynamic characterization of bottlebrush block copolymers in a selective solvent, where the backbone of the core block is tethered onto long fluoroalkyl pendent chains. Such bottlebrush block polymers readily self-assemble into spherical micelles with stretched cores, due to the increased chain stiffness of the bottlebrush core block. We examine the size of the core and corona within micelles scaled with the core block length, deviating from the classical theories based on Gaussian chains. In contrast, the fast relaxation of the bottlebrush core blocks enables the facile equilibration of the micelle formation. The kinetics of chain exchange between micelles is measured using time-resolved small-angle neutron scattering (TR-SANS), from which we find that the chain exchange among bottlebrush block copolymer micelles is tens of times faster than flexible block copolymer counterparts with similar activation energy.

2L1-6 김영기 (Youngki Kim) (15:25-15:50)

2007 고려대학교, 물리학과 (학사)
2009 한양대학교, 정보디스플레이공학과 (석사)
2015 Kent State University, Chemical Physics (박사)
2015-2018 University of Wisconsin-Madison, Chemical & Biological Engineering (Post-Doc.)
2018-2019 Cornell University, Chemical & Biomolecular Engineering (Post-Doc.)
2019-현재 포항공과대학교 화학공학과 조교수

Design of Smart Material from Colloidal/Molecular Self-Assembly via Liquid Crystalline Soft Template

김영기† 포항공과대학교

Surfaces decorated with fiber arrays are ubiquitous in the natural world because they can provide functions such as sensing (hair cells), wetting (lotus leaf), and adhesion (gecko foot). However, recreation of these functions in synthetic materials is challenging due to multiscale engineering processes to control properties of individual fibers and their arrays. Here, we introduce chemical vapor deposition can be performed on surfaces coated with liquid crystal films to synthesize end-attached nanofibers.[1,2] The approach enables access to nanofiber arrays with controlled size, shape, and organization via self-assembly of monomers mediated by elasticity of liquid crystal template.[1,2] We also demonstrate the nanofiber arrays to permit tailoring

of a wide range of functionalities, including wetting, conductivity, and adhesion. Our recent discovery for these various lines of investigation will be also discussed. (1) Y.-K. Kim, *et al.*, *Nature*, **557**, 539 (2018). (2) K. C. K. Cheng, *et al.*, *Science*, **362**, 804 (2018).

2L1-7 김용주 (Yongju Kim) (15:50–16:15)

2005	서울대학교 화학부 (학사)
2012	서울대학교 화학부 (박사)
2013	서울대학교 화학부 (Post-Doc.)
2018	Jilin University 화학과 부교수
2019	Jilin University 화학과 교수
2019-현재	고려대학교 KU-KIST융합대학원 부교수

Supramolecular Two-dimensional Materials as Biofunctional Modulators

김용주† 고려대학교

Various biological systems rely on the supramolecular assembly of biomolecules through noncovalent bonds for performing sophisticated functions. In particular, cell membranes, which are 2D structure in biological systems, have various characteristics such as a large surface, flexibility, and molecule-recognition ability. Supramolecular 2D materials based on biological systems provide a novel perspective for the development of functional 2D materials. The physical and chemical properties of 2D structures, attributed to their large surface area, can suggest the potential utility of functional 2D materials as candidates for biological systems. In this regard, we will introduce the rational design of self-assembling aromatic amphiphiles, the formation of 2D structures, and the biological applications of functional 2D materials.

2L1-8 김신현 (Shin-Hyun Kim) (16:15–16:40)

2004	연세대학교 화학공학과 (학사)
2009	KAIST 생명화학공학과 (박사)
2009-2010	KAIST 광자유체집적소자연구단 (Post-Doc.)
2010-2012	Harvard University (Post-Doc.)
2012-현재	KAIST 생명화학공학과 조교수, 부교수
2017-현재	KAIST Campus Asia 운영센터 센터장

Interfacial Assembly of Amphiphilic Photonic Tiles

김신현† 한국과학기술원

In nature, many creatures produce photonic nanostructures in their cells and assemble the cells to compose macroscopic skins rather than making photonic surfaces in one step. Learning from nature, we design photonic structures in a granular format through colloidal self-assembly and prepare macroscopic surfaces through secondary assembly of the photonic granules. In detail, colloidal particles are crystallized to form a regular lattice in a photocurable resin, which is then micropatterned by photolithography to prepare microdisks. After etching out colloidal particles from the composite, the top and side surfaces of the porous microdisks are subjected to reactive ion etching with SF6 gas, selectively rendering the surfaces hydrophobic. The resulting amphiphilic photonic microdisks are assembled at the air-water interface under the action of gravity, providing highly flexible and reconfigurable photonic surfaces which are other wide very difficult to produce using single-step assembly.

신진연구자 특별 심포지움 (II) | Young Polymer Scientists (II)

제2회장 [10월 7일(수)]

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

2L2-1 김민수 (Min Soo Kim) (13:00–13:25)

2006-2008	중앙대학교 화학공학과 (석사)
2008-2009	일진머티리얼즈 연구소
2010-2014	한국과학기술원 생명화학공학과 (박사)
2014-2015	성균관대학교 화학공학과 (Post-Doc.)
2015-2016	New York University, Department of Chemistry (Post-Doc.)
2015-현재	울산과학기술원 에너지공학과 연구교수

Structure Engineering of Polymer Dielectric Films for Multifunctional Triboelectric Devices

김민수, 고현협† 울산과학기술원

Output performance of triboelectric devices critically depends on surface charge density on the dielectric materials. The dielectric constant (ε) of materials is known to greatly affect the surface charge density. Fluorinated polymers have superior electron affinity, leading to negative triboelectric materials. However, increasing ε is greatly limited for the pure polymers. Herein, we show that interfacial polarization in bilayer polymer films, consisting of PDMS coated with triboelectric materials, significantly enhance the ε of films, resulting in significant enhancement of triboelectric performances compared to hard single-layer films, which is the first report to introduce interfacial polarization for the enhancement of triboelectric output performance. For proof-of-concept, we demonstrate a temperature sensitive triboelectric sensor and a vibration-based triboelectric nanogenerator.

2L2-2 송우진 (Woo-Jin Song) (13:25–13:50)

2005-2013	숭실대학교 화학공학과 (학사)
2013-2018	울산과학기술원 에너지 및 화학공학과 (박사)
2018-2019	포항공과대학교 화학과 (Post-Doc.)
2019-현재	Stanford University, Chemical Engineering (Post-Doc.)

Functional Separator Membrane Based on Phase Separation Method for Use in Energy Storage Devices

송우진† 충남대학교 유기재료공학과

Li-ion batteries (LIBs) are considered to be one of the most promising energy devices of transportation applications; however, at high temperature (> 55 ℃), improving the performance of LIBs still remains a tough challenge because side reaction compounds generated from the electrolyte decomposition cause a severe degradation of the battery performance. In this work, we present a seaweed-extracted multifunctional biomaterial for LIB components including a separator membrane and binder with highly stable cycling performance even at high-voltage operation under high temperature. In particular, surface modification was employed to enable the biomaterial to develop the well-defined porous structure after the phase inversion process, which is one of the promising methods for the fabrication of membrane with microporous structures due to its simplicity and scalability.

2L2-3 오진우 (Jinwoo Oh) (13:50–14:15)

2012	인하대학교 고분자신소재공학과 (학사)
2014	인하대학교 고분자공학과 (석사)
2018	서울대학교 화학생물공학부 (박사)
2018-현재	KIST 광전하이브리드센터 (Post-Doc.)

Directed Self-assembly of Block Copolymer thin Film with Vertical Lamellae by Applying Filtered Plasma and Repeated Shear Stress

오진우, 손정곤† 한국과학기술연구원

Directed self-assembly (DSA) of block copolymer (BCP) is a promising technology for nanoscale lithography for semiconductors and nanodevices. Although defect-free BCP lamellar nanostructure with vertical orientation nanopattern is necessary for the wide range of applications of BCP self-assembly, the formation of defect-free BCP lamellar nanostructures with vertical orientation is still a difficult challenge. In this study, we proposed a new approach of filtered plasma treatment and repeated shear stress on BCP film for aligned and vertical lamellar BCP nanostructure. We introduced filtered plasma on the surface to produce crosslinked neutral surface, and subjected to shear stress to create a vertical oriented lamellae structures. In order to improve the quality of the alignment of the BCP nanostructures, the shear stress was repeatedly applied to the BCP film and the defects were greatly reduced. It suggests the potential for application in nanolithography and optical devices.

2L2-4 한원배 (Won Bae Han) (14:15–14:40)

2011	한양대학교 신소재공학과 (학사)
2015	한양대학교 신소재공학과 (박사)
2015-2018	한국과학기술연구원 뇌과학연구소 (Post-Doc.)
2019-현재	고려대학교 KU-KIST융합대학원 연구교수

Fabrication of Phospholipid- and Block Copolymer-based Artificial Sensory Organ Arrays on Chips

한원배† 고려대학교

The bio-sensory organs of living creatures have evolved to have the best sensing performance. Among them, microvilli on the tongue and cilia on the olfactory system are 3-dimensional protrusions that have large surface areas to accommodate a large number of membrane proteins such as ion channels and G-protein coupled receptors, enabling high sensitivity and specificity to target molecules. From the perspective of mimicking these systems, herein, we fabricated solvent-free, 3-dimensional, free-standing phospholipid and block copolymer structure arrays, and demonstrated their structural advantages for efficient and rapid protein reconstitution, compared to 2-dimensional structures. Finally, we detected a neurotransmitter, serotonin, using the proposed structures as a sensing platform mimicking bio-sensory organs.

2L2-5 박성민 (Sungmin Park) (15:00–15:25)

2010	동의대학교 나노공학과 (학사)
2012	부산대학교 인지메카트로닉스공학과 (석사)
2018	고려대학교 화학과 (박사)
2018-현재	한국과학기술연구원 광전하이브리드연구센터 (Post-Doc.)

High-Performance and Stable Nonfullerene Acceptor-Based Organic Solar Cells for Indoor to Outdoor Light

박성민, 안형주[1], 김지영, 손해정† 한국과학기술연구원; [1]포항가속기연구소

We synthesized a donor polymer consisted of chlorine and sulfur-bridged 2-ethylhexyl thiophene substituted benzodithiophene (BDT) and 1,3-bis(2-ethylhexyl)-5,7-di(thiophene-2-yl)-benzo[1,2-c:4,5-c′]dithiophene-4,8-dione. PBDB-TSCl shows more efficient exciton dissociation and charge generation than PBDB-TF includes

fluorine and 2-ethylhexyl thiophene on BDT and those results are probably from reduced exciton binding energy because of large dipole moment changes between ground and excited states. Consequently, despite large phase separated morphology and a small donor-acceptor interface in the bulk heterojunction (BHJ) active layer, PBDB-TSCl shows higher power conversion efficiency (PCE) than PBDB-TF for outdoor to indoor light; PBDB-TSCl shows 13.13% of PCE under 1 sun illumination and its higher than the 12.12% of PBDB-TF. Moreover, PBDB-TSCl achieved higher PCE of 21.53% with fill factor (FF) of 76.29% than 15.57% of PBDB-TF with FF of 65.25% under a 500 lx fluorescence lamp.

2L2-6 심재현 (Jae Hyun Sim) (15:25-15:50)

2004 한양대학교 화학과 (석사)
2012 Virginia Tech, Chemistry (박사)
2013-2016 Kyushu University, Applied Chemistry (Post-Doc.)
2016-2020 한양대학교 나노과학기술연구소 연구교수
2020-현재 한양대학교 기초과학융합연구소 연구교수

1D Hypo-Crystals: Crystallization of Stereo-Irregular Polymers with Entropy Diluent

심재현, 강영종† 한양대학교

In this study, we introduce highly-ordered and closely packed, extended amorphous polymers such as poly(methyl methacrylate) (PMMA) by thermal quenching of the molten solution of polymer/volatile cryatallizable additive (VCA). Resultant PMMA films showed 1D crystallinity due to ordered lateral packing between chains which is independent on the tacticity while the packing is amorphous-like for the other two directions. We named the crystalline PMMA as 1D hypo-crystalline PMMA (hc-PMMA). Surprisingly, small angle X-ray scattering (SAXS) revealed unprecedented extended conformation of PMMA in the molten PMMA/VCA solutions. Specific VCA such as BA which induces spontaneous chain-stretching in solution was designated entropy diluent. Upon quenching, PMMA chains are further stretched because of the large tensile stress induced by the sudden temperature drop and because of mechanical squeezing by concomitant directional crystallization of anisotropic lath-like BA crystals.

2L2-7 박현진 (Hyunjin Park) (15:50-16:15)

2011 단국대학교 전자전기공학과 (학사)
2013 포항공과대학교 정보전자융합공학과 (석사)
2019 포항공과대학교 전자전기공학과 (박사)
2019-현재 한국화학연구원 (Post-Doc.)

Low-temperature Solution-processed Soluble Polyimide Gate Dielectrics: From Molecular-level Design to Electrically Stable and Flexible Organic Transistors

박현진, 김윤호, 원종찬† 한국화학연구원

In this work, aromatic soluble polyimide (PI) is presented as an alternative to low-temperature processable gate dielectric layers. Low-temperature processability of soluble PI is demonstrated by comparing dielectric and electrical properties with conventional PI at various annealing temperatures. The chemical structure effects of aromatic dianhydride and diamine monomers on device performance are then systematically investigated by evaluating four soluble PIs, in which monomeric precursors containing different backbones, side groups, and linkages. The results indicate that based on 4,4'-(hexafluoroisopropylidene)diphthalic anhydride soluble PI is the most promising gate dielectric candidate due to its high field-effect mobility, near-zero threshold electric-field, and excellent electrical stability. This work presents a step forward to the development of soluble PI gate dielectrics for flexible electronic devices with high device performance.

2L2-8 강명균 (Myeong-Gyun Kang) (16:15-16:40)

2014 울산과학기술원 의생명과학 (학사)
2020 울산과학기술원 화학과 (박사)
2020-현재 서울대학교 화학부 (Post-Doc.)

Spatiotemporal Proximity Crosslinking by Light Activation (Spotlight) for in Vivo Interactome Mapping

강명균† 서울대학교

Proximity labeling is a recently developed method that enables proteomic profiling of specific regions in living cells. However, the diffusive character of in situ-generated reactive species by proximity labeling enzymes cannot be used easily to identify physically interacting partners with the protein of interest (POI). In the present study, we developed an in vivo proteome mapping method that enables spatiotemporal proximity crosslinking by a genetically targeted light-activated ligand of the HaloTag protein in a live mammalian cell (Spotlight). Spotlight was used to reveal the unknown interaction partner of a newly identified mitochondrial protein, exonuclease 3′-5′ domain containing 2 (EXD2) in mammalian cells.

고분자 합성: 기초 합성에서 첨단 소재까지 | Polymer Synthesis

제3회장 [10월 7일(수)]

Organizer: 김병수(연세대), 김정곤(전북대)

2L3-1 강범구 (Beom-Goo Kang) (13:00-13:25)

1999-2005 성균관대학교 고분자공학과 (학사)
2006-2007 광주과학기술원 신소재공학과 (석사)
2007-2012 광주과학기술원 신소재공학과 (박사)
2012-2016 테네시대학교 화학과 및 프린스턴대학교 화학생명공학과 (Post-Doc.)
2016-2019 LG화학 중앙연구소 미래기술센터 책임연구원
2019-현재 숭실대학교 화학공학과 조교수

Precise Synthesis of Block Copolymers Containing Triphenylamine via Living Anionic Polymerization and Their Applications

강범구† 숭실대학교

It has been well known that living anionic polymerization is the most established polymerization method to synthesize polymers with controlled molecular weights and narrow molecular weight distributions. From the synthetic viewpoint, successful living anionic polymerization of certain monomers allows functional block copolymers with precise macromolecular structures to be prepared by sequential addition of monomers. I previously reported the successful living anionic polymerization of triphenylamine-containing styrene through introduction of protecting group. Based on this, I am planning to present precise synthesis of block copolymers containing triphenylamine via living anionic polymerization and their applications. In particular, synthetic strategy to well-defined functional block copolymers that could be used as hole-transporting layer of organic light-emitting diodes and active layer of organic memory devices will be discussed.

2L3-2 장성연 (Sung-Yeon Jang) (13:25-13:50)

2000 경북대학교 고분자공학과 (학사/석사)
2004 U. of Connecticut, Materials Science (박사)
2004-2006 UC Berkeley Chemical Engineering (Post-Doc.)
2006-2011 한국과학기술연구원 선임연구원
2011-2019 국민대학교 응용화학과 부교수
2019-현재 울산과학기술원 에너지 및 화학공학부 부교수

Development of Organic Semiconducting Materials for Solar Cell Devices

장성연† 울산과학기술원

In this talk, the development of organic conjugated materials, which are applicable to various solar cell devices, will be discussed. To design and synthesize appropriate organic materials for the solar cell application required to consider their optical and electrical properties in addition to the energy levels. In the case of organic photovoltaic (OPV), the bandgap and energy levels for the electron donors and electron acceptors should be concerned to optimize the photon absorption and charge separation, while the charge mobility is essential for the efficient charge collection. The p- and n-type organic semiconductors were synthesized and used as the photoactive materials for OPVs. At the same time, the p-type materials were also employed as the hole-transport materials in quantum dot and perovskite solar cells.

2L3-3 김윤희 (Yun Hi Kim) (13:50-14:15)

1986 부산대학교 화학교육과 (학사)
1990 KAIST 화학과 (석사, 박사)
1995-1996 MIT 화학과, 재료공학과 (Post-Doc.)
2009-현재 경상대학교 화학과 교수
2011-현재 경상대학교-삼성 디스플레이 OLED 센터장
2019-현재 국가기술 자문회의 심의회의 소부장 기술 특위 위원

Development of High Peroformance New Semiconducting Materials

김윤희† 경상대학교

Polymer semiconductors have been attracted great attention and developed for the past decades because of their advantage such as physical flexibility, lightweight and low price. In this presentation, we report synthesis and characterization of new organic semiconducting polymer for electronic devices. The polymer was prepared using a palladium-catalyzed Stille cross-coupling reaction.

2L3-4 임은희 (Eunhee Lim) (14:15-14:40)

2001 KAIST 화학과 (학사)
2003 KAIST 화학과 (석사)
2006 KAIST 화학과 (박사)
2006-2008 University of Cambridge 화학과 (Post-Doc.)
2008-2012 한국생산기술연구원 선임연구원
2012-현재 경기대학교 화학과 부교수

Alkyl Side-Chain Engineering of Non-Fullerene Acceptors for Large-Area Organic

Solar Cells

임은희† 경기대학교

The development of non-fullerene acceptors (NFAs) recently led to important breakthroughs in the field of polymer solar cells (PSCs). Both the large-area manufacturing and eco-friendly processing are considered as key issues for the commercialization of PSCs. Here, we developed very simple-structured NFAs for high-efficiency PSCs. Previously, we reported an impressive power conversion efficiency (PCE) of 11.55% using highly crystalline symmetric NFA in a PTB7-Th-based ternary-blend device. Here, the facile asymmetric strategy could effectively improve both the material properties and device performance without sacrificing facile synthesis and physical properties that well match those of the PTB7-Th polymer donor, resulting in a PCE of 12.01% in single-junction ternary-blend devices and a PCE of 9.32% in large-area NFA-OSC modules (substrate size = 100 cm^2, aperture size = 55.5 cm^2) under ambient conditions using a D-bar coater.

2L3-5 이재석 (Jae-Suk Lee) (15:00–15:25)

1979	전남대학교 화학공학과 (학사)
1981	한국과학기술원 화학공학과 (석사)
1989	Tokyo Institute of Technology (박사)
1994-현재	광주과학기술원 부교수, 교수
2015-현재	광주과학기술원 특훈교수
2016-현재	한국과학기술한림원 정회원

Study on Synthesis of Polyisocyanates from 1994

이재석† 광주과학기술원

For the past 60 years after the pioneering work on the anionic polymerization of isocyanates by Shashoua, polyisocyanates as a class of rodlike helical polymers have made a substantial impact on multidisciplinary chemistry. The essential key to success has been to completely protect the amidate anions from undesired side reactions, including cyclotrimerization and termination. For the last 27 years, we have been working on this research topic. Our group has invented advanced protocols for living anionic polymerization of isocyanates, and we published numerous articles in the journals of high repute. Despite the early hardships regarding the extension of this work due to lack of funds as this work is not industrially oriented, we solitarily were able to strengthen this field. Among numerous papers until now on isocyanates, the first paper was published in 'Macromolecules' on the study on polymerization of isocyanate using crown ether in 1999 and the recently published (36th) in 2019.

2L3-6 백현종 (Hyun Jong Paik) (15:25–15:50)

1991	서울대학교 화학과 (학사)
1993	서울대학교 화학과 (석사)
2001	Carnegie Mellon University 화학과 (박사)
2003	Cornell University (Post-Doc.)
2003-현재	부산대학교 고분자공학과 교수

Molecular Weight Distribution of Polystyrenes Prepared by Reversible Deactivation Radical Polymerization

백현종† 부산대학교

Reversible deactivation radical polymerization (RDRP) is a method to obtain complex polymeric architectures with a narrow molecular weight distribution (MWD) and chain end functionalities. Through the reversible generation of radicals, RDRP exhibits characteristics of living polymerization. However, due to the unavoidable radical termination, the mixture of living and dead chains is produced. I will discuss separation and analysis of living chains of polystyrenes synthesized by atom transfer radical polymerization (ATRP) and reversible addition fragmentation chain transfer (RAFT) polymerization, Nitroxide-mediated radical polymerization (NMP). Living chains of both polystyrenes prepared by ATRP, RAFT and NMP were separated by high performance liquid chromatography (HPLC). Separated living polystyrene chains were characterized using size exclusion chromatography, nuclear magnetic resonance (NMR), and matrix assisted laser desorption/ionization mass spectrometry (MALDI-MS).

2L3-7 이동원 (Dongwon Lee) (15:50–16:15)

1997	영남대학교 섬유공학과 (학사)
1999	영남대학교 섬유공학과 (석사)
2004	University of Florida 재료공학과 (박사)
2006	University of South Florida College of Medicine/James A. Haley Veterans Hospital (Post-Doc.)
2008	Georgia Institute of Technology (Research Associate)
2008-현재	전북대학교 고분자 · 나노공학과 교수

Molecularly Engineered Redox-regulating Biopolymers for Nanomedicines

이동원† 전북대학교

Recent advance in nanotechnology, biology and chemistry have led to the development of various polymeric nanomaterials for biomedical applications such as drug delivery and bioimaging. When polymers are designed to respond specifically the pathological conditions, their medical performance could be further enhanced, enabling precise nanomedicines. Compared to normal cells and tissues, pathological conditions such as cancer and inflammation have altered redox balance and acidic pH. In our lab, we developed several polymers for therapeutic and imaging applications by exploiting simple chemistry to respond altered redox balance and acidic pH in various pathological conditions. I will discuss molecularly engineered biopolymer nanoparticles implicating that simple chemistry extends the medical applications of polymeric nanoparticles.

2L3-8 백경열 (Kyung-Youl Baek) (16:15–16:40)

1996	숭실대학교 섬유공학과 (학사)
1999	Kyoto Univ. 고분자화학과 (석사)
2002	Kyoto Univ. 고분자화학과 (박사)
2002-2006	UC Berkeley & LBNL (Post-Doc.)
2006-현재	한국과학기술연구원(KIST) 책임연구원
2009-현재	과학기술연합대학원대학교(UST) 교수

Effective Design of Polymer Matrix for MOF Based Toxic Chemical Detoxification System

서진영, 백경열† 한국과학기술연구원

Among several toxic chemicals, chemical warfare agent (CWA) is as one of the most hazardous chemicals. These toxic chemicals are generally removed by absorbents such as active carbon etc., which however require additional treatments to detoxify the chemicals. Recently developed Zr-based metal organic framework (MOF) has been known as effective detoxification catalyst for CWAs, especially the fatal nerve agents. However, the powder catalyst is limited to apply for a military system directly due to its poor processability. In this study, we have developed effective polymer composites with UiO-66 catalyst not to decrease the intrinsic catalytic performance of UiO-66 as possible by design of polymer matrixes such as porous structure and functionalization. Obtained unique polymer composites of UiO-66 showed excellent catalytic performances to detoxify the nerve agent simulant both in solution and in solid.

유무기 양자소재 및 응용기술 | QD Hybrid Architectures: Promises and Challenges

제4회장 [10월 7일(수)]

Organizer: 정소희(성균관대), 이도창(KAIST)

2L4-1 배병수 (Byeong-Soo Bae) (13:00–13:25)

1986	서울대학교 무기재료공학과 (학사)
1988	미국 Drexel Univ. (석사)
1993	미국 Univ. of Arizona (박사)
1993-1994	미국 AML (Post-Doc.)
1994-현재	KAIST 신소재공학과 교수

In Situ Sol-Gel Synthesized Siloxane-Encapsulated Quantum Dot Resin for Color Converters in Display Applications

배병수† 한국과학기술원

We have reported siloxane-encapsulated QD (Cd-based QD passivated oleic acid) resin via in situ sol-gel reaction of silane precursors in the presence of QDs, where QDs are chemically encapsulated by siloxane matrix. Photo-curable (for On-Surface) and thermal-curable (for On-Chip) QD/siloxane hybrid without ligand exchange and additional protective layers is developed for BLU application in LCD. These resins have permanent dispersion stability of QD in siloxane matrix and its cured film shows high thermal- (>85 ℃ and 85 ℃/85% RH) and chemical-(in acid, base, alcohol) stability. Using them, we demonstrated white light-emitting diode (LED) with wide color gamut and excellent reliability. Also, silica-modified QD through ligand-exchange improves the stabilities. Finally, we synthesized photo-patternable (~ 10 um) high QD concentration (> 10 wt%) in siloxane matrix. The photo-lithography of the QD ink photo-resist can fabricate QD color filters in various display applications.

2L4-2 장효숙 (Hyosook Jang) (13:25–13:50)

1998	KAIST 화학과 (학사)
2000	KAIST 화학과 (석사)
2004	KAIST 화학과 (박사)
2005	KAIST 화학과 (Post-Doc.)
2006	The University of Western Ontario 화학과 (Post-Doc.)
2007-현재	삼성종합기술원 전문연구원, Research Master

Highly Bright and Narrow Emission from InP-based Quantum Dots

장효숙, 장은주†, 원유호, 김용욱 삼성종합기술원

Quantum dots (QDs) are promising materials for display applications due to color tunability, high efficiency and narrow emission. While intensive efforts have focused on CdSe-based QDs with toxicity, researches about environmentally-friendly InP-based QDs were delayed due to their synthetic difficulties. In this talk, we suggest the optimized red and green-emitting InP-based QD structures with uniform core and multi-shell and explain their optical properties.

2L4-3 최문기 (Moon Kee Choi) (13:50–14:15)

2009 서울대학교 화학생물공학부 (학사)
2016 서울대학교 화학생물공학부 (박사)
2016-2017 서울대학교 나노입자연구단 선임연구원
2017-2019 UC Berkeley Bioengineering (Post-Doc.)
2019-현재 울산과학기술원 신소재공학부 조교수

Ultrathin Flexible Optoelectronic Devices for Wearable/Implantable Applications

최문기† 울산과학기술원(UNIST)

Soft electronic devices, in particular healthcare-related ones, have been intensively studied over the past decade due to their unique advantages in biomedical applications. To achieve the soft nature in high performance electronics and to apply this technology to wearable biomedical electronics/optoelectronics, several strategies have been employed, such as the designed assembly, unconventional manufacturing processes, deformable design of individual devices, and disease-specific system-level integration of diverse soft electronics. Here, we describe ultrathin flexible optoelectronic devices for wearable/implantable applications. Ultrathin high-resolution red-green-blue quantum dot LEDs can be utilized next-generation electronic tattoo, transparent smart display, and display of healthcare monitoring wearable devices. In addition, graphene-MoS_2 heterostructures can be applied to the ultrathin curved image sensors for the retina prosthetics.

2L4-4 방준하 (Joona Bang) (14:15–14:40)

1999 서울대학교 화학공학과 (학사)
2004 Univ. of Minnesota 화학공학과 (박사)
2006 Univ. of California, Santa Barbara (Post-Doc.)
2006-현재 고려대학교 화공생명공학과 교수

Surface Modification of Quantum Dots with Cross-linkable Polymer Ligands

방준하†, 고재완 고려대학교

Along with the rapid advances on the colloidal quantum dot (QD)-based devices, endowing patternable functionality to QDs has been highly desirable to achieve high-resolution QD displays. However, quantum dots are known to be sensitive to heat, moisture and oxidization. In this work, we improved the thermochemical stability of quantum dots by surrounding them with a physical barrier to suppress the creation of surface defects. This protective shell was made using a polymer cross-linkable polymer ligand and was shown to significantly reduce the deleterious effects of exposure to high temperatures and an oxidizing agent. Furthermore, we also demonstrate that an introduction of UV patternable and conducting copolymer ligand to QDs can undergo conventional photolithographic process, readily applicable to high-resolution QD displays with simple processability and cost-efficiency.

2L4-5 한철종 (Chul Jong Han) (15:00–15:25)

1995 한국과학기술원 화학과 (학사)
1997 한국과학기술원 화학과 (석사)
2002 한국과학기술원 화학과 (박사)
2002-2006 LG전선 (현 LG이노텍) 디스플레이 연구소 선임
2006-현재 전자부품연구원 디스플레이연구센터 센터장

양자점 고분자 복합체의 다양한 응용 기술 동향

한철종†, 박경원, 이정민 한국전자기술연구원

최근 각광받고 있는 양자점 소재는 기존 형광체의 발광 특성을 뛰어 넘는 색순도, 발광 효율 및 응용 가능성을 지니고 있어 다양한 응용분야가 개발되고 있다. 가장 상업적으로 성공한 LCD 디스플레이용 QDEF 소재를 비롯하여 투명 디스플레이, 에너지 하베스팅 태양전지 및 마이크로 LED용 색변환 소재 등이 대표적인 응용 분야로 들 수 있다. 그러나 이렇게 다양한 양자점의 응용에 있어 단독으로는 사용되기 어렵고 다양한 고분자 수지와의 결합을 통해 사용이 가능하다. 이때 다양한 응용 분야에 있어 복합체의 특성을 극대화 시키기 위한 고분자의 특성에 대해 논의하고 양자점과 응용분야에 최적화 하기 위한 고분자 기술 개발 방향에 대해 고찰한다

2L4-6 이광걸 (Kwang-Geol Lee) (15:25–15:50)

2000 서울대학교 물리학과 (학사)
2007 서울대학교 물리천문학부 (석박사통합)
2008-2011 스위스연방공과대학교 (ETH Zurich), 막스플랑크연구소 (Erlangen, Germany)
2012-2015 한양대학교 물리학과 조교수
2015-현재 한양대학교 물리학과 부교수

Experimental Studies on the Photophysics of Single Fluorescent Emitters

이광걸† 한양대학교 물리학과

Photons emitted from single-emitters have been discussed as the building blocks of optical science and technology. An essential prerequisite for a successful application of single emitters is to study the photon emission characteristics of them like emission spectrum, polarization state, quantum-yield, coherence length, and etc.. A deeper understanding of those properties can be possibly obtained when a single object is dealt with instead in an ensemble state. For example, a detailed energy level structure and the transition probability between levels can be elucidated from statistical analyses of emitted photons from a single-emitter. In this presentation, in addition to other properties, two interesting phenomena of the single photon emission and the fluorescence emission intermittency (often called blinking) will be discussed in more detail.

2L4-7 우주영 (Ju Young Woo) (15:50–16:15)

2012 인하대학교 섬유신소재공학과 (학사)
2014 KAIST 생명화학공학과 (석사)
2018 KAIST 생명화학공학과 (박사)
2018 한국기계연구원 나노응용역학연구실 (Post-Doc.)
2018-현재 한국생산기술연구원 마이크로나노공정그룹 선임연구원

Understanding Surface-Ligand Interactions of All-Inorganic Cesium Lead Halide Perovskite Nanocrystals

우주영†, 임성남, 송신애, 김기영, 김시형 한국생산기술연구원

Over the past few years, all inorganic cesium lead halide perovskite nanocrystals ($CsPbX_3$ NCs where X=Cl, Br, and/or I) have gained immense attention because of their facile solution synthesis, high PL QY, and outstanding color purity. However instability of $CsPbX_3$ NCs seriously impedes broader utilization of them. Recently stability of $CsPbX_3$ NCs was significantly enhanced by introducing additional metal halides during the synthesis, but the role of the additional metal halides have not been revealed for years. Here, the role of additional metal halides in enhancement of stability is demonstrated for the first time. Because of the surface ligand transition with the presence of additional metal halides, difference in formation energy between (100) and (110) surfaces changes dramatically. Finally the enhanced stability of $CsPbX_3$ NCs is interpreted in the context of suppressed formation of merging-vulnerable (110) surfaces with the presence of additional metal halides.

2L4-8 김영훈 (Younghoon Kim) (16:15–16:40)

2008 국민대학교 신소재공학부 (학사)
2010 국민대학교 신소재공학과 (석사)
2014 고려대학교 화공생명공학과 (박사)
2015 고려대학교 화공생명공학과 (Post-Doc.)
2017 토론토대학교 전기전자컴퓨터공학과 (Post-Doc.)
2017-현재 대구경북과학기술원 에너지융합연구부 선임연구원

Colloidal Quantum Dots of Fully-inorganic Cesium Lead Halide Perovskites for Photovoltaic Applications

김영훈† DGIST

Colloidal quantum dots (CQDs) of fully-inorganic cesium lead halide have excellent optical, electrical and optoelectronic properties revealing in bulk perovskites as well as originating from the quantum-size effects. These are receiving much attention as a photoactive material in optoelectronic applications of both solar cells and light-emitting devices because of their simultaneously outstanding energy harvesting and light-emitting features. It has been reported that $CsPbI_3$-QDs are used as a photovoltaic absorber showing the best performance in CQD solar cells. In addition, $CsPbI_3$-QD solar cells show the electroluminescence (EL), indicating that $CsPbI_3$-QDs can simultaneously reveal dual functions within a single device. Here, we demonstrate that the photovoltaic performance of $CsPbI_3$- and $CsPbBr_3$-QD solar cells can be improved by designing the surface ligand manipulations of $CsPbI_3$-QDs.

2L4-9 이정용 (Jung-Yong Lee) (16:40–17:05)

2000 서울대학교 전기공학부 (학사)
2002 서울대학교 전기공학부 (석사)
2010 Stanford University Electrical Engineering (박사)
2010 Stanford University Postdoctoral Researcher
2010 KAIST 조교수
2014-현재 KAIST 부교수

Efficient Colloidal Quantum Dot: Organic Hybrids Solar Cells

이정용† 한국과학기술원

Solution-processed semiconductors are promising materials to realize optoelectronic devices that combine high performance with inexpensive manufacturing. It will be interesting to unite colloidal quantum dots (CQDs) capable of harvesting infrared photons with more strongly absorbing organic molecules. Unfortunately, CQD:organic hybrid photovoltaics have been limited to power conversion efficiencies (PCEs) below 10% because of chemical mismatch and difficulty in facilitating charge collection. Here, we propose a new hybrid architecture that synergistically exploits the benefits of CQDs and organics in photovoltaics by introducing small molecules into a CQD/organic stacked structure The resulting hybrid solar cells exhibit PCEs of 13.1% and retain over 80% of their initial PCE after 150 hours of continuous operation. (1) Lee *et al.*, *Nature Energy*, **4**, 969 (2019).

Korea-Taiwan Joint Symposium: Advanced Polymer Science and Engineering (English) 제5회장 [10월 7일(수)]

Organizer: Moon Sung Kang (Sogang Univ.), Younsoo Kim (POSTECH)

2L5-1 Jeng-Shiung Jan (13:00-13:25)

1994	B.S. National Taiwan University
1996	M.S. National Taiwan University
2002-2006	Ph.D. Texas A&M University
2007-2008	Post-Doc. Georgia Institute of Technology
2008-2012	Assistant Professor, National Cheng Kung University, Taiwan
2012-2016	Associate Professor, National Cheng Kung University, Taiwan
2016-Present	Professor, National Cheng Kung University, Taiwan

Synthesis and Hydrogelation of Polypeptide-Based Polymers

Jeng-Shiung Jan†, Xuan-You Shen, Chen-Chi Tang Department of Chemical Engineering, National Cheng Kung University

Polypeptide-based copolymers recently have attracted increasing interest due to their biodegradability/biocompatibility, ordered chain conformation, stimuli-responsiveness, and possibly biological functions. We report the synthesis and hydrogelation of block copolypeptides in solution. The hydrogelation was determined by the packing of the polypeptide assemblies, dictated by the balance between the intermolecular hydrogen bonding interactions and charge repulsion exerted respectively by sheet-like and positively charged polypeptide segments. These noncovalent interactions can be manipulated by varying polypeptide chain composition and conformation as well as topology, which governed their critical gelation concentration, gel molecular assembly, and gel mechanical property. This study reveals that sheet-like segments can trigger the self-assembly and hydrogelation of polypeptides.

2L5-2 차채녕 (Chaenyung Cha) (13:25-13:50)

2001-2007	한국과학기술원 화학과 (학사)
2007-2011	University of Illinois, Urbana-Champaign 화학과 (박사)
2012-2014	Brigham and Women's Hospital, Harvard Medical School (Post-Doc.)
2014-현재	울산과학기술원 신소재공학부 교수

In Situ Forming Hydrogels with Tunable Mechanics for Biomedical Applications

차채녕† 울산과학기술원

Hydrogels are widely used as scaffolds for biomedical applications including tissue engineering and drug delivery. Hydrogels are generally developed by crosslinking hydrophilic monomers (or macromonomers). Since many crosslinking reactions themselves or additives (e.g. initiators and catalysts) often display cytotoxicity, it is desirable to employ "in situ" crosslinking reactions which occurs under mild conditions and does not involve the use of initiator. Herein, biocompatible hydrogels developed by Schiff base formation that are readily formed under physiological condition and capable of are presented; (1) poly(ethylene glycol) diacrylate (PEGDA) – polyethyleneimine hydrogels, (2) PEGylated chitosan – PEG dialdehyde hydrogels, and (3) alginate – polyaspartamide hydrogels. Their physicomechanical properties controlled via physical parameters (e.g. polymer concentration, molecular weight, and graft density) as well as biocompatibility are evaluated.

2L5-3 Yi-Cheun Yeh (13:50-14:15)

2005	B.S. National Taiwan Normal University, Taiwan
2007	M.S. National Taiwan Normal University, Taiwan
2014	Ph.D. University of Massachusetts at Amherst, USA (advisor: Vincent Rotello)
2017	Post-Doc. University of Pennsylvania, USA (advisor: Jason Burdick)
2017	Assistant Professor, Tunghai University, Taiwan
2018-Present	Assistant Professor, National Taiwan University, Taiwan

Fabrication of Photocurable and Elastomeric Poly(glycerol sebacate)-*co*-Poly (ethylene glycol) Hydrogels

Yi-Cheun Yeh† Institute of Polymer Science and Engineering, National Taiwan University

We developed a new type of photocurable and elastomeric hydrogels using bio-compatible and biodegradable norbornene-functionalized poly(glycerol sebacate)-*co*-poly(ethylene glycol) (Nor_PGS-*co*-PEG) copolymers. Nor_PGS-*co*-PEG macromers can be crosslinked using 2,2'-(ethylenedioxy)diethanethiol to prepare hydrogels in the presence of light and photoinitiator. The properties (*i.e.* mechanical property, swelling ratio and degradation rate) of Nor_PGS-*co*-PEG hydrogels can be modulated using different amount of crosslinkers. In particular, the elongation of Nor_PGS-*co*-PEG hydrogels can be modulated up to 950%, making it a promising stretchable biomaterials for applications in wound dressing and wearable devices. Nor_PGS-*co*-PEG hydrogels have been successfully demonstrated in the fabrication of microfibrous scaffolds and 3D printed structures, expanding the utility of PGS-*co*-PEG materials in biomedical filed using biofabrication techniques. In addition, the cytocompatibility of Nor_PGS-*co*-PEG was also investigated using in vitro cellular viability studies. Taken together, we have demonstrated that Nor_PGS-*co*-PEG is an elastomeric biomaterial with highly tailorable properties, making it a versatile hydrogel model for specific applications.

2L5-4 이근형 (Keun Hyung Lee) (14:15-14:40)

2007	서울대학교 화학생물공학부 (학사)
2012	University of Minnesota 화학공학 (박사)
2012-2014	UC Berkeley 재료공학 (Post-Doc.)
2014-현재	인하대학교 화학공학과 부교수

Highly Conductive Polymer Gel Electrolytes for Deformable Thin-film Devices

이근형† 인하대학교

Highly conductive and nonvolatile polymer gel electrolytes based on ionic liquids, known as ionogels or ion gels, have attracted significant research attention as promising candidates for various electrochemical devices due to their outstanding properties including negligible vapor pressure, wide electrochemical stability window, high ionic mobility, and high specific capacitance. The resulting ion gels were successfully employed in flexible supercapacitors as electrolyte membranes primarily due to their wide electrochemical stability window. By using the ion gel electrolytes energy, storage performance of the supercapacitor was significantly improved. These ion gels were also incorporated in electrolyte gated thin-film transistors as a gate dielectric layer because of their high capacitance originated from the nanometer-thick electrical double layers. Ion gel gated thin-film transistors operated at low voltages below 1 V with high on/off current ratios.

2L5-5 박정태 (Jung Tae Park) (15:00-15:25)

2007	연세대학교 화학공학과 (학사)
2012	연세대학교 화학공학과 (박사)
2012	UPenn, Chem. & Bio. Eng. (Visiting Scholar)
2014	MIT, Chem. Eng. (Post-Doc.)
2015	전북대학교 유연인쇄전자공학과 조교수
2016-현재	건국대학교 화학공학부 조교수, 부교수

Advanced Energy Conversion and Storage Devices Using Double Comb Copolymers

박정태† 건국대학교

New materials hold the key to fundamental advances in energy conversion and storage, both of which are vital in order to meet the challenge of global warming and the finite nature of fossil fuels. Double comb copolymers offer unique properties or combinations of properties as electrodes and electrolytes in a range of energy conversion and storage devices. Also, one of the key challenges facing the widespread use and commercialization of promising energy conversion and storage devices (i.e. solar cells, photoelectrochemical cells, electrochemical cells, supercapacitors etc.) is the high cost of the electrode and electrolyte materials and inefficiencies in their assembly and utilization. In this talk, I will present examples of how we are designing double comb copolymers that can be incorporated into multifunctional composites for high performance energy conversion and storage devices.

2L5-6 Chien-Lung Wang (15:25-15:50)

1999	B.A. National Taiwan Normal Univ.
2001	M.S. National Taiwan Univ.
2011	Ph.D. Univ. of Akron
2011	Post-Doc. Xiong Gong, Univ. Minnesota
2011-2015	Assistant Professor, National Chiao Tung University
2015-2019	Associate Professor, National Chiao Tung University
2019-Present	Professor, National Chiao Tung University

Influences of Structure Defects on the Performances of Solution-Processed OFET

Chien-Lung Wang†, Yi-Fan Huang, Kuan-Yi Wu, Chou-Ting Hsieh Department of Applied Chemistry, National Chiao Tung University

The quality of charge-transport channel strongly affects the performances of organic field-effect transistors (OFET). To achieve higher charge mobility, solution-processed single-crystal (SPSC) techniques have been used to build up crystal arrays of conjugated molecules as effective charge-transport channels. Nevertheless, subtle structural defects in the crystal arrays truncate the charge-transport pathway and affect the OFET mobility. In this presentation, characterization procedures to identify the low-angle grain boundary (LAGB), polymorphism, and crystallinity of the crystal arrays of conjugated molecules will be demonstrated. Following that, the influences of lattice alignment, packing structure and crystallinity on the OFET mobility will be discussed. It was found that (1) unification the lattice orientation and packing structure, and (2) continuity of the crystalline domain play important roles in the performances and reproducibility of the solution-processed OFETs.

2L5-7 서명은 (Myungeun Seo) (15:50-16:15)

2002	KAIST 화학과 (학사)
2004	KAIST 화학과 (석사)
2008	KAIST 화학과 (박사)
2008-2009	KAIST 화학과 (Post-Doc.)
2009-2013	University of Minnesota 화학과 (Post-Doc.)
2013-현재	KAIST 나노과학기술대학원 조교수, 부교수

PIMS-Based Nanoporous Polymer Membrane: How Small Can We Go?

서명은† KAIST

Polymerization-induced microphase separation (PIMS) is a process where a growth of a polymer chain from the end of a different polymer produces an emergent block polymer and spontaneously induces microphase separation in the polymerization mixture at a critical conversion. Typically, reversible addition-fragmentation chain transfer (RAFT) copolymerization of a monomer and a cross-linker in the presence of a macro-chain transfer agent (macro-CTA) produces yields a cross-linked block polymer consisting of a disordered bicontinuous morphology at a nanometer scale. In this talk, I will discuss how to control the domain size in the PIMS process towards fabrication of permselective membranes, and also our efforts to lower the limit of accessible pore size.

2L5-8 Han-Yu Hsueh (16:15-16:40)

2005	B.S. National Tsing Hua University
2007	M.S. National Taiwan University
2011	Ph.D. National Tsing Hua University
2014	Post-Doc. National Tsing Hua University
2015	Post-Doc. University of Massachusetts Amherst
2016	Principal Engineer, TSMC
2016-Present	Assistant Professor, National Chung Hsing University

Macroscopic Geometry-Dominated Orientation of Symmetric Microwrinkle Patterns and Their Applications

Han-Yu Hsueh† Department of Material Science and Engineering, National Chung Hsing University

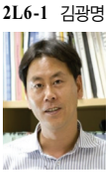
In recent decades, people in different fields attach great importance to mechanical instabilities in soft materials, specifically buckling, owing to their simplicity, low cost, and applicability to arbitrary surface morphologies. Here we will demonstrate a wet release-induced strategy to fabricate symmetric buckles with precisely-controllable pattern dimensions and orientations. The wet release-induced method is based on the release from polymeric sacrificial layers in solutions and crosslinking contraction of the elastomer substrates. Crosslinking contraction leads to the development and stabilization of surface buckling morphology, and a polymeric sacrificial layer provides a mild and simultaneous release process to form orientated wrinkles. Stable wrinkles fabricated from various materials including metals, ceramics, and carbons can be achieved. Those new approaches should give rise to an easy yet competitive way for fabrication of cost-effective, mold-free, large-area, and well-ordered buckled surface through the wet release-induced buckle formation process for broad use in practical applications, such as dry adhesives, antifouling coatings, superhydrophobic layers, and cell alignment.

의료용 고분자 부문위원회 (II) | Biomedical Polymers Division (II)

제6회장 [10월 7일(수)]

Organizer: 한동욱(부산대), 이용규(한국교통대), 양승윤(부산대)

2L6-1 김광명 (Kwangmeyung Kim) (13:00-13:25)



1997	성균관대학교 화학공학 (학사)
1999	광주과학기술원 신소재공학 (석사)
2003	광주과학기술원 신소재공학 (박사)
2005-2011	한국과학기술연구원 선임연구원
2011-현재	한국과학기술연구원 책임연구원

Cancer-specific Prodrug Nanoparticles for Cancer Targeting Therapy

김광명† Korea Institute of Science and Technology (KIST)

Cancer nanomedicine using nanoparticle-based delivery system has shown outstanding promise for improving anticancer treatment for last decades. However, the limited targeting efficiency, lower drug loading efficiency and innate toxicity of nano-sized drug carriers caused severe problems so that there are few clinically available. Here, we newly developed a self-assembled and tumor cell-specific prodrug containing tumor cell-overexpressed cathepsin B-cleavable peptide and doxorubicin (DOX), which can form stable nanoparticle structure without any natural and synthetic drug carriers. Our new carrier-free nanoparticles can solve many serious problems of current drug carriers including the lower drug lading efficiency, toxicity of nanoparticle itself, limited targeting efficiency, and quality control of mass production of nanoparticles for clinical applications.

2L6-2 최종훈 (Jonghoon Choi) (13:25-13:50)

2004	서울대학교 화학생물공학부 (학사)
2008	메릴랜드대학교 화학생물공학과 (박사)
2009-2012	MIT 화학공학과 (Post-Doc.)
2012-2013	한국과학기술연구원 의공학연구소 선임연구원
2013-2015	한양대학교 ERICA 생명나노공학과 조교수
2016-현재	중앙대학교 융합공학부 부교수

Lectin-Janus Nanoparticles for the Exosome-mediated Diagnosis of Metastatic Pancreatic Cancer

최종훈†, 최용현 중앙대학교

This study introduces the pancreatic cancer cell-derived exosome detection technology, which is based on the specific binding of lectins to distinctive glycan profiles on the surface of exosomes. Lectins with a high and specific affinity for sialic acid or fucose were attached to bifunctional Janus nanoparticles (JNPs), which facilitated interactions with pancreatic cancer cell-derived exosomes in a microfluidic device. Here, we show that pancreatic cancer cell-derived exosomes from two cell lines and plasma samples collected from patients diagnosed with pancreatic cancer were successfully captured on the lectin-conjugated JNPs with affinities that were comparable to those of CD19-9, a conventional antibody. In addition, exosome detection using our platform was able to differentiate between metastatic and nonmetastatic pancreatic cancer cells.

2L6-3 임성갑 (Sung Gap Im) (13:50-14:15)

1997	서울대학교 화학공학과 (학사)
1999	서울대학교 화학공학과 (석사)
2009	MIT 화학공학과 (박사)
1999-2004	LG화학/LG Display 연구원
2009-2010	Harvard Medical School/Research Fellow
2010-현재	KAIST 생명화학공학과 교수

Vapor-phase Synthesized Functional Polymer Films for Conformal Modification of the Biochip Surfaces

임성갑† KAIST

A new polymer deposition method, the initiated chemical vapor deposition (iCVD), was utilized for fabrication of novel thin film materials and structures. The iCVD is a process that can deposit functional polymer films with the exceptional compositional control and conformality. The solvent-free process provides non-toxic coatings of anti-microbial, superhydrophobic, functionalizable, insulating, and bio-compatible polymers without damaging underlying substrates. With this versatile tool, we are exploiting the possibility of the functional polymer coatings to develop next-generation of engineering devices. In this presentation, we are focusing on the application of functional polymer coatings to the conformal surface modification of various biochip devices.

2L6-4 강선웅 (Sun Woong Kang) (14:15-14:40)

2002	한양대학교 화학공학과 (학사)
2004	한양대학교 화학공학과 (석사)
2008	한양대학교 화학공학과 (박사)
2009	유타대학교 (Post-Doc.)
2012	KIST (Post-Doc.)
2013-현재	안전성평가연구소 책임연구원

Applications of Hyaluronic Acid Particles for 3D Cell Culture and Tissue Regeneration

강선웅†, 박경환, 허강무[1] 안전성평가연구소; [1]충남대학교

히알루론산은 세포외기질(extracellular matrix, ECM)을 구성하는 지지체에 존재하는 글리코스아미노 글리칸(glycosamino glycan)중의 하나로 세포의 운동성, 세포분화 및 상처치유에 있어 중요한 역할을 하고 있다. 또한, 우수한 생체적합성을 갖고 있어 조직공학(Tissue Engineering)과 약물전달시스템(Drug delivery system) 등의 다양한 분야에 활용되고 있다. 본 연구에서는 히알루론산 미립구를 이용한 삼차원 배양과 연골, 심장, 간 조직 등의 재생을 위한 화학적으로 가교된 히알루론산의 다양한 활용법에 대해 살펴보고자 한다.

2L6-5 노인섭 (Insup Noh) (15:00-15:25)

1989	건국대학교 섬유공학과 (학사)
1995	Univ. of Texas at Austin화학공학과 (석사)
1995-1997	California Institute of Technology 화학공학과 (Special Graduate Student)
1997	Univ. of Texas at Austin 화학공학과 (박사)
1997-1999	Harvard Univ-MIT Health Science and Technology (Post-Doc.)
1999-현재	서울과학기술대학교 화공생명공학과 교수

Highly Stretchable Self-healing Co-polymeric Gel Controlled by Molecular Interactions Between Acrylic Acid and Methyl Methacrylate

노인섭† 서울과학기술대학교

Functional hydrogel with highly stretchable, self-healable, and adhesive co-polymeric gel (PAA-PMMA gel) was synthesized from the immiscible acrylic acid (AA) and methyl methacrylate (MMA). The self-healing property is triggered by the hydrophobic interaction, as well as the breakdown and reformation of sacrificial noncovalent crosslinking through the weak hydrogen bonds. The gel shows simultaneously improved energy dissipation and excellent adhesiveness to the surfaces of polystyrene, glass, wood, metal, stone, ceramics, skins. Furthermore, the calcium phosphate mineralization yielded a hydrogel with enhancement of MC3T3 cell adhesion and proliferation. Overall, the PAA-PMMA gel could employed for diverse applications based on the synthesis parameters.

2L6-6 박귀덕 (Kwideok Park) (15:25–15:50)

1994 한양대학교 화학과 (학사)
2001 Univ. of Iowa 의공학과 (박사)
2002-2004 Univ. of Memphis/VA Medical Center (Post-Doc.)
2007-2010 한국과학기술연구원 선임연구원
2011-현재 한국과학기술연구원 책임연구원
2012-현재 과학기술연합대학원대학(UST) 교수

Enabling Technology of Cell-derived Extracellular Matrix for Advanced Tissue Repair

하상수, 김인걸[1], 최동훈[2], 박귀덕† Center for Biomaterials, Korea Institute of Science and Technology/Division of Bio-Medical Science and Technology, KIST School, University of Science and Technology (UST); [1]Department of ENT, Seoul National University Hospital; [2]Cardiology Division, Severance Cardiovascular Hospital, Yonsei University

Extracellular matrix (ECM) is a complex but highly organized network of macromolecules that plays a critical role in cell adhesion, migration, and differentiation. While the effects of individual ECM component, *i.e.*, collagen, fibronectin, or laminin have been well documented, the real face of a physiologically relevant ECM is much less understood, due mainly to the lack of proper resource and limited enabling technology. To address such issue, we have investigated the impact of cell-derived ECM (CDM) that is obtained from in vitro-cultured cells via decellularization process. This naturally derived self-assembled CDM-based enabling technology is introduced in this talk. We physically combine biocompatible polymer and CDM together and eventually develop an ECM patch that seeks advanced tissue repair, including cardiovascular, skin wound, and cornea. We envision a new class of therapeutic patches based on natural ECM toward regenerative applications.

2L6-7 김장호 (Jangho Kim) (15:50–16:15)

2006 전남대학교 생물산업공학과 (학사)
2009 서울대학교 바이오시스템공학전공 (석사)
2009-2010 일리노이대학교 컴퓨터전기공학과 연구원
2014 서울대학교 바이오시스템공학전공 (박사)
2015-현재 전남대학교 지역 · 바이오시스템공학과 부교수

Multiscale Biomimetic Approaches for Regulation of Cell Function and Tissue Regeneration

김장호† 전남대학교

Living cells are exposed to complex and functional microenvironment including soluble macromolecules, biophysical cues, and interactions between cell-cell and cell-extracellular matrix (ECM). This suggests that the design and manipulation of engineered cellular microenvironments is great important in a wide variety of biological applications such as medicine, and developing *in vitro* disease models. Compared with the effects of soluble macromolecules and biophysical cues, the extent and importance of architecture of ECMs or tissue in defining cellular function are currently poorly understood. Namely, the architecture effects of ECMs or specific tissues are mainly neglected or minimized as a considering factor for most *in vitro* and *in vivo* experimentaton. In this talk, I will present multidisciplinary efforts directed towards the development of multiscale engineerd biomimetic systems for biomedical applications.

2L6-8 박윤신 (Yoon Shin Park) (16:15–16:40)

1995, 1997 성신여자대학교 식품영양학과 (학사, 석사)
2002 성신여자대학교 식품영양학과 (박사)
2002-2010 질병관리본부 국립보건연구원 생명의과학센터 보건연구사
2008-2011 미시간대학교 약학대학, 의과대학 의공학과 연구교수
2012-2016 이화여대 의과학연구소 분자의과학교실 연구교수
2016-현재 충북대학교 생명시스템학과 부교수

Sustained Release of Reactive Oxygen Species via *in situ* Cross-linking Gelatin Hydrogels Attenuates Tonsil-derived Mesenchymal Stem Cells Senescence by Redistribution of Glucose-regulated Protein

박윤신† 충북대학교 자연과학대학 생명과학부

Accumulating evidence suggests that reactive oxygen species (ROS) is toxic by-products of aerobic metabolism that are harmful to living cells, cell death and senescence. Hence, the low level of stress produced by ROS can promote the cell proliferation and control senescence. In this regard, we examined the association of mesenchymal stem cells (MSC) senescence with sustained ROS release in biomimetic environmental culture using ROS releasing in situ forming hydrogel system using tonsil-derived MSC (TMSC). We divided experimental groups into two groups as follows; young TMSC (3 ~ 8p) and old TMSC (15 ~ 25p), individually. Decreased protein expression of glucose-regulated protein (GRP) in old TMSC, an ER stress-related factor, was recovered with mild-ROS environment by sustained ROS releasing 3D culture condition. Here, we suggest that the mild level of ROS releasing hydrogel system can control TMSC senescence as well as ER stress of TMSC by regulation of the GRP protein expression and intra/extracellular distribution.

기능성 고분자 | Functional Polymer

제7회장 [10월 7일(수)]

Organizer: 곽효원(서울대), 윤현석(전남대)

2L7-1 박치영 (Chiyoung Park) (13:00–13:25)

2003 인하대학교 화공고분자생물공학부 (학사)
2005 인하대학교 고분자공학과 (석사)
2008 인하대학교 고분자공학과 (박사)
2015-2017 한국과학기술연구원 선임연구원
2017-2019 부경대학교 공업화학과 조교수
2019-현재 DGIST 에너지공학과 조교수

Mechano- and Electro-Active Nanocapsules and Elastomeric Patches

박치영† DGIST

We report a series of nanocage-composites tailored with coordination network, which can exhibit mechanochemically and electrochemically responsive release characteristics for guest payloads. The guest molecules are entrapped into the porous channels of mesoporous silica nanoparticles (MSNs), and the exterior was simply wrapped with coordination network to stabilize entrapped guests. The resulting nanocomposite exhibited guest release characteristics by dissociation of the coordination complexes induced by ultrasound. Integration of the nanocapsules with polymer matrixes enabled a series of responsive composites capable of successive guest release from the channels of MSNs upon repeated ultrasounds, compressions, or electrical input.

2L7-2 박종진 (Jong Jin Park) (13:25–13:50)

1989 인하대학교 고분자공학과 (학사)
1995 한국과학기술원 신소재공학과 (석사)
1999 한국과학기술원 신소재공학과 (박사)
2002-2014 삼성전자 종합기술원 Master
2014-현재 전남대학교 고분자융합소재공학부 교수

Wearable Multimode Sensors Using Textile Structure for Detecting Human Body Signals

박종진† 전남대학교

In this study, a new wearable multimode sensor based on textile structure with pre-strained monofilament was proposed, which features two modes. First, the vibration mode detects bio-signals from voice printing, respiration and blood pulse. Second, the tensile and compression mode, which detects signals from body movement based on pressure of fingertip and gait, four movement of neck, and joint movement (elbow and knee). Previous research studies mainly focused on investigation on how to enhance the output performance of piezoelectric PVDF film via nanostructure. However, this study explores how macro-sized textile structure can improve the piezoelectric performance of PVDF film and the sensitivity of conductive yarn patterned textile. The multimode sensor utilizes the pre-strained monofilament of textile structure as a pressure transmitter to create amplified strain resulting from multi-local strain (MLS) in PVDF film in order to improve the PVDF piezoelectric performance.

2L7-3 이승애 (Seungae Lee) (13:50–14:15)

2007-2011 한양대학교 화학공학과 (학사)
2011-2016 서울대학교 화학생물공학부 (박사)
2016-2018 노스웨스턴대학교 재료공학과 (Post-Doc.)
2018-현재 건국대학교 화학공학부 조교수

Conducting Polymer-based Stimuli-responsive Smart Fluids

이승애† 건국대학교

Conducting polymer-based core-shell-structured particles are prepared and adopted for stimuli-responsive smart fluids. Smart fluids composed of conducting polymer-based particles exhibit outstanding electro-responsive performances, ascribed to their low density, intrinsic polarizability, geometric features and facile change in electrical conductivity. Furthermore, the magnetite is composited with conducting polymers so that the fluids show controllable rheological characteristics in response to the external magnetic fields as well as electric fields. Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2019R1C1C1007578) and the Technology Innovation Program (20004627) funded By the Ministry of Trade, Industry & Energy (MOTIE, Korea).

2L7-4 신근영 (Keun-Young Shin) (14:15–14:40)

2008 연세대학교 전기전자공학 (학사)
2014 서울대학교 화학생물공학부 (석박사통합)
2014-2016 한국과학기술연구원 (Post-Doc.)
2016-2017 연세대학교 전기전자공학 BK연구교수
2017-2020 한림대학교 융합신소재공학과 조교수
2020-현재 숭실대학교 유기신소재파이버공학과 조교수

Fabrication of Highly Conductive Polymer Hybrid Nanomaterials for High Performance

Flexible Radio-frequency Antenna Application

신근영† 숭실대학교

Rapid advances in wireless communications using radio frequency antennas to transfer data have led to the development of ubiquitous sensor networks that build on the embedding of small devices into daily objects. Large efforts have been devoted to the fabrication of flexible, miniaturized, and reliable antennas. In this presentation, we describe a novel route toward the fabrication of highly conductive polymer hybrid nanomaterials for high performance flexible radio-frequency antenna application. Furthermore, various line patterning techniques such as inkjet, screen printing and spray coating have been introduced for the fabrication of antenna electrode. Acknowledgements: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (NRF-2020R1F1A1048868).

2L7-5 현진호 (Jinho Hyun) (15:00–15:25)

1993	서울대학교 천연섬유학과 (학사)
1995	서울대학교 천연섬유학과 (석사)
1995	North Carolina State University (Materials Science and Engineering) (Ph.D.)
2004-2008	Duke University, Department of Biomedical Engineering (Research Assistant Professor)
2004-현재	서울대학교 바이오시스템 · 소재학부 교수

Shape Control of Cellulose Nanofiber Hydrogels

현진호† 서울대학교

A hydrogel ink was prepared by mixing an incubation medium, bacteria, and cellulose nanofibers (CNFs). CNFs modified the rheological properties of hydrogel ink for the efficient 3D printing. Viscous inks containing the biocompatible rheology modifier have been used to form a variety of features on substrates via direct 3D printing. However, printed gel structures are easily deformed by gravity and contact with substrates flattens the features. In addition, it is not possible to permeate oxygen which is essential for aerobic biosynthesis. PTFE microparticle matrix enabled an oxygen-permeable surface of culture medium and diverse 3D structures of tubular bacterial cellulose (BC) were fabricated. The mechanical strength of tubular CNF/BC was enhanced by ionic crosslinking and a biocompatible tube was successfully applied to mass flow mimicking blood streaming and vascular tissue engineering without leakage.

2L7-6 김병석 (Byoung-Suhk Kim) (15:25–15:50)

1993	전북대학교 섬유공학과 (학사)
1995	전북대학교 섬유공학과 (석사)
1999	홋카이도대학 이학연구과 (박사)
2008-2011	Shinshu University, Faculty of Textile Science and Technology (Global COE Researcher)
2012-현재	전북대학교 유기소재파이버공학과 교수

Nanofiber-Based Flexible Transparent Composite Electrodes for Wearable Electronics

김병석†, 이승희, 고태훈 전북대학교

In recent years, flexible transparent electrodes have attracted great attention in many wearable optoelectronic devices, such as touch screens, organic light-emitting diodes, solar cells, electronic skins, renewable energy, displays etc. The basic requirements for foldable transparent electrodes are optical transparency, low electrical resistance, and high level of extreme bending toughness without significant decrease in the electrical performance. In this work, we report a novel approach for the fabrication of nanofiber-reinforced highly transparent and extremely foldable electrodes and its potential applications, such liquid crystal smart windows, energy storage devices, and chromic displays.

2L7-7 이병선 (Byoung-Sun Lee) (15:50–16:15)

2007	서울대학교 재료공학부 (학사)
2009	서울대학교 재료공학부 (석사)
2012	서울대학교 재료공학부 (박사)
2013-2016	삼성종합기술원 전문연구원
2016-2018	University of California, Department of Nanoengineering (Post-Doc.)
2019-현재	생산기술연구원 선임연구원

A Low Cost Cationic Selective Ion-exchange Membrane for Rechargeable Zinc Batteries

이병선† 단국대학교 고분자시스템공학부 파이버융합소재전공

Development of aqueous rechargeable batteries has been forced owing to safety issue of current Li rechargeable batteries. Multi-valent Zn-ion batteries have been emerged as promising candidate of the Li-ion batteries alternatives because of its abundance, safety, and electrochemical property. Zn-ion chemistry have been successfully commercialized as primary batteries for ear-aid power source applications, but dendrite formation on zinc anodes during charging prevents enough cycling performances of zinc rechargeable batteries. Unregulated ionic deposition on Zn anode surface due to nonselective ion transport has been recognized as the most critical cause of dendrite formation. Thus, cationic selective ion-exchange membrane can be the best option for regulating ionic deposition behavior to improve cyclability. In this presentation, a low cost cationic selective ion-exchange membrane for dendrite suppression will be thoroughly introduced.

2L7-8 강 효 (Hyo Kang) (16:15–16:40)

2004	중앙대학교 화학신소재공학부 (학사)
2010	서울대학교 화학생물공학부 (박사)
2010-2014	삼성종합기술원 전문연구원
2014-2015	서울대학교 화학생물공학부 (Post Doc.)
2015-현재	동아대학교 화학공학과 부교수

Thermo-responsive Polymeric Materials for Water Treatment Application

강 효† 동아대학교

Recently, among the water treatment technologies, the forward osmosis (FO) system has been received much attention due to the advantages in energy consumption. However, the practical application of the FO system has been limited because of the remaining obstacles such as the absence of both adequate draw solute and efficient membrane. In this study, polymers having lower critical solution temperature (LCST) and upper critical solution temperature (UCST), one of the thermo-responsive characteristics, are used as the draw solutions. These materials could be recovered easily by heating them to above their LCST and to below their UCST, respectively. Finally, we believe that our results will provide insight into the synthesis of thermo-responsive draw solutions for water treatment applications.

분자전자 부문위원회 (II) | Molecular Electronics Division (II)

제8회장 [10월 7일(수)]

Organizer: 박상혁(공주대), 오진우(부산대), 윤명한(GIST)

2L8-1 송명관 (Myungkwan Song) (13:00–13:25)

2004	동국대학교 화학과 (학사)
2006	동국대학교 화학과 (석사)
2011	부산대학교 화학과 (박사)
2011-2013	재료연구소 (Post-Doc.)
2013-현재	재료연구소 책임연구원

Recent Progress and Challenges of Fiber Dye-sensitized Solar Cells

송명관†, 최진우 재료연구소

Fiber-shaped solar cells have attracted significant attention for their potential applications in portable and wearable electronics. Developing highly efficient and stable fiber-shaped dye-sensitized solar cells is a research challenge. Fiber-shaped solar cells are lightweight, super-flexible, formable, and foldable. Thus, they could be ideal power-harvester alternatives to common flexible solar cells required in smart textiles, electronic textiles, and wearable electronic devices. This review displays a brief overview on fiber-shaped and it introduces the most recent research reports on the different types of Fiber-shaped solar cells, including details on their fabrication techniques. It also addresses the current challenges and limitations of their technology development, and the encountered issues for their future application and integration in novel devices.

2L8-2 이윤구 (Youngu Lee) (13:25–13:50)

1996	서울대학교 화학과 (학사)
1998	서울대학교 화학과 (석사)
1998-2003	LG화학 기술연구원 연구원
2008	The University of Chicago 화학과 (박사)
2008-2011	삼성전자 책임연구원
2011-현재	DGIST 에너지공학전공 부교수

High-Resolution Patterning of Metal Nanowire Based Electrodes for Flexible and Stretchable Electronic Devices

이윤구† 대구경북과학기술원

Metal nanowires such as silver nanowires (AgNWs) and copper nanowires (CuNWs) have received considerable attention as novel materials for flexible and stretchable transparent electrodes (TCEs). However, it is still difficult to utilize metal nanowires as electrodes for integrated electronic devices due to the lack of a suitable micropatterning process. Recently, various printing technologies such as inkjet, screen, flexographic, and gravure printings have received considerable attention as promising patterning techniques. However, they have critical limitations in achieving micrometer-scale fine line width, sharp line edge and uniform thickness. Therefore, new printing technology should be developed to achieve high-quality and high-resolution micropatterning of metal nanowire based TCEs. Here, I will present a high-resolution and large-area patterning of metal nanowire based TCEs using reverse offset printing and photonic sintering for flexible and stretchable electronic devices.

2L8-3 김범준 (Bumjoon Kim) (13:50–14:15)

1994-2000 서울대학교 화학공학과 (학사)
2006 UCSB 화학공학과 (박사)
2008 UC Berkeley (Post-Doc.)
2019 Georgia Tech 방문교수
2008-현재 KAIST 생명화학공학과 조교수, 부교수, 교수

Influence of Acceptor Type and Polymer Molecular Weight on the Mechanical and Photovoltaic Properties of Polymer Solar Cells

김범준† 한국과학기술원

The mechanical robustness of polymer solar cells (PSCs) is of great importance to ensure the long-term stability and enable their use as power-generators in flexible and stretchable electronics. Here, we present a comparative study of the mechanical properties of small-molecule acceptor (SMA)-based, polymer acceptors (PA)-based, and fullerene-based PSCs. To understand the difference between the mechanical properties of SMA-based and PA-based PSCs, we control the number-average molecular weight (Mn) of P(NDI2OD-T2) from 15 to 163 kg mol−1 in all-PSCs. The superior mechanical robustness of all-PSCs is attributed to using a PA above the critical molecular weight (Mc), which produces tie molecules and polymer entanglements that dissipate substantial mechanical strain energy with large plastic deformation. The connectivity between the crystalline domains generated by PA tie chains leads to high charge mobilities and photovoltaics performances of all-PSCs.

2L8-4 송영민 (Young Min Song) (14:15–14:40)

2004 연세대학교 의용전자공학과 (학사)
2006 광주과학기술원 정보통신공학과 (석사)
2011 광주과학기술원 정보기전공학부 (박사)
2011-2013 일리노이대 재료공학과 (Post-Doc.)
2013-2016 부산대학교 전자공학과 조교수
2016-현재 광주과학기술원 전기전자컴퓨터 부교수

플렉서블 소자 응용을 위한 초박형 컬러 구현 및 위조방지필름

송영민† 광주과학기술원

광소자 및 광부품에서 흔히 이용되는 고투과 구조 또는 발색구조는 주로 유전체 박막에서 발생하는 빛의 보강 또는 상쇄간섭을 이용한다. 한편, 최근에는 금속과 유전체의 혼합 또는 금속과 초박형 광흡수성 필름의 조합을 통해 고반사/무반사 등 원하는 광학적 특성을 나타내는 연구가 활발히 연구되고 있으며, 매우 얇은 두께로 구성되기 때문에 플렉서블 소자 응용을 위한 기반기술로 활용되고 있다. 그러나, 각 재료의 조합에 따른 물성 분석에 대한 소개는 많이 이루어지고 있는 반면, 그 이론적 배경이나 광학적 특징을 이용한 분야 확장에 대한 소개는 거의 없는 실정이다. 본 발표에서는 초박막 필름의 발색구조에 대한 이론적 배경과 몇 가지 실험결과를 소개한다. 특히 초박막 필름의 색상을 변화시키고자 할 때 이루어지는 다공성 매질의 이방성 특징을 활용한 편광 의존형 색상변화 기술에 대해서 다루며, 이를 위조방지 필름에 적용하고자 하는 응용방식에 대해서도 언급한다. 또한, 초박막 필름의 외부 환경에 따른 색상변화를 활용한 비색감지 센서로의 응용에 대해서도 다룬다.

2L8-5 정인환 (In Hwan Jung) (15:00–15:25)

2006 KAIST 화학과 (학사)
2008 KAIST 화학과 (석사)
2011 KAIST 화학과 (박사)
2011-2014 University of Chicago 화학과 (Post-Doc.)
2014-2017 한국화학연구원 선임연구원
2017-현재 국민대학교 응용화학부 조교수

High-detectivity Organic Photodetectors by Development of Novel Conjugated Polymers

정인환† 국민대학교

The p-n junction organic photodetectors (OPDs) have been actively studied to achieve high-resolution image sensors. In terms of development of organic materials, it is most important to realize the materials capable of generating a low dark current density (Jd) and high photo-induced current density (Jph) in the OPDs, which is crucial for high-detectivity and responsivity in OPDs. In this study, the conjugated polyelectrolytes and polymers were designed and synthesized to increase Jph as well as decrease Jd in the devices. The synthesized cathode buffer layer materials was coated on the electron transporting layer (ETL), which dramatically enhanced the photodiode properties via modifying the work function of the ETL and improving the surface contact properties between ETL and active layer. In case of active layer, the lamellar ordering of conjugated polymer was highly important to suppress Jd and increase Jph in the devices. The detailed discussion will be given in the presentation.

2L8-6 우상혁 (Sanghyuk Wooh) (15:25–15:50)

2006 서울대학교 화학생물공학부 (학사)
2008 서울대학교 화학생물공학부 (석사)
2013 서울대학교 화학생물공학부 (박사)
2014-2016 Max Planck Institute for Polymer Research (Post-Doc.)
2017 Max Planck Institute for Polymer Research (Group Leader)
2017-현재 중앙대학교 화학신소재공학부 조교수

Evaporation Driven Surface-Templated Supraparticle Synthesis

우상혁† 중앙대학교

Supraparticles have been synthesized by solution process which is difficult to control shapes, sizes and materials. Even though supraparticles have great functionalities and potentials, this limited shape, size and material have been serious huddles of supraparticle researches. Recently we have developed a strategy to synthesize spherical supraparticles on superamphiphobic surfaces with various sizes and components. Due to the strong liquid repellency of superamphiphobic surface, spherical supraparticles could be formed by drying of nanoparticle dispersion with constant contact angle. During the process, no energy consumption and wasting chemicals were applied. By applying magnetic colloids and tuning dispersity of the drop, shapes and porosities of the supraparticles can be controlled. In addition, drying dispersion drop by using Ouzo effect is introduced that allows supraparticle synthesis on normal flat hydrophobic surface by self-lubricating colloidal dispersion evaporation.

2L8-7 박성준 (Seongjun Park) (15:50–16:15)

2013 서울대학교 기계항공공학부 (학사)
2015 MIT 기계공학과 (석사)
2018 MIT 전기컴퓨터공학과 (박사)
2018-2019 MIT RLE (Post-Doc.)
2019-현재 KAIST 바이오및뇌공학과 조교수

Next-Generation Neural Interfaces: From Flexible Optoelectronic Fibers to Nanomaterials

박성준† 한국과학기술원

To understand the mechanism underlying the dynamics of the nervous system or to treat neurological disorders, it is essential to develop the techniques capable of modulating and recording signals employed by neurons. However, current approaches are limited in terms of side effects, non-specificity, and mechanical invasiveness. My talk will introduce various complementary strategies to address these challenges: (1) Flexible and stretchable fiber-based probes for interfacing with the brain and spinal cord; (2) Biocompatible fiber scaffold to help the regeneration of neural tissue; (3) Wireless nanoparticle-based techniques for deep brain stimulation. These technologies enabling the interrogation with neural circuits across their diverse signaling modalities without inducing a foreign-body reaction helps the study of information processing as well as pathologies of the nervous system.

2L8-8 김정훈 (Jeonghun Kim) (16:15–16:40)

2007 연세대학교 화공생명공학과 (학사)
2012 연세대학교 화공생명공학과 (박사)
2015 ㈜ 동진쎄미켐 전자재료사업부 R&D Center (과장)
2017 University of Wollongong, Institute for Superconducting & Electronic Material (Research Associate)
2019 The University of Queensland, 화학공학과 (Research Fellow)
2019-현재 국민대학교 응용화학부 조교수

Synthesis of Nanoarchitectured Functional Materials from Polymers for Emerging Applications

김정훈† 국민대학교

Functional nanomaterials using polymers have received significant interest in various applications such as energy harvesting/storage systems, catalysts, environmental applications, optoelectric devices, biomedical applications, sensors etc. due to their outstanding chemical and physical properties. Interestingly, the nanoarchitecturing approaches such as shape/dimension controls, pore formation, and nanoassembly on materials can provide more improved performances and new properties in diverse applications. In this presentation, design and synthesis of nanoarchitectured materials from conducting polymers, block copolymer, nanoporous materials, carbons, metal oxides, and their hybridized form based on nanoarchitecturing will be presented with emerging applications.

Graduate Student Oral Session (II) (English)

제9회장 [10월 7일(수)]

Organizer: Jeong Jae Wie (Inha Univ.), Dong Ki Yoon (KAIST), Keun Hyung Lee (Inha Univ.)

2O9-1 NGUYEN MINH DUONG (13:00–13:15)

Single-Cation Two-dimensional Formamidium Lead Halide Perovskite Films: Fabrication and Study of Optical Properties

NGUYEN MINH DUONG, 강영종† 한양대학교

Metal halide perovskites are an emerging class of low-cost and solution-processable semiconducting materials potential for various optoelectronic applications. Recently, two-dimensional (2D) metal halide perovskites have received tremendous attractive research interest owing to their bright fluorescent at solid state, strong exciton binding energy, and showing higher stability against moisture compare to 3D counterparts. In this work, we provided a simple in situ fabrication technique to prepare the quantum confined single-cation 2D FAn+1PbnBr3n+1 films. The prepared single-cation FAn+1PbnBr3n+1 films showed an interesting phase transition to 3D $FAPbBr_3$ under

intense humidity or light exposure. The solvent- and photo-induce phase transition can be utilized for security inks and anti-counterfeiting applications.

2O9-2 임석인 (13:15-13:30)

Crystal Engineering of Azobenzene-based Organic Dye for Paintable Metallic Luster

임석인, 김대윤[1], 정광운† 전북대학교; [1]한국과학기술원

Using self-assembly control of supramolecular dyes and programmed hierarchical superstructures with various dimensions, we developed azobenzene-based organic dye (A_1GC) with metallic gold luster. From the morphological and diffraction study, large agglomerated powdery textures with smooth surfaces are formed by merging small powder crystals during the recrystallization process. The A_1GC crystal provided the sharp contrast between intensive light absorption and reflection, resulting in the metallic luster. By the combination of chemical functionalities and hierarchical superstructures, we can produce organic paints with brilliant gold color. When A_1GC thin film crystals are transferred to polymers to produce the composite materials, these materials can used in optoelectronic devices or paintable metallic coloration. This work was supported by Basic Research Laboratory Program (2020R1A4A1018259) and Korea Agency for Infrastructure Technology Advancement (20POQW-B152753-02).

2O9-3 김동연 (13:30-13:45)

Nanofiber Based Multifunctional Filter Platform Using Metal-Organic Frameworks (MOFs) Decorated Fe-doped TiO_2 Nanorod Composites

김동연, 윤기로† 한국생산기술연구원

Urban air pollution related to the various volatile organic compounds (VOCs) emitted from industrial processes, transportation and household products, and exacerbated COVID-19 in the recent, severally threaten the health of people such as respiratory diseases. In order to deal with this issue, tremendous researches such as a photocatalytic oxidation, an adsorption and a biological treatment have been made. Herein, we prepare a polyacrylonitrile (PAN) based nanofilters containing metal-organic frameworks (MOFs) decorated on iron (Fe)-doped Titanium dioxide (TiO_2) nanorod (NR), which serve as a multifunctional filter that has an efficient antibacterial performance as well as a VOCs removal property under a visible light irradiation. We demonstrate that PAN based nanofilters containing UiO-66 (Zirconium based MOFs)/Fe-TiO_2 NR catalysts are to be a class of effective and efficient multifunctional filter platform contributing to resolve the air condition related environmental problems.

2O9-4 신이삭 (13:45-14:00)

Viscosification of Nanoparticle Dispersion via Modulation of the Hydrogen Bonding Mode

신이삭, 서명은† 한국과학기술원

We report a terpolymer composed of a self-complementary hydrogen bonding unit and a solubilizing unit within a PMMA backbone by RAFT copolymerization. Using this polymer, we have devised a kinetic pathway to target the metastable nanoparticle state by inducing intramolecular collapse. By DLS analysis, we confirmed that uniformly dispersed nanoparticles were produced; and with temperature variation, we discovered that these nanoparticles were sensitive to heat and its thermal history. Temperature-dependent 1H-NMR analysis showed that the polymer nanoparticles held together by hydrogen bonding started to loosen above a certain temperature. By exploiting these properties of the polymer nanoparticle in solution, we demonstrate that by applying heat the dispersed nanoparticle in the non-polar solvent gradually releases individual chains and in turn change the macroscopic property of the polymer solution, providing an interesting possibility of controlling polymer solution viscosity.

2O9-5 아난두 모한 (14:00-14:15)

Dual Responsive PdNPs-SBA-15-PNIPAM/PMAA as a Versatile and Heterogeneous Green Nanocatalyst for the Suzuki-Miyaura Coupling Reactions in the Aqueous Medium

아난두 모한, 박성수, 제롬 피터, 안주 마리아 토마스, 하창식† 부산대학교

The Suzuki coupling reaction catalyzed palladium nanoparticle is one of the most promising and adaptable methods for forming C-C bonds in the field of pharmaceutical and organic chemistry. To develop a green and cost-effective platform for cross-coupling reactions, dual (temperature and pH)-responsive poly (N-isopropyl acrylamide-co-methacrylic acid) functionalized SBA-15 was synthesized by using free radical polymerization by using the initiator potassium persulfate and decorated with palladium nanoparticles (PdNPs-SBA-15-PNIPAM/PMAA). The catalyst displayed swelling behaviors at low temperatures (< 32 ℃) and high pH (> 4), but exhibited deswelling behaviors at high temperatures (> 32 ℃) and low pH (< 4). The resultant PdNPs-SBA-15-PNIPAM/PMAA catalyst was used for the Suzuki coupling reaction in aqueous medium at room temperature. The catalyst was successfully recovered from the reaction mixture and could be reused without any loss of catalytic activity.

2O9-6 이지은 (14:15-14:30)

In situ Deprotection of Polymeric Binders for Solution-Processible Sulfide-based All-Solid-State Batteries

이지은, 최장욱, 차국헌† 서울대학교

Sulfide-based all-solid-state batteries have been featured as promising alternatives to the current lithium-ion batteries mainly owing to their superior safety. Nevertheless, a solution-based scalable manufacturing scheme has not yet been established because of the incompatible polarity of the electrode components during slurry preparation. Herein, we overcome this dilemmatic issue by subjecting the acrylate (co)polymeric binders to protection-deprotection chemistry. Protection by the tert-butyl group allows for homogeneous dispersion of the binder in the slurry based on a less polar solvent, with subsequent heat-treatment during the drying process to cleave the tert-butyl group. This exposes the polar carboxylic acid groups, which are then able to engage in hydrogen bonding with the active cathode material. Deprotection strengthens the electrode adhesion and the key electrochemical performance parameters are improved markedly in both half-cell and full-cell settings.

2O9-7 안연호 (14:30-14:45)

Sulfonated Poly(arylene ether ketone) Impregnated Porous PTFE Electrolyte Membranes with Ultra-low Vanadium Ion Permeability for Vanadium Redox Flow Battery

안연호, 김덕준† 성균관대학교

The proton conductive electrolyte membranes were prepared by impregnating sulfonated poly(arylene ether ketone) (SP) into the porous polytetrafluoroethylene (PTFE) substrates for vanadium redox flow battery application. To impregnate SP, the surface of porous PTFE was chemically hydrophilized with catechol and polyethyleneimine. The SP filled PTFE membranes (trPTFE/SP) showed enhanced thermal, and mechanical stability, compared with the pristine SP membranes. Also, this pore filling process slightly decreased the proton conductivity of the pure SP membranes by 10%, it hugely decreased the vanadium ion permeability about 5 times. The lowest vanadium permeability of prepared membranes (1.37×10^{-7} cm^2 min^{-1}) was even 15 times lower than that of Nafion117 (20.28×10^{-7} cm^2 min^{-1}). This low vanadium permeability led to high coulombic efficiency over 96% and energy efficiency around 84% during the 100 charge-discharge cycling tests, which are better than Nafion 117 membrane.

2O9-8 이학준 (14:45-15:00)

Pushing the Band Gap Envelope of Quasi-Type II Heterostructures to Blue: $ZnSe/ZnSe_{1-X}Te_X/ZnSe$ Spherical Quantum Wells

이학준, 장준혁[†], 이승현[†], 윤상민[†], 허성필[†], 배완기[†,†] 서울대학교; [1]성균관대학교

$ZnSe_{1-X}Te_X$ is promising Cd-free quantum dots (QDs) because of its wide band gap tunability. However, there are major obstacles on achieving highly luminescent $ZnSe_{1-X}Te_X$ QDs. First, high reactivity of tellurium precursor and large lattice mismatch between ZnSe and ZnTe (7.7%) induce inhomogeneous nucleation of ZnSe and ZnTe. Second, undisclosed band position of $ZnSe_{1-X}Te_X$ hinders designing sophisticate core/shell heterostructures. Herein, we propose highly luminescent $ZnSe/ZnSe_{1-X}Te_X/ZnSe$ spherical quantum wells (SQWs) as a new class of Cd-free quasi-type II heterostructure. By introducing SQW structure, we alleviate lattice mismatch and interfacial defect effectively and accomplish high PL QY (> 90%) even at high X (0.5). Additionally, spectroscopic analysis clarifies quasi-type II band alignment of $ZnSe/ZnSe_{1-X}Te_X/ZnSe$ QDs. Based on these results, we control two factor, ZnSe shell thickness (dimension) and X (composition), to tune band gap widely with high PL QY.

2O9-9 김기관 (15:10-15:25)

3-Dimensional Display through a Selective Plasticization and Nondisruptive Origami of Polymer Substrate

김기관, 김영민, 유성광, 장훈수, 고흥조† 광주과학기술원

This study demonstrates a 3-dimensional (3D) display using a general matrix circuit design using a nondisruptive origami. A non-zero Gaussian curvature, such as sphere and polyhedron, requires biaxial bending or stretching g, which acquires kirigami technology or tucking-based origami both of which hamper the design of the electrical connection lines. This study demonstrates a new method of tucking-based origami in the electrics level without losing typical row and column electric connection lines, which is extremely important in matrix image or display circuit design. This method uses selective plasticization of ABS film by injecting plasticizer through a microfluidic channel. The elastic/hardening moduli of plasticized ABS film decreased by a thousand times of magnitude and the ability of the viscoplastic flow protect the electronic component during ±180 degree of folding. As a demonstration, we will present a hexahedral LED array with a matrix circuit design using this method.

2O9-12 김형준 (15:55-16:10)

Fabrication of Fiber Optoelectronic Devices via Conformal Transfer of Inkjet-printed Carbon Nanotube Microelectrodes for Smart Wearable E-textile Applications

김형준, 강태형, 이현정, 임정아† 한국과학기술연구원

A new strategy to prepare optoelectronic fiber devices including organic field-effect transistor and organic photodiode with a spirally wrapped carbon nanotube microelectrodes is proposed. Inkjet-printed carbon nanotube microelectrodes with desired microstructure on an agarose hydrogel is conformally transferred to functional microfiber surface. Organic field-effect transistors (OFETs) with conformal deposition of CNT microelectrodes exhibit a high performance that exceed the previous structural limitations and the electrical performance is maintained even after bending deformation. Furthermore, a fiber organic photodiode (OPD) consisting of bulk heterojunction (BHJ) layer and transparent CNT microelectrodes also exhibit a high responsivity and I_{light}/I_{dark} ratio. As a proof of concept, textile photoplethysmogram(PPG) bandage for real-time heart-rate monitoring is successfully demonstrated by integrating the flexible fiber OPD with LEDs into the textile.

2O9-13 서의현 (16:10-16:25)

Unique Polymorph of P3HT by Brønsted Acid Doping for Highly Conductive and Stable Organic Thermoelectric via Solution Mixing

서의현, 김상범, 정영제, 장재영† 한양대학교

Molecular doping is crucial for improving thermoelectric (TE) properties of conjugated polymers. Although solution mixing (i.e. mixing of the polymer and the dopant in a single solvent) provides a facile route to the uniform doping of farily thick polymer films suitable for TE applications, low solubility of dopants restricts high quality film fabrication. Here, we report on the effects of Brønsted acid doping of poly (3-hexylthiophene) (P3HT) with a largely soluble molecular dopant. Interestingly, P3HT formed a unique type II polymorph upon doping in ambient condition, while a conventional crystal structure is observed in inert conditions. Moreover, the doped P3HT films showed a conformational change to quinoid structure, increasing the backbone planarity. As a result, the Brønsted acid doped P3HT films exhibited outstanding electrical and TE properties, which are at least an order of magnitudes higher than those of P3HT films doped with F4TCNQ, with excellent air stability.

2O9-14 장웅식 (16:25–16:40)

Noise-Restrained Detection and Fast Response via a Non-Fullerene Acceptor for Stable Operation of Organic Photodiode

장웅식, 조재상, 김병기, 임지현, 김민수, 김진영, 왕동환† 중앙대학교

Emergences of non-fullerene-based acceptors have opened new avenues with regard to improve the figure of merits of organic photodiodes (OPDs) including well-matched energy level and wide absorption based on ultraviolet photoelectron spectroscopy. Herein, eh-IDTBR has been employed in OPDs and the results have been compared with fullerene derivatives ($PC_{71}BM$), in combination with electron donor PBDTTT-EFT material. eh-IDTBR based OPDs has shown excellent detectivity from 400 nm to 740 nm in comparison to $PC_{71}BM$ based OPDs due to suppressed injected carriers and trap density. Furthermore, morphological and electrical changes depending on thermal and electrical stress have been investigated in the two different acceptor systems. This study elucidates the importance of eh-IDTBR acceptor in OPD and will pave the way for the wavelength specific solution processable non-fullerene-based acceptors based OPDs in the future.

2O9-15 이창현 (16:40–16:55)

Long-term Retention and Low Power OTFT-NVMs with Hydroxyl Group Charge Trapping Layer via Ultrathin iCVD Dielectric

이창현, 박관용, 최준환, 김민주, 조병진, 임성갑† KAIST

With the development of wearable devices, Organic flash memory is considered as one of the essential devices for data storage. However, OTFT-NVMs have high operation voltage and data stability problems caused by thick insulation layer. This study introduced iCVD dielectric. Tunneling layer is poly(1,3,5-trimethyl-1,3,5-trivinyl cyclotrisiloxane) (pV3D3) and blocking dielectric is poly(1,4-butanediol diacrylate) (pBDDA), with excellent insulation properties (Ebreak > 8 MV/cm with its thickness of 21.3 nm). Between the tunneling and the blocking a 6-nm thick ultrathin trapping layer with a hydroxyl group was fabricated. Novel trapping layer synthesize with the copolymer of BDDA and 2-Hydroxyethyl acrylate (HEA). Finally, we can fabricate low power and stable memory. Large window 5.86 V at programming/erasing voltage 16 V. Highly stable memory retention characteristics, after 108 s. In addition, excellent flexibility maintains memory performance after 2.72% of strain applied.

2O9-16 Dieu Linh Tran (16:55–17:10)

Novel Injectable Nitric Oxide Releasing Hydrogel Accelerate M2 Macrophage Polarization for Wound Healing Applications

Dieu Linh Tran, 박기동†, Le Thi Phuong Ajou University

Nitric oxide (NO) is an endogenous gas molecule which played a key role in wound healing process due to their beneficial effects on inflammation, cell proliferation and remodeling. However, the clinical application of NO is limited due to their burst and short half-life release. To overcome this, copper ions (NO-generating catalyst) was incorporated in the gelatin-based hydrogel (GH/Cu) for in situ release of NO in the presence of endogenous S-nitrosothiol. GH/Cu hydrogels presented the sustained release of NO for over 2 weeks within the physiological level (0.5-4×10-10mol/cm-2/min-1), which stimulated the macrophage polarization from M1 (pro-inflammatory) macrophage to M2 (anti-inflammatory) macrophage. Overall, these results confirm the pro-wound healing activity of GH/Cu and showed that GH/Cu is the promising material for wound treatment. Acknowledgements: 2019R1A6A1A1 1051471, NRF-2018R1A2B2004529.

대학원생 구두발표 (II) | Graduate Student Oral Session (II) (Korean) 제10회장 [10월 7일(수)]

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

2O10-1 최경현 (13:00–13:15)

Mechanochemically and Electrochemically Responsive Nano-Capsules Tailored with Metal-Phenolic complexes

최경현, 박치영† 대구경북과학기술원

Recently, smart controlled release system has attracted great interest for use in applications such as controlled release implants. Toward this goal, mesoporous silica nanoparticles (MSNs) have widely studied as responsive gate keepers with structural characteristics such as large surface area, highly uniform framework, and on-demand release. However, various nanovalves on MSNs in response to certain stimuli has rarely been reported owing to complicated processes. We report rapid and facile strategy for producing mechanochemically and electrochemically responsive nanocapsule using phenol-metal coordination and by applying ultrasound and voltage to nanocapsule, we can induce decomposition of metal organic bond and controlled drug release of gel-capsule composites.

2O10-2 류승운 (13:15–13:30)

Morphology Control via Strategic Halogen Substitution Achieving High-performance Small-molecule Based Tandem Solar Cells Exceeding 15% Efficiency

류승운, 박상아, 정우택, 김성룡, 송창은†, 이종철†, 박태호† POSTECH; †KRICT

In this study, a series of benzodithiophene (BDT) based active materials with specific halogen atoms substituted were devised. In addition, how these halogen atoms affect the BHJ morphologies is demonstrated via microstructure analyses. The chlorine substituted one shows a well-mixed morphology and interpenetrating networks when blended with PC71BM, facilitating effective charge transportation. This controlled morphology helps achieve excellent performance with 10.5% power conversion efficiency (PCE) and the highest fill factor of 78.0% in the single-junction SM-SCs. It can also be extended to two-terminal (2T)-tandem solar cells, achieving an outstanding PCE of 15.1% via complementary absorption in the 2T-tandem solar cells that incorporate the SM-SCs. These results suggest that tailoring interactions with halogen atoms is an effective way to control BHJ architectures, thereby achieving remarkable performance in SM-SCs.

2O10-3 고재완 (13:30–13:45)

High-Resolution Patterning of Quantum Dots via Azide-Containing Hole Transporting Polymeric Ligand

고재완, 장준혁†, 정병국†, 정준영, 박성남, 최동훈, 배완기†, 방준하† 고려대학교; †성균관대학교

Despite rapid advances of colloidal quantum dots (QDs) in terms of facile synthetic method and superb optical quality, cutting-edge patterning technology is continuously required which enable QDs to be realized into display devices with high-definition. In this work, we report one-step patterning methodology which does not requires complicated surface treatment, soft-hard baking, or lift-off processes. Multifunctional photo-crosslinkable & hole transporting polymeric ligands are grafted and simple photolithography step is conducted, resulting in extremely uniform full-colored QD micro-patterns. We also demonstrated possibility of extended application into the patterning of various nanomaterials such as metal nanoparticles and perovskite nanocrystals. We believe that our simplified approach suggest alternative patterning technology for the optical and optoelectronic devices.

2O10-4 서진영 (13:45–14:00)

Destruction of Toxic Chemicals Using Amine Functionalized Polymer and Metal-organic Framework Catalyst

서진영, 이정현†, 백경열† KIST; †고려대학교 화공생명공학과

Destruction of toxic chemicals using catalyst was regarded as the most efficient process for dealing with environmental crisis. Among them, the chemical warfare agents (CWAs) was emerging as top priority due to its extreme toxicity. The catalyst including ionized polymer, artificial enzyme, and Metal-Organic Framework (MOF) was developed, but it present insufficient reactivity, durability, processability, and stability. In this study, we firstly classify catalyst contamination mechanism, and develop the durable, and processable catalyst system for hydrolysis of chemical warfare agents. The amine functionalized polymer can enhance not only catalytic performance over 100 times, but also processability. These novel catalyst system was anticipated as highly potential material for protection against chemical weapon.

2O10-5 엄태식 (14:00–14:15)

Nanostructured Natural Melanin Composites with Tunable Multifunctional Properties

엄태식, 심봉섭† 인하대학교

The electric-ionic conductivity, biocompatibility, and physicochemical properties of conducting materials are crucial subjects in the field of neural interface. In this study, we reported the nanostructured natural melanin composites with multifunctional properties and electrical conductivity, produced by two nanofabrication techniques: Layer-by-layer assembly (LBL) and depletion-attraction force assisted casting method. The LBL melanin coating possesses anti-inflammatory property and unique UV-visible light absorption with the structural colors. The depletion-force casted films of melanin NPs have shown well-ordered nanostructures with unconventionally high electrical conductivity. Experiments with *Zophobos Morios larvae* demonstrated their edibility and biocompatibility. These results showed the potential applications of our melanin composite films in the optoelectronic devices, implantable devices, and neural interfaces with unique electrical and biological properties.

2O10-6 김소담 (14:15–14:30)

On-site Fabrication of Injectable Biodegradable ^{131}I-Labeled Microgels for Local Radiotherapy

김소담, 임상구, Ajeesh Chandrasekharan, 성금용, 이태욱, 이유진†, 김근영², 최성용†, 양승윤† 부산대학교; †한양대학교; ²부산대학교병원

Nuclear medicine is an important clinical options for diagnostic imaging and disease treatment. Encapsulating radioisotopes in injectable hydrogels is ideal for achieving

long-term, low-dose radiotherapy by targeting radionuclides to tissues or organs. However, difficulties in the on-site fabrication of radioactive hydrogels during treatment and unpredictable radiation levels at the target site are major obstacles to clinical use. Here, we developed a strategy that facilitates the on-site fabrication of radioactive microgels requested in clinical environment using a ^{131}I-labeled hyaluronic acid (HA) and a microfluidic system. This approach allows for on-site fabrication of injectable, radioactive, biodegradable (IRB) HA microgels, enabling immediate therapeutic application with improved local retention. We demonstrated the clinical utility of this comprehensive approach by preparing IRB HA microgels within 15 min and localizing them beyond 1 week to minimal off-target biodistribution.

2O10-7 박경태 (14:30–14:45)

Wet-spun Carbon Nanotube Fiber for Flexible Thermoelectric Generators

박경태, 박종래[1], 김희숙† 한국과학기술연구원; [1]서울대학교

As the concept of practical and wearable thermoelectric (TE) generator begins to surface, requirements such as flexibility, being lightweight and mass producibility have become important. The thermoelectric generators based on fiber or yarn are of special interest because of their ability to easily integrate into clothing. Herein, we have demonstrated wet-spun CNT fibers with excellent TE performance. The TE performance of CNT fibers strongly depends on the dispersion of CNT powder in chlorosulfonic acid used as a dope solvent. The acid pre-treatment of CNT powder can control the CNT dispersion, thereby leading to an enhanced power factor of 1344 μW/mK^2. The CNT fibers were then doped into p- and n-type fibers to produce flexible TE generator.

2O10-8 최용석 (14:45–15:00)

Vertical Organic Synapse Expandable to 3D Crossbar Array

최용석, 조정호† 연세대학교

Recently, three-terminal synaptic devices have attracted considerable attention owing to their nondestructive weight-update behavior, which is attributed to the completely separated terminals for reading and writing. However, the structural limitations of these devices, are predicted to result in low processing speeds and high energy consumption of the entire system. Here, we propose a vertical three-terminal synapse featuring a remote weight update via ion gel, which is also extendable to a crossbar array structure. This synaptic device exhibits excellent synaptic characteristics, which are achieved via precise control of ion penetration onto the vertical channel through the weight-control terminal. Especially, the applicability of the developed vertical organic synapse array to neuromorphic computing is demonstrated using a simple crossbar synapse array.

2O10-9 박정은 (15:10–15:25)

Magnetic Actuation of Anisotropically Designed Micropillar Arrays

박정은, 전지수, 원수경, 위정재† 인하대학교 첨단소재연구실

Shape-reconfiguration of micropillar arrays was manifested by programming alignment of magnetic particles within polymer matrix. Previous studies have predominantly reported actuation of cylindrical micropillars where the stiffness distribution is radially balanced, inducing attenuation of actuation with unfocused momentum. Alternatively, we demonstrate the effects of anisotropic geometry on magnetic actuation using rectangular form factor. As the fundamental quadrangular polygon has only four edges, rectangular geometry is advantageous to compare numerically calculated stress distribution of pillars with experimentally measured actuation degree of pillars. Long axis of rectangle has larger bending stiffness than short axis of that, resulting in concentrated magnetic momentum on actuation along long axis of micropillars. We will discuss the relationships between geometry factors of micropillars and magnetic actuation as well as wetting properties.

2O10-10 한문종 (15:25–15:40)

Highly Ordered and Oriented Water Soluble Semiconducting Polymer Using a DNA Template

한문종, 윤동기† KAIST

We demonstrate organic field effect transistor (OFET) devices based on highly aligned aggregates of the conjugated polymer, poly[3-(potassium-7-hexanoate)-thiophene-2,5-diyl] (P3PHT) using self-assembled DNA, in which the P3PHT/DNA comlex can be effectively aligned by a simple shearing method. The charge carrier mobility of the P3PHT/DNA complex is 3 orders of magnitude higher compared to the case of neat P3PHT, owing to the versatility of DNA as a template and charge injection layer. Additionally, the specific chemical interactions and physical electrostatic binding affinities between DNA and Cu^{2+} enables p-doping, affording hole mobilities as high as 0.22 cm^2 V^{-1} s^{-1}, which represents the highest reported values for water-soluble polythiophene materials. The interdisciplinary convergence between DNA nanotechnology and aqueous processed organic electronics can suggest important guidelines for the design of sustainable and efficient organic optoelectronic devices.

2O10-11 이상혁 (15:40–15:55)

An Efficient Route to Carbon Nanotube/Polymer Gels with Controlled Porosity

이상혁, 윤현석[1,†] 전남대학교 대학원 고분자공학과; [1]전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

We present an efficient route to carbon nanotube (CNT)/polymer gels using the microphase separation behavior of two polymers, polyvinyl alcohol (PVA) and polyacrylonitrile (PAN). The two polymers exhibit different phase behaviors in a binary-solvent consisting of water and dimethyl sulfoxide (DMSO). CNTs were integrated into the binary-polymer/binary-solvent system, offering a unique opportunity to control the physical gelation behavior and furthermore to achieve desirable physicochemical characteristics of the resulting gels. The CNTs were individually wrapped with PVA chains, which extended the binary polymer system to a ternary polymer system consisting of PVA bound to SWNTs, free PVA, and PAN. The amount of the CNTs and water-to-DMSO volume ratio were considered as key variables to control the porosity of the gel. It is also important to note that the CNT/polymer gels showed strong potential as precursors for producing functional carbon electrode materials.

2O10-12 정재환 (15:55–16:10)

Synthesis of Photocurable Resins Based on Engineering Thermoplastic for Biocompatible Stereolithography 3D Printing Process

정재환, 이동현† 단국대학교 고분자공학과

In this study, polyetherimide (PEI)-based photocurable resin is prepared for applying DLP stereolithography process. The PEI resin is synthesized via condensation reaction between dianhydrides and diamino acids. In addition, glycidil functional groups are introduced into the PEI main chains for photochemical reaction. To prepare the photocurable resin for the stereolithography 3D printing process, the PEI resins are mixed with reactive diluents and photo initiators. By adjusting light dosage and compositions of the reactants, the photocuring reaction of the resin can be precisely controlled in the DLP stereolithography process. The photocurable resins and the printed specimens are characterized by using UTM, DSC, TGA, FT-IR and H^1-NMR spectroscopy. In addition, biocompatibility of the PEI based resins is investigated by conducting cell culture experiments.

2O10-13 김진석 (16:10–16:25)

Synthesis and Characterization of Biocompatible Copolymers Containing Plant-Based Cardanol and Zwitterionic Groups for Antifouling and Bactericidal Coating Applications

김진석, 이종찬†, 이시영 서울대학교

A series of copolymers (PSH#s, where # is the molar content (%) of (dimethylamino) ethylmethacrylate (DMAEMA) and sulfobetaine methacrylate (SBMA)) containing both plant-based cardanol and zwitterionic moieties was synthesized via free radical polymerization of 2-hydroxy-3-cardanylpropyl methacrylate (HCPM) and DMAEMA, followed by betainisation with 1,3-propanesultone. Transparent PSH# films could be prepared on the silicon wafers through spin-coating and UV-crosslinking processes. The bactericidal and antifouling properties of the polymer films were found to be closely related to the ratio of the HCPM and SBMA moieties in the copolymers. The films having a larger content of the bactericidal HCPM moiety show better bactericidal properties, while those having a larger content of the hydrophilic SBMA moiety show enhanced adhesion resistance to biofoulants. Moreover, all the films having both HCPM and SBMA moieties have sufficient biocompatibility, regardless of their ratio.

2O10-14 오민택 (16:25–16:40)

Conjugated Polymer Framework via Interfacial Knoevenagel Condensation: Covalent Self-Assembly from 0D Particle to 2D Film

오민택, 이택승† 충남대학교

Covalent organic frameworks (COFs) which are a class of crystalline porous polymers have been developed due to their multi-chemical functionality. Unlike traditional polymers, COFs are capable of precisely organizing molecular species into networks featuring structural periodicity and inherent porosity. However, although sp^2 carbon-linked COFs can be very stable, very few examples have been reported until now. It could be explained by the low reversibility of the formation of C=C bonds and it has been proven to be a big challenge. In this work, we synthesized a novel COF via Knoevenagel condensation and it was the first time to make sp^2-carbon linked COF via interfacial polymerization. COF was characterized by FT-IR and solid-state ^{13}C NMR and SEM images revealed that COF particles were self-assembled and connected each other. As a result, crystalline film was formed depending on the time and it has high thermal stability. PXRD also exhibited that it has crystallinity.

2O10-15 권상우 (16:40–16:55)

Dissipative Particle Dynamics Simulation of Bottlebrush Copolymers: Effect of Brush Configuration and Crosslinking of Backbone Chain

권상우, 김용주[1], 이원보† 서울대학교; [1]국민대학교

Recently, bottlebrush copolymers gain significant attention due to their self-assembly behavior arising from unique architecture. We study self-assembly behavior of ABC-type bottlebrush copolymers using DPD simulation. Solvophobic A and solvophilic B brushes are grafted on backbone chain C in different topology: C-g-(A-r-B) type (brushes A and B are randomly grafted on backbone chain) and C-g-(A-b-B) type (brushes A are grafted on the first half and brushes B are grafted on the second half). DPD simulations suggest that C-g-(A-b-B) polymers are self-assembled into more uniform morphology compared to C-g-(A-r-B) polymers. Moreover, backbone chain crosslinking effect is introduced by additional bonds between backbone chain beads which prevents rearrangement of backbone chains. Collapsed conformation of two different systems results in different morphologies. This study suggests that grafting topology and crosslinking effect can be significant factor to control self-assembly structure.

신진연구자 특별 심포지움 (III) | Young Polymer Scientists (III)

제1회장 [10월 8일(목)]

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

3L1-1 염지현 (Jihyeon Yeom) (09:30–09:55)

2009 KAIST 신소재공학과 (학사)
2010-2011 Argonne National Lab. 연구원
2011-2017 University of Michigan (박사)
2017-2020 MIT (Post-Doc.)
2020-현재 KAIST 신소재공학과 조교수

Chiral Nanomaterials: Design Strategies and Their Properties

염지현† 카이스트

Recently, chirality of nanomaterials has been considered of much importance due to the potential application in chiral biocataysis, biosensing, telecommunication, and display technologies. Chiral nanomaterials show the unique, exotic, and sensitive properties. However, the control over chiral structures of nanogeometry is a great challenge to achieve due to their complexity. During the talk, I will introduce strategies including (1) chirality transfer from biomolecules to inorganic nanoparticles and amplification of optical activity of the nano-system by incorporating magnetic components that enable real-time optical applications and (2) chirality control of nanostructures using the ability of nanoparticles retaining circularly polarized information of light. (3) The chiral-selective interactions between nanostructures and biosystems, e.g., cellular membranes and proteins, will also be covered.

3L1-2 권지언 (Ji Eon Kwon) (09:55–10:20)

2006 서울대학교 재료공학부 (학사)
2014 서울대학교 재료공학부 (박사)
2014-2016 서울대학교 창의인재양성 재료사업단 (Post-Doc.)
2016-2020 서울대학교 신소재공동연구소 연구조교수
2020-현재 한국과학기술연구원 기능성복합소재연구센터 선임연구원

Designing Disruptive Organic Electrode Materials for Next-Generation Organic Batteries

권지언†, 박수영[1] 한국과학기술연구원; [1]서울대학교

Organic redox-active molecules are one of the most promising alternatives to conventional metal oxide-based electrode materials for next-generation secondary batteries due to their advantages in high specific energy and power, low-cost, natural abundance, environmental friendliness, and easy chemical tunability. To date, a lot of organic materials, including conducting polymers, organosulfurs, nitroxides, and carbonyl compounds, have been studied as electrode materials for metal-ion batteries. However, their redox potentials mostly lie on impractical intermediate voltage ranges (< 3 V and > 1 V vs. Li/Li+), leaving much room to catch up with the inorganic materials. Furthermore, they are still plagued by high solubility in the liquid electrolytes and by low electric conductivity, which limits their cycle stability, rate performance, and energy density. In this talk, we present novel molecular design strategies to solve such issues for achieving disruptive organic electrode materials.

3L1-3 임종철 (Jongchul Lim) (10:20–10:45)

2009 충남대학교 고분자공학과 (학사)
2015 포항공과대학교 화학공학과 (박사)
2015-2019 (영국) 옥스퍼드대학교 물리과 (Post-Doc.)
2020-현재 충남대학교 에너지과학기술학과 조교수

Insights on the Optoelectric Properties of Perovskite Semiconductors via Transient Photoconductivity

임종철† 충남대학교

It is particularly important to understand the long-range charge transport within the metal halide perovskite for optimisation of operating devices, where the charges have to travel over on the order of microns, and if these properties change in different carrier density regimes, or through different methods of processing the films. Here we introduce an advanced methodology: Transient photoconductivity. We accurately estimated the internal free-carrier density during photo-excitation, accounting for both early-time recombination and exciton-to-free-carrier branching ratios to determine long-range charge carrier mobility in metal halide perovskite thin films and single crystals, to be invariant over many orders of magnitude of charge density. We also demonstrate that the processing method of perovskite layer has a strong influence on the long-range charge transport. We believe this study is the first accurate evaluation of photo-induced long-range mobility of metal halide perovskites.

3L1-4 이성수 (Albert Lee) (10:45–11:10)

2008 UC Berkeley 화학과 (학사)
2014 과학기술연합대학원대학교 나노재료공학과 (박사)
2014-2017 한국과학기술연구원 물질구조제어연구센터 (Post-Doc.)
2017-2019 Los Alamos National Lab (Director's Fellowship Post-Doc.)
2019-현재 한국과학기술연구원 물질구조제어연구센터 선임연구원

Synergistically Integrated Membranes and Ionomers for High Performance High Temperature Fuel Cells

이성수† 한국과학기술연구원

Modern electrochemical energy conversion devices require more advanced proton conductors for their broad applications. Phosphonated polymers have been proposed as anhydrous proton conductors for fuel cells. However, anhydride formation of phosphonic acid functional groups lowers proton conductivity and prevents its use in the fuel cell applications. Here, we report a poly(2,3,5,6-tetrafluorostyrene-4-phosphonic acid), which does not undergo anhydride formation, thus maintains protonic conductivity above 200 ℃. We used the phosphonated polymer in fuel cell electrodes with an ion-pair coordinated membrane in a membrane electrode assembly. The synergistically integrated fuel cell reached peak power densities of 1,130 mW cm^{-2} at 160 ℃ and 1,740 mW cm^{-2} at 240 ℃ under H_2/O_2 conditions, significantly outperforming polybenzimidazole- and metal phosphate-based fuel cells.

3L1-5 백세웅 (Se-Woong Baek) (11:10–11:35)

2006 KAIST 생명화학공학과 (학사)
2011 KAIST EEWS 대학원 (석사)
2013 KAIST EEWS 대학원 (박사)
2017 KAIST 응용과학연구소 (Post-Doc.)
2017-2020 University of Toronto (Post-Doc.)
2020-현재 고려대학교 화공생명공학과 조교수

근적외선 광전변환을 위한 콜로이달 퀀텀닷/유기 반도체 앙상블 구조

백세웅† 고려대학교 화공생명공학과

콜로이달 양자점은 이들의 물리적 크기에 따라 광특성을 가시광에서 적외선까지 자유롭게 조절이 가능해서 다른 반도체 소재 대비 큰 장점을 가지고 있다. 이는 근적외선 대역 광전변환이 중요한 여러 유망 분야, 인식/진단, 자율주행, 가상현실 및 IoT등에 필요한 센서 및 발광 등에 응용 가능하다. 특히 광대역 흡수 특성은 근적외선 대역 에너지 변환이 가능하기 때문에 태양전지 응용시에 큰 장점이 될 수 있다. 본 연구에선 콜로이달 양자점을 이용한 광전에너지변환의 가능성에 대해 논한다. 특히 이론적으로 이상적인 구조와 양자점 표면 화학에 대해 보여줄 예정이다. 더 나아가 기존의 콜로이달 양자점에 유기반도체를 도입해 더 강한 근적외선 대역 흡수와 개선된 광전자 추출이 가능한 플랫폼을 제시한다. 분광학적 접근을 통해 기존의 물리화학적 호환성이 낮았던 양자점/유기 복합소재의 원인을 밝히고 향상된 구조를 제시한다. 끝으로 실제 양자점/유기 복합소재를 이용한 광대역 광전에너지소자를 제작한 후, 반투명 페로브스카이트 태양전지와 함께 적용하여 35mA/cm^2 이상의 광전류를 얻을 수 있는 방법론을 제시할 예정이다.

3L1-6 구강희 (Kang Hee Ku) (11:35–12:00)

2012 KAIST 생명화학공학과 (학사)
2014 KAIST 생명화학공학과 (석사)
2018 KAIST 생명화학공학과 (박사)
2018-2019 KAIST 생명화학공학과 (Post-Doc.)
2019-2020 MIT 화학과 (Post-Doc.)
2020.09-현재 충남대학교 응용화학공학과 조교수

Self-assembly of Dendronized Brush Block Copolymers in Emulsion for Color-Switchable Photonic Ellipsoids

구강희† 충남대학교

Full-color reflective photonic ellipsoidal polymer particles, capable of a dynamic color change, are created from dendronized brush block copolymers. Surfactants composed of dendritic monomer units allow for the precise modulation of the particle shape from spheres to striped ellipsoids. Strong steric repulsions between wedge-type monomers promote rapid self-assembly of polymers into large domains (i.e., 153 nm ≤ D ≤ 298 nm). Of note, highly ordered axially stacked lamellae within an ellipsoid give rise to a near-perfect photonic multilayer. The reflecting color is readily tunable across the entire visible spectrum by alteration of the molecular weight. Finally, the photonic ellipsoids are functionalized with magnetic nanoparticles organized into bands on the particle surface to produce real-time on/off coloration by magnetic field-assisted activation, representing a new class of switchable photonic materials.

Mechanochemical Approach to Polymers

제2회장 [10월 8일(목)]

Organizer: 김병수(연세대), 김정곤(전북대)

3L2-1 Lars Borchardt (09:30–09:55)

2009 Diploma Inorganic Chemistry, TU Dresden, Germany
2011 Research Fellowship, Drexel University, USA
2013 Ph.D. on Porous Materials, TU Dresden, Germany
2013-2014 Post-Doc. on Catalysis, ETH Zurich, Switzerland
2015- Habilitation on Mechanochemistry, TU Dresden, Germany
2019-Present Professor for Inorganic Chemistry, Ruhr-University Bochum, Germany

Polymerization in Ball Mills – From Linear Polymers to Porous Polymer Frameworks

Sven Grätz, Lars Borchardt† Faculty of Chemistry and Biochemistry, Ruhr-University Bochum

It is a major challenge of our time to develop sustainable chemical processes and to reduce the amount of waste generated by the chemical industry. Particularly solvents, often harmful for the environment, accumulate in many of the chemical processes. Our group develops new synthesis concepts, completely avoiding the use of any solvents. These syntheses are based on mechanochemistry. We utilize mechanical energy, which is brought into the system by ball milling, to initiate chemical reactions, rather than temperature as in conventional thermally-induced reactions. With this, an unconventional chemistry is possible with different reaction mechanism, reaction products, and product selectivities as compared to classical solvent-based syntheses. We are focusing on the mechanochemical synthesis of linear polymers, hyper-branched polymers and porous polymer framework. Therefore, we utilize polycondensation-, C-C-cross-coupling-, Friedel-Crafts- and oxidative polymerization reactions. Recently, we developed a novel concept for polymerization denoted as direct mechanocatalysis. Therein, the milling balls themselves are utilized as polymerization catalysts making the use of any catalyst additives as well as their solubility obsolete. We are highly motivated by the fundamental curiosity how ball-milling, commonly utilized to destroy matter, can be applied to construct fragile and defined framework materials.

3L2-2 Chia-Chih Chang (09:55–10:20)

2009 B.S. Colorado School of Mines
2016 Ph.D. Univ. of Masssachusettes Amherst
2016-2017 Post-Doc. S. L. Craig, Duke University
2018-Present Assistant Professor, National Chiao Tung University

Fluorescence "turn-on" Upon Activating Mechanochemically Responsive Polymers

Yu-Hsuan Tung, Hao-Chun Chang, Chia-Chih Chang† Department of Applied Chemistry, National Chiao Tung University

Covalent polymer mechanochemistry offers a platform for next generating materials featuring stress-sensing capability through facile detection of polymer chain scission events prior to the onset of catastrophic material failure. Externally applied mechanical force can be exploited to promote selective chemical transformation in the overstressed region, resulting in the formation of highly fluorescent moieties. Here we report that a Diels-Alder adduct based mechanophore, which unveils a highly fluorescent anthracene carboxyimide (ACI) through mechanically triggered retro Diels-Alder reaction. ACI exhibits a quantum yield (QY) of up to 85%, which is by far the brightest anthracene derivative suitable for stress-sensing. Pulsed ultrasonication and compression experiment result in appearance of fluorescence because of mechanically triggered chemical reaction. Relative mechanical labilities of several anthracene-based Diels-Alder adducts are established, revealing that ACI-maleimide adduct requires the highest force relative to other existing anthraces-based mechanophores.

3L2-3 송창식 (Changsik Song) (10:20–10:45)

2001 한국과학기술원 화학과 (학사)
2007 MIT 화학과 (박사)
2007-2011 MIT 화학공학과 (Post-Doc.)
2011-2015 성균관대학교 화학과 조교수
2015-현재 성균관대학교 화학과 부교수

Facile Mechanochemical Synthesis of Sustainable and Recyclable Network Polyurethanes Using a Biomass-Derived Furan Diol

김현우, 윤영섭, 양지원, 차인환, 송창식† 성균관대학교

Due to environment issues, it is highly demanding to generate recyclable polymers and to use sustainable biomass-derived ingredients. In this work, we utilized 2,5-bis-hydroxymethylfuran (BHMF) as a starting material to produce thermoplastic and network polyurethanes (TPU and NPU) under facile, solvent-free (solid-state) ball-milling conditions. Interestingly, the urethanes bonds may undergo thermally-controlled trans-carbomoylation, a reversible dynamic covalent bond exchange. Because of this chemistry, we can demonstrate the self-healing, reprocessing, and shape memory properties from NPU films. We characterized topology freezing transition temperature (Tv), stress-relaxation behavior using dynamic mechanical analyzer (DMA) under different temperatures. This mechanochemical approach is facile, scalable, extensible to sustainable and recyclable polymers from other biomass-derived chemicals.

3L2-4 조홍열 (Hong Yul Cho) (10:45–11:10)

2005 부산대학교 응용화학공학부 (학사)
2008 부산대학교 고분자공학과 (석사)
2014 Carnegie Mellon University 화학과 (박사)
2015-2016 University of Illinois at Chicago 약학과 (Post-Doc.)
2016-2020 울산과학기술원 화학과 (Post-Doc.), 기초과학연구원 다원탄소재료 연구단 연구위원
2020-현재 부산대학교 고분자공학과, 생산기술연구소 연구원

Ball Milling Prompted Atom Transfer Radical Polymerization in the Solid-State

조홍열, Christopher W. Bielawski[1,†] 기초과학연구원 다차원탄소재료 연구단; [1]기초과학연구원 다차원탄소재료 연구단/울산과학기술원

Poly(2-vinylnaphthalene) was synthesized in the solid-state by ball milling a mixture of the corresponding monomer, a Cu-based catalyst, and an activated haloalkane as the polymerization initiator and the reaction was optimized. The reaction was monitored and found to be linear correlations between monomer conversion and polymer molecular weight. While the polymer molecular weight was effectively tuned by changing the initial monomer-to-initiator ratio, the experimentally measured values were found to be lower than their theoretical values. The difference was attributed to premature mechanical decomposition and modeled to accurately account for the decrement. Random copolymers of two monomers with orthogonal solubilities were also synthesized in the solid-state. Collectively, the data indicated that the solid-state polymerization reaction is controlled, follows a mechanism similar to that described for solution-state atom transfer radical polymerizations.

3L2-5 Gregory Peterson (11:10–11:35)

2010 B.S. Pacific Lutheran Univ.
2015 Ph.D. Univ. of Washington (Advisor, Boydston, A. J.)
2015-2017 Post-Doc. Univ. of Akron (Advisor, Becker, M. B.)
2017-Present Research Professor, Seoul National Univ. (Advisor, Choi, T.-L.)

Mechanochemical Degradation of Amorphous Polymers with Ball-Mill Grinding

Gregory Peterson†, Yejin Hwang[1], Tae-Lim Choi Seoul National University; [1]Inha University

We explored the influence of various ball-mill grinding process parameters and polymer properties on the mechanochemical degradation of amorphous polymers (polystyrene, PS, and polymethyl methacrylate, PMMA). Grinding frequency was found to be the most influential BMG parameter on degradation rates of PS, with ca. 17 times difference in rate constants between the lowest and highest frequencies studied. Molecular weight and molecular weight dispersity were both shown to indirectly influence degradation rates. Linear relationships were found between degradation rate constants and the initial glass transition temperature, for both PS and PMMA, suggesting that the glass transition temperature was a better predictor of the degradation rate than molecular weight (above a limiting molecular weight value). We also conducted ultrasonication experiments for comparison.

신진연구자 특별 심포지움 (IV) | Young Polymer Scientists (IV)

제3회장 [10월 8일(목)]

Organizer: 강영종(한양대), 김용주(고려대), 홍성우(KITECH)

3L3-1 이진현 (Jin Hyun Lee) (09:30–09:55)

1995 인하대학교 고분자공학과 (학사)
2004 코네티컷대학교 화학공학과 (석사)
2008 조지아공과대학교 고분자섬유공학과 (박사)
2009-2011 옥스퍼드대학교 재료학과 (Post-Doc.)
2012-2015 퍼듀대학교 약학/의공학 (Post-Doc.)
2018-현재 인하대학교 고분자공학과 연구교수

Polymer Systems with Network Structure and Their Applications

이진현† 인하대학교

We live in contact with many polymer systems with network structure around us, and their unique characteristics resulted from the structure allow various applications. For example, there are the rubbers used for car wheels or shoe soles, fabrics for fashions and interiors, high-strength lightweight plastics used in aircrafts and projectiles, smart fluids used in automobile parts, photoresists for semiconductors,

and hydrogels for medical and pharmaceutical applications. Many research groups around the world are conducting the studies to develop new polymer systems with network structure for the target applications, improve their properties, and expand their uses. In this presentation, I will talk about the smart fluids, chemically modified fabrics, robust and lightweight foams, and hydrogel systems that I have studied and also discuss their network structures, structural control, characteristics, performances, and applications.

3L3-2 김지현 (Ji-Hyeon Kim) (09:55–10:20)

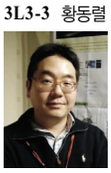
2006-2010 경북대학교 화학과 (학사)
2013-2018 울산과학기술원 원자력공학과 (석박통합)
2019-현재 재료연구소 표면기술연구본부 (Post-Doc.)

Study on the Antibacterial Performance of Zinc Oxide and Silver Nanowire Films

김지현†, 마준비, 이승훈, 김창수 재료연구소(KIMS)

ZnO and Ag nanowire (NW) were investigated on the antibacterial performance and associated properties. Firstly, to evaluate the functional sustainment in an ozone disinfection system, ZnO films were subjected to ultraviolet-ozone treatment for different periods. Despite the morphological and chemical changes, the satisfactory antibacterial-activity against *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*) was sustained. Secondly, the antibacterial activity of a AgNW film were enhanced by 1200 kGy electron beam irradiation. Generated Ag-O islands improved the antibacterial activity from 93.5 to 97.3% for *S. aureus* and 96.1 to 99.9% for *E. coli*. Thirdly, the antibacterial activity of AgNW films was improved by post-heat treatment. With increasing the heating temperature, the AgNWs broke into more segments, and became more oxidized, and consequently the antibacterial activity increased from 31.7 to 94.7% for *S. aureus* and from 57.0 to 98.7% for *E. coli*.

3L3-3 황동렬 (Dong Ryeol Whang) (10:20–10:45)



2003, 2008, 2014 서울대학교 재료공학부 (학사, 석사, 박사)
2014-2016 서울대학교 재료공학부 (Post-Doc.)
2016-2020 오스트리아 요하네스케플러대학 물리화학과 조교수
2018-2020 유럽재료소재전문가협회 부회장
2018-2020 재오스트리아과학기술자협회 부회장
2020-현재 한남대학교 신소재공학과 조교수

Artificial Photosynthesis: Learning from Nature

황동렬† 한남대학교

Artificial photosynthesis has been devised and investigated in pursuit of solving 21st century's energy problem. Despite such advances in recent decades, applying the technology in real life is still a challenging subject for the scientists. As the term "artificial photosynthesis" stems from mimicking the natural photosynthesis, we can learn from the nature's strategies which have been evolved for 3.4 billion years. This talk highlights our recent progress on developing highly efficient and robust artificial photosynthetic systems by mimicking the important strategies of natural photosynthesis. Starting with a brief description of photosystem II in natural photosynthetic autotrophs, two relevant bioinspired strategies are discussed in this talk: i) supramolecular chemistry, ii) accumulative charge transfer, and iii) self-healing. Finally, remaining challenges and perspectives for future development of artificial photosynthesis will be discussed.

3L3-4 김 민 (Min Kim) (10:45–11:10)

2008 포항공과대학교 화학공학과 (학사)
2014 포항공과대학교 화학공학과 (박사)
2015-2016 포항공과대학교 고분자연구소 (Post-Doc.)
2016-2019 Italian Institute of Technology (Post-Doc.)
2020-현재 전북대학교 화학공학부 조교수

Passivating Defect Sites of Perovskite Materials to Improve Device Stability

김 민† 전북대학교

The intrinsic instability of lead halide perovskite materials in the ambient atmosphere is one of the most critical issues that impede perovskite solar cell commercialization. Defect engineering of perovskite material has been investigated to overcome this stability issue. Here we present an overall understanding of defect physics of metal halide perovskite material. Time and temperature-resolved photoluminescence technique was introduced to characterize the defect-related photophysics. Based on the understanding, we show passivation engineering techniques to mitigate defect-assisted material degradation. Our findings correlate the optical characterization of the perovskite material with device engineering in regards to material degradation, and propose a general approach for improving the reliability of perovskite-based optoelectronic devices.

3L3-5 김봉훈 (Bong Hoon Kim) (11:10–11:35)

2005 고려대학교 재료금속공학부 (학사)
2007 KAIST 신소재공학과 (석사)
2012 KAIST 신소재공학과 (박사)
2012-2018 University of Illinois Urbana-Champaign (Post-Doc.)
2019-현재 숭실대학교 유기신소재파이버공학과 조교수

4차 산업혁명 시대를 위한 사물인터넷 소자와 3D 기능성 재료

김봉훈† 숭실대학교

최근 세계적으로 우리 생활에 큰 변화를 가져 올 4차 산업혁명에 대한 관심이 높아지고 있다. 본 발표는 이러한 4차 산업혁명 관련 기술들 중에서 사물인터넷을 이용한 피부 접착형 전기전자 소자와 2D에서 구현할 수 없는 물성을 갖는 3D 재료에 대해서 다룰 예정이다. 또한 신생아 집중 치료실에서 사용 가능하면서 무선으로 전력과 데이터를 송수신할 수 있는 피부 부착형 소자에 대해서 발표하고자 한다. 한편으로는 3D 형태의 소자를 만들기 위하여 3D printing process, two-photon lithography, bottom-up growth process, self-assembly process과 같은 다양한 제조 방법들 역시 오랫동안 연구 개발되어 왔다. 그러나 이러한 접근 방식은 많은 장점에도 불구하고 대부분 passive 3D 구조만을 만들 수 있다는 단점을 가지고 있다. 본 발표에서는 adhesion force와 mechanical strain을 이용하는 mechanical buckling process를 사용해서 electronic active devices가 삽입되어 있는 다양한 3D 구조를 구현하는 연구에 대해 발표할 예정이다.

3L3-6 곽효원 (Hyo Won Kwak) (11:35–12:00)

2010 서울대학교 바이오시스템 · 소재학부 (학사)
2016 서울대학교 바이오시스템 · 소재학부 (박사)
2016-2017 University of Sheffield (Post-Doc.)
2017-2018 인하대학교 고분자연구소 (Post-Doc.)
2019-현재 서울대학교 산림과학부 조교수

Strategies for Manufacturing Eco-friendly Lignocellulosic Biosorbent and Improving Their Heavy Metal Removal Capacity

곽효원† 서울대학교

Recently, with the emergence of problems related to micro-plastics and environmental pollution, interest in environmental remediation materials using eco-friendly bio-polymers has increased. Lignin and cellulose, collectively called "lignocellulose", is the most abundant polymers in nature. Since they have a functional group containing a hydroxyl group in a monomer unit, they have advantages in chemical modification or polymer processing. In this study, various types of multi-dimensional adsorption materials using lignocellulose were prepared. Eco-friendly nanocellulose-based beads and hydrogels using top-down and bottom-up methods and lignin-based microbeads using reverse-phase polymerization will be introduced. In addition, we introduce the chemical modification method of lignocellulosic adsorbents using polyethylene imine (PEI) and understand their hexavalent chromium (Cr(VI)) remediation behavior and its mechanism.

차세대 기능성 고분자젤과 응용
Next-generation Functional Polymer Gels and Application

제4회장 [10월 8일(목)]

Organizer: 김연수(POSTECH), 염봉준(한양대)

3L4-1 이상영 (Sang-Young Lee) (09:30–09:55)

1991 서울대학교 공업화학과 (학사)
1997 KAIST 화학공학과 (박사)
2001 막스플랑크 고분자연구소 (Post-Doc.)
1997-2008 LG화학 배터리연구소 책임연구원
2008-2012 강원대학교 화학공학과 부교수
2012-현재 유니스트 에너지및화학공학과 정교수

Gel Electrolytes: A Soft Route to All-solid-state Batteries

이상영† 울산과학기술원

All-solid-state lithium batteries (ASSLBs) have recently garnered considerable attention as a next-generation energy storage system beyond current state-of-the-art lithium-ion batteries (LIBs). A key component enabling the ASSLBs is solid-state electrolytes. Previous studies on solid-state electrolytes have mostly focused on inorganic-based ionic conductors. As a promising alternative to the inorganic solid electrolytes, an interest in gel electrolytes has reemerged. This talk briefly overviews opportunities and challenges of gel electrolytes for use in energy storage systems. Based on this understanding, we introduce some noteworthy research achievements of gel electrolytes, with a focus on printable gel electrolytes and their application to ASSLBs. We believe that the printable gel electrolytes described herein hold promise as an effective and scalable platform technology to move ASSLBs closer to commercialization.

3L4-2 차형준 (Hyung Joon Cha) (09:55–10:20)

1990 서울대학교 화학공학과 (학사)
1995 서울대학교 화학공학과 (박사)
1999-현재 포항공과대학교 화학공학과 교수
2010-현재 해양바이오산업신소재연구단 연구단장
2012-2015 포항공과대학교 세아젊은석좌교수
2017-2033 포항공과대학교 세아석좌교수

Protein-based Adhesive Hydrogels for Regenerative Medicine and Drug Delivery

Applications

차형준† Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH)

Marine mussel adhesion is known to be mediated by adhesive proteins, which are secreted through the mussel byssus and have great potential as biologically and environmentally friendly adhesive biomaterials due to their biocompatibility and biodegradability. In addition, mussel adhesive proteins (MAPs) have strong adhesion ability even on wet and underwater surfaces due to their unique amino acid arrangements and composition. However, researches using the natural amino acid composition have been limited due to extreme difficulties in obtaining sufficient quantities of MAPs for practical applications and commercialization. Previously, we successfully produced redesigned MAP using a bacterial expression system and this bioengineered MAP showed significant adhesion ability and biocompatibility. Herein, I will present our research team's efforts on development and evaluations of MAP-based adhesive hydrogels in diverse applications including regenerative medicine and drug delivery.

3L4-3 조승우 (Seung-Woo Cho) (10:20-10:45)

1999	서울대학교 응용화학부 (학사)
2001	서울대학교 응용화학부 (석사)
2006	서울대학교 응용화학부 (박사)
2007-2009	매사추세츠 공과대학 화학공학과 (Post-Doc.)
2010-2018	연세대학교 생명공학과 조교수, 부교수
2018-현재	연세대학교 생명공학과 정교수

Biomimetic Hydrogels for Regenerative Medicine

조승우† 연세대학교

Regenerative medicine with stem cell, reprogramming, and tissue engineering can provide highly effective therapeutics for treating incurable diseases. Several engineering approaches have been employed to improve regenerative medicine. In particular, functional biomaterials such as hydrogels can enhance the efficacy of regenerative medicine by providing tissue-mimetic biochemical and biophysical cues. Herein, biomimetic hydrogel platforms are demonstrated to improve stem cell engineering, reprogramming and organoid technology. Acknowledgment: This work was supported by a grant (2018M3A9H1021382) from the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT (MSIT), Korea.

3L4-4 김재윤 (Jaeyun Kim) (10:45-11:10)

2001	서울대학교 응용화학부 (학사)
2003	서울대학교 응용화학부 (석사)
2007	서울대학교 화학생물공학부 (박사)
2008	존스홉킨스 의대 (Visiting Researcher)
2008-2012	하버드대학교 Bioengineering (Post-Doc.)
2012-현재	성균관대학교 화학공학/고분자공학부 조교수, 부교수

Adhesive Hydrogels for Soft Tissue Mimicking and Transdermal Drug Delivery

김재윤† 성균관대학교

Hydrogels have been used as biocompatible material platforms for tissue regeneration and drug delivery as it can hold a large amount of water within its three-dimensional hydrophilic polymer network. However, due to high amount of water, most hydrogels show limited mechanical properties and do not exhibit adequate adhesiveness to tissue; it is challenging to achieve adhesive hydrogels with high mechanical properties. Increasing adhesion to tissue by incorporation of adhesive moieties in polymer chain often leads to the decrease in the strength of hydrogel, resulting in a limited application of adhesive hydrogels. In this talk, I will introduce our recent achievements for fabricating adhesive hydrogels with enhanced adhesiveness by increasing the strength of hydrogel and the adhesion to tissue simultaneously, which may be potentially applicable to soft tissues mimetics and transdermal drug delivery.

3L4-5 윤진환 (Jinhwan Yoon) (11:10-11:35)

2002	포항공과대학교 화학과 (학사)
2007	포항공과대학교 화학과 (박사)
2007-2009	포항공대 기능성분자집합체연구센터 (Post-Doc.)
2009-2011	Univ. Massachusetts, Amherst (Post-Doc.)
2011-2017	동아대학교 화학과 조교수, 부교수
2017-현재	부산대학교 화학교육과, 화학소재학과 부교수

Mechanically Reinforced Highly Stretchable Hydrogels and Their Applications

윤진환† 부산대학교

The development of the hydrogels with high toughness and stretchability is one of the most important topics in soft matter research. In this presentation, the design of a dual physical crosslinked network for the fabrication of ultra-stretchable tough hydrogels is covered. Outstanding mechanical properties are achieved by the synergistic contribution of reversibly disruptable ionic and metal-coordination bonds and the highly elastic network formed by the macro-crosslinker. Secondly, double network hydrogels containing conducting fillers were simply prepared by using microfluidic devices in aqueous condition. We envision their application for the wearable sensor that accurately detect human motion such as bending of finger, mild touching, walking, running, and jumping in real time. Based on the high linearity and reliability, strain sensors enable to quantitatively convert measured resistance change to the extent of stimuli as well as the simple detection of the motion.

3L4-6 선정윤 (Jeong-Yun Sun) (11:35-12:00)

2005	서울대학교 재료공학부 (학사)
2012	서울대학교 재료공학부 (박사)
2012-2014	Harvard University (Post-Doc.)
2014-2018	서울대학교 재료공학부 조교수
2018-현재	서울대학교 재료공학부 부교수

Stretchable Ionics - Current & Future

선정윤† 서울대학교

As many devices for human utility target fast and convenient communications with users, superb electronic devices have been demonstrated as hardware for Human-Machine Interface (HMI) in wearable forms. Wearable devices for daily health-cares and self-diagnosis desire more human-like properties unconstrained to deformation. In this sense, stretchable ionics based on flexible and stretchable hydrogels is on the rise as another field to develop wearable devices for bio-applications due to two major reasons; i) ionic currents, choosing the same signal carriers with biological areas, and ii) the adoption of hydrogel ionic conductors which are intrinsically stretchable materials with bio-compatibility. Here, forte and current status of stretchable ionics as well as future applications whose positive effects can be magnified by stretchable ionics are going to be introduced.

전력산업분야 고분자 복합소재 개발 및 응용
Development and Application of Polymer Composites in Electric Power Industry

제6회장 [10월 8일(목)]

Organizer: 장세규(KIST)

3L6-1 이중범 (Joong Beom Lee) (09:30-09:55)

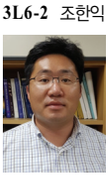
1987	경희대학교 화학공학과 (학사)
1989	경희대학교 화학공학과 (석사)
2007	고려대학교 화공생명공학과 (박사)
1994-현재	한국전력공사 전력연구원 (현 R&D 운영팀장)

전력산업분야 고분자 복합소재 개발 및 응용

이중범† 한전 전력연구원

4차 산업혁명은 우리 후손들이 미래에 살아갈 지구의 환경 개선을 포함하는 새로운 개념의 '인간 중심 산업혁명'이라고 한다. 그 중심에 있는 에너지 4.0은 인간과 환경을 조화롭고 이롭게 하는 새로운 시대의 사명이라고 할수 있다. 에너지 4.0의 기본 개념은 에너지믹스, 송변전 센서, ICT, 빅데이터, IoT 기술을 활용한 에너지 수송과 수요의 혁명, 안전한 거래를 위한 보안시스템으로 블록체인 기술 등을 추가하여 완성할 수 있을 것이다. 전력산업 분야에서 에너지 4.0 실현을 위해 기후변화 해결 등을 위한 에너지믹스 등을 포함하는 다양한 기술 개발 연구가 진행 중이다. 본 고에서는 에너지 4.0을 위한 기술 중에서 전력산업과 관련된 핵심 소재 개발에 대하여 간략하게 소개하고자 한다. 우선 태양광 효율과 수명 향상을 위한 기술로 페로브스카이트 투명 태양전지 기술 개발이 진행중이며 생산된 에너지의 고효율 저장을 위한 기술로 슈퍼커패시터 개발에 그래핀 소자 활용 기술이 개발 중이다. 또 에너지 수송 고도화를 위한 기술로 초전도 케이블 개발과 고품질 맞춤형 부품 생산에 필요한 3D 프린팅 기술이 소재 기술과 융합 개발 중이다.

3L6-2 조한익 (Han-Ik Joh) (09:55-10:20)



2003	성균관대학교 화학공학과 (학사)
2006	서울대학교 화학생물공학과 (석사)
2010	서울대학교 화학생물공학과 (박사)
2010-2017	KIST 연료전지연구센터 (Post-doc.)
2010-2017	KIST 탄소융합소재연구센터 연구원/선임연구원
2017-현재	건국대학교 미래에너지공학과 조교수

탄소섬유 전구체를 이용한 투명 전극 및 고전도성 도선 구현 연구

조한익† 건국대학교 미래에너지공학과

기계적 및 전기적 특성이 뛰어난 탄소섬유는 고분자나 핏치를 섬유형태로 방사한 후, 열처리를 통해 제조된다. 탄소섬유 제조에 사용되는 전구체는 일반적인 고분자와 달리, 낮은 열처리 온도에서는 선형 고분자가 육각고리 구조를 형성하고, 고온 열처리 과정에서는 육각고리 구조의 고분자끼리 연결되어 그래핀과 유사한 구조를 형성한다. 본 연구에서는 탄소섬유 전구체의 특성을 이용하여 전도성 투명 전극을 구현하고, 이를 바탕으로 전력선에 사용되는 구리 도선의 전기전도도를 향상시킨 결과를 소개하고자 한다. 전도성 투명 전극은 금속 필름없이 탄소섬유 전구체가 열처리 과정에서 육각고리 구조를 형성하는 특성을 이용하여 구현하였으며, 제조된 전극은 유기태양전지에 활용하였다. 또한, 구리 도선에 동일한 공정을 적용한 결과, 기존 도선 대비 본 기술이 적용된 구리 도선의 전기전도도는 약 5~8% 향상됨을 확인할 수 있었다.

3L6-3 배수강 (Sukang Bae) (10:20–10:45)

2006 동국대학교 화학과 (학사)
2012 성균관대학교 나노과학기술학 (박사)
2012-2013 성균관대학교 나노과학기술학 (Post-Doc.)
2013-현재 한국과학기술연구원 선임연구원

Carbon-Copper Composite Wires for High Performance Electrical and Mechanical Cables

배수강† 한국과학기술연구원

Recent development in mobile electronic devices and electric vehicles requires electrical wires with reduced weight as well as enhanced stability. In addition, since electric energy is mostly generated from power plants located far from its consuming places, the mechanically stronger and higher electric power transmission cables are strongly demanded. However, there has been no alternative materials that can practically replace copper materials. Here, we report a method to prepare ultra-strong carbon-Cu core-shell wires with significantly enhanced electrical and mechanical properties. The core carbon nano-material based fibers (CFs) are synthesized by chemical vapor deposition (CVD), followed by electroplating of Cu shells, where the large surface area of CFs in contact with Cu maximizes the mechanical toughness of the cores-shell wires. At the same time, the unique electrical and thermal characteristics of graphene allows ~10 times higher current density limit, providing more efficient and reliable delivery of electrical energies through the CFs-Cu wires. We believe that our results would be useful to overcome the current limit in electrical wires and cables for light-weight, energy-saving and high-power applications.

3L6-4 이건웅 (Geon-Woong Lee) (10:45–11:10)

1999 서울대학교 화학공학과 (박사)
2000-2003 한국과학기술연구원 연구원
2003-2005 Georgia Tech. 섬유공학과 (Post-Doc.)
2006-현재 한국전기연구원 전기재료연구본부 본부장
2019-현재 국가지정연구실(N-lab) 책임자
2020-현재 국가연구협의체(N-team) 책임자

스마트 전기소재 · 부품을 위한 e-나노소재 응용기술

이건웅† 한국전기연구원

스마트 전기소재.부품을 위한 e(electric)-나노소재를 나노카본(전도성), 나노하이브리드(절연성), 나노에너지저장(전기저장) 및 나노에너지변환(전기변환) 분야에 초점을 두고 개발하고 있다. 전도성 나노카본 분야는 합성, 정제, 분리 등의 기반기술을 중심으로 대량 생산용 나노카본 페이스트화 기술 및 박막형성기술을 개발하고 있다. 절연분야는 고기능 나노하이브리드소재 개발을 통해 저유전성 절연재료 및 기능성 절연코팅재 개발을 추진하고 있다. 전기저장 나노소재 분야는 차세대전지 중 가장 먼저 상용화가 가능할 것으로 예상되는 전고체전지의 고체전해질에 대해서 기존기술과 차별화된 나노기술의 도입을 통해 핵심 소재인 고체전해질 소재부품 특허를 회피하기 위한 전략으로 활용하고 있다. 전기변환 분야는 나노기술을 도입한 신소재 기반 열전/광전/압전 기술의 융합으로 분산전원급의 에너지하베스팅 기술을 연구하고 있다. 이상과 같이 스마트 전기소재.부품을 위한 e-나노소재 응용기술 개발을 통해 정부의 소부장 2.0 추진을 지원하고, 국내 전기.전력 소재.부품 산업분야의 경쟁력을 강화할 수 있을 것으로 기대된다.

3L6-5 정순종 (Soon-Jong Jeong) (11:10–11:35)

1989 연세대학교 금속공학과 (학사)
1991 연세대학교 금속공학과 (석사)
2000 워싱턴주립대학교 재료공학과 (박사)
1991-현재 한국전기연구원 전기재료연구본부
전기변환소재연구센터

전력기기 감시용 복합 소재 및 이를 적용한 하베스팅 소자

정순종†, 신동진, 고중혁[1] 한국전기연구원 전기재료연구본부; [1]중앙대학교 전기전자공학부

전력설비의 안정적인 운전을 위한 유지보수 기술은 온라인 진단기술로 발전되고 있으며, 전력설비의 불시고장으로 인해 발생하는 전기재해를 예방하기 위한 에너지 독립형 전력설비 진단용 기술 개발 및 전력설비 통합 온라인 감시진단, 공통 SoC 및 플랫폼 개발, 전력설비 진단 센서용 에너지 하베스팅 및 스마트 센서를 개발이 필요하다. 이에 적합한 센서 및 SoC 전원으로는 전지나 기존 전력설비 만 전력선 전원을 사용되고 있으나, 향후 보다 효과적으로 진단 설비를 유지하기 위해서는 자가 전원기술이 필요하다. 일반적인 환경에서는 잡음 전자파 에너지로부터 얻을 수 있는 발전량이 많지 않기 때문에 거의 실용되지 않고 있지만 전력설비 주변에서는 전자파로부터 오히려 가장 많은 발전을 할 수 있기 때문에, 전력설비 진단용 무선/무전원 센서를 고려한다면 이를 위한 안정되고 높은 효율의 에너지 하베스팅 기술이 필요하며 이에 대한 현황 및 핵심 기술에 대해서 소개한다.

3L6-6 유승건 (Seunggun Yu) (11:35–12:00)

2008 서울과학기술대학교 신소재공학과 (학사)
2011 연세대학교 신소재공학과 (석사)
2017 연세대학교 신소재공학과 (박사)
2017-2018 한국과학기술연구원 (Post-Doc.)
2018-현재 한국전기연구원 절연재료연구센터 선임연구원

Interface-engineered Polypropylene Blends for High Voltage Power Cable Insulations

유승건, 이대호† 한국전기연구원

Here, we introduce design of insulative polypropylene (PP) blends with engineered interfaces to improve electrical durabilities as well as mechanical properties. PP-based insulating materials were prepared via melt-blending with rubbery ethylene-1-octene copolymer (EOC), followed by mixing an ethylene-propylene random copolymer (rPP) as a surfactant for high-voltage power cable applications. Simple melt-blending of rPP formed a core-shell nanostructure composed of EOC/rPP and a fine dispersion of macron-sized EOC domains. The nanostructured PP ternary blends exhibited multiple advantages in terms of thermal stability, mechanical properties, dielectric performances, and long-term stability compared to the existing crosslinked polyethylene (XLPE). This study provides a straightforward, rational design of environmental insulation materials for high voltage power cable applications.

대학원생 구두발표 (IV) | Graduate Student Oral Session (IV) (Korean)

제7-1회장 [10월 8일(목)]

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

3O7-1 허태환 (09:30–09:45)

Preparation of Porous Silicon Carbonitride Ceramics with Micro-/Meso-/Macropore Using Branched Structured Polysilazane as Precursor and Freeze Casting Method

허태환, 곽영제† 숭실대학교

The porous ceramics have received attention in various fields such as catalyst support, membrane, scaffold, and fuel reforming application because of their high thermal stability, excellent chemical, creep and oxidation resistance, along with their large surface area. The use of preceramic polymer is one of the good recipes to manufacture porous ceramics, since micro- or meso-sized pores are generated by removing organic groups during pyrolyzing preceramic polymer to ceramics. However, if the cross-linking density of the preceramic polymer is not sufficient before the pyrolysis, the formed pores will collapse. In this study, we tried to fabricate porous silicon carbonitride (SiCN) using phenyl-silsesquiazane (SSQZ) and freeze casting method. Due to the branched structure of SSQZ that increased cross-linking density, the structural stability of the generated pores was improved. In addition, glycidyl-POSS and diepoxide was also used to further increase the cross-linking density.

3O7-2 이혜영 (09:45–10:00)

3D Bioprinted Gelatin-methacrylate Hydrogels Containing Poly(lactic-co-glycolic acid) Nanofiber Fragments

이혜영, 고윤제, 권오형† 금오공과대학교

Hydrogel is an optimal biological environment for cell encapsulation. A fiber-reinforced gelatin-methacrylate (gelMA) hydrogel bioink that can improve the compressive modulus and cell proliferation using poly(lactic-co-glycolic acid) nanofiber fragments (PLGA-NF) as an artificial extracellular matrix to build specific soft tissues. The microstructures of the nanofiber fragments were observed via SEM. The degree of substitution of synthesized gelMA was investigated considering the mole ratio of MA and gelatin. The compressive modulus of hydrogels was measured using a texturometer. Cell viability of the encapsulated fibroblast was confirmed using live-dead stains and phalloidin-DAPI stains. Cell proliferation in bioprinted gelMA/PLGA-NF hydrogels was increased in comparison to the control groups. The combination of hydrogel bioink with nanofibrous fragments will be a critical foot step in the field of 3D bioprinting.

3O7-3 김민주 (10:00–10:15)

Luminescence Enhancement of Upconversion Nanoparticle Sensitized Perovskite Quantum Dots in Metal-insulator-metal Configuration under NIR Excitation

김민주, 김영지, 고형덕[1], 현가담, 김동하† 이화여자대학교; [1]한국과학기술연구원

All inorganic perovskite quantum dots (PeQDs) have received much attention due to excellent optical properties. However, due to their low efficiency under near-infrared (NIR) light excitation, potential applications have been limited. Recently, upconversion nanoparticle (UCNP) sensitized PeQD has been reported as a solution, but low quantum yield of UCNPs and photoluminescence (PL) intensity of PeQD film have still remained as challenges. In this work, UCNP sensitized PeQDs and polystyrene-block-poly (2-vinylpyridine) (PS-*b*-P2VP) capped gold nanorods (AuNRs) were deposited on a metallic reflector, forming AuNRs/UCNPs and PeQDs/Ag film (MUPM) configuration. By exploiting gap plasmon polariton and localized surface plasmon effects, PL intensity of PeQDs increased under NIR excitation. Furthermore, PS-*b*-P2VP used as capping ligand prevented PL quenching from the direct contact of AuNRs and Ag film. This work provided a new platform to boost PL intensity of PeQD film under NIR excitation.

3O7-4 손동완 (10:15–10:30)

Planar Color Display Boards Detecting Local Environmental Changes

손동완, Muhammad Umar[1], Sara Arif[1], 김성환[1], 김명웅† 인하대학교; [1]아주대학교

Optical resonators based on stimuli-responsive insulator layer are used in sensing in biochemical environments, as the optical behavior responds with the environmental variations. The PNIPAm, due to its thermoresponsive properties, is used in chemical and biological sensing applications Here, we design stimuli-responsive insulator

layer to create thermo-responsive metal-insulator-metal (MIM) resonators for color filters and superabsorbers. We synthesized cross-linkable poly(NIPAm-r-GMA) to form hydrogel thin films. The copolymer-sandwiched MIM device exhibited optimal optical response which could be controlled by the temperature of the aqueous environment. In biological and non-biological applications, the temperature of the environment could be precisely traced by observing the optical response. The MIM provide a new way to sense local environmental changes optically.

3O7-5 장지운 (10:30-10:45)

Electrical Conductivity of Polymer Composites Highly Filled with Carbon Nanotube

장지운, 김성훈†, 김성률[1] 한양대학교; [1]전북대학교

There are growing interests in polymer composites incorporating nanocarbon fillers such as graphene (electrical conductivity of 104-106 S/m) or carbon nanotube (CNT, 104-106 S/m) due to the demand for lightweight materials exhibiting high electrical conductivity. The electrical conductivity of the polymer composite incorporating the nanocarbon filler is based on the percolation behavior generated by the electron tunnel effect. Many studies on polymer composites incorporated with CNT have reported percolation behavior in the range of 1-3 wt% CNT content. However, the electrical conductivity of the composite has been rarely reported at a filler content of 20 wt% or more. In this study, the behavior of electrical conductivity based on material structure and theory was investigated after preparing a high-filled (>20 wt%) polymer composite with uniform dispersion of CNTs via in situ polymerization of oligomer resin.

3O7-6 구권모 (10:45-11:00)

Study on the Mechanical Characteristics of Injection Molded Glass Fiber-reinforced Polyamide 66 Composites for the Application of Automotive Lightweighting

구권모, 김양수†, 김경건†, 정재흠[1], 김영길[1] 인제대학교 나노융합공학부; [1]대흥알앤티

Polyamide 66 is widely known to be a good candidate plastic material for the application of automotive lightweighting. In this study, injection molded glass fiber-reinforced polyamide 66 composites were prepared and their mechanical characteristics depending on the variation of glass fiber content were analyzed. It was carried out a detailed analysis regarding mechanical properties such as tensile strength, flexural strength, impact strength, and mechanical loss tangent. It could be successfully sought for a commercial grade of glass fiber-reinforced polyamide 66 composites, which shows over 88% of the specification of specific automobile part based on tensile strength and flexural strength. The Izod impact strength test was carried out at both room temperature and low temperature of -40 °C, and also it was tried dynamic mechanical analysis in order to estimate loss tangent value depending on the glass fiber content.

3O7-7 한지훈 (11:00-11:15)

Improved Network Formation in Polyelectrolyte Complex Hydrogels via Suppression of Micellization

한지훈, 김연수† 포항공과대학교

Physical hydrogels composed of oppositely charged polyelectrolytes have unique functions like sol-gel transition and self-healing. However, it is difficult to obtain both of high water content and excellent mechanical properties in the physical hydrogel. Generally, physical hydrogels can be easily obtained by using ABA triblock copolymers, where A blocks are charged blocks and B blocks are hydrophilic neutral blocks. At critical gelation concentration, ABA triblock copolymers construct a 3-dimensional polymer network through self-assembled micelles, especially flower-type micelles. In this case, the loop-shaped polymers do not contribute to connection of network at all, which lowers the efficiency of gel formation. Here, we propose new BABAB pentablock copolymers showing direct network formation rather than loop formation through suppression of micellization. The mechanism of the directly formed polymer network as well as the rheological properties of our hydrogels will be discussed.

3O7-8 강석원 (11:15-11:30)

Inverted Cylinder Structures from AB/AC Diblock Copolymer Blends with Hydrogen Bonding

강석원, 김진곤† 포항공과대학교

Block copolymers with various microdomains have investigated for various nanolithography applications. In general, hexagonally packed cylindrical microdoains have been found where the volume fractions of cylinder blocks are about from 0.2 to 0.35. This study presents a binary blend of block copolymers interacting hydrogen bonding to fabricate inverted cylinder structures by self-assembly. This blend system consists of polystyrene-*block*-poly(2-vinylpyridine) (PS-*b*-P2VP) and polystyrene-*block*-poly(4-hydroxystyrene) (PS-*b*-PHS). The hydrogen bonding between P2VP and PHS change the interface curvature. The blends exhibited inverted HEX cylindrical microdomains having the volume fraction of cylinders was more than 0.6 and investigated by transmission electron microscopy and small angle X-ray scattering. The thin films with vertically oriented inverted cylinder patterns were prepared by solvent vapor annealing.

3O7-9 안정빈 (11:30-11:45)

Food Waste-driven N-doped Carbon Dots: Applications for Fe^{3+} Sensing and Cell Imaging

안정빈, 김형섭† 건국대학교

In this work, highly fluorescent N-doped carbon dot (CDs) were synthesized from food waste and the relationship between the chemical structure and the fluorescent properties were deeply investigated. The cat feed stocks driven from food waste was used for the model material. The chemical transition from model waste to CDs were studied. The core of the CDs was successfully self N-doped without extra pre-/post-treatments and resulted in high quantum yield as 23%. To demonstrate the conversion of real food waste into CDs, the hamburger sandwich leftover was utilized for CD synthesis. The food leftover driven CD had similar chemical/optical properties to that of the waste model, with quantum yield of 28%. The synthesized CD was applied to fluorescence probe for Fe^{3+} detection. It showed high selectivity, even under the interference of other metal. Moreover, the CD exhibited good cell viability over 80% and adjusted to bio-imaging material.

3O7-10 이재경 (11:45-12:00)

Multicolor, Transparent, Design-it-Yourself (DIY) Electrochemical Displays Based on Oxidatively Tuned Ion Gels

이재경, 문홍철† 서울시립대학교

In this study, we present user-customized, design-it-yourself (DIY) transparent displays based on electrochromic (EC) ion gels containing viologens. The realization of multicolor electrochromic displays (ECDs) indicating balanced color intensity at a certain voltage is not trivial due to the discrepancy of operating voltages and different electrochemical characteristics of each chromophore. To address this issue, we propose a simple but effective strategy, tuning oxidation activity of anodic species (i.e., ferrocene (Fc) derivatives) by modifying pendant groups. We systematically investigate the effects of the prepared Fc derivatives on the behaviors of ECDs. Moreover, to demonstrate user-customizable fabrication concept, referred to as DIY, we draw images using the optimized RGB gel inks and prepare the transparent displays.

대학원생 구두발표 (V) | Graduate Student Oral Session (V) (Korean)

제7-2회장 [10월 8일(목)]

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

3O7-11 김민철 (09:30-09:45)

Implementation of Bottlebrush Polymer in Inducing Perpendicular Orientation of High-χ Block Copolymers on Thin Film

김기현, 김민철, 방준하† 고려대학교

Inducement of the perpendicular orientation of high-χ block copolymer (BCP) on thin film has been of utmost importance for its applicability to next-generation nanolithography. In this study, we present inducement of high-χ BCP (PS-*b*-PMAA) perpendicular to the substrate without any surface treatment by implementing bottlebrush polymer(BBP) with random copolymer side chains. Architecture difference between bottlebrush and linear polymer leads to the air and substrate interfaces be entropically favorable to BBP and make BBPs neutralize the interfaces. Synthetic methods for BBPs are RAFT followed by ROMP to from BBPs with random copolymer side chains. BBPs with PS-*r*-PtBMA side chains go through hydrolysis reactions and are converted to BBPs with PS-*r*-PMAA side chains. Used as additives, BBPs segregated towards the surface and the substrate after going through the spin coating and thermal annealing. Perpendicular orientation of PS-*b*-PMAA is proved by SEM and GI-SAXS.

3O7-12 김민지 (09:45-10:00)

Intervertebral Disc Regeneration Using Stem Cell/Growth Factor-Loaded Porous Particles with a Leaf-Stacked Structure

김민지, 이진호[1], 김준수[2], 김호용, 이희천[2], 변준호[3], 이재훈[2], 김나현[4], 오세행† 단국대학교; [1]한남대학교; [2]경상대학교; [3]경상대학교병원; [4]안전성평가연구소

Although biological therapies based on growth factors and transplanted cells have demonstrated some positive outcomes for intervertebral disc (IVD) regeneration, repeated injection of growth factors and cell leakage remain as challenges for human applications. Herein, we prepare human bone marrow-derived mesenchymal stem cells (*h*BMSCs) and transforming growth factor-β3 (TGF-β3)-loaded particles with a leaf-stacked structure throughout the entire matrix (LSS), as a combination bioactive delivery for degenerated IVD. The LSS particles allow sustained release of TGF-β3 and stable cell adhesiveness. On the basis of in vitro and in vivo studies, it was observed that the *h*BMSCs/TGF-β3-loaded LSS particles can provide an appropriate environment for chondrogenic differentiation of *h*BMSCs and induces IVD regeneration in a beagle dog model. Thus, therapeutically loaded LSS particles offer the promise of an effective bioactive delivery system for regeneration of various tissues including IVD.

3O7-13 오준용 (10:00-10:15)

Cloaking Protein Shield Zr-MOF Delivery Platform for Targeted Nanomedicine

오준용, 유자형†, 울산과학기술원; [1]울산과학기술원 자연과학부

In this study, we intended to advance the possibilities of a Zr-MOF-based delivery platform by utilizing self-assembling bonds between the MOF active site and various carboxyl groups in functional shield proteins. Functional cloaking proteins such as

GST-Afb (HER2 and EGFR) are very stable, inhibit reactions with other proteins and can be used for targeting. Such proteins can stabilize the active site of the MOF and also act as a targeting moiety. We effectively controlled the MOF surface via an intrinsic reaction between the active site and recombinant proteins to develop a targeted drug delivery platform. This study provides an insight into the potential applications of Zr-MOFs in nanomedicine and the future of the biointerface of MOFs.

3O7-14 박원기 (10:15–10:30)

Anti-counterfeiting Application of Chiral Photonic Crystals Made of Aligned Helical Liquid Crystal Structures

박원기, 윤동기† 한국과학기술원

Photonic crystals (PCs) have been widely used in anti-counterfeiting purposes due to their beautiful and diverse color change. For example, depending on the viewing angle, the reflection color of PCs is changed, and thus it is currently used in many bills. Here, we demonstrated a new type of anti-counterfeiting code whose color changes depending on the light's polarization state. Chiral PCs with optical activity were used to rotate the linearly polarized light, and the transmission color was changed dramatically, which can be detected with two plastic polarizers in real-time. To realize the system, helical nanofilament liquid crystal phase has been studied, including its alignment method and chiro-optical properties. As this is the unique functionality only possible in chiral PCs, this can be used as advanced anti-counterfeiting technology, which cannot be imitated easily with conventional PCs.

3O7-15 남정용 (10:30–10:45)

Dissipative Particle Dynamics Simulation of Self-assembly of Thin Film of Diblock Copolymers and Nanoparticles under Soft Confinement

남정용, 김용주[1], 이원보† 서울대학교; [1]국민대학교

Self-assembly behavior of thin film of diblock copolymers and nanoparticles studied using DPD simulation. Two types of diblock copolymer are considered: coil-coil and rod-coil. Nanoparticles are modeled from fcc with a shape close to the sphere. To model the soft confinement, two different repulsive beads are introduced on the top and bottom of thin film of diblock copolymers and nanoparticles. Self-assembled structure is lamellar phase in the case of coil-coil polymer and smectic lamellar phase in the case of rod-coil polymer by using one bead fraction value as 0.4~0.6. We found the positions of nanoparticles within the thin film are changed as functions of nanoparticles size and diblock copolymer types. We also found relative interaction between nanoparticle and diblock copolymer affects the position of nanoparticles within the thin film. The significance of this study is to open the possibility of like solving the system like air-liquid interface problems using soft confinement.

3O7-16 안 솔 (10:45–11:00)

Thiol-Modified Cellulose Nanofibers Enabling Effective Functionalization Routes and the Adsorption of Heavy Metal Ions

안 솔, 김명웅, 이호익[1,†] 인하대학교; [1]한국생산기술연구원

Cellulose is one of the attractive materials as an eco-friendly and renewable natural polymer. In particular, its fibrous structure has drawn attention due to high surface area, high porosity, and flexibility. To expand the applicability, tailoring their surface chemical properties is essential. Hence, efficient chemical reaction routes under mild conditions are necessary to develop. Herein, we demonstrate thiol-functionalized cellulose nanofibers that can offer three different chemical functionalizations: (i) metal adsorption, (ii) thiol-ene nucleophilic Michael addition, and (iii) radical thiol-ene click reaction. Furthermore, it is shown that the surface immobilized thiol is effective to adsorb heavy metal ions, opening up the potential of cellulose materials as a heavy metal removal membrane. We finally highlight the potential of the presented chemistries to expand to functionalized surfaces of other carbohydrate-based materials to achieve the desired properties.

3O7-17 오승택 (11:00–11:15)

Understanding Marangoni Flow-driven Solidification of Polymer Semiconducting Films on an Aqueous Substrate

오승택, 이화성† 한양대학교 에리카캠퍼스

in the context of the polymer film on an aqueous transfer process, A high value of spreading coefficient (S) is key to improving the polymer film uniformity and crystalline structure, which affect the organic field-effect transistor (OFET) device performance. In addition, solidified orientations are different depending on the direction in which the film is transferred. The differences between the upward(UST) and downward (BST) confirmed that the solvent in the polymer solution droplet was rapidly extracted at the interface with the base media and was slowly evaporated near the air interface with the polymer solution. The results induce rapid solidification with poor structural properties at the base media interface and slow solidification with good structural properties at the air interface. The surface properties of films were advantageous in the vicinity of the air/polymer solution interfaces for use as a channel active layer, resulting in good OFET device performances for the UST case.

3O7-18 박성민 (11:15–11:30)

Growth Modeling of InAs Colloidal Quantum Dots in Continuous Process

박성민, 김태완, 정소희† 성균관대학교

InAs quantum dot is considered promising for NIR/IR optoelectronics based on the bandgap tunability of 0.82~1.77 eV stemmed from the quantum confinement effect. Size-tuned synthesis of InAs quantum dot requires the fine control of the reactivity of both indium and arsine precursors yet challenging mainly because of the limited choice of arsine precursors. In this study, instead of modifying the chemical reactivity of precursors, we investigated the synthetic process. Growth of the particle is monitored by absorbance measurements and TEM analysis. We then mathematically modelled the mode of crystal growth utilizing monomer diffusion dynamics. Nucleation and growth step are individually configured to induce monodispersed growth thus allowing larger sized particles without the expense of dispersity.

3O7-19 김영은 (11:30–11:45)

Effect of Fiber and Matrix Modifications on Properties of Carbon Fiber/ABS Composites: Comparative Studies between SFT and LFT

김영은, 조동환† 금오공과대학교

탄소섬유강화 열가소성 플라스틱(CFRTP)은 다양한 산업분야에서 널리 사용되고 있다. CFRTP에서 강한 섬유-매트릭스 계면결합을 형성하기 위한 접근 방법 중의 하나로 섬유를 multi-walled carbon nanotube(MWCNT)로 개질하고 매트릭스 수지를 milled carbon fibers(MCF)로 각각 개질하여 계면특성 향상의 시너지 효과를 꾀할 수 있다. CFRTP는 종종 압출공정과 사출공정 방법으로 제조된다. 이 경우, 압출공정 중 스크류 전단력에 의해서 섬유가 손상되고 short fiber thermoplastic(SFT) 복합재료가 얻어지게 된다. 이러한 점을 개선하기 위해 long fiber thermoplastic(LFT) 공정을 도입하여 섬유의 손상을 최소화하는 기술이 주목받고 있다. 따라서, 본 연구에서는 polyethyleneimine로 처리된 MWCNT를 탄소섬유에 코팅하고, MCF를 ABS 매트릭스에 혼입하여 개질하였다. 개질된 탄소섬유와 ABS 매트릭스를 이용하여 각각 압출공정과 LFT공정을 통해 SFT 펠렛 및 LFT 펠렛을 제조하였다. 이를 이용하여 사출성형을 통해 각각의 탄소섬유/ABS 복합재료를 제조하고, 인장, 굴곡, 충격, 열변형온도 등에 미치는 섬유와 매트릭스 개질에 따른 SFT와 LFT 영향을 조사하였다.

3O7-20 김중권 (11:45–12:00)

Transparent, Water-stable, Cellulose Nanofiber-based Packaging Film with a Low Oxygen Permeability

김중권, 진정호† 울산대학교

Herein, we report on a transparent, water-stable, high oxygen barrier packaging film made from a combination of cellulose nanofiber (CNF) and a fluoropolymer (FP) coating. Nanofibrillation of the hardwood kraft pulp was carried out using succinic anhydride pretreatment and aqueous counter collision (ACC) technique to obtain ultrafine (5 – 7 nm) succinylated cellulose nanofibers (SCNF), which was readily fabricated into a thin coating (on PET film) as well as a self-standing film. Introducing the FP topcoat on SCNF enabled a synergistic enhancement of both oxygen barrier performance and stability against water-swelling.

Graduate Student Oral Session (III) (English)

제9회장 [10월 8일(목)]

Organizer: Jeong Jae Wie (Inha Univ.), Dong Ki Yoon (KAIST), Keun Hyung Lee (Inha Univ.)

3O9-1 Tony Kiio (09:30–09:45)

Soft Nanoliposomes as an Effective Drug Carrier in Breast Cancer

Tony Kiio, 박소연[1,†] Keimyung University; [1]계명대학교 약학대학

Nanoliposomes (NLPs) as novel drug carriers have been physically and chemically modified for better pharmaceutical functions. The effect of NLPs elasticity on cell uptake has been explored to a lesser extent. We successfully designed NLPs with varying elasticity while other physical and chemical properties of NLPs were kept consistent. Using the atomic force microscope-based force spectroscopy, the NLPs with aqueous core exhibit the lowest Young's modulus while the NLPs with calcium crosslinked alginate core exhibited the highest Young's modulus. We found that the soft NLPs exhibited higher permeability in human umbilical vein endothelial cells than the hard counterparts. We also observed the enhanced cellular internalization of the soft NLPs in breast cancer cells compared with the hard NLPs. We concluded that the softness of nanoparticles plays a fundamental role in facilitating the drug uptake and efficacy in breast cancer in vitro.

3O9-2 김진민 (09:45–10:00)

Emulsion-based Synthesis of Semi-permeable Protocells Composed of Poly(*N*-isopropylacrylamide)-albumin Hybrid Amphiphiles

김진민, 오승수† 포항공과대학교

By controlling molecular transport, semi-permeable membranes can be highly useful for biosensors. Body fluids such as blood contain not only small analytes but also many other large molecules, of which potential fouling severely impairs the sensing performance. If sensing probes are protected by the membranes that are selectively impermeable to the fouling molecules, the desired analytes can be sensitively detected even in a *non-treated clinical sample*. In this work, we propose the use of polymer-protein conjugates to build semi-permeable microcapsules, proteinosomes. We invented a self-assembly method using the amphiphilic structure of the conjugates comprised of PNIPAm with tunable hydrophobicity and hydrophilic albumin, an antifouling serum protein. Employing an oil-in-water emulsion process, the desired albumin-crosslinking networks were created; by encapsulating aptasensors, we

demonstrate that the protocells can serve as high-performance biosensors, even in *undiluted serum*.

3O9-3 최후연 (10:00-10:15)

Sequestering ATP Inside Mitochondria by Nucleopeptide Induces Cancer Cell Apoptosis

최후연, 유자형† UNIST(Ulsan National Institute of Science and Technology)

Mitochondria are essential organelles involving in cellular processes, especially adenosine triphosphate (ATP) production. ATP is a major energy source and can be a good eliminating target for anticancer therapy. We describe selective cancer treatment by sequestration of ATP and self-assemblies with ATP inside mitochondria using mitochondria-targeting nucleopeptide (MNP). We designed thymine containing MNP which can interact with ATP through electrostatic interaction and hydrogen bond between MNP and ATP. MNP exhibits selective higher binding affinity with ATP resulting in large complex and assemblies with ATP. MNP preferentially forms large assemblies with ATP even though MNP/ADP (adenosine diphosphate) complex is preformed after addition of ATP. Thus, sequestration of ATP and large assemblies of MNP/ATP inside mitochondria cause physical stress by large structures resulting in apoptosis.

3O9-4 Asmita Banstola (10:15-10:30)

ROS-responsive and PD-L1 targeted Thioketal Nanoparticles Triggered Mitochondrial-mediated Apoptotic Cell Death in Melanoma Model

Asmita Banstola, Simmyung Yook† College of Pharmacy, Keimyung University

Melanoma (MEL) is characterized by high PD-L1 expression and hypoxic tumor environment. Hypoxic condition promotes reactive oxygen species (ROS) production and this could be a target for MEL. In this study, we have prepared PD-L1 targeted and temozolomide-loaded ROS-responsive thioketal nanoparticles (anti-PD-L1-TMZ-TKNPs) for treatment of MEL. Anti-PD-L1-TMZ-TKNPs was successfully constructed with the particle size of 103.2 ± 1.6 nm and zeta potential of −12.9 ± 0.3 mV. The release study showed that 80% of TMZ was released at 48 h from anti-PD-L1-TMZ-TKNPs with 1 mM H_2O_2 at acidic pH suggested the ROS-responsive behavior. In B16F10 xenograft mice model, maximum distribution with a significant decrease in tumor volume was observed after intravenous injection of anti-PD-L1-TMZ-TKNPs. In conclusion, anti-PD-L1-TMZ-TKNPs offers the targeted and ROS-responsive release of TMZ for treatment of MEL.

3O9-5 응웬티엔티앱 (10:30-10:45)

Potentiated Local Immunomodulatory Effect of Uniformly Engineered Hybrid Stem Cell/Drug Depot Spheroids on Xeno-Source Pancreatic Islet Transplantation Outcomes

응웬티엔티앱, 박준형, 쉬레스타먼주, 팜탄텅, 박필훈, 김종오, 용철순, 육심명[1], 정지헌† 영남대학교; [1]계명대학교

Here, we report a method to potentiate immunomodulatory effect of mesenchymal stem cells (MSCs) by constructing hybrid spheroids with rapamycin-releasing PLGA microspheres (RAP-MS). These hybrids were devised to prevent the strong rejection of xeno-source pancreatic islets. RAP-MS exhibited a narrow size of 4.4 ± 1.7 μm. RAP was sustainably released for 30 days without burst event. Here, the hybrids were rapidly formed in the methylcellulose medium. The hybrids achieved a large size while maintaining high cell viability. Interestingly, RAP-MS were uniformly distributed throughout the hybrids. Importantly, RAP-MS potentiated the effects of MSCs by upregulating pivotal gene expression, thereby improving MSC retention. As the result, these hybrids effectively enhanced islet xenograft survival time after their co-localization under kidney capsule of diabetic mice. We envision that these hybrid spheroids would provide a promising platform for efficient use of MSCs for immunomodulation.

3O9-6 김영국 (10:45-11:00)

Activation of NK Cell Functionality by Coacervate-mediated Interleukin-15 Delivery

김영국, 김교범† 동국대학교

A successful delivery of IL-15 to natural killer (NK) cells and a subsequent activation of NK cells' anticancer efficacy could be a promising immuno-cancer therapy. For the protection of IL-15 with maintaining its bioactivity, coacervate (a complex (1) methoxy polyethylene glycol-poly(ethylene arginyl aspartate diglyceride) (mPEG-PEAD), a cationic polymer, (2) heparin, anionic counterpart, and (3) cargo IL-15)) were developed. Release profile of IL-15 could be controlled by varying PEG chain length of mPEG-PEAD. Proliferation rate of NK cells was enhanced by coacervate-mediated IL-15 delivery. During 4 hr of co-cultured NK and MCF-7 with IL-15, the bolus group more killed MCF-7 than coacervate groups. Also, bolus group produce more interferon-γ than coacervate group. Although IL-15 did not release sufficiently from coacervate in the short-term culture, it is expected that IL-15 released sufficiently in the long-term culture, which could lead to better results than the bolus group.

3O9-7 Vu Nguyen Oanh Pham (11:00-11:15)

Copper-free Clicked Nanoclusters of Gold Nanoparticles and Quantum Dots for in vivo Real-time Imaging and Tumor Sensing

Vu Nguyen Oanh Pham, 신지운, Wei Mao, 이주원, 박재근, 이미소, 조완호, 유혁상† 강원대학교

Nowadays, fabrication of biosensors for cancer detection, monitoring of angiogenesis or cancer metastasis and cancer imaging holds vast potential. In this study, a biosensor based on clustering of matrix metallopeptidase (MMP) enzyme responsive gold nanoparticles (AuNP) and quantum dots (QD) by azide-alkyne copper-free click reaction was proposed. Briefly, AuNP were surface-decorated with two different types of poly(ethylene glycol) (PEG). Carboxylate-PEG was used to conjugate with MMP cleavable peptide (MMP CP) and azide-PEG was used for azide-alkyne copper-free click reaction between AuNP and alkyne decorated QD to form clusters at tumor site. As a result, FRET occurred during the clustering process and fluorescence intensity of QD was quenched. Thereby, our MMP-responsive nanoclusters could be used for *in vivo* real-time imaging as well as sensing tumor-specific environments.

3O9-8 Ramesh Duwa (11:15-11:30)

Evaluation of EGFR Targeting Cetuximab Conjugated Temozolomide Loaded Poly (lactic-co-glycolic acid) Nanoparticles for the Treatment of Cancer

Ramesh duwa, Simmyung Yook† College of Pharmacy, Keimyung University

Overexpression of the epidermal growth factor receptor (EGFR) is known to accelerate the growth of cancer cells. In this study, cetuximab (Cmab) conjugated temozolomide (TMZ) loaded poly (lactic-co-glycolic acid) nanoparticles (PLGA NPs), termed Cmab-TMZ-PLGA NPs was developed to target EGFR overexpressing cancer cells. TMZ loaded PLGA NPs (TMZ-PLGA NPs) were prepared by the emulsion solvent evaporation method. Cmab was conjugated to PLGA-NPs by EDC/NHS cross-linking chemistry. The mean particle size of Cmab-TMZ-PLGA NPs was 162.26 ± 5.09 nm with spherical surface morphology. Further study showed that Cmab-TMZ-PLGA NPs have higher cellular uptake, higher cytotoxicity, higher apoptotic effect, and upregulated γ-H2A.X expression than TMZ-PLGA NPs and free TMZ in U-87MG, SW480 and SK-Mel 28 cancer cells. Thus, Cmab-TMZ-PLGA-NPs offer a versatile nanoplatform to treat EGFR overexpressing cancers.

3O9-9 Prakash Shrestha (11:30-11:45)

Combination Therapy of Sustained Release Immune Modulatory Drug and PEGylation of Islets in Presence of Hydrogel for Treatment of Type 1 Diabetes Mellitus

Prakash Shrestha, Shiva Pathak[1], Shobha Regmi[1], 정지헌† Yeungnam University; [1]Standford University

Though, normoglycemia and the reduction of many complications of type 1 diabetes are achieved through islet transplantation, the life long need of systemic immunosuppressive drug and immune rejection of graft after transplantation are common in islet transplantation. Here, in this study we report the single synchronous delivery of pegylated islet cells and prolonged and sustained rapamycin releasing microspheres (RMs) in presence of hydrogel in the subcutaneous space of mice resulted in long term functioning of the graft. Immunohistochemical analysis revealed the higher infiltration of immune cells inside the graft without pegylation and rapamycin. In addition, graft, graft associated tissue (GAT), spleen and peripheral lymph nodes(PLN) showed higher amount of CD40, CD80, CD86 and CCR7 activated dendritic cells and CD4+ and CD8+ t-cells in control group as compared to PEGylated islet transplanted group.

3O9-10 Phuong Le Thi (11:45-12:00)

Injectable Hydrogels Scavenging Reactive Oxygen Species for Wound Management and Tissue Repair

Phuong Le Thi, 박기동† 아주대학교

Injectable hydrogels have been widely used as wound dressing because they can maintain a moist wound microenvironmet that protect the wound from bacterial infection and absorb large amount of exudates. However, the excessive reactive oxygen species (ROS) at the injured sites can impair cutaneous wound healing by triggering deleterious processes (e.g., necrosis, inflammation and fibrotic scarring). Herein, we developed an injectable hydrogel with highly free radical scavenging properties, using the antioxidant gallic acid conjugated gelatin (GGA). The hydrogels were rapidly formed within 10 sec *via* HRP-catalyzed cross-linking reaction. The physico-chemical properties and free radical scavenging activities of hydrogels were characterized and controlled. The effect of hydrogels on promoting the wound healing and repair was also investigated *in vivo*, using a full-thickness mice skin defect model.

Acknowledgement: NRF-2018R1A2B2004529 & 2019R1A6A1A11051471.

대학원생 구두발표 (III) | Graduate Student Oral Session (III) (Korean) 제10회장 [10월 8일(목)]

Organizer: 강영종(한양대), 이동윤(경북대), 전석진(금오공대)

3O10-1 최기헌 (09:30-09:45)

Tuning Interfacial Properties by Spontaneously Generated Organic Interlayers in Top-Contact-Structured Organic Transistors

최기헌, 이화성† 한양대학교 에리카

One of the important factors to improve the performance of organic field-effect transistors (OFETs) is an effective charge carrier injection from the metal electrode to organic semiconducting layer, and thus various studies have been conducted so far to improve this. In this study, the organic semiconducting layer was formed by blending the thiol SAM materials with PBTTT-C14 solution to control the nature of the charge carrier injection in the top-contact bottom gate (TCBG) structure of the OFETs, for which a spontaneously generated organic interlayer was produced

through thermal process on the electrodes. This result is simple and applicable on the TCBG-structured OFETs, which is impossible to be applied with SAM treatment until now. The field-effect mobility of PBTTT-C14 FETs with spontaneously generated organic interlayer was improved to 0.25 cm^2/Vs as compared to 0.041 cm^2/Vs of the pristine case, and the threshold voltages also converge to zero.

3O10-2 장원태 (09:45–10:00)

High Refractive Index Polymer (n>1.9) Synthesized by the Novel Process Using Elemental Sulfur, Termed Sulfur Chemical Vapor Deposition (sCVD)

장원태, 김도흥, 최건우, 임지우[1], 임성갑† 한국과학기술원; [1]경희대학교

High refractive index polymers (HRIPs) which have refractive index exceeding 1.6, have a many attention due to variety of optoelectronic devices such as optical waveguides, image sensors, lithography, and light-emitting diodes. However, up to date, the HRIPs exceeding 1.8 is still rare, and HRIPs with maintaining full transparency in the visible range have remained challenging. Herein, our groups develop a novel one-step vapor-phase process, termed sulfur chemical vapor deposition, to synthesize successfully ultrahigh refractive index (n > 1.9) polymers directly from elemental sulfur. Notably, the HRIP thin film showed unprecedented optical transparency (>90%) in the visible range, attributed to suppress the formation of long polysulfide segments within the SCPs. The colorless organic film with high refractive index will will serve as a key component in a wide range of optoelectronic device.

3O10-3 김도관 (10:00–10:15)

On-demand Disposable Yet Reliable Co-citrate Based Polymer for Wearable Sensor

김도관, 정용철† 한국생산기술연구원

We reported a wearable strain sensor, composed of a water-soluble electrode and a pH-sensitive encapsulation layer, with conforming flexibility and wear-resistance. It is enabled by the polysilsesquioxane-incorporated co-citrate elastomer that dissolves in a well-controlled manner upon pH-sensitivity. Different from the transient electronic devices, unique features of the encapsulation material give rise to exceptional operation reliability in daily life as well as selective disposability upon specific stimuli. Their organic-inorganic hybrid network structures provide enhanced surface hardness without sacrificing flexibility. The pH-sensitive dissolution behavior and mechanical properties of the co-citrate elastomer are characterized by varying the content of the polysilsesquioxane crosslinker. Finally, we demonstrate an on-demand disposable strain sensor with co-citrate elastomer that monitors fine movements of the human body and can be disposed of entirely by laundering it.

3O10-4 정희경 (10:15–10:30)

($Zn_xAg_yIn_z$) S_2 Synthesis Mechanism and Various Ligand Effects According to Components

정희경, 정종진[1,†] 한남대학교; [1]한남대학교 화학과

Quantum dot is a semiconductor nanoparticle and has excellent photophysical properties, but it is difficult to use biologically because it contains toxic substances such as tellurium and cadmium. So, we synthesized fluorescent nanoparticles using ZAIS, which has almost no heavy metal. We hypothesized that $AgInS_2$ seeds are initially formed at low temperature and Zn layer would be formed as the temperature rises. On the other hand, the distribution of each component of $ZnAgInS_2$ is relatively uniform at high temperature due to the formation of $ZnAgInS_2$ seeds at the temperature. With this mechanism, it was compared with AIS in which Zn was removed. In addition, when other constituents other than AIS are removed, how the mechanism changes according to intensity and temperature. In addition, when other components other than AIS are removed, how the mechanism changes according to intensity and temperature was analyzed.

3O10-5 김수경 (10:30–10:45)

Wireless Smart Contact Lens for Diabetic Diagnosis and Therapy

김수경, 한세광† 포항공과대학교

Among various wearable devices, a smart contact lens is especially promising for healthcare applications, because it can be used as an excellent platform to facilitate the interface between the human body and an electronic device. However, there has been no report on electrically controlled drug delivery in combination with real-time biometric analysis. Here, we developed a smart contact lens for both continuous monitoring and treatment of diabetic retinopathy. In diabetic model rabbits, we could measure tear glucose levels to be validated by the conventional invasive blood-glucose tests and trigger drugs to be released from reservoirs for the treatment of diabetic retinopathy. Taken together, we successfully demonstrated the first example of smart contact lenses for non-invasive and continuous diabetic diagnosis and diabetic retinopathy therapy.

3O10-6 홍서화 (10:45–11:00)

Fabrication of Chemically Surface Modified Microcrystalline Cellulose Reinforced HDPE Composites and Their Mechanical Properties

홍서화, 박진환, 황석호† 단국대학교 고분자시스템공학부 고분자공학

The interest in using cellulosic fiber-type fillers as reinforcing elements in composite materials based on polymeric matrices is constantly growing, mainly because of the many advantages associated with this renewable material. However the preparation of cellulose-based composites is perturbed by the highly hydrophilic character of the fibers, which is associated with a low interfacial compatibility with hydrophobic polymer matrices, as well as with a loss of mechanical properties. In this study, we will describe a new approach for chemically surface modification of a microcrystalline cellulose (MCC) using poly(ethylene-co-glycidyl methacrylate) (PEGMA) to construct an MCC surface anchored by PEGMA. When applied the modified MCC (PEGMA-a-MCC) to high-density polyethylene (HDPE) composite, interfacial adhesion performance between the PEGMA-a-MCC and HDPE matrix showed better and stronger than that of the pristine MCC, which will induce in better mechanical properties of the composites

3O10-7 정재민 (11:00–11:15)

Efficient Debundling of Few-walled CNTs by Donor-Acceptor Polymer for High Performance and Flexible Thermoelectric Power Generators

정재민, 서의현, 정용진[†], 양한솔, 이택성, 장재영† 한양대학교; [†]한국교통대학교

Recently, soluble conjugated polymer/carbon nanotube (CNT) composites have been actively studied as thermoelectric (TE) materials, but the effects of the wrapping polymers on debundling of CNTs are not fully understood yet. Herein, we introduce novel polymer/CNT composites composed of donor-acceptor (D-A) type polymers and few-walled CNTs (FWCNT). Three kinds of D-A polymers are utilized to disperse FWCNTs and their properties are compared with the composite using conventional donor-only poly(3-hexylthiophene). We found that effective de-bundling of FWCNTs is occurred with the aid of strong intermolecular interaction and high backbone planarity of the D-A polymers. As results, the D-A polymer/FWCNT composite films showed superior TE properties with higher electrical percolation, and resulting flexible TE generators exhibited maximum power output of 0.21 μW ($\triangle T$ = 20 K). The power output could be further improved by up to 6.76 μW ($\triangle T$ = 30 K) by doping the FWCNTs with ionic liquids.

3O10-8 하경원 (11:15–11:30)

AlGaN Light-Emitting Diodes with Localized Surface Plasmon Resonance Mediated by High Density Array of 40 nm Al Nanoparticles

이종원, 하경원, 박정현, 송현규[†], 박재용, 이재용, 조용훈[†], 이종람, 김진곤†, 김종규 포항공과대학교; [†]카이스트

Research on localized surface plasmon resonance (LSPR) has recently attracted academia attention because of metal nano-structure having a size of nm can interact with electromagnetic waves and bring significant electromagnetic enhancement. In particular, Al nano structures below sereral tens of nanometer exhibit properties at deep ultraviolet regions. However, it is difficult to form metal nano structures below several tens of nanometers. In this study, we present a remarkable improvement in the efficiency of light-emitting diodes (LEDs) based on AlGaN through the coupling with high-density array of Al nanoparticles (NPs) generating LSPR. The Al NPs with diameter of ~ 40 nm were uniformly distributed near the AlGaN multiple quantum well active region by block copolymer lithography. The LSPR generated by the array of Al NPs reduced the radiative recombination lifetime, increasing the internal quantum efficiency by 33.3% and electroluminescence property by 57.7% respectively.

3O10-9 김상필 (11:30–11:45)

Intramitochondrial Polymerization-induced Self-Assembly (Mito-PISA) Using Covalent Bond Controls Cancer Cell Necrosis

김상필, 유자형† 울산과학기술원

The energy consuming reactions to biological dissipative state are ubiquitous in biological system, and its mimicry is a great challenge in synthetic chemistry. Herein, we developed an intra-mitochondrial polymerization strategy for constructing macroscopic structures by ROS-dissipative system. For the first time, we found that the disulfide polymerization occurred inside cancer mitochondria owing to the high ROS concentration of cancer mitochondria, while it is hardly happened inside cell due to intracellular reductive environment. Polymerization process of thiol-containing monomer further increases ROS level inside mitochondria, which enables the autocatalytic process to accelerate polymerization and induce mitochondrial dysfunction. This in-situ polymerization shows great potential for anticancer treatment against various cancer cell lines including drug resistant cancer cell.

3O10-10 김영식 (11:45–12:00)

Realized Well-Defined Surface of InP Quantum Dot and Their Growth Control

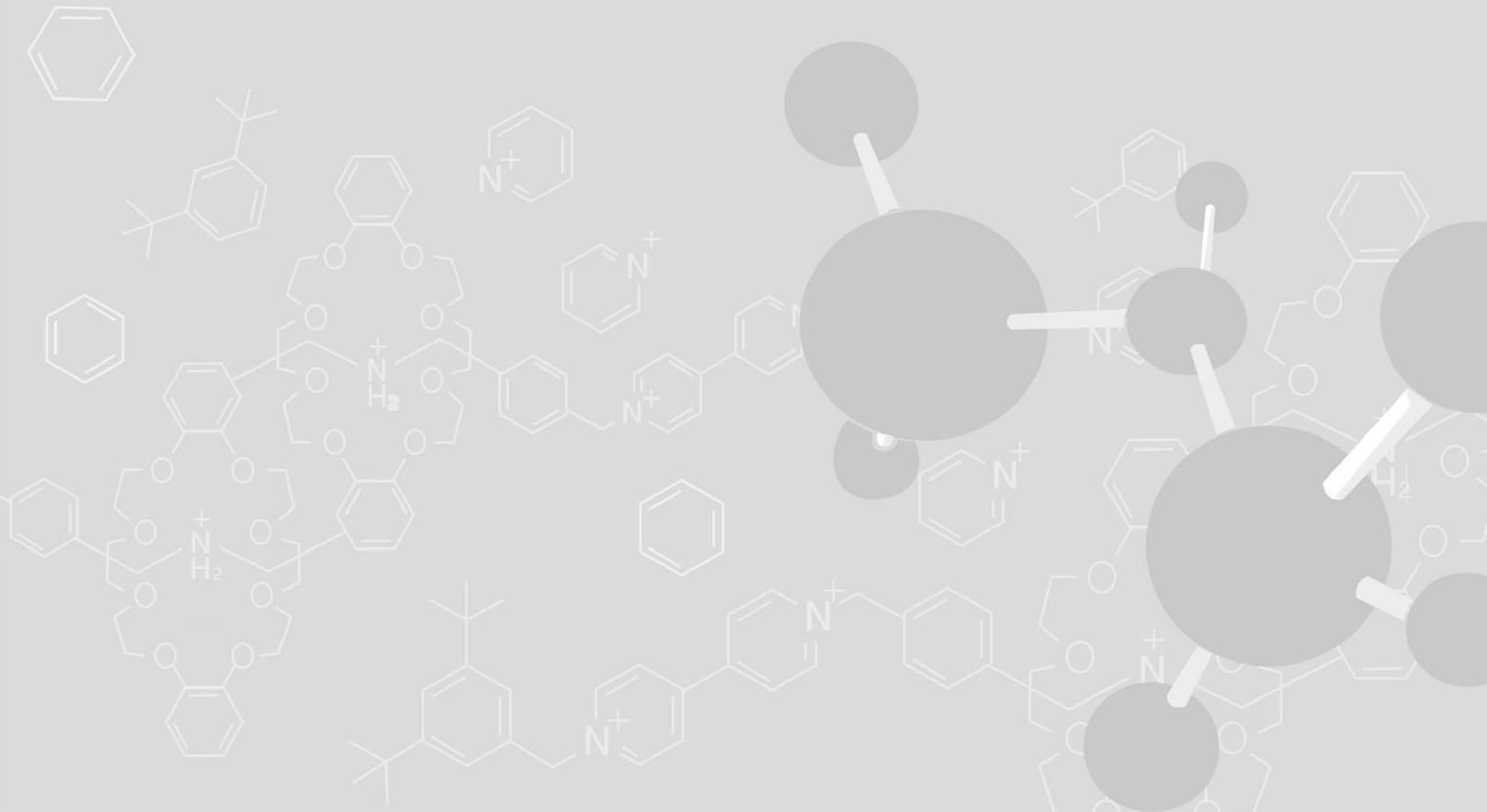
김영식, 정소희† 성균관대학교

Colloidal quantum dots (QDs) are semiconductor nanocrystals that are affected by the quantum confinement effect. Although QDs have been actively studied and developed for 30 years, an understanding of the surfaces is still lagging, especially in III-V QD. In our work, we show the controllable colloidal growth in colloidal InP quantum dots based on the well-defined surface energy. This result show that the understanding of the quantum dot surface could be used as a tool to control of colloidal growth.

2020년 추계학술대회
연구논문 초록집

The Polymer Society of Korea

초록_ 포스터 발표



포스터 발표 (I)

기능성 고분자 (II)

1PS-1 황태순

Preparation and Application of Poly(N-isopropylacrylamide) Hydrogel Coated Dip-Pen Nanolithography Probe via E-beam Irradiation

황태순, 김경민[1], 임정혁[1,†], 곽효빈[1] 한국교통대학교 나노고분자공학과; [1]한국교통대학교

Dip-pen nanolithography (DPN) is important technology to transfer micro- and nano-materials through water meniscus formed between the substrate and atomic force microscopy (AFM) probe. Poly(N-isopropylacrylamide) (pNIPAAm) is one of the thermo-responsive polymers with lower critical solution temperature (LCST) behavior, such as swelling (below the LCST) and shrinking (above the LCST) in solution. Moreover, direct temperature control of pNIPAAm enhance patterning arrays by optimizing the interactions of DPN probe and the surface. In this study, we report strategy to fabricate pNIPAAm hydrogel-coated AFM probe by E-beam irradiation. Using pNIPAAm-coated DPN probe, we have generated patterns of a large molecular weight materials. pNIPAAm hydrogel can be applied micro-and nano bio technology such as drug delivery system and bio sensor. Therefore, it is expected to be applied to various fields by improving the properties of the existing pNIPAAm hydrogel.

1PS-3 황아름

Waste Cotton-derived Porous Carbon Textiles as Electrode Materials for Supercapacitors

황아름, 이병민, 최재학† 충남대학교

Porous carbon materials are widely used as electrode materials for supercapacitors due to their large surface area, high conductivity, tunable pore size, and low price. In addition, the N-doping of carbon materials is an effective way to further enhance the electrochemical performance of supercapacitors. In this study, N-doped porous carbon textiles (N-PCTs) were prepared from waste cotton textiles (WCTs) as electrode materials for supercapacitors. WCTs were stabilized in air and then carbonized under inert atmosphere. The prepared porous carbon textiles (PCTs) were doped by nitrogen using urea. The final N-PCTs were characterized in terms of their pore properties, morphology, and electrochemical performance. The N-PCTs exhibited a specific capacitance of ~230 F/g and an excellent cycling performance of ~100% at 5 A/g after 1,000 cycles.

1PS-5 황세영

Adhesive Behavior of Polyelectrolyte Hydrogel Bonded to Concrete Surfaces

황세영, 나양호† 한남대학교

Recently, Polyelectrolyte (PE) hydrogel has attracted attention among tough hydrogels. This hydrogel possesses the physical ionic crosslinking of cation and anionic monomers with a reversible network structure. It features strong mechanical properties, biocompatibility, self-healing property, and adhesion to tissues with positive and negative charges. The previous works in our group showed that PE hydrogels adhere to concrete structures. In this study, we investigated the mechanism by which PE hydrogels bind to concrete surfaces. Experimental results suggest that the hydrogels are electrostatically bonded to the cement surface. The chemical composition of the gel with the best adhesive properties could be determined. There was no dependency of peeling speed on binding energy with concrete. In addition, it was found that the adhesion properties decreased when the mixture was added to the conventional Portland cement.

1PS-7 황규현

Structural Stability, Electric Properties of Polyimide Thin Films Introduced with MXene

황규현, 정영규† 충남대학교

MXene had inherent electrical conductivity and the water compatibility. The conductive films have been investigated as electric heating elements or devices the prevent aerospaces, automobiles and windows form fogging or icing. In this works, as a precursor of PI film, poly(amic acid) was synthesized by using 4,4'-oxydiphthalic anhydride and 2,2-Bis[4-(4-aminophenoxy)phenyl]propane. Polyimide was used as a protection material for MXene-based film. we had fabricated 2D MXene flakes by using the minimally intensive layer delamination method and a series of thin films based on MXene and polyimide was manufactured by spin-coating of MXene aqueous solution and poly(amic acid) solution. SEM images of the thin films revealed that MXene was coated on glass substrate. The optical transparency of the thin films was characterized with aids of a UV-visible spectrometer. The electric conductivity and electric heating performance of the thin films were investigated by using ohmmetery.

1PS-9 홍상기

Surface Sealable Poly(ε-caprolactone) (PCL) Hollowed Nanoparticles and On-Demand Pore Generability for Easy Loading and NIR Light-Triggered Opening System for Drug Release

홍상기, 현동준†, 문건대[1], 안형주[2], 박주향, 김다인, 서호준, 김혜지 경북대학교; [1]한국생산기술연구원; [2]포항가속기연구소

An easy loading system using NIR Light-Triggered Opening Property for Drug Release is introduced. It consists of hollowed PCL nanoparticles with surface openings containing a biodegradable fatty acid with phase-change ability and a biocompatible photothermal agent. These openings not only enhance the connectivity between the interior and the exterior but enable the easy loading of drug molecules into the interior voids. When the photothermal agent exposures to a NIR light irradiation, it generates heat that raises the local temperature of the hollow particles above the melting point of the fatty acid, and consequently, the instant release of the encapsulated drug molecules through the pores. The activity of the hyperthermia effect from the photothermal agent and the NIR-triggered release of the drug molecules results in noticeable anticancer efficacy.

1PS-15 허은서

Versatile Metal/Carbon Nanohybrid Electrocatalysts Created Using Biomass Mold

허은서, 윤현석[1,†] 전남대학교 대학원 고분자공학과; [1]전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

Materials from nature can perform a wide variety of complex performances, providing good opportunities for the development of new materials and processing systems. As a sustainable and renewable source, in this work, pine cones were employed as a biomass mold to create new and useful metal/carbon nanohybrids (MCNHs). The unique ability of the cone to absorb water was used as the driving force to introduce the precursor solution into the cone mold. The functional group inside the cone mold acts as a stationary site for metal ions in aqueous solutions of single metal precursors or binary metal mixtures, leading to the controlled deposition of metal phases in confined interior spaces. Subsequent heat treatment resulted in unique MCNHs which have great potential for highly efficient electrocatalysts.

1PS-17 허예진

Surface Morphologies and Wetting Properties of Porous Layer-by-layer Film Prepared Using Polyelectrolyte Mixture of Two Average Molecular Weights

허예진, 김주영, 성충현† 동의대학교

In this study, layer-by-layer (LbL) assembly method was used to prepare hydrophobic surface. LbL films of poly(allylamine hydrochloride) (PAH) and poly(acrylic acid) (PAA) were prepared. For PAA, PAA mixture of two average molecular weights, 100,000 and 1,500 g/mol was used. These LbL films were immersed in acidic solution followed by perfluorooctaonic acid treatment to prepare hydrophobic porous surface. The surface morphologies and wetting properties were influenced by PAA mixing ratio and acid treatment condition. At acid treatment condition of pH 2.4, water contact angle decreased as 1500 g/mol PAA increased. In contrast, at acid treatment condition of pH 2.0, water contact angle showed maximum when PAA of two molecular weights were properly mixed.

1PS-19 함정우

SERS-based Multiple Detection Bioassay Platform with Shape-coded PEGDA Hydrogel Microparticles

함정우, 고원건†, 김혜원, 김지영, 안수정 연세대학교

Surface-enhanced Raman scattering (SERS)-based immunoassay is an efficient tool which can quickly detect even very small concentrations of target molecule. For multiple detection, distinguishability between targets is important. However, existing platforms have a problem with differentiating certain group of substrates like antibody-coated beads from another until significant difference is observed between SERS spectra of targets. To solve this problem, we introduced shape-coded hydrogel as a substrate. The hydrogel was made of poly(ethylene glycol)-diacrylate (PEG-DA). After that, hydrogel particles were decorated with silver nanoparticles. Square particles were coated with 4-MPBA by self-assembly. Circular particles were processed with HS-PEG2K-NH_2 and glutaraldehyde. Then anti-HSA solution was added. As a result, SERS-based multiplex immunoassay applying shape-coded hydrogel is capable of specifically detecting target molecules depending on the shape of hydrogel particle.

1PS-21 한효원

Perovskite Nanocrystals in Block Copolymer Photonic Crystal Films for Dual-Responsive Anticounterfeiting

한효원, 오진우, 박철민† 연세대학교

In this work, through simple and time efficient two-step process, highly luminescent PeNCs could be obtained in nano domain of BCP photonic crystal (PC) films. Structural color of BCP PCs is changed by crosslinking concurrently with crystallization of PeNCs. Firstly, Thin PS-b-P2VP PC films are immersed in ethanol containing one of the precursors of perovskite. The precursor is bonded in P2VP domain by Lewis acid-base interaction with N of pyridine ring and concurrently crosslink P2VP domain, resulting in blue-shift of photonic bandgap of BCP PCs. In the second step, the other precursor is cast on the PS-b-P2VP films. Then, precursors in P2VP domain were combined to form perovskite, leading to P2VP domain recover to initial state of photonic bandgap. Combining PL of PeNCs and structural color of BCP PCs, dual-responsive anticounterfeiting devices which can decrypt informations by two kinds of stimuli, ultraviolet light and liquids are achieved.

1PS-23 한진아

Polypropylene-Based Nanocomposites with High Mechanical and Dielectric Strength for High-Voltage Application

한진아, 이대호†, 유승건, 한세원, 박효열, 안명상, 김인성 한국전기연구원
With the expansion of high-voltage direct current (HVDC) power cables, increasing attention is paid to polypropylene (PP) as an insulation materials to replace crosslinked polyethylene (XLPE) due to its recyclability and cost-effectiveness. However, PP has disadvantages of mechanical brittleness and low thermal conductivity compared to XLPE. Improvement of dielectric strength is important because it can provide safe and reliable performance, thus enabling reduction of the insulation thickness and increase of heat dissipation. In this study, polyolefin elastomer (POE) was selected to as a blending material to improve the mechanical flexibility, and nanocomposites were manufactured based on PP/POE blending to improve dielectric and mechanical performances. Sol-gel method was employed for synthesis and surface modification of inorganic nanoparticles, the proper surface modification played a decisive role in obtaining high dielectric and mechanical strength.

1PS-25 한정훈

Built-in Polymerized Elastomer Electrolytes for Highly Stable Li Metal Batteries

한정훈, 이승훈[1], 이경빈[1], 이영준, 이승우[1], 김범준† KAIST; [1]Georgia Institute of Technology
All-solid-state lithium metal batteries (ASSBs) have gained much attention to address unstable issues of Li metal by replacing organic liquid electrolytes with solid-state polymer electrolytes (SPEs). SPEs simultaneously satisfying high ionic conductivity, mechanical stability, low interfacial resistance and wide electrochemical stability are necessary to actualize high performance of ASSBs. In here, we introduce a new class of built-in PCEEs that succinonitrile is embedded within butyl acrylate-based elastomer matrix by built-in polymerizing liquid solution in assembled electrochemical cells. The symmetric Li cell with the built-in PCEE exhibits an excellent cycling performance with low polarization at high current. Application of built-in PCEEs in 4.5 V of Li//NMC (622) demonstrates a high reversible capacity of ~170 mAh g^{-1} at a high current density retaining high Coulombic efficiencies over ~99.8%. Our study suggests a new route for advanced SPEs to achieve high-energy density ASSBs.

1PS-27 한윤수

Preparation and Chemical Resistances of UV-cured Resins Based on Siloxane Acrylate Oligomer

공민선, 전유성, 이연주, 노화정, 한윤수† 대구가톨릭대학교
We prepared ultra-violet (UV) curable resins composed of a siloxane acrylate oligomer, a monomer, a photoinitiator and a crosslinker were prepared, and then cured by exposure to 365-nm irradiation. Acid and alkali resistances of the cured films were evaluated with content of the crosslinker, and the swelling ratio, cross-linking density and average molecular weight between cross-linking points in the films were also quantified. As a result, the cured films based on siloxane acrylate oligomer showed high acid and alkali resistances. *Acknowledgements: This work is financially supported by the Ministry of Education, Science and Technology (MEST) through the fostering project of Industrial Complex Campus. This work was partly supported by the Technology development Program funded by the Ministry of SMEs and Startups (MSS, Korea).

1PS-29 한윤수

Preparation and Physical Properties of Irradiation-curable Resins for Applications to Glass Slimming Process

전유성, 공민선, 이연주, 한윤수† 대구가톨릭대학교
Slimness and lightness are key competitive factors of consumer information technology devices that use flat panel displays, such as thin film transistor-liquid crystal display or organic light emitting diode. In this study, we prepared various irradiation-curable resins based on an urethane acrylate oligomer, which were then applied to the glass slimming process to protect against HF penetration. Also, the thermal and mechanical properties of films irradiation-cured from various compositions were investigated. *Acknowledgements: This work is financially supported by the Ministry of Education, Science and Technology (MEST) through the fostering project of Industrial Complex Campus. This work was partly supported by the Technology development Program funded by the Ministry of SMEs and Startups (MSS, Korea).

1PS-31 하성균

Thiourea-based Chemical Actuator Using Photo Induced Fluoride Generation and Amplification

하성균, 송창식† 성균관대학교
Soft actuators with large deformation and high output force in response to multi-stimuli are highly demanded for the development of biomimetic applications. Based on this bilayer actuator, diversely biomimetic motions including human hand movement are realized, revealing its potential application in soft robotics, artificial muscles, wearable electronics, and biomedical devices. In this study, we prepared a bilayer actuator composed of thiourea network film with internal photo-generated fluorine (PGF) and fluorine amplification molecules is fabricated by a simple and fast method. This actuator produces large deformation, and dual-stimuli response, owing to the volume contraction of thiourea film with the absorption of fluorine, and the kosmotropic effect. The novel functional actuator is especially suitable for research on improving the anion sensitivity of soft actuators applied with a chemical amplification reaction of anions.

1PS-33 탄하오

Microfluidic Fabrication of Polyacrylic Acid Hydrogel Microspheres Toward Calcium Sensing

탄하오, 위나라, 홍효진, 박수영[1,†] 경북대학교 응용화학공학과; [1]경북대학교 고분자공학과
A calcium sensor for human serum and saliva was fabricated with uniformly-sized crosslinked poly(acrylic acid) (PAA) hydrogel droplets in the storage chamber of the polydimethylsiloxane (PDMS) chip which was designed for flushing an aqueous solution with inlet and outlet channels. The uniformly-sized PAA droplets were produced by microfluidics with a mixture of AA and N, N'-methylenebisacrylamide (MBA, cross linker) as a disperse phase and mineral oil as a continuous phase after in-situ UV polymerization, functionalized with KOH in the PDMS chip, and succesfully used as an indicator of the amount of Ca^{2+} ions in an aqueous solution by measuring the droplet size.

1PS-37 최지호

Study on the Water Purification Using Graphene Oxide for Eliminating Microplastics, COD, and Bacteria

최지호† 한국외국어대학교
The use of graphene oxide (GO, hereafter) for the water filtration is receiving attention as a strategy to solve the microplastic pollution. In this study, the microplastic filtration ability and COD reduction rates of the GO powders are investigated. The effect of the amounts of GO and flowrate of the filtrated seawater has been studied in the present work. This study also identified the antibacterial performance of GO using samples of Staphylococcus aureus and Pneumococcus. The GO was prepared by the Hummer's method and observed using the SEM, BET, and XPS methods. The experiment revealed that the higher amounts of GO results in better COD reduction rates (4 g GO sample acquired the highest reduction rate amounts to 40%). The lower wastewater flowrates exhibited better microplastic filtration (10 liter/min sample had a 5% higher average filtration rate than the 20 liter/min sample). GO filters also showed antibacterial performance with a 99% removal rate for both bacteria specimens.

1PS-39 최준환

Vapor-Phase Synthesis of High-*k*, Ultrathin Polymer Dielectric with Molecular Thin, Hydrophobic Skin Layer for Extremely Stable Organic Thin-Film Transistor (OTFT) Operation

최준환, 임성갑† KAIST
A sub-20 nm, high-*k* copolymer dielectric with hydroxyl functionality was synthesized via initiated chemical vapor deposition (iCVD). The inherently dry environment offered by the vapor-phase polymer synthesis prompted the snuggling of polar hydroxyl functionalities into the bulk polymer film to form a molecular thin hydrophobic skin layer at its surface. The chemical composition of the copolymer dielectric was optimized systematically to achieve high dielectric constant (*k*~6.2) as well as extremely low leakage current densities even with sub-20 nm thickness, leading to one of the highest capacitance achieved by a single polymer dielectric to date. Exploiting the structural advantage of the crosslinked high-*k* polymer dielectric, high-performance OTFTs with the suppressed hysteresis were obtained owing to the hydrophobic skin layer. Furthermore, the OTFTs with the copolymer dielectric showed an unprecedentedly excellent operational stability.

1PS-41 최준영

Flexible and Low-cost Solid-State-Supercapacitor Based on Poly(vinyl alcohol)-based Nanocomposite Polymer Electrolytes

최준영, 최우혁† 인하대학교
Due to the increasing demands of wearable devices, the development of flexible energy storage devices with high performances has received much attention. In this work, we prepared poly(vinyl alcohol) (PVA)-based solid polymer electrolytes (SPEs) by combining a mixture of 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl) imide (BMIM-TFSI = $BMIM^+$ $TFSI^-$) and phosphoric acid (H_3PO_4 = H^+ $H_2PO_4^-$) as ionic charge carrier. The mixture of BMIM-TFSI and H3PO4 acts as proton conducting ionic liquids because it has an acidic anion. PVA exhibits a good thermal property, mechanical strength, and chain flexibility due to its hydroxyl group that provides hydrogen bonding between ionic liquid and PVA. Furthermore, after assembling the SPEs with electrodes, we fabricated solid-state supercapacitors, and their electrochemical properties were investigated using electrochemical impedance spectroscopy.

1PS-43 최종선

NIR-triggered Photodynamic Therapy and Bioimaging Based on Multi-shell Structured Upconversion Nanoparticles

최종선, 김소연† 충남대학교
Lanthanide-doped upconversion nanoparticles (UCNPs), which can emit high energy visible light upon near-infrared (NIR) excitation, have been intensively employed for biomedical field due to high photostability, deep penetration into tissues, low toxicity, and significantly improved signal-to-noise ratio in optical bioimaging. In general, since green emissions emitted from UCNP is greater than red emissions, photodynamic therapy (PDT) using photosensitizer (PS) activated for red emissions has little effect. In this study, a multi-shell structured UCNPs, which have enhanced photoluminescence and can emit UV, blue, green and red emission, were fabricated. Then, their surface modification was conducted for NIR-triggered PDT and bioimaging. In addition, the morphology and photoluminescence effect of multi-shell structured UCNPs were investigated.

1PS-45 최종선

Design of Surface Modified Magnetic Nanoparticles for Biosensor Application

최종선, 김소연† 충남대학교
Magnetic nanoparticles (MNPs) have been studied a lot as a new materials in the area of biotechnology, biosensing and nanomedicine because of their unique and tunable magnetic properties. The utilization of MNPs for the selective capture and separation of specific glycoproteins from biological samples provides a fast, accurate and sensitive advantage in detecting diseases. In this study, MNPs with uniform size and shape were synthesized by thermal decomposition method. In addition, surface functionalization of MNPs was carried out using specific ligands for biomolecule binding and biocompatibility enhancement. Furthermore, their morphology, electromagnetic characteristics, and binding ability with biomolecules were investigated

1PS-47 최은지

Morphology, Rheological and Thermo-Mechanical Properties of TLCP/PCT Blends Fabricated by Melt-compounding

최은지, 정영규[1,†] 충남대학교; [1]충남대학교 유기소재섬유시스템공학과
Thermotropic liquid crystalline aromatic polyesters (TLCPs), based on copolyesters of hydroxynaphthoic acid and hydroxybenzoic acid, have been received much attention in the field of engineering plastics owing to their excellent properties such as low melt viscosity, chemical resistance, thermal endurance, and mechanical properties. Poly(cyclohexylenedimethylene terephthalate) (PCT) is a thermoplastic and semi-crystalline polyester with good chemical resistance, dimensional stability, and processibility at elevated temperatures. In this study, TLCP/PCT blends with different mixing ratios were fabricated via melt-compounding. The morphology and microstructures of the blends were characterized by using SEM, FT-IR, and NMR. The crystallization kinetics, thermal transition, and thermal stability, rheological and mechanical properties of the blends were investigated by using DSC, TGA, rheometer, and DMA.

1PS-49 최용우

EIS-based Biosensor to Measure the Cortisol with PEDOT:PSS/MXene Electrode

최용우, 유필진† 성균관대학교
Cortisol well-known as a stress hormone level should be regulated and measured condignly. In this research, cortisol biosensing platform was fabricated. Electrode of the biosensor was manufactured by fabrication metallic MXene which shows fascinating electrical conductivity and biocompatibility. PEDOT:PSS was brought to make adhesion between MXene and substrate through electrostatic interaction and van der waals force. Modification of functional groups should be preceded by immobilization of antibody. Hydroxyl group, one of functional group of MXene, was modified with oxalic acid one of dicarboxylic acid. Carboxyl groups on modified MXene can be reacted with amino groups emerging amide bonding through EDC chemistry. Finally, BSA was introduced to passivate non-specific binding. Among a bunch of methods in sensing system, EIS which indicates outstanding performance in selectivity and sensitivity. It is expected that MXene could be employed as a pleasant platform for biosensors.

1PS-51 최수비

Liquid Crystal Elastomers with Slide-Ring Polyrotaxane Cross-linkers

최수비, 김빛가람[1], 서지훈[1], 안석균† 부산대학교; [1]고려대학교
In this study, we synthesized a new class of liquid crystal elastomers (LCEs) comprising various amount (0.3-2.0 wt%) of polyrotaxane (PRX) cross-linkers (LCE-PRX). In particular, we investigated the impact of the slide-ring PRX crosslinker on the mechanical properties and actuation performance of the LCEs. Interestingly, both stiffness and extensibility of the LCE-PRX can be considerably enhanced at lower PRX content (0.3-0.5 wt%) as compared to the pristine LCE, while the LCEs with higher PRX content (1.0-2.0 wt%) become more compliant. Both one- and two-way shape memory properties were further demonstrated using polydomain and monodomain LCE-PRX, respectively. Lastly, dynamic nature of PRX crosslinker allowed for the scratched surface of LCE-PRX to be thermally healed, which was not possible for the pristine LCE.

1PS-53 최민영

Polyaniline (PANI)-based Textile pH Sensor for Monitoring of Chronic Wounds

최민영, 구형준†, 이민지[1], 김수영, 소주희[1] 서울과학기술대학교; [1]한국생산기술연구원
Determining the pH of a chronic wound is one of the key indicators for the treatment progress. Since pH sensor made of polymer films possess limited flexibility and breathability, the sensors may cause discomfort to the patients who lie on beds for a long time. A pH sensor that can be continuous monitoring over large areas with enhanced flexibility and breathability is required. In this study, we propose a highly flexible textile pH sensor using polyaniline as a working electrode to solve this problem. Polyaniline (PANI) can have different level of conductivity depending on the concentration of hydrogen ions in its environment, which can generate electromotive force to a reference electrode. During the fabrication of a working electrode, carbon nanotubes and agarose were added to polyaniline suspension to improve conductivity and durability. We confirmed the performance of the fabricated pH sensor by measuring the potential difference as a function of the pH of sample buffer solutions.

1PS-55 채지애

Compressible Mesoporous Polymer Monoliths for the Selective Removal of Oils from Water

채지애, 김형우† 전남대학교
This poster demonstrates the design of compressible mesoporous polymer monoliths that can be effectively used for the separation of organic solvents from their aqueous mixtures. The network structures can be prepared via condensation polymerization and obtained as a monolith; intrinsic porosity of the networks gave rise to better selectivity and rapidity for the absorption behavior. As a result, the spongy materials were able to readily absorb most organic solvents while excluding water, and be reused after additional washing and drying.

1PS-57 진우진

Tuning of Volume Phase Transition of Thermo-responsive Ionogels Depending on Ionic Liquids

진우진, Bernard Timothy, 윤진환† 부산대학교
Ionogels are crosslinked polymeric network swollen in ionic liquid (IL) of cation-anion couple structure. Ionogels are promising candidate for wide range of applications due to its tunable thermal, mechanical durability and electrical properties, however tuning the thermo-responsive behaviors of ionogels in various ionic liquids are a challenging issue. As an effort to clarify the temperature dependent volume transition of ionogels, we prepared the series of ionogels swollen in various ionic liquids and their mixture, then investigated the swelling behavior such as swelling ratio and transition temperature. We found that the variation of cation and anion in ILs affects on the transition temperature of ionogels.

1PS-59 진우경

Tandem Interactive Sensing Display De-convoluting Dynamic Pressure and Temperature

진우경, 김의혁, 박철민† 연세대학교
we demonstrate a tandem interactive sensing display enabling not only direct visualization of both pressure and temperature but also quantitative de-convolution of these two simultaneously varied stimuli. Our tandem display consists of 5 polymer layers vertically stacked on a transparent substrate. Impedance change of two responsive layers upon dynamic temperature and pressure is instantly detected, at the same time giving rise to stimuli-interactive electroluminescence of light emitting unit and, respectively when AC field is applied between two parallel polymer electrodes. Dynamic and simultaneous variation of temperature from 30 to 80 ℃ and pressure from X to 20 kPa is conveniently mapped in 3 dimensional coordinate of light intensity (z-axis) and color coordinate (x-y plane), resulting in a 2 dimensional contour surface plot. The plot allows for efficient and quantitative de-convolution of the unknown information of various mixed stimuli.

1PS-61 진레이

Studies and Synthesis Poly(biphenyl piperidine) Membranes by Super Acid Copolycondensations for PEMFC

진레이, 류태욱, 파이즈아메드, WEI ZHANG, 윤수진, 김대호, 이용훈, 장호현, 김환기† 건국대학교
Polymer exchange membrane fuel cells (PEMFC) are now obtaining increasingly attention applying as a power sources in electrical vehicles, because their high energy efficiencies and no oil combustion. However, some barriers above membrane such as cost, and durability also need to be solved. In this study, we synthesized a super spiro polymer by 4-piperidone monohydrate hydrochloride and electron-rich biphenyl, herein, a super acid, trifluoromethane sulfonic acid, employed as a catalyst. The sulfonated polymer was followed by sulfonation concentrated sulfuric acid to prepare. The morphology of sulfonated membrane was depicted by AFM and high proton conductivity. The synthesized copolymers were characterized by 1H NMR spectroscopy, thermogravimetric analysis (TGA), proton conductivities, water uptake, and ion exchange capacity (IEC) measurement.

1PS-63 주성환

Fabrication of Transparent Anti-Fogging and Self-Cleaning Coating on Greenhouse Film

주성환, 이찬민, 이준영, 황기섭† 한국생산기술연구원
Transparent polymer materials such as thermoplastic PE play an essential role in our daily life. However, due to the unavoidable condensation of water vapor on solid surfaces, these materials undergo fogging under normal operating conditions. Specially, The hydrophobic surface of PE causes poor wettability and poor adhesion in practical applications. The condensed water forms spherical droplets to minimize the contact area between the water and the film. These droplets reduce the light transmission and due to gravity will often fall down inside the greenhouse resulting in physical damage to plants as well as increasing the risk of disease. Herein, we developed facile super-hydrophilic coating by using polymer and additives. In our super-hydrophilic coating achieved high durable anti-fogging and self-cleaning properties. The authors are very grateful for financial support from Minisrty of Agriculture, Food and Rural Affairs - South Korea (Grant No. 1545021219).

1PS-65 조은혜

Programmable Photoresponsive Main-chain Liquid Crystal Elastomers Prepared by a Two-stage Thiol-acrylate Reaction

조은혜, Luu, 박수영† 경북대학교
Liquid crystal elastomers (LCEs) have been used as various stimuli-responsive polymers due to extraordinary changes in shape, soft-elasticity behavior, and tunable optical properties in response to a stimulus such as heat or light. For example, liquid crystal polymers using azobenzene, which is a photosensitive material, have a property

of changing structure and shape in response to light. In this study, di-acrylated crosslinkers with a long azobenzene core is synthesized to easily achieve high orientation order. We introduced a two-stage thiol-acrylate michael addition-photopolymerization reaction to prepare main-chain azo-LCEs. The first stage reaction is used to create a polydomain LCEs via the thiol michael addition reaction, then second-stage photopolymerization reaction between excess acrylate groups is used to permanently fix an aligned monodomain. This photoresponsive main-chain LCEs can be potentially useful for artificial muscles, sensors, and actuators.

1PS-67 조예린

Efficient Conduction of Nonconjugated Small-Molecule Organic Radicals

조예린, 유일환, 고재형, 김대윤, 손대원[†], 주용호[†] 한국과학기술연구원 전북분원; [1]한양대학교

We present a molecular conductor towards a novel class of electronic material. We investigate electrical properties of a stable radical, h-TEMPO (4-hydroxy-2,2,6,6-tetramethylpiperidin-1-oxyl), which has well been known for containing stable radicals. The chemical component of this radical molecule allows us to form a single crystal via physical vapor deposition (PVD). The charge transport of this macroscopic open-shell single crystal is rather low, but the thermal annealing of a well-defined single crystal allows the molecule to have a fast charge transfer reaction due to the electronic communication of the open shell site with each other, which results in electrical conductivities greater than 0.05 S m^{-1}. This effort shows a model that differs significantly from the conjugated polymers or molecules generally accepted for the generation of next generation conductors.

1PS-69 조승현

Facile Preparation of Polyethyleneimine-Coated Microgel Capsules via Schiff Base Formation for Removal of Heavy Metal Ions

조승현, 장민철[†] 전남대학교

The treatment of water pollutants such as heavy metal ions has become a critical issue to maintain a healthy environmental system. Herein, we report a facile preparation of polyethyleneimine (PEI) functionalized microgel capsules as an effective adsorbent of heavy metal ions from water, using a microfluidic approach. To synthesize the PEI-coated microgel capsules, the middle phase of double emulsions composed of polyvinyl alcohol (PVA) and glutaraldehyde (GA) was exposed to hydrogen ions, thus changing from liquid to a gel. Subsequently, PEI molecules were immobilized at the surface of the hydrogel by the reaction with carbonyl groups (i.e., Schiff base formation). After adsorption of heavy metal ions, the microgel capsules were readily separated from the suspension by applying buoyancy difference and magnetic force. The adsorption behaviors of resultant microcapsules were evaluated, and the adsorption efficiency of microgel capsules was studied by varying process parameters.

1PS-71 조슬기

바이오파울링 저감을 위한 초소수성으로 처리된 수처리용 나노다공성 polyvinylidene fluoride(PVDF)분리막의 제조

조슬기, 문강민, 오준균[†] 단국대학교

본 연구에서는 수처리용 분리막의 주요 문제인 분리막의 오염 및 습윤을 해결하기 위해 초소수성 다공성 polyvinylidene fluoride(PVDF)막을 제조하였다. PVDF막을 NaOH 수용액을 사용하여 표면을 OH기로 활성화한 다음 FTOS(1H, 1H, 2H, 2H-perfluorooctyltriethoxysilane)로 불소화된 SiO_2 나노입자들을 dip-coating 을 통해 초소수성 성질을 부여하였다. 기존의 PVDF 막의 경우 물과의 접촉 각도가 97°가 나온 것에 비해 표면처리된 PVDF막의 경우 150° 이상의 높은 물 접촉 각도를 가짐으로써 초소수성 성질을 나타냈다. SEM, AFM을 이용하여 표면 처리된 PVDF막의 표면구조를 관찰하였으며 표면처리된 PVDF 막의 경우 불소화된 SiO_2 나노입자로 인하여 기존의 막 보다 거칠고, 계층적인 구조를 가지는 것을 확인할 수 있었다. 또한, 표면 처리된 PVDF막의 경우 낮은 표면에너지로 인하여 오염 방지 효과가 탁월한 자가세정(self-cleaning) 특성을 나타내는 것을 확인하였다. 따라서 이와 같이 초소수성으로 표면이 처리된 PVDF막은 수처리 관련 산업에서 바이오파울링(biofouling) 저감 소재로의 응용이 기대된다.

1PS-73 조문정

Dielectric Behavior of Polyimide Aerogel Films with Controlled Pore Structure

조문정, 이대호[†], 한세원, 박효열, 유승건 한국전기연구원

Aerogel have attracted a lot of attention due to their unique and excellent properties such as lightness, low thermal conductivity, and low dielectric constant. Since the silica aerogels are typically brittle, and increasing attention is being paid to polymer aerogels to achieve better mechanical performance and expand the applicability. PI aerogel is generally prepared by supercritical drying method. In this presentation, we provide a new approach to control the porosity and pore structure of PI aerogels by adjusting solvent properties during the solvent exchange process. After applying a conventional vacuum drying, PI aerogels with controlled porosity in a various range (50 ~ 85%) were produced. Based on our approach, it was possible to fabricate PI aerogels with various dielectric constants between 1.2 and 2.5, while exhibiting high dielectric strength greater than 10kV/mm. Furthermore, PI aerogels were also produced in the form of films with various thickness.

1PS-75 조동익

Fabrication of Super Liquid-repellent and Transparent Glass Surfaces with Antifouling Properties

조동익, 이한나, 오준균[1,†] 단국대학교; [1]단국대학교 고분자공학과

자연모사를 통해 광학 등급의 투명함을 유지하는 동시에 초소수성을 띄는 유리 표면을 제조하였다. 오염 물질에 대한 뛰어난 반발력을 나타내는 낮은 표면 에너지를 갖는 초소수성 유리 표면을 제조하기 위해 나노스케일 수준의 거칠기를 도입하고자 프라즈마 에칭(plasma etching) 후 초소수성으로 표면을 기능화하였다. 유리의 표면 형태를 확인하고 화학적 조성을 분석하기 위해 scanning electron microscope, atomic force microscopy, 그리고 Fourier-transform infrared spectroscopy을 사용하였다. 초소수성 유리의 투명성을 확인하기 위해 UV-Visible spectrophotometer를 이용하여 투과도를 측정하였고 초소수성을 확인하기 위해 tensiometer로 물에 대한 접촉 각도을 측정하였다. 또한 각종 오염 물질에 대한 방오 효과를 확인하기 위해 anti-dust test를 진행하였다. 본 연구에서 제조한 초소수성 유리 표면은 일반 유리와 비슷한 투과도를 보였으며 물 접촉 각도가 150도 이상의 초소수성을 나타냈을 뿐만 아니라 먼지(dust)와 같은 오염원에 대한 우수한 방오 효과를 확인하였다.

1PS-77 정태훈

Phase Separated Hydrogels with Embedded Microgels to Improve Shrinking and Re-swelling

정태훈, 김재영, 김연수[†] 포항공과대학교

Thermoresponsive hydrogels have attracted considerable interest in various fields because they undergo volumetric changes in response to temperature. For the application of a versatile thermoresponsive hydrogel, fast swelling/shrinking and large volumetric changes are required. In addition, for repeatable use, the shrunken gel should re-swell rapidly until it reaches an equilibrium swollen state. Here, we propose a novel type of thermoresponsive hydrogels that show improved shrinking and re-swelling. By using globular structure of poly(*N*-isopropylacryamide) in salt solution, it is possible to synthesize phase separated hydrogels with large and rapid shrinkage than normal type of hydrogels. Furthermore, we incorporated simply synthesized microgels in phase separated hydrogels. As a result, hydrophilic and ionic microgels effectively improved the rate of swelling. In this presentation, synthetic strategy of thermoresponsive hydrogels and improved kinetics of them will be discussed.

1PS-79 정주현

Enhancement of Anti-biofouling Properties of Polypropylene Membrane via Bioinspired $CaCO_3$ Coating and Hydrophilic Graft Polymerization

정주현, 송상하, 오준균[†] 단국대학교

Commercial membranes are generally manufactured by using hydrophobic polymer materials, but hydrophilic surface membranes are essential for polymer-based water purification membranes. The surface modification of micropolypropylene membrane (MPPM) was performed by the sequential photoinduced graft polymerization of acrylic acid (AA) and the bioinspired $CaCO_3$ coating technique. The structural and morphological changes of membrane surface were characterized by Fourier transform-infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM). The water contact angle of the modified membrane through grafting was significantly decreased (i.e., decreased to <10° after mineral coating) with the increase of grafting degree (GD). In addition, the analysis of ultraviolet visible light spectroscopy showed a clear difference in bovine serum albumin (BSA) adhesion compared to unmodified membrane.

1PS-81 정재경

Synthesis and Characterization of Thienoquinoline-Based Conjugated Polymer Donors for Organic Photovoltaics

정재경, 황도훈[†] 부산대학교

In this study, new electron accepting building block based on thienoquinolinone (TQO), which consisted of thiophene as spacer between two TQO units, was synthesized to resolve steric hindrance of bithienoquinolinone. The synthesized electron accepting builiding block was polymerized with benzodithophene (BDT) or fluorinated BDT via Stille polymerization to give PBDT-biTQO and PFBDT-biTQO. Absorption spectra of the synthesized polymers showed below 600 nm with wide bandgap. PFBDT-biTQO showed lower-lying highest occupied molecular orbital energy level that that of PBDT-biTQO owing to fluorine effect. Non-fullerene based inverted devices, which consisted of indium-tin-oxide/ZnO/polymer:IT-4F/Moo3/Ag, were fabricated to investigate the photovoltaic characteristics. PFBDT-biTQO:IT-4F exhibited the best power conversion efficiency of 8.50% with high short circuit current.

1PS-83 정영두

Visualization of Strain Sensor by Structural Color of Block Co-polymer

정영두, 박철민[†] 연세대학교

We demonstrate a highly stretchable, large strain capacitive sensor that can visualize strain based on the strain-responsive structural color (SC). Our device contains an elastomeric sensing film that produces a capacitance change under strain, in which a self-assembled block copolymer (BCP) photonic crystal (PC) film with 1D periodic in-plane lamellae aligned parallel to the film surface is embedded for the efficient visualization of strain. The capacitance change arises from changes in the dimensions of the elastomer film under strain. The mechanochromic BCP PC film responds to strain, giving rise to an SC change with strain. The initial red SC of the sensor blueshifts and turns blue when the sensor is stretched to 100%, resulting in a full-color SC alteration as a function of the strain. Our BCP SC strain sensor exhibits a fast strain response with multi-cycle reliability of both the capacitance and SC changes over 1000 cycles.

1PS-85 정송아

Multifunctional Role of MoS_2 in Preparation of Composite Hydrogels: Radical Initiation and Cross-Linking

정송아, 이경민[1], 김형우† 전남대학교; [1]서울대학교
Effect of molybdenum disulfide (MoS_2) on the preparation of composite hydrogels has been newly demonstrated. The MoS_2 nanoplatelet was found to generate radical species with persulfates for initiating polymerization of acrylic monomers and to provide physical cross-linking points for the formation of hydrogel network. In particular, the addition of MoS_2 caused more rigid and elastic networks when compared to control hydrogels with a chemical cross-linker, and the resultant nanocomposites were able to exhibit self-healing properties upon heating owing to the reversible, noncovalent network. This synthetic approach would pave the way for the modular design of nanocomposite hydrogels.

1PS-87 정다영

Remote-Controllable Liquid Crystal Physical Gels Based on Photo-responsive Supramolecule with Electro-optical Properties

정다영, 정광운† 전북대학교
For the development of the stimuli-responsive electro-optic devices which can be controlled from a light scattering state to a transmittance state reversibly, a supramolecule based on photo-responsive azobenzene mesogens tethered to a benzene-1,3,5-tricarboxamide (B-3AZ) core was newly synthesized. The liquid crystal physical gels (LCPGs) were fabricated by introducing the B-3AZ supramolecules into the nematic liquid crystal (NLC) medium. The prepared LCPGs exhibited that the light scattering of the LCPGs can be converted to a transmittance state at lower driving voltage (22 V). Furthermore, it was demonstrated that the rewritable photo-responsive B-3AZ LCPG films can be remote-controlled by the photoisomerization of the azobenzene moieties under the UV-vis light. This work was supported by Ministry of Trade, Industry, and Energy (20011031).

1PS-89 전하빈

Long Term Durability Evaluation of Thermotropic Liquid Crystalline Polyester-based Nanocomposites for Automotive Applications

전하빈, 정영규† 충남대학교
Thermotropic liquid crystalline polyesters (TLCPs) with rigid main chains of wholly aromatic rings linked by ester groups are a family of high-performance engineering plastics noted for their high strength, modulus, and melting point. Accordingly, TLCPs have been employed in automotive parts, ovenware, electronic devices, etc. Especially for automotive applications, long-term durability is very critical. In this study, a stepped isothermal method was adopted as an engineering approach to estimate the long-term durability in thermal and mechanical performance of TLCP nanocomposites with different multiwalled carbon nanotube (MWCNT) contents. The moduli changes at each temperature step can be rescaled and shifted to generate a master curve, which was matched with the moduli predicted by the time-temperature superposition principle. This study demonstrates that the influence of the MWCNT content on the long-term mechanical performance in TLCP/MWCNT nanocomposites.

1PS-91 전진천

Solid Electrolyte Membrane Based on Poly(arylene ether sulfone)-*g*-poly(ethylene glycol) with Various End Groups for Lithium-ion Battery

전진천, 김덕준† 성균관대학교
In this study, the solid-state polymer electrolyte membrane with high lithium-ion conductivity and lithium-ion transference number was prepared from poly(arylene ether sulfone) grafted with various end-group functionalized poly(ethylene glycol). PEG plays the role of lithium ion conductor by segmental motion, but the crystallinity of PEG disturbs the conduction of lithium-ion. In this report, the end group of PEG was modified to reduce the crystallinity and improved lithium salt solvation. So that the lithium-ion conductivity and transference number can be improved. Among the prepared membranes, the PAES-g-PEG with A-type end group showed the highest room-temperature lithium-ion conductivity of $8.97*10^{-4}$ S cm^{-1} and lithium-ion transference number of 0.4 resulting in the improvements in full solid-state lithium battery performance.

1PS-93 전지수

Programmable Microtextures by Programming Magnetic Actuation of Polymer Composites Microarray

전지수, 박정은, 원수경, 위정재† 인하대학교
Magnetically responsive materials are emerging candidates for untethered shape-reconfigurable devices owing to penetration of magnetic field through the obstacles, suitable for packaged devices. Furthermore, magnetic actuations of micropillar arrays with soft magnetic systems endow programmable and synchronized actuations by suppressing interference among micropillars. In this presentation, we discuss fabrication method of reconfigurable microtextures capable of on-demand magnetic actuation including bending, twisting, and their hybridized actuation by engineering arrangement of the magnetic particles. In addition, we demonstrate the programming of actuation modes for arbitrary locations of microarray utilizing a masking technique. Remarkably, reversible magnetic actuations of microarrays are demonstrated for performing 100 actuation cycles. Furthermore, we will discuss evaporative self-assembly of magnetically actuated micropillars resulting in unique 3D microarchitectures.

1PS-95 전민욱

Preparation of Thermoresponsive Core-shell Nanoparticles with PNIPAM

전민욱, 김태동†, 김 윤 한남대학교
The structure and property of poly(N-isopropylacrylamide) (PNIPAM) known as a thermoresponsive polymer can be controllable by external stimuli such as temperature and pH. Due to its unique characteristics of PNIPAM, many studies have been tried to form polymeric nanoparticles combining PNIPAM with polystyrene (PS) for the applications of chemical delivery, catalyst, sensor and so on. In this work, core-shell polymeric nanoparticles were prepared through the seeded emulsion polymerization of a styrene monomer under the presence of PNIPAM particles. The notable feature of this process is that the transition of PNIPAM from hydrophilic to hydrophobic above 32 ℃. This change to hydrophobicity promotes the binding between PS and PNIPAM in aqueous media. As a result, stable core-shell polymeric nanoparticles can be successfully achieved. Their morphology and size distribution were measured by scanning electron microscope (SEM), transmission electron microscope (TEM), and dynamic light scattering (DLS).

1PS-97 전민우

Functional Poly(2-alkyl-2-oxazoline)-based Stimuli-responsive Hydrogel

전민우, 장우동† 연세대학교
Various stimuli-responsive hydrogels were used in various fields of cutting-edged technologies, such as biomimetic nanomaterials, sensors, tissue engineering, and drug delivery systems. In this study, we have designed poly(2-alkyl-2-oxazoline)-based polymeric hydrogels as a multimodal stimuli-responsive materials. POxs show unique thermoresponsive phase transition behavior via lower critical solution temperature (LCST). Furthermore, POxs are excellent biofunctional materials owing to their superior biocompatibility. During the preparation of POx-based hydrogel, we used azobenzene groups as the crosslinking agents. Thus obtained hydrogel showed thermoresponsive phase transition as well as pH dependent color changes.

1PS-99 장진하

Designing Ionic Liquids for Stabilizing Lithium Metal Batteries

장진하, 강지형† 한국과학기술원
Uncontrollable Li dendritic growth, which exacerbates the safety and cycling efficiency of Li metal batteries (LMBs) hinders the practical use of LMBs. Ionic liquid (IL) electrolyte can circumvent this shortcoming via the synergistic effects of their cation and anion, but the effects of the structure and charge in the IL's components on mitigating the dendrite growth have not yet been studied. Herein, We design a new class of IL additives consisting of a pyrrolidinium-based cation—with varied functional groups, chain lengths and numbers of charge—and a bis(fluorosulfonyl)imide anion. Li interphase characterization revealed ether-based cations build a durable solid-electrolyte interphase while a long chain with a high charge generates a lithiophobic effect, which induces a uniform Li deposition. This work suggests a design protocol for IL-based electrolytes and provides a prospective way to high efficiency, stable-cycling LMBs.

1PS-101 장지혜

Enhancement of Electrochemical Properties of Cathode in Lithium Ion Batteries by Using Poly(triethylene glycol methyl ether methacrylate-co-methyl methacrylate)

장지혜, 한미정†, 석정돈, 김영진[1] 한국화학연구원; [1]충남대학교
To improve the ionic conductivities of binders used for the cathode of the lithium ion batteries, copolymers having ethylene glycol (EG) were synthesized by free radical polymerization using ethylene glycol methyl ether methacrylate (EGMMA) and methyl methacrylate, and the numbers of EG groups were varied from 3 to 9. The ionic conductivities depending on the temperature were measured from −15 to 100 °C, and ionic conductivities of binders increased as the lengths of EG group increased. When the number of EG group was 9, it had the highest ion conductivity of $6.6X10^{-6}$ S cm^{-1}, while PVDF had $3.7X10^{-9}$ S cm^{-1} at 25 °C. Binders prepared in this experiment were also electrochemically stable up to 5 V. At 45 °C, cycle performance and initial discharge capacity of binders having EG groups were significantly improved compared to those of PVDF. Binders exhibited much higher discharge capacity (83.6 ~ 113.3 mAh g^{-1}) than that of PVDF (40.0 mAh g^{-1}) at high rate (2 C).

1PS-103 장지혜

Shape-Transformable and Electrical & Mechanical Self-Healing Electroluminescence Displays Using Viscoelastic Polymer Composite

장지혜, 이승원, 박철민† 연세대학교
This study demonstrates self-healable and shape-transformable EL displays (SSELDs). Light-emitting materials are fabricated by adding a amount of a plasticizer, Triton X-100, to elastomeric poly(urethane) containing light-emitting Cu-doped ZnS microparticles to obtain a viscoelastic composite. A capacitive SSELD exhibits frequency-dependent field-induced light emission under alternating current. Color mixing and tuning of EL is achieved by mixing two or more Cu-doped ZnS microparticles. Most importantly, an SSELD self-recovers its EL within few minutes of electrical failure. Further, the AC EL device endures more than 100 cycles of failure-recovery operations. By combining with a shape-deformable ionic liquid, a novel fiber display that exhibits excellent shape-deformable and self-healing EL performance is demonstrated.

1PS-105 장준화

Kinetic Control of Polymorphic Superstructure for Tuning Optical Properties

장준화, 정광운† 전북대학교
To fabricate the security materials with simultaneous manipulation of both transparency

and luminescence, a monopyrene-based dendron (mPLD) was newly designed and synthesized. Based on the fundamental phase-transition behavior and the microscopic structure analysis, mPLD has polymorphic superstructures, which is determined by the competition between intermolecular interactions (H-bonding and π−π interaction). There are significant changes in optical properties of mPLD due to the polymorphic superstructure. The transparency and luminescence of mPLD can be tuned by processing method and external stimuli. Optical switching of luminescent materials caused by controlling the molecular packing structure via kinetic control can be a great way for developing secret ink. This work was supported by Basic Research Laboratory Program (2020R1A4A1018259) and Ministry of Trade, Industry, and Energy (20011031).

1PS-107 임민우

The Fabrication of Coatable E-type Polarizer by Photopolymerization of Perylene-based Reactive Mesogens

임민우, 정광운† 전북대학교

For the fabrication of E-type thin film polarizer (TFP), a new perylene-based reactive mesogen (PRM) was designed and synthesized. The optical property and molecular self-assembly of PRM were investigated on the basis of using scattering, spectroscopic and microscopic analyses. From the results of polarized optical microscopy and wide angle x-ray diffraction, it was found that PRM molecules formed π-π stacking interaction and ionic repulsion in the nano-column structure. The E-type polarized film was successfully fabricated by mechanical shearing of the PRM H_2O solutions on the polymer substrates and by photopolymerizing process. Furthermore, chemical and mechanical the stabilities of PRM E-type TFP were experimentally investigated from the atomic force microscopy, optical microscopy, and 3D surface profiler. This work was supported by Basic Research Laboratory Program (2020R1A4A1018259).

1PS-109 이호준

Preparation and Properties of Silicone Hydrogel Contact Lenses Using Thiol-ene "Click" Reaction

이호준, 곽기섭†, 김효진† 경북대학교; [1]대구테크노파크 나노융합실용화센터

Silicone hydrogel contact lense is well known as a high oxygen permeability because of the affinity of the internal silicon atom and oxygen molecule. However, silicon atoms in the lense are usually present in the form of siloxanes, thereby increasing hydrophobicity and deteriorating biocompatibility. To compensate these disadvantages, surface modification was attempted to enhance hydrophilicity of the lens but the surfaces are not persisted. In this study, new monomers of siloxane with permanently hydrophilic groups were synthesized with high purity and high yield through thiol-ene click reaction of multifunctional vinyl silicone monomers and thiol compounds having hydrophilic groups. Silicone hydrogel contact lense was prepared through bulk copolymerization with conventional hydrophilic monomers and the new siloxane monomers, and then oxygen permeability, water content, and contact angle were measured to evaluate their physical properties according to the content of the silicon atom.

1PS-111 이호익

Thiol-Functionalization of Cellulose Nanofiber for Heavy Metal Removal

이호익† 한국생산기술연구원

This work reports the fabrication of a thiol-functionalized cellulose nanofiber that can effectively adsorb heavy metal ions. Thiol was incorporated onto the surface of cellulose nanofibers and subsequent esterification of a thiol precursor molecule. Adsorption mechanism was investigated using adsorption isotherms. Adsorption capacity as a function of adsorbate concentration was described well with Langmuir isotherm, suggesting that metal ions form a surface monolayer with a homogenously distributed adsorption energy. The time dependent adsorption capacities followed a pseudo-second-order kinetic model, suggesting that chemisorption of each doubly charged metal ion occurs with two thiol groups on the surface. These results highlight the significance of surface functionality on biocompatible and sustainable cellulose materials to expand their potential and applicability towards water remediation applications.

1PS-113 이혁중

Dual Functionalization of Hexagonal Boron Nitride Allotropes Using Pyrene-tethered Poly(4-vinyl-pyridine)

이혁중, 박철민† 연세대학교 신소재공학과

For solution processability, the development of a stable dispersion of two-dimensional (2D) boron nitride (BN) has received significant attention for cutting-edge optic/electronic applications. Herein, we report an efficient method to disperse BN nanosheets (BNNSs) in polar solvents via dual non-covalent interactions using pyrene-tethered poly(4-vinylpyridine) (P4VP-Py). P4VP-Py enables bi-functionalization, resulting in highly stable BNNS dispersions in polar solvents. The blend of P4VP-Py-functionalized BNNS with the P4VP matrix resulted in increased thermal conductivity and dielectric constant combined with superior thermal stability by forming a compatible interface between the P4VP-Py matrix and the BNNS adjacent to the P4VP-Py. We demonstrated that dual non-covalent functionalization of BNNSs based on molecular design presents a strategy to achieve high dispersion of 2D materials into various media for the expansion of advanced optic/electronic applications using BNNSs.

1PS-115 이한나

Analysis and Characterization of Catechol Lipid Based Natural Lacquers According to the Types of Catechol Lipid Molecules

이한나, 김동영, 이보라, 이연희, 이상수, 임정아† 한국과학기술연구원

Natural lacquer, inferring ottchil in Korea, has received reignited attention as an eco-friendly natural coating material due to its high durability, strong adhesion strength, spontaneous curability at room temperature, and anti-bacterial properties. Natural lacquer film is obtained from oxidative polymerization of catechol-lipids molecules whose molecular structures differs depending on the types of lacquer trees. However, fundamental studies on the properties of natural lacquer according to the different types of catechol lipids had not been reported yet. In this work, we will present facile method for verification of the co-existence of two different catechol lipids with similar molecular structures, urushiol and laccol, and the correlation between their compositions to the physical properties of the lacquer films.

1PS-117 이한나

Anti-Biofouling Performance of Low-Density Polyethylene Films by Photografting Modification with a Fluoromonomer

이한나, 오준균†, 조동익 단국대학교 고분자공학과

Due to inadequate hygiene in the food processing, the development of materials that prevent the formation of biofilms on the surfaces of substances in contact with food is highly demanded. Therefore, bacteria-repellent superhydrophobic surfaces was fabricated through a simple process using UV-grafting method. 1H,1H,2H-perfluoro-1-decene (HDFD) was placed between two low-density polyethylene (LDPE) films and irradiated with UV. As a result, contact angles of two grafted surfaces have a higher angle than the normal LDPE films. When nanorough PE surface was used, it showed superhydrophobic properties after an irradiation time of 40 minutes. When bacteria were inoculated on our superhydrophobically-modified PE surfaces, the number of bacterial populations significantly decreased compared to that of a general food packaging film surfaces.

1PS-119 이하영

Synthesis and Characterization of Activated N-doped Carbon Aerogel for Lithium Sulfur Battery

이하영, 권용구† 인하대학교

N-doped carbon aerogels (NCAs) can be prepared by sol-gel process, through polymerization of precursors and freeze drying. Melamine and resorcinol, as precursors, dissolved into di-ionized water. After that add base catalyst and formaldehyde which is used for initiator to make it sol state. At freeze drying, volume shrinkage can be occurred because of high surface tension of water. This can be avoided by a solvent substitution process in which water is replaced with alcohol. Because melamine has 6 functional group, NCAs can be controlled by manipulating the amount of melamine. Because NCAs have high surface area and a lot of micro-, meso- pores, they prevent volume expansion of sulfur directly connected lithium sulfur battery efficiency. NCAs were characterized by measuring electrical property and structural forms.

1PS-121 이하늬

Electrochemical Transducers Based on Graphene Nanohybrids and Their Application to Biocide Detection

이하늬, 윤현석[1,†] 전남대학교 Alan G. MacDiarmid 에너지연구소; [1]전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

Biocides are usually chemical substances that are capable of destroying and exerting a controlling effect on any harmful organisms. The problem is that biocides may kill living organisms without selectivity and thus pose a serious risk even to human health and welfare. Therefore, techniques of detecting biocides have recently received considerable attention from both academic and industrial points of view. Many researchers have tried to develop simple electrical sensing methods by employing novel sensing materials. Graphene, a typical 2D material, has high electronic conductivity and good dimensional stability. In addition, graphene can be functionalized with various receptors via appropriate chemical routes. We report the electrochemical transducers based on functionalized graphene nanohybrids to detect a target biocide.

1PS-123 이창은

Self-assembled Block Copolymer Non-volatile Structural Color through Thermal Cross-linking for Optical Data Storage

이창은, 박철민†, 어홍규, 김태빈 연세대학교

Here, we demonstrate a self-assembled block copolymer (BCP) structural color (SC) that can be used for optical information storage. Our method is based on photo-thermal conversion, resulting in controlled cross-linking of the BCP's microdomains. Exposure of near infrared (NIR) laser on a poly(styrene-block-quaternized poly(2-vinyl pyridine)) (PS-b-QP2VP) on a photo-thermal conversion layer, composed of poly (3,4-ehtylenedioxythiophene) doped with tosylate, allows photo-thermal cross-linking. The localized heat irradiating from the NIR-to-thermal conversion of the photo-thermal conversion layer is exerted on the BCP lamellae stacks, which results in thermal cross-linking between quaternized pyridines. Consequently, programmed SCs can be fabricated, which can be read with ethanol, a swelling agent. The degree of cross-linking of the QP2VP domains can be controlled with laser-power and exposure time, which gives data storing of SC per area, providing a non-volatile optical data storage.

1PS-125 이진형

Liquid Crystalline Vitrimers with Poly(ether–thiourea) Bonds

이진형, 김동균[1], 김용석[1], 안석균† 부산대학교; [1]한국화학연구원

The incorporation of dynamic covalent bonds within liquid crystal elastomers (LCEs) can bring great benefits including reprocessability and self–healing capability which are not allowed in the conventional LCEs. In this study, we synthesized a new class of LC vitrimers by Michael addition between diacrylate–functionalized LC monomers and diamine–functionalized poly(ether–thiourea) as crosslinkers. Most interestingly, the resulting LCEs were not only mechanically aligned by uniaxial stretching allowing the reversible thermal actuation, but also reprocessible and reconfigurable when heated around 140 °C due to dynamic nature of thiourea linkages. Specifically, we demonstrated the small fragments of LCEs can be reprocessed into a homogeneous film by compression molding, and the multiple permanent shapes can be obtained thanks to the plasticity of dynamic covalent networks.

1PS-127 이지하

코팅소재 응용을 위한 바이오매스 기반 생분해성 고분자 경화소재 개발

조계용†, 권영제, 이지하, 조수현, 김은영, 정수진, 김하진 부경대학교

바이오 매스를 기반으로 한 생분해성 수지 Poly lactic acid(PLA)를 이용하여 에폭시 수지의 "녹색"경화제로서 사용하였다. PLA와 에폭시 수지 간의 반응성을 위해서 PLA의 표면을 amine 기로 개질 시켰다. 이렇게 개질 시킨 amine – modified PLA는 생분해성 고분자의 특성으로 가교 된 분자의 자연분해를 유도할 수 있으면서, 경화제의 분자량과 amine의 개수 조정 등을 통하여, epoxy와의 경화 정도를 조정하여 기계적인 특성을 조정할 수 있다. 따라서, 본 연구는 생분해성 고분자를 응용한 경화제를 통해 에폭시 수지에 생분해 특성을 부여하는 새로운 방법을 제공한다.

1PS-129 이지원

Synthesis and Preparation of Low Dielectric Polyimide Having Excellent Adhesion Property

이지원, 박노균[1], 김현철[1], 김윤호[1], 고민재[2], 최성룡[3], 원종찬[1,†] 한국화학연구원/한양대학교; [1]한국화학연구원; [2]한양대학교; [3]ABC나노텍

Due to the development of 5G communication, the amount of data transmission is needed and high frequency band is used. To reduce signal loss, Dielectric substrate should be required having low–dielectric and low–dielectric loss property. In this study, we designed new polyimide structure. The long aliphatic diamine was used to increase free volume, and cross–linking moiety was introduced to reduce the polarization. This leads to low dielectric and low dielectric loss. Polyimide as well as copper foil are used for 5G communication. The low–roughness copper foil used as a 5G communication has a problem of low adhesion to polyimide. Therefore, alkoxy silane compound was introduced to improve adhesion. We can obtained polyimide having a dielectric constant of 2.6 or less at 1 GHz and adhesive strength 1000 gf/cm or more.

1PS-131 이지선

Self–Healing Protective Coating Corresponding to Crack–Growth

이지선, 이준서, 안현수, 정찬문† 연세대학교

Self–healing materials are a kind of biomimetic materials that have the function to heal itself from damage. Recently, self–healing protective coatings, which can automatically heal the damage that occurs in them, are being studied to extend material lifetime, reduce maintenance cost and enhance public safety. One of the healing methods of self–healing materials is to disperse microcapsules containing healing substance in the material. When a crack occurs, microcapsules in the crack's passing area are broken and healing material flows out to have a healing function. Microcapsule–type can heal not only topical crack but also large crack and can be applied to various kinds of materials. However, according to the existing studies, the microcapsule–type has the disadvantage that secondary defects may occur as the defect width increases. In this study, using a viscoelastic PDMS type polymer, a self–healing protective coating that maintains healed state upon crack–growth was developed.

1PS-133 이준서

Preparation of Polymer–encapsulated Liquid Metal Droplets

이준서, 이지선, 안현수, 정찬문† 연세대학교

Gallium–based liquid metal has liquid phase at room temperature. This liquid metal has non–toxic, low viscosity, high electrical and thermal conductivity characteristics. In this study, we synthesized polymer–encapsulated liquid metal droplets to improve their dispersibility against matrix and thermal stability. These encapsulated liquid metal droplets can be utilized as self–healing material which is stable at high temperature or conductive material in electronic devices. We prepared liquid metal microcapsules having polystyrene shell by surface–initiated radical polymerization method. The polymer–encapsulated liquid metal droplets were characterized by Fourier–transform infrared spectroscopy (FT–IR), thermogravimetric analysis (TGA), optical microscopy and scanning electron microscopy (SEM).

1PS-137 이준규

Multifunctional Hybrid Scaffold with bECM/Mg(OH)$_2$ and PDRN–BMP2 Nanocomplex Using Human Fetal MSCs for Bone Regeneration

이준규, 김다슬[1], 허 윤, 김태형[1], 한동근† 차의과학대학교; [1]중앙대학교

Poly(lactic–co–glycolic) acid (PLGA) has been widely used as biomedical materials due to its great biocompatibility and biodegradability. However, there are considerable hurdles that the byproducts of PLGA cause an acidic environment, and the synthetic polymer has a lower mechanical property. Here, we have prepared a PLGA combined with bone extracellular matrix (bECM) hybrid scaffold with magnesium hydroxide [Mg(OH)$_2$] to enhance mechanical property and anti–inflammatory. We verified that human fetal derived MSCs (hfMSCs) demonstrated a great potential to osteogenesis. BMP2 is known for osteogenic differentiation of MSCs. Since the initial release of BMP2 has side effects, we induced the controlled release of BMP2 by forming nanocomplex (NC) with polydeoxyribonucleotide (PDRN). The hybrid scaffolds improved the ALP activity and bone regeneration capacity. In conclusion, we suggest that hybrid scaffold immobilized with NC and hfMSCs has a high synergistic effect on bone regeneration.

1PS-139 이주홍

Synthesis and Properties of Thermoplastic Polyurethane for Crash Pad

이주홍, 허필호†, 권충렬, 민진규, 원종찬, 배지홍 부산대학교

Thermoplastic polyurethanes (TPUs) series were synthesized by mixing poly tetramethylene glycol (PTMG), polyethylene glycol (PEG) and Polypropylene glycol (PPG) as polyol, methylene diphenyl diisocyanate (MDI), hexamethylene diisocyanate (HDI) and isophorone diisocyanate (IPDI) as Isocyanate and 1,4–butandiol (1,4–BD) as chain extender based on different NCO index. Synthesized TPU materials were evaluated using universal test machine (UTM), viscometer and fourier transform infrared spectrometer (FT–IR). Mechanical properties were evaluated using Universal Testing Machine (UTM) and viscometer. Synthesized TPU materials exhibited high mechanical properties and light weight and high functionality for instrument panel applications.

1PS-141 이제남

Cross–linked Composite Separator for High Performance Lithium–ion Batteries with Enhanced Safety

이제남†, 송진광, 송승원[1], 유지상 전자부품연구원; [1](주)제라브리드

Lithium–ion batteries (LIBs) plays an important role in cellular phones, computers and electric vehicles, etc. LIB separator, placed between cathode and anode, is mainly used to prevent short circuits inducing battery explosion. Commercial polyolefin–based microporous membranes have been used as separator in LIBs because of high tensile, low cost, and advanced electrochemistry. However, poor thermal stability of polyolefin–based separator was one of the reason of poor safety issue in current LIBs. Especially, low melting point and poor wettability limit their applications in large–size batteries or elevated working temperatures. To solve such issue, researchers have been focused on the modification of the separator to improve the thermal stability of polyolefin–based separators. In this study, we investigated the effect of composite coated separator, which was made by crosslinking, on the effect thermal stability behavior.

1PS-143 이제남

Effect of Polyimide–based Composite Binder for the Lithium Sulfur Batteries

이제남†, 김동범, 우상길, 유지상 전자부품연구원

Lithium–sulfur (Li–S) batteries has been considered as one of the key technologies for the future applications such as portable electronics and EV. However, there are a few barriers to commercialize Li–S batteries. The intermediate reaction product between lithium and sulfur generates soluble polysulfide, which can be directly reduced on lithium anode to consume active material or induce "shuttling effect" between electrodes. Additionally, intrinsic insulating characteristic of sulfur decreases the utilization of sulfur and impacts on the cell performance. To resolve such problem, many researches have been focused on the modification of the cathode, electrolyte, separator, and anode that can stop or slow down the lithium polysulfide dissolution effect, polysulfide dissolution effect. In this work, we investigate the effect of polyimide–based composite binder on the PS dissolution behavior and electrochemical characteristics of Li–S batteries.

1PS-145 이정훈

Stimuli–Responsive Conformational Transformation of KLA Peptide for Selective Cytotoxicity

이정훈, 오은택, 이한울, 김지원, 김하경, 박헌주, 김철희† 인하대학교

KLA peptide는 α–helix 구조를 통해 mitochondria의 막을 파괴하여 세포사멸을 유도한다고 알려져 있으나 낮은 선택성으로 인해 치료제로의 활용에 큰 제약이 따른다. 본 연구에서는 이러한 한계를 극복하기 위하여 KLA peptide에 disulfide bond의 도입을 통해 peptide의 conformation을 제어하여 세포독성을 조절하고 선택성을 부여하는 연구를 수행하였다. Helical 구조를 나타내는 KLA peptide의 양 말단을 disulfide bond를 이용하여 cyclization하면 helicity가 현저하게 감소하는 것을 확인하였으며, 여기에 암세포에서 과발현된다고 알려진 glutathione을 처리하면 helicity가 다시 회복되는 것을 확인하였다. 이러한 peptide를 hyaluronate와 complexation을 시킨 경우 CD44가 발현되는 암세포에 선택적으로 targeting하여 들어갈 수 있을 뿐만 아니라 glutathione이 과발현되는 세포에서만 peptide의 helicity가 회복되어 선택적으로 세포독성을 보이는 것을 확인하였다. 따라서 본 연구에서 사용한 peptide의 자극감응형 conformational transformation 방법을 peptide를 이용한 선택적 치료제의 개발에 유용하게 사용할 수 있을 것으로 기대된다.

1PS-147 이정언

습식방사 및 불균일계 비누화를 통한 PVA/MMT 복합섬유의 제조 및 특성 분석

이정언, 염정현†, 양성백 경북대학교

습식방사는 고분자용액을 방사구를 통해 응고액 속으로 토출시켜 섬유를 제조하는 가장 기본적인 방사법이다. MMT는 나노 복합소재로 사용되는 대표적인 필러로서, 고분자/MMT 나노복합체는 기계적 성질, 내열성 및 난연성이 향상되는 특징을 가진다. Poly(vinyl alcohol)(PVA)은 일반적으로 폴리비닐 에스터계 고분자의 비누화에 의하여 합성되며,

일반적으로 PVA 섬유를 제조하기 위해서는 PVA 고분자를 용매에 용해시켜 이를 방사하는 방법으로 섬유를 제조한다. 그러나 본 연구에서는 PVA의 전구체인 Poly(vinyl acetate)를 MMT를 분산시킨 상태에서 습식방사에 의하여 섬유를 제조한 후 이를 불균일계 비누화 공정으로 가수분해하여 PVA/MMT 섬유를 제조하였다. 제조된 PVA/MMT 복합섬유는 기존의 PVA 섬유보다 내열성 및 물성이 향상된 특성을 나타내었고, 일반적으로 제조된 PVA/MMT 복합섬유보다 불균일계 비누화법에 의하여 제조된 PVA/MMT 복합섬유는 표면에 미세기공 형성 및 비표면적이 증가된 특성을 보였다. 이 연구는 2020년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(No. 2020R1I1A3075002).

1PS-149 이정언

용융원심방사를 이용한 PVB 나노 섬유 제조 및 특성 분석

이정언, 염정현†, 양성백 경북대학교

원심방사는 고분자 재료의 용융체 또는 용액을 강한 원심력으로 방사하여 나노 웹을 제조하는 방법으로, 빠른 생산속도와 배향된 나노섬유를 얻을 수 있는 특징을 가진다. 용융 원심방사법은 열가소성 고분자 재료를 용융시켜 원심력으로 방사하며, 별도의 용매 회수 공정이 필요없어 단순하고 경제적이다. Poly(vinyl butyral) (PVB)는 수지내 결합력, 표면 부착력, 강인성 및 광학적 투명성이 우수하여 접착제, 코팅제, 바인더 및 자동차 안전유리에 널리 적용되고 있는 우수한 고분자 재료이다. 일반적으로 PVB 수지는 매우 질기고 단단한 성질에 의해 가공이 어려워, 가소제를 첨가한 유연성을 가진 필름 형태로 제조되는 단계를 거친 후에 사용되고 있다. 본 연구에서는 용융 원심방사를 통하여 나노 웹 형태의 PVB 섬유를 제조하였다. 제조된 PVB 나노 섬유는 기존 PVB 수지의 강인성을 일정수준 유지하면서 유연성을 가지는 것을 확인하였으며, 나노 구조에의해 비표면적이 증가된 특성을 보였다. 이 연구는 2020년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(No. 2020R1I1A3075002).

1PS-151 이운한

A Highly Elastic and Stretchable Polymer Gel for Quantum Dots-based Light Emitters

이운한, 조혜미, 윤현석[1,†] 전남대학교 대학원 고분자공학과; [1]전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

Owing to the poor mechanical reliability of the solid matrices, little progress has been made in developing stretchable down-conversion white light-emitting diodes (WLEDs). In this work, we propose a novel strategy for fabricating flexible and stretchable down-conversion WLEDs based on six-color quantum dots (QDs)-incorporated gel matrix. Transparent and stretchable gels with large pores were created by binary-solvent-based gelation of polyvinyl alcohol (PVA) at low temperatures. Importantly, both of the QDs and the gel were created in the same two solvents, which made the QDs compatible with the gelation process. The QDs were incorporated into the gel without any properties' degradation. Namely, the optical properties of the QDs in the liquid phase were retained in the gel phase. The QD gel (QDG) exhibited elastic deformation up to 200%, with uniform luminescence. In addition, the performance of the QDG-based WLED remained unchanged after more than 1000 bending/stretching cycles.

1PS-153 이용훈

The Urea Structure in Which Fluorosulfonyl Isocyanate was Introduced into Methacryl that was Applied to Lithium Ion Batteries with PEGDMA by Photopolymerization and Radical Polymerization

이용훈, 류태욱[1], 진레이[1], WEI ZHANG[1], 윤수진[1], 김대호[1], 장호현[1], 김환기[1,†] 건국대학교 글로컬캠퍼스; [1]건국대학교

The methacryl has a double bond, which allows photopolymerization and radical polymerization. PEGDMA was synthesized by reacting methacroylchloride with PEG 1000, 4000, and 8000 with different molecular weights without inhibitors. The advantage of EO of PEG used is that it provides a high donor count for alkali metals, so Li ions can easily form coordination bonds with them. Longer amorphous chain segments allow for faster segment dynamics allowing for faster cation mobility. In radical polymerization, the synthesized urea structure was substituted with Li then used as a lithium salt. The advantage of this aliphatic lithium salt is that the Tg point is lower than aromatic structure, which shows high conductivity at low temperatures. In addition, the dissociation energy is lower so giving better Li ion.

1PS-155 이영수

Patterning Technique of Silver Nanowire Electrodes for Flexible and Transparent Photodetector

이영수, 엄두승[1], 임성동[2], 고현협† 울산과학기술원; [1]세종대학교; [2]옥스포드대학교

Silver nanowire electrodes attract significant attention in flexible and transparent optoelectronic devices. Here, we have introduced a simple technique for high-resolution patterning of AgNW networks, based on simple filtration of AgNW solution on a patterned polyimide shadow mask. This technique enables the high-resolution patterning of AgNW electrode down to a width of 3.5 μm. Moreover, the patternd AgNW electrode could be transferred various arbitrary substrate, such as silicon, glass and PET. Finally, we fabricated flexible and semi-transparent UV photodetectors based on ZnO with AgNW electrode. AgNW electrodes are embedded in ZnO films to enhance the photocurrent by light scattering and trapping. In addition, our photodetector could be operated well under extremely bent conditions and provide excellent durability. The proposed patterning technique of AgNWs has a significant potential for applications in the development of flexible and transparent optoelectronic devices.

1PS-157 이시윤

Preparation of Non-porous Alginate-based Hydrogel Crosslinked via Diels-Alder Click Chemistry for Drug Release Application

이시윤, Sonita Afrita Purba Siboro, 조성우, 임권택† 부경대학교

Alginate-based hydrogels were prepared by Diels-Alder click reaction beween alginate-furfuryl amine (Alg-FA) and disulfide-maleimide crosslinkers (S-Ma). Results showed alginate-based hydrogels having a non-porous morphology, which produced no by-products since gelation was processed via addition reaction between FA and Ma groups. From the drug release test of the hydroges, the fast release continued during the first hour after the initial release test, followed by an extremely slow release till the 10thday. The initial rapid release could be attributed to the dense structure. Moreover, size increment after 10 days indicated the steric hindrance that prevented water molecules from diffusing freely.

1PS-159 이시윤

Chitosan-based Dual pH and Thermal Responsive Polyelectrolyte Hydrogel for Colon Targeted Controlled Drug Delivery: Effect of Crosslinker Type on Drug Loading and Kinetics Release

이시윤, Hoang Thi Huong, 박한솔, 임권택† 부경대학교

The novel dual pH and thermal responsive hydrogel for colon targeted controlling drug delivery was prepared based on polyelectrolyte network of Polyacrylic acid (PAA) and Norbornene-modified Chitosan (CsNb) simultaneously taken place with chemical cross-linked with bisTetrazine-Poly(N-isopropyl acrylamide) (bisTz-PNIPAM). FTIR, DSC, WAXD and morphological analysis were carried out to demonstrate the successful formation of polyelectrolyte network of -COO- and -NH3+ groups. BisTz-PNIPAM crosslinker performed the outstanding properties in comparison with non-covalent crosslinker and non-polymeric crosslinker system: it inhibited release in acid environment; increased of drug loading content because of more porosity structure and entanglement of PNIPAM chains, and controlled the release based on shrinkage mechanism.

1PS-161 이시윤

The Novel Carbazole-based Polyimide as The Hole Transporting Material for Optoelectronic Application

이시윤, Tu Thi Kieu Trang, 박 찬, 임권택† 부경대학교

We report a novel potential hole transporting material based on polyimide comprising of carbazole and arylamine moieties. 4,4'-(9H,9'H-[3,3'-bicarbazole]-9,9'-diyl) dianiline is the electron-rich molecule, which is the notable one of the prerequisites for an electrochromic behavior. From this monomer, electrochromic PI is prepared via the chemical imidization process. The structure and properties of PI are investigated by physic-chemical measurements. This polyimide exhibits not only the high-performance properties of typical PI: excellent thermal stability (T_d > 500 °C); a high refractive index of 1.74; reasonable stable transparency of 85%, but also characterizes of an electrochromic material: shallow highest occupied molecular orbital (HOMO) level of −5.4 eV, and hole mobility of 7.44 x 10^{-4} $cm^2V^{-1}s^{-1}$.

1PS-163 이승화

Synthesis of Reduced Graphene Oxide Compunds for Improved Photothermal Effect and Photodynamic Effect

이승화, 김소연† 충남대학교

A mutifunctional photothermal therapy (PTT) system with the ability to selectively kill cancer cells has received attention recently. There are various carbon compounds which are being studied as a main material for PTT system. Especially, reduced graphene oxide (rGO) compounds have a superior photothermal conversion efficiency compared to normal GO compounds. However, there are problems in maintaining stability and strong cytotoxicity in the body. To overcome these problems, we have manufactured a nanocompound combining rGO with modified surface and gold nanorods (AuNRs) and Chlorine e6. The physicochemical, morphological and optical properties of rGO/AuNR nanocompound were determined. Their photothermal stability was also investigated upon exposure to near-infrared (NIR) light irradiation.

1PS-165 이승화

Design of Self-healable, Stretchable, Electro-active Tough Hydrogel for Soft Robotics Using Graphene Oxide

이승화, 최종선, 김소연† 충남대학교

Multifunctional hydrogels with self-healing, stretchable, electro-active and tough properties have attracted a lot of attention in various fields, including soft robotics, wearable electronics, smart sensors, drug delivery, and tissue engineering. In addition, graphene oxide (GO) is an oxidative form of graphene with layered structure and many oxygenated defects can be used for various fields. GO/PAA nanocomposite hydrogel with Fe^{3+} ions provides self-healing ability by dual cross-linking effects through Fe^{3+} enabled strong, dynamic and reversible ionic bonding. In this study, we prepared GO-based multifunctional hydrogel using iron chloride and acrylic acid. In addition, their mechanical and electrical characteristics are investigated under an electrical stimulation.

1PS-167 이승현

Non-volatile Resistive Random Access Memory Based on Aromatic Polyimide Containing Anthracene Moiety

이승현, 최주영, 진승원, 박형주, 최윤제, 김담비, 정찬문† 연세대학교

Recently, resistive random access memory (ReRAM) have attracted much attention from researchers as a next generation nonvolatile memory due to simple metal electrode-insulator-metal electrode(MIM) structure and excellent memory characteristics. Polyimides are attractive polymers for resistive random access memory

applications due to their outstanding thermal stability, chemical resistance, and mechanical strength. In this study, aromatic polyimides containing the anthracene moieties were prepared from (4,4'-(hexafluoroisopropylidene)diphthalic anhydride (6FDA) and diamine containing anthracene moiety and later used as memory active layer in the fabrication of a ReRAM device. We studied their polymer properties including resistive random access memory characteristics originated from the anthracene moieties.

1PS-169 이승연

Fabrication of the Nitrogen Doped Nano-onion Hybrids with Fe_2O_3 for the Efficient Oxygen Reduction Reaction in the Zinc-air Battery

이승연, 김동은, 김창근† 중앙대학교

Zn-air batteries are promising as an alternative to lithium-ion secondary batteries but limited by their charge-discharge cycling efficiency and safety issues. Hence, in this study, nitrogen-doped nano-onions (NNOs) covalently bonded with Fe_2O_3 particles (NNO-c-Fe_2O_3) were fabricated for use as a cathode material of Zn-air batteries. Firstly, ONO-c-Fe_2O_3 were produced by reacting ONO functionalized with acyl chloride groups with Fe_2O_3 functionalized with amine groups. Then through the pyrolysis process of ONO-c-Fe_2O_3 with urea, NNO-c-Fe_2O_3 were produced. The formation was confirmed by XPS, HR-TEM, XRD and EDS. The electrochemical activities of the NNO-c-Fe_2O_3 were tested through half cell test and zinc-air battery test. Oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) were compared with those of the NNO and NNO mixture with Fe_2O_3 (NNO-m-Fe_2O_3). NNO-c-Fe_2O_3 exhibited better power density and bifunctional electrocatalytic activity in both of the ORR and OER.

1PS-171 이수현

Tough Self-healing Polymer System Based on Metal-Ligand Interactions

이수현, 강구민, 강지형† 카이스트

Self-healing polymers are a kind of smart materials that can respond to external mechanical stimulus and restore mechanical properties after mechanical damages. Recently, I developed the new type of tough self-healing polymers based on metal-ligand coordination. This material shows i) autonomous self-healing property ii) high stretchability (500%>) and iii) high toughness (>5,000 J/m^2). The key of this new features is derived from the various strength of metal-ligand crosslinking moieties. When coordinating counter-anion and non-coordinating counter-anion are co-existing in system, crosslinking networks can exhibit multiple energy dissipation modes. In my poster presentation, I will discuss more details for the design of tough self-healing polymers based on metal-ligand interactions and their dynamic mechanical properties.

1PS-173 이수진

Surface-functionalized Micro-fluidic Chip for Monitoring of Drug Efficacy Toward Mammalian Cells

이수진, 양성윤† 충남대학교

Micro-fluidic systems can be used in controlled drug release study for monitoring drug concentration in micro-level. Here, we fabricated a micro-fluidic device for the study of an anticancer drug efficiency and cell toxicity. For the study, drug-encapsulated hydrogel beads were synthesized and placed within a micro-channel of the device. We utilized layer-by-layer (LbL) deposition method to modify the surface of the micro-channels in the device in order to prevent bio-fouling as well as provide the better cell culturing condition. Since the cancerous cells were concentrated in the specific areas without contamination, this system performed as the optimal environment for the clear monitoring of pure drug efficiency. We also evaluated the drug efficacy toward cancer cells over normal cells. The results of this study indicate that the micro-fluidic device suitably surface-functionalized has high potential as the in-situ drug monitoring system.

1PS-175 이선우

Tough, Transparent Ionic Conductor with Multivalent Cation

이선우, 강지형† KAIST

Ionic liquids are molten salts which melting point is below 100 ℃. Their unique properties arise from the interaction between cations and anions, which are easily modified by molecular structure designing. Especially, multivalent ionic liquids such as oligomeric ionic liquids show a multivalent effect. These ionic liquids can be combined with polymers and this synergetic combination is a new platform for multifunctional smart materials. Here, I report multivalent ionic liquid-polymer ionic conductor that simultaneously possesses high toughness, transparency, and conductivity.

1PS-177 이석영

Two-dimensional Titanium Carbide (MXene) Electrode Polymer Light-Emitting Diode under Alternating-Current Operation

이석영, 박철민†, 김의혁, 진우경 연세대학교

MXenes are promising new materials for next electrodes of the other electronics, in which properties are required, including conductivity, transparency and mechanical reliability. Among the classes of various MXene family, Ti3C2 MXene exhibits metal-like conductivity and hydrophilic surface including majority terminal group. Herein, we prepared MXene thin-film electrode with transparency, high conductivity and flexible for operating PLED. Our AC-driven PLED based on MXene shows a high performance than device made from other 2D materials capable of solution processing. Moreover, the MXene electrode prepared on the PET with solution-processing exhibited both physical stability and durability under mechanical deformation. Therefore, we expect that this MXene electrode with solution processable 2D materials will provide tremendous potential to fabricate PLEDs toward high-performance, flexible, and transparent as well as a variety of other functionality.

1PS-179 이사라

Cancer Specific Fluorescence Imaging Using Folate-Alginate Nanoparticles

이사라, 배채원, 김창헌, 박예철, 정한나, 이강원† 서울대학교

In cancer nanomedicine, numerous studies have been conducted on the surface modification and transport capacity of nanoparticles (NPs); however, biological barriers, such as enzymatic degradation or non-specific delivery during circulation, remain to be cleared. Herein, we developed pH-sensitive NPs that degrade in an acidic environment and release 5-aminolevulinic acid (5ALA) to the target site. NPs were prepared by conjugating alginate with folic acid, followed by encapsulation of 5ALA through a water-in-oil (W/O) emulsion method. AF NPs were specifically internalized by cancer cells through receptor-mediated endocytosis. After alginate was deprotonated in the lysosomes and released 5ALA, which was converted to protoporphyrin IX (PpIX) through mitochondrial heme synthesis. Our study outcomes demonstrated that AF NPs were not degraded, and fluorescent precursors were specifically and accurately delivered to cancer cells to generate fluorescence.

1PS-181 이동익

Low Shrinkage, High Porosity Polyimide Composite Aerogels Containing Silica Nanoparticles

이동익, 김혜선, 김승현† 인하대학교

Aerogels are ultralight materials with high porosity, low density, large surface area, and low thermal conductivity, leading to the application in many fields like energy storage, catalysis, sensor, and thermal and acoustic insulation. PI aerogels have recently drawn much attention due to excellent mechanical properties and high-temperature stability. However, the loss of porosity and strength due to large shrinkage during the formation of PI aerogels has led to the loss of their performance, and various efforts have been made to improve such problems. In this work, polyimide aerogels cross-linked with silica nanoparticles are synthesized to reduce shrinkage and enhance strength. Silica nanoparticle with varying weight percent was added into the PI precursor solution, and the structures of the resulting composite aerogel and pure PI aerogel were confirmed by SEM, and the characteristics of PI aerogels such as the shrinkage, density, and porosity were measured.

1PS-183 이동익

Synthesis and Characterization of Polyimides Containing Phosphorus Groups

이동익, 김혜선, 김승현† 인하대학교

Due to the high thermal stability, good chemical resistance, good mechanical properties as well as good electrical and dielectric properties, polyimide (PI) films and fibers have been used in a wide range of fields including aerospace, automotive, chemical and electronic industry. Especially, they are strong in high temperature use to maintain their performance at higher temperature. Much efforts have still been taken to further increase higher-temperature resistance and flame retardancy. In this work, PI containing the phosphorous groups was synthesized by copolymerization with phosphorous-containing monomer to enhance the thermal stability and flame retardant behavior. Synthesis of phosphorus containing monomers and co-PI was confirmed by FT-IR and NMR analysis. The thermal stability and mechanical properties of neat PI and phosphorus-containing co-PI were measured and compared by TGA, LOI and UTM.

1PS-185 이도영

Influence of Fluorination on the Charge Transport Property and Air Stability

이도영, 이해랑, 조영준[1], 정아영[2], 이정호[1], 이상면[1], 주세훈[1], 곽상규[1], 양창덕[1], 오준학† 서울대학교; [1]UNIST; [2]포항공과대학교

Incorporating Fluorine (F) atom into polymer backbones can not only lower the highest occupied molecular orbital (HOMO)/lowest unoccupied molecular orbital (LUMO) levels but also prompt denser packing through non-covelant interactions. In this study, by introducing different ratios of F into a n-type copolymer P(NDIOD-T2) consisting of NDI and 2,2'-thiophene (T2), the influence of fluorination on the charge transport property and air stability was investigated. It was discovered that as the ratio of F increased, the size of the crystallites decreased, affected by less-oriented crystalline structure. However, P(NDIOD-T2F100) exhibit superior operational stability under wet conditions and does not show any negative change in the electrical properties after immersion in water for 30 min. This allows us to understand the change in the morpholgy/crystallinity, device performance, and device stability of n-type copolymers as a function of F content.

1PS-187 이규혁

Effect of Silane Content in Acrylic Polymer Binder with High Transparency, Good Shear Strength and Water Resistance for Protecting Phosphorescent Material

이규혁, 임홍섭, 이주홍, 권충렬, 배지홍, 허필호† 부산대학교

For the safety to vehicle, driver and passenger, phosphorescent material is in use line marking but that is weak in water. Generally, silicone material has hydrophobic property. To increase lifespan and efficiency of phosphorescent material, Silane at a controlled rate added to default acrylic polymer binder material. Transmittance, shear strength and contact angle of acrylic polymer binder material with silane are

evaluated accoroding to silane content ratios using UV-Visible Spectrophotometer (UV), Universal Test Machine (UTM), Contact Angle Meter. Also, Polymerization of the binder and samples were confirmed by Fourier Transform Infrared Spectrometer (FT-IR).

1PS-189 이강혁

Synthesis and Characterization of Polymeric Nanoparticles Based on Polystyrene-block-Poly(4-vinylpyridine)

이강혁, 김 윤, 김태동† 한남대학교

The shape and size of block copolymers can be easily controlled by self-assembly. It is also well known for the block copolymers to form nanoparticles for the applications such as catalysts, templates, storages, and chemical delivery systems. Here, we synthesized a block copolymer consisting of polystyrene (PS) and poly (4-vinylpyridine) (P4VP) via Reversible Addition Fragmentation chain Transfer (RAFT) polymerization. P4VP shows Low Critical Solution Temperature (LCST) behavior which can be used for efficient chemical loading and delivering by changing temperatures. The size of the nanoparticles was also controlled by adjusting the solvent ratio. We confirmed UV-vis spectroscopy to understand the aggregation point at which nanoparticles can be formed. And scanning electron microscopy(SEM) and transmission electron microscopy (TEM) were utilized to measure the size of nanoparticles.

1PS-191 이강인

Characterization and Synthesis of Thienopyrroledione Derivatives Based Polymer Donors for Organic Solar Cells

이강인, 황도훈† 부산대학교

In this study, two polymer donors, PBDT-biTPD(T), PBDT-biTPD(B), composed of thienopyrroledione (TPD) derivatives, and benzodithiophene were synthesized to investigate their photovoltaic properties. PBDT-biTPD(T) and PBDT-biTPD(B) showed good solubility in common organic solvents, such as chloroform, chlorobenzene, and o-dichlorobenzene. The synthesized polymer donors showed broad absorption spectra with wide bandgap. And also, different electrochemical characteristics were observed in the synthesized polymers. Comparison with Y6 as non-fullerene acceptor, the synthesized polymers showed complementary absorption and well matched frontier molecular orbital energy levels. The Y6 based OPV inverted devices, such as ITO/ZnO/active layer/MoO_3/Ag, were fabricated to evaluate photovoltaic characteristics. As a result, PBDT-biTPD(T):Y6 showed the best power conversion efficiency of 11.5% with high short circuit current.

1PS-193 윤지원

Plasmonic Microcylinders for Direct Raman Detection of Target Small Molecules in Pristine Samples

윤지원, 이건호, 김신현† 한국과학기술원

Various metal nanostructures and nanoparticles have been developed for more effective molecular detection based on surface-enhanced Raman scattering (SERS). However, it is still challenging to selectively detect target molecules dissolved in complex biological fludis. In this study, we design hydrogel microcylinders containing gold nanoparticles for direct Raman analysis of small molecules in complex mixtures. The microcylinders are fabricated through a micromolding, where hydrogel precursors and gold precursors are confined in cylindrical holes and UV-irraidated. During the photopolymerization of hydrogel precursors, the gold precursor are also photoreduced, resulting in high-density gold nanoparticles embedded in hydrogel matrix. The hydrogel matrix provides molecular size- and charge-selective permeation and the gold nanoparticles selectively show SERS for permeated molecules through the hydrogel.

1PS-195 윤수진

Synthesis of Blending Membranes by Florosulfonyl Imide and Sulfonic Acid Based Polymers for Proton Exchange Membranes Fuel Cell

윤수진, 류태욱, 진레이, Ahmed Faiz, WEI ZHANG, 김대호, 이용훈, 장호현, 김환기† 건국대학교

Polymer electrolyte membrane with high conductivity is an indispensable need in fuel cell applications due to some major drawbacks of the commonly used polymer electrolytes. We were prepared blend polymer electrolytes by blending PDDPCSFS and SPmax-1200 polymer with different ratios and observed that the blend polymer electrolytes exhibited enhanced performances compared to their parent's compounds by forming an excellent ion-conducting channel. The blend polymers, Blend (9:1), and Blend (8:2) exhibited excellent IEC (2.09 and 2.19) meq./g, σ (93.14 and 117.50) mS/cm at 80 ℃ under 80% relative humidity (RH), mechanical, and chemical stability, which are higher or comparable to Nafion 117.

1PS-197 유일환

Efficient Electron Transport in Radical Polymers through Mixed Ionic and Electronic Conduction

유일환, 전대영[1], Bryan Boudouris[2], 주용호[1,†] 한국과학기술연구원 전북분원; [1]한국과학기술연구원; [2]Department of Chemistry, Purdue University

Organic mixed ionic and electronic conductors typically have heterogeneous conjugated macromolecular backbones and ether-based pendant groups to transport ions and charges. Non-conjugated redox active radical polymers that conduct both charge and mass when moving from this archetype to the one with a single component have significant benefits. Here, we use the ionic dopant lithium bis(trifluoromethanesulfonyl)imide salt for long-distance (i.e., length > 50 μm) mixed ionic and electron conduction. Using this ionic dopant to tune the exact chemistry of the functional radical pendant group is of key importance in improving long-distance electrical conductivity. Our findings demonstrate a polymer design paradigm that differs significantly from the generally accepted heterogeneous configuration for the generation of next-generation organic mixed ionic and electron conductors.

1PS-199 원종찬

Synthesis and Characterization of Photo-curing Acryl-polyurethane through Optimizing of Viscosity and UV Condition

원종찬, 정석훈, 민진규, 이규혁, 배지홍, 허필호† 부산대학교

Thermoplastic UV-curable PU series were synthesized using poly(tetramethylene ether) glycol (PTMG) as polyol, methylene diphenyl diisocyanate (MDI) as isocyanate and 1,4-butandiol (1,4-BD) as chain extender based on different molecular weight of pre-polymer. Designed photocurable acryl-PU is a photo-curing system containing acrylic monomers, polyurethane, and a photoinitiator, whose properties can be manipulated by exposure to light at specific wavelengths (385~405 nm). Photocurable acryl-PU will be synthesized by attaching 1,6-hexanediol diacrylate (HDDA) and used for DLP 3D printing by controlling the content ratio of photo-initiator and addition multifunctional acrylate. UV-curable PUs were evaluated by Fourier transform infrared spectroscopy (FT-IR) and gel permeation chromatography (GPC). The printed 3D structure exhibited good mechanical properties(hardness, elasticity).

1PS-201 우경식

Nanoporous Membrane Prepared with Ultra-thin Films of Polymer Ternary Blends

우경식, 양성윤† 충남대학교

Membranes for the water treatment require several key properties including high water flux, good rejection efficiency and antifouling effect. In this paper, we have fabricated functional coatings for supporting membrane, which were prepared with amphiphilic copolymer and/or graft copolymer and homopolymer blends. The blends are ultra-thin films and they were fabricated by layer-by-layer process. As the results, the deposited films exhibits controllable wettability, various surface morphology and bio-adhesiveness. We also studied annealing effct to the films with two different solvents which can selectively react with one part of the amphiphilic copolymer, therefore, the surface morphology has changed by the process. Finally, we tested filtration ability of these samples with sevral aqueous solutions and found the potentials of them in membrane applications.

1PS-203 오효준

Effect of Amplitude of Ultrasonic Waves in Emulsification for Lacquer Thin Film with Improved Characteristics

오효준, 박민주, 김하연, 황준호, 이은지† 광주과학기술원

Lacquer sap is a excellent natural coating materials. However, it has two drawbacks that make it difficult to be easily applied in the industry. The drawbacks are the very long drying times and discoloration to dark brown. In order to improve the peculiar characteristics of lacquer sap, we proposed the W/O nano-emulsification using ultrasonic waves. Due to the cavitation effect generated by the ultrasonic waves, the W/O emulsion micelles of lacquer sap were crushed to nano-sized, and smaller by higher amplitude. Also, the lacquer thin film prepared with higher amplitude was dried faster and the transmittance was more improved at the same ultrasonication time. It seems that the crosslinking of urushiol was more activated by smaller emulsion micelles through ultrasonication with higher amplitude. Nano-emulsification using ultrasonic waves is expected to simply and effectively control and improve the drying property and transmittance of lacquer thin film.

1PS-207 오윤진

Graphical Encoding of Oil@Hydrogel Core-Shell Microcapsules

오윤진, 이상민, 김신현† KAIST

Microcapsules are widely used for pharmaceutics, cosmetics, and food industry, because we can endow the diverse types of functionality inside the capsules. However, it is difficult to distinguish the capsules with different functionalities, when they are dispersed in the same solution. In this work, we propose the method for fabricating the microcapsules that have hydrogel shell labeled with SU-8 particles, which is called 'encoding technology' that enables easy distinction of different capsules in one solution. Here, we prepare oil-in-water-in-oil double emulsion drops by using a microfluidic device. The inner drop contains oil and desired oil-soluble materials. The middle phase consists of aqueous PEGDA solution to fabricate a hydrogel shell, and SU-8 particles are added to label the shell. We can apply this technology to selective reaction between two different types of microcapsules. For example, only reaction between A and B labeled capsules is valid, not A and A or B and B.

1PS-209 오유리

Sustainable Adhesive Thermosets: Preparation, Reuse, and Signal-Induced De-Bonding

오유리, 김형우† 전남대학교

In this presentation, we demonstrate sustainable adhesive thermosets synthesized via simple thiol-ene photopolymerization. The adhesives consist of a reversible cross-linker and a self-immolative linker; the former unit contains a triazolium moiety that supports the cross-linked structure yet causes covalent bond exchange via transalkylation, while the latter, phenyl-based unit generates a signal-specific, elimination reaction that promotes selective de-cross-linking of the entire networks. Therefore, the materials showed a high lap-shear strength as found in a commercial glue and could be reused by heat treatment. Furthermore, the de-cross-linking

reaction rapidly de-bonded the polymer adhesives after exposure to the molecular signal.

1PS-211 오왕석

Modular Protective Nanoporous Polyurea Network Membranes for Enzymatic Catalysis

오왕석, 박지웅[1,†] 광주과학기술원; [1]광주과학기술원 신소재공학부

Immobilization in porous solid supports are commonly employed for enzymes, while various nanoporous structures have shown additional benefits such as shielding against deactivation agents. However, a few reports employed bicontinuous nanoporous membrane for enzyme protection and efficient enzymatic functions simultaneously. Recently, we reported caging lipase in nanoporous covalent polymer membrane prepared from the poly(ethylene glycol)/poly-urea network mixtures. Facile membrane preparation and enzyme loading by filtration and improved lifespan compared to free enzyme. To broaden the scope of the enzymes and examine the protective effects of confinement on the activity of enzymes, we studied the enzymatic reactions by other categories of enzyme. The effect of confinement on enzymatic kinetics and shielding efficiency were thoroughly investigated to prove the general applicability of caging in the bicontinuous nanoporous structure.

1PS-213 오민택

Photo-responsive Wringing Gel Fabricated from Azobenzene-based Asymmetric Gelator

오민택, 정광운[1,†] 전북대학교 공과대학; [1]전북대학교

To fabricate wireless switches which can be controlled by light, an asymmetric macrogelator (BP-Azo) composed of biphenyl and azobenzene mesogens is newly designed and successfully synthesized. The BP-Azo shows an overlapped phase transition when cooling and the phase transition is separated or overlapped according to the cooling rate. Based on wide-angle X-ray diffraction (WAXD) and small-angle X-ray scattering (SAXS) experiment results, intercalations of alkyl chains crosslinked by intermolecular hydrogen bonding are identified. To investigate the photo-responsibility of BP-Azo, we irradiated UV light to the BP-Azo organogel resulting that gel-sol transition to squeeze organic solvents and color change of organogel. The wringing behavior to squeeze organic solvents is resulted from the morphology change from the metastable 3D network to the stable layer structure. This work was supported by the Basic Research Laboratory Program (2020R1A4A1018259).

1PS-215 엄준혁

해양 유출 기름 방제를 위한 생분해성 Polycaprolactone(PCL) 흡착제 연구

엄준혁, 박세진, 김현구, 남창우† 전북대학교

해양에서 유출된 기름 방제를 위해 주로 사용되는 멜트 블로운 폴리프로필렌(melt blown Polypropylene) 흡착제는 사용이 편리하고, 기름 흡착 성능 또한 우수하지만, 재활용이 어렵고, 매립 및 소각으로 인한 2차 환경오염을 일으킬 수 있다. 따라서 본 연구에서는 친유성과 더불어 생분해 특성을 갖는 Polycaprolactone(PCL)을 기반으로 한 흡착제를 전기방사법을 통해 제조하였다. 흡착제의 표면적을 넓히기 위해 용매의 종류에 따른 섬유 직경의 크기 변화를 측정하였으며, PCL의 농도 변화를 변화시켜 흡착제 강도 변화를 관찰하였다. 특히, Dichloromethane과 Ethanol 용액을 사용하여 제조된 PCL 섬유의 직경이 작아 비표면적이 증가하여 분해 속도가 증가하는 것으로 나타났다. 이러한 PCL 기반 흡착제를 해양 기름유출 방제에 사용할 경우, 우수한 기름 회수 성능을 가지면서도 환경 오염없이 해양 유출 기름을 방제 할 수 있을 것으로 판단된다.

1PS-217 양승철

Chiral Photonic Crystal Film Based on Thermal-responsive Cholesteric Liquid Crystal

양승철, 정광운† 전북대학교

Photonic crystal has been researched in biomimetic science and technology. A cholesteric liquid crystal (CLC) monomer (CBP-RM) is newly synthesized for fabricating chiral photonic crystal (CPC) film. The CPC film is constructed by copolymerization between the CBP-RM and well-known achiral LC reactive mesogen. The helical pitch of the CLC monomer mixtures can be controlled by temperature. After polymerization at selected temperature, the fixed free-standing film is fabricated. The CPC film exhibits the good mechanical, thermal, and chemical properties for various applications. We expect that CPC film can be applied in smart paints, and optical device films. This work was supported by Basic Research Laboratory Program (2020R1A4A1018259) and Korea Agency for Infrastructure Technology (20POQW-B152753-02).

1PS-219 알렘 아라야 메레사

Charge Carrier Recombination Analysis of Organic Solar Cells Based on Lewis Acid Doped PTB7-Th:PCBM

알렘 아라야 메레사, 김선주† 중앙대학교

Charge recombination is a major loss process in organic photovoltaics (OPVs). Due the relatively low dielectric constant of organic materials, electrons and holes in the active layer can easily recombine and decay. In this work, we investigated how a Lewis acid doping affects the recombination properties in OPVs based on Poly[4,8-bis(5-(2-ethylhexyl) thiophen-2-yl)benzo[1,2-b:4,5-b'] dithiophene-co-3-fluorothieno[3,4-b] thiophene-2-carboxylate] (PTB7-Th) as a donor and phenyl-C71-butyric acid methyl ester (PC70BM) as an acceptor. Diverse characterization tools, including power density dependent electrical measurement, electrochemical impedance spectroscopy, and charge carrier mobility extraction, were applied to study the charge carrier dynamics in the doped system.

1PS-221 아딜라

Ultra-microporous Carbon-based Materials as Efficient CO_2 and Methylene Blue Adsorbents

아딜라, 박수진† 인하대학교

Microporous carbon materials are envisaged as efficient contenders for mitigating CO_2 level and global climate change by virtue of their rich surface chemistry, high specific surface area, tunable pore structures, moderate heat of adsorption, and facile regeneration. Current work presents a solvent-free activation approach for designing a series of microporous carbons using economically favorable avenue. Synthesized carbon materials possess a high surface area, large pore volumes, and hierarchical meso-micro and ultramicroporous structures. The high CO_2 and methylene blue adsorption capacities make these microporous carbons amongst the most promising adsorbents in clean energy and environmental applications.

1PS-223 아딜라

Facile Synthesis of Heteroatom-doped Microporous Carbons by Potassium Salts Activation

아딜라, 박수진† 인하대학교

Microporous carbons synthesized from biomass in the presence of potassium salts present a facile strategy to design high micropore content in the carbonaceous materials. Series of nitrogen-doped samples were prepared by changing the ratio of precursors. The optimized material possesses excellent textural features, narrow micropores and high micropore volume. Furthermore, at 273 K and 1 bar, excellent CO_2 uptake was observed. Present work highlights the role of potassium salts activation to generate highly microporous carbons as efficient CO_2 adsorbents.

1PS-225 아딜라

Solvent Free Synthesis of Microporous Carbons for Enhanced CO_2 Adsorption

아딜라, 박수진† 인하대학교

In the present study, a series of alkali-activated carbon materials were prepared by a single-pot polymerization-carbonization-activation method using KOH as a dynamic molecular porogen. The fabricated materials possess a tunable porous network with high specific surface area, large micropore volume, and high population of micropores in sub-nanometer range. At 1 bar, activated carbons adsorbed CO_2 efficiently, attributed to their large pore volume (< 0.73 nm). Moreover, present work demonstrates an insight mechanism for CO_2 adsorption by micropore filling and illustrate the high adsorption potential of micropores with the pore size less than 0.73 nm. Consequently, as-prepared activated carbons are proclaimed as efficient contenders for CO_2 adsorption, an effort devoted for a green sustainable environment.

1PS-227 심현보

Colorimetric Sensing of Barium Ion in Water Based on Polyelectrolyte-Induced Chemical Etching of Silver Nanoprisms

심현보, 김문호† 부경대학교

In the present study, a colorimetric sensing platform for detecting Ba2+ in an aqueous medium will be reported. The platform stands on the basis of the localized surface plasmon resonance (LSPR) properties of Ag nanoprisms, where a strong polyelectrolyte, poly(styrene-4-sulfonate) (PSS), is used as a powerful chemical etchant for the nanoprisms. Upon the addition of PSS to a solution of the Ag nanoprisms, the sharp tips of the Ag nanoprisms were immediately etched and the nanoprisms spontaneously transformed into spheroidal nanostructures, giving rise to dramatic changes in their LSPR properties. The chemical etching reaction of Ag nanoprisms exposed to PSS was retarded in the presence of Ba2+, which enabled the design of a new chemical sensing platform for the sensitive and selective detection of Ba2+ in aqueous media. The proposed Ba2+ sensing platform using highly anisotropic Ag nanostructures and a polyelectrolyte etchant offers numerous advantages over existing platforms.

1PS-229 심소현

Tissue-adhesive Sealant Using Natural Polymer

심소현, 나양호† 한남대학교

Recently, tissue adhesive sealants have been used to treat damaged tissue or to replace conventional suture technology in the treatment of diseases requiring surgery. Existing tissue adhesive sealants are mostly toxic or at risk of viral infection. Therefore, it is necessary to develop a sealant having excellent adhesion and no toxicity. In this study, biocompatibility, biodegradability, and tissue adhesion materials using natural polymers are investigated. Natural polymers are suitable materials for tissue-adhesive and biodegradable hydrogels, but it is disadvantageous in that they possess weak mechanical properties. By controlling the structure of the hydrogel made of natural polymer, it has sufficient strength and adhesion as a sealant. In addition, mechanical properties and structural differences according to their solvents were also investigated.

1PS-231 신혁수

Fluorinated Covalent Organic Polymers for High Performance Sulfur Cathodes in Lithium−Sulfur Batteries

신혁수, 김도윤[1], 김현진, 김지헌[1], 차국헌†, Cafer T. Yavuz[1], 최장욱 서울대학교; [1]카이스트

Lithium-sulfur (Li-S) batteries offer far higher theoretical energy density than that of the commercial lithium-ion battery counterparts, but suffer predominantly from an irreversible shuttling process involving lithium polysulfides. Here we report a fluorinated covalent organic polymer (F-COP) as a template for high performance

sulfur cathodes in Li–S batteries. Fluorination allows facile covalent anchoring of sulfur to a porous polymer framework via nucleophilic aromatic substitution reaction (SNAr), leading to high sulfur contents, e.g. over 70 wt%. The F–COP framework is microporous with 72% of pores being confined to three well–defined pore sizes, 0.58, 1.19, and 1.68 nm, effectively suppressing polysulfide dissolution via steric and electrostatic hindrance. Our findings suggest the F–COP family with the adaptability of SNAr chemistry and well–defined micropore structures as useful frameworks for highly sustainable sulfur electrodes in Li–S batteries.

1PS-233 신주영

Eco–Friendly Colored Ink from Bio–Based Oriental Lacquer

신주영, 임가현[†], 김효진[†], 노유진[†], 임호선[†,*] 숙명여자대학교; [1]숙명여자대학교 화공생명공학부

최근 환경호르몬 문제가 전 세계적으로 대두되면서 천연 도료, 천연코팅제, 천연접착제 등의 친환경 소재에 관한 관심이 높아지고 있다. 대표적인 천연 소재 중의 하나인 옻칠은 60~70%의 카테콜과 글라이콜프로테인, 지용성 단백질, 폴리사카라이드 당류, 1~2% 락카아제 효소로 구성된 물질로 락카아제 효소와 대기 중의 산소가 반응하여 카테콜 분자의 중합을 일으키는 산화 중합 반응을 일으키는 것으로 알려져 있다. 옻칠은 내구성이 우수하고 높은 광택을 나타내며 여러 우수한 물성을 가지고 있어 생활용품, 공예용 도료, 나전칠기 등에 사용되어왔다. 본 연구에서는 바이오 기반의 컬러옻칠을 제조하고 컬러옻칠의 색상 구현을 위해 안료 비율에 따른 컬러옻칠 도막의 색채변화 및 물성 변화를 측정, 비교하였다. 또한, 시간에 따른 컬러옻칠 도막의 변색 정도를 색채 측정을 통해 관찰하였다. 이 결과는 컬러옻칠이 다양한 산업 분야에서 친환경 코팅재료 및 도료로 이용될 수 있는 기초자료가 될 수 있을 것이다.

1PS-235 신재환

Effects of High–energy Beam Irradiation on the Properties of Polymer/Silane Hybrid Aerogels

신재환, 김선주[†] 중앙대학교

Organic/inorganic hybrid systems can utilize advantages of the constituent materials. In this work, we prepared an aerogel system based on conducting polymer and silane precursors and investigated the property changes induced by electron beam. We were able to get the porous structures of the aerogel by freeze–drying from aqueous mixtures. We then irradiated electron beam to the hybrid aerogel with the dose ranging from 1 to 50 kGy and measured the force required to make compressive deformation. It revealed that increasing the electron beam irradiation dose showed improved resistance to deformation by external stress.

1PS-237 신영은

High–Performance, Self–Powered Multimodal Sensors *via* Ferroelectric Polarization

신영은, 손소담, 신형준, 고현협[†] 울산과학기술원

Self–powered multimodal sensors have been receiving great attention for their potential use in sustainable wearable electronics. In this work, we demonstrate a facile approach for the development of self–powered multimodal pressure–temperature sensors based on an identical ferroelectric copolymer, poly(vinylidenefluoride–co–trifluoroethylene) (P(VDF–TrFE)) for the contact pair materials by switching the triboelectric polarity for the first time. The aligned dipoles in P(VDF–TrFE) critically affect the triboelectric polarity, which relies on the applied bias direction during electrical polarization. This approach enables the identical material–based triboelectric devices with remarkably enhanced output performances even without any additional chemical functionalization or mechanical modification of the contact pair materials. In addition, this work provides a facile approach for triboelectric and pyroelectric hybrid sensors to discriminate multiple stimuli without signal interference.

1PS-239 송선구

Synthesis of Dopamine–Incorporated Thiourea Polymers and Their Applications

송선구, 하성균, 하채연, 김현우, 송창식[†] 성균관대학교

Fabrication of film using polymer–based structures are getting more interest because it is easy to control the chemical and physical properties such as porosity, ion–selectivity, storage modulus, compare to existing films. In this study, we used thiourea which has been studied for its unique properties such as anion selectivity by its hydrogen bonding property. Thiourea is also shows great binding affinity to Ag ions which shows great effect on anti–bacterial properties. Also, it is easy to produce the gels by forming the network structures by hydrogen bonding. Dopamine is interesting material for its metal binding properties and adhesive ability to substrate and bio–compatible moiety. Herein, we designed and synthesized the various dopamine–containing thiourea with simple reaction for the control of the physical and chemical property for the application.

1PS-241 송상하

Superhydrophobically–Modified Nanoparticles Embedded Dual–Functional Low–Density Polyethylene Film for Antibacterial and Self–Cleaning Properties

송상하, 정주현[†], 오준균[†] 단국대학교 고분자공학과; [1]단국대학교

이번 연구에서는 trichloro (1H, 1H, 2H, 2H – perfluorooctyl) silane과 fumed silica를 이용하여 "fluorinated silica nanoparticles" (FSNs)를 제조하였다. 이후 준비한 LDPE를 magnetic bar를 이용하여 xylene으로 용해시킨다. 완전히 용해된 후, 앞서 준비한 FSN 용액을 LDPE 용액 내부로 넣어준다. 위 과정으로 만들어진 필름은 IR 분석결과CF3 peak 가 검출되고, 아주 높은 contact angle 값을 보인다 (167±2°). 아무 처리가 되지 않은 LDPE의 contact angle 값이 88±2° 인 것으로 미루어 보아 초소수성을 띈다고 볼 수 있다. 박테리아 부착방지 기능의 실험은 Staphylococcus aureus 와 Escherichia coli 두 종으로 진행된다. FSN이 내장된 필름의 경우 표면의 미세구조와 낮은 표면에너지로 인해 초소수성을 띄게 된다. 박테리아 부착실험은 pour–plating method와 SEM을 통해 진행되었다. FSN이 내장된 필름에서는 S. aureus와 E. coli의 군집수가 99.9% 이상 감소됨을 확인할 수 있었다.

1PS-243 송광식

The Synthesis of Photosensitive Polyimide Using Various Groups for Application of Semiconductors

송광식, 박성만, 김영랑, 김영훈, 허윤정, 백정주, 장기철, 이효선, 배근열, 최경호, 신교직[†] 한국생산기술연구원

Aromatic polyimide (PI) is a kind of excellent high performance polymer having thermal resistance and chemical resistance to radiation. Besides, since it has a relatively low dielectric constant and excellent mechanical properties, it is widely used in the space industry and semiconductor industry. Therefore a large molecular weight and flexibility has been required to improve physical properties of PI such as elongation rate. In this study, we synthesized DHBA having a hydroxyl functional group in the molecular structure and three kinds of aromatic ethylene diamines to improve flexibility of the PI film. And then polymerization was performed using DHBA and various kinds of synthesized monomers. After polymerization, Di–tert–butyl dicarbonate, 2–Nitrobenzyl bromide was substituted to the hydroxyl group of the polymer to synthesize photosensitive polyimide. The structure of the polymerized PSPI was analyzed by NMR and FT–IR. Thermal stability was also evaluated by TGA.

1PS-245 손경철

Multifunctional Elbow and Knee Pad Sensor System Using Carbon Ink

손경철, 안다혜, 김준서, 박상기, 조유장, 정재선, 최형섭, 박종진[†] 전남대학교

In this study, we report a multi–functional elbow & kneepad system. We introduced the humidity, temperature, textile–based touchpad and bending sensor on the elbow pad while introducing the counter and generator&heater system on the kneepad. Firstly, the swelling of PVA which caused the resistance gone up was used in the humidity sensor. The PVA–copolymer will absorb the water which will make the swelling, and leads the resistance gone up. Secondly, the Carbon Ink&PEDOT coated Nylon11–SEBS filament can sensing when wire bending. Thirdly, we dipping the textile in the Carbon Ink&PEDOT solution to make it conduction. Finally, the kneepad principle is the piezoelectrical property. We use the sponge–PVDF–sponge layer to enhance the piezoelectrical effect which is a benefit to detect the kneecap bending. In front of the kneecap, we set the PVDF generator & heater system, which can receive electric energy through the piezoelectrical effect and store it in the capacitor.

1PS-247 백정주

Formation of Functional Coating Layers Derived from Fluorine–modified Polysilazane and Their Coating Properties

백정주, 신교직[†], 최경호, 배근열, 이효선, 허윤정, 장기철, 김영훈, 송광식, 박성만, 김영랑 한국생산기술연구원

Recently, surface treatment technology has been required to improve the quality to a reliability and stability of semiconductors, optical lenses, solar cells and display materials; hydrophobicity is one of the important characteristic for corrosion resistance, chemical resistance, anti–fingerprint. In this study, fluorinated siloxane precursors having low surface energy modified with various functional group were synthesized by the sol–gel reaction. And then transparent water–repellent coating layer was fabricated using synthesized fluorine–modified polysilazane derived from fluorinated siloxane and perhydropolysilazane (PHPS). The layers appeared transparent hydrophobicity as measuring above 92% transmittance, below 0.3% haze and above 108° water contact angle. Besides, the coating layer on glass was measured as 9H pencil hardness at a load of 1Kg. Thus, that could be contributed to transparent functional film industry.

1PS-249 백승엽

Highly Porous Oxime–functionalized Lyocell–based Cellulose Droplets and Their Filter Applications

백승엽, 박수영[†] 경북대학교

Highly monodispered and porous oxime–functionalized cellulose droplets were prepaerd by microfluidic method. Cellulose was dissolved in N–methylmorpholine N–oxide (nMMO) monohydrate and the dope was used as the disperse phase. Mineral oil (EM 90, 3 wt%) was used as the continuous phase. The achieved droplets were then washed with DI water. nMMO is miscible with water. After washing, the nMMO was removed and the droplets were mostly filled with water. After drying, the internal sturcture shrinked and could not swelled again due to the hornification of lyocell. But after cross–linking with epichlorohydrin, the droplets were not totally shrinked and porous sturcture was achieved. This cross–linked droplets were then applied to metal ions adorption by oxime functionalize.

1PS-251 배지홍

Design of 3D Printing Materials Based Photoactivating Acryl–polyurethane to Add Flexible Functionality to Exquisite Structures

배지홍, 원종찬, 정석훈, 민진규, 이규혁, 허필호[†] 부산대학교

In order to improve the flexibility of the photocurable 3D printing structure, the structure was successfully fabricated by appropriately including the designed acryl–PU. It was confirmed that the flexible properties of the 3D structure improved as the polyurethane content increased. An acryl–functionalized polyurethane series were synthesized using poly(tetramethylene ether) glycol–methylene diphenyl diisocyanate (PTMG–MDI) oligomer based on urethane methacrylates. The raw materials of acryl–PU were analyzed through UV absorbance analysis and viscometer. Acrylic additives

and photoinitiators were important elements for fabricating 3D printed structures. Structures with precise fine patterns were manufactured by controlling the inherent viscosity and exposure conditions of the materials. The results showed that acryl-polyurethane demonstrated the potential applicability in field of photocurable 3D printing materials.

1PS-253 배소연

Construction of Heat Radiating Material with High Effective Heat Transfer Channel Using PS-PMMA Diblock Copolymer

배소연, 박찬수, 조남주† 부산대학교

Conventional heat radiating materials are produced by simply dispersing ceramic fillers in a polymer matrix. And it forms a heat transfer path over 50 wt% of ceramic filler, which decreases in the tensile strength of heat radiating material due to the high content of ceramic fillers. It is a barrier to commercialization. In this study, we use amphiphilic diblock copolymer which can selectively disperse aluminum oxide (Al_2O_3), thermally conductive filler. If Al_2O_3 is selectively dispersed through interaction with a specific block in a phase-separated block copolymer, Al_2O_3 is concentrated in a specific block. And it forms a 3D network heat transfer path by adding carbon nanotubes (CNT) to act as a heat transfer bridge between Al_2O_3. Therefore, the heat transfer path can be formed even at 50 wt% or less. Accordingly, it is expected to develop an electric insulating heat radiating material having lower ceramic filler content and improved tensile strength as well as thermal conductivity.

1PS-255 반유정

Preparation of Carbon-Based Aerogels Embedded with Transition Metal Oxide for Lithium-Sulfur Battery Applications

반유정, 권용구† 인하대학교

To overcome the unfavorable lithium polysulfide shuttle problems, frequently found in a number of lithium-sulfur batteries, we prepared functional carbon-based aerogels embedded with transition metal oxide as an electrode material. The dissolution of LiPS can be effectively prevented by physical and chemical adsorption with the use of transition metal oxide. These carbon aerogels were impregnated with sulfur through both solution infiltration and melt-diffusion process. The sulfur content entrapped in the porous structure of the carbon aerogels, determined by TGA, ranged from approximately 50% to 80% in weight. The surface characteristics of the carbon aerogels were analyzed by various characterization methods. Their electrochemical properties were characterized by cyclic voltammetry, discharge-charge cycling test and impedance measurement.

1PS-257 박희정

Preparation of Highly Self-healable Polyurethane Using Polyols with Blocky Segments of Imide Methacrylate

박희정, 이동현, 홍성우[1,†] 단국대학교; [1]한국생산기술연구원

In this study, a new type of crosslinked polyurethane is prepared for highly enhanced self-healing ability. Polyols with blocky segments of n-(phthalimido) ethyl methacrylate are first synthesized by reversible-radical addition fragmentation (RAFT) polymerization. The resulting polyols are then reacted crosslinker with multiple isocyanates to synthesized self-healable crosslinked polyurethanes (shPUs). To confirm the self-healing properties of shPUs, polyols with no imide groups are reacted with crosslinker to prepare conventional crosslinked polyurethanes (cPUs) as a reference. Interestingly, shPUs demonstrate remarkably enhanced self-healing ability compared to cPUs. FT-IR analysis reveals that the unique supramolecular network induced by strong hydrogen bonding interaction between urethane groups and serially connected imide groups in polyurethane. The self-healing and mechanical properties of samples are characterized by using single scratch analysis and universal tensile machine.

1PS-259 박태정

Pd Nanoparticle Immobilized BIJEL Catalytic Membrane Using Phenolic Ligands

박태정, 유필진† 성균관대학교

Hollow fiber membrane can be used as catalytic reactor substrate because of high surface area to volume ratio and high packing density. However, metal catalyst embedded membranes fabrication requires multiple and long-time processing. Also, it still has problems of catalyst leaching. Here, we use single-step solvent transfer-induced phase separation method to prepare bicontinuous interfacially jammed emulsions gels (BIJEL) hollow fiber membrane. Due to a dense layer of silica nanoparticles embedded on the surface of BIJEL membrane, it is easier to impart functionality strongly. In addition, metal catalyst coated membrane is achieved by simply shacking using tannic acid which enables reducing and stabilizing metal nanoparticles on the membrane surface. In order to compare catalytic properties of each structure and figure out best structure for catalytic reaction process, the Suzuki-Miyaira cross-coupling reaction was carried out.

1PS-261 박진경

Antifreeze Block Polymers

박진경, 모두미타파텔, 정병문† 이화여자대학교

Understanding of the ice crystallization process plays a key role in storaging cells. Surface of ice is known to be rather hydrophobic and amphiphilic block copolymers with appropriate hydrophobicity can adsorb on the ice surface to inhibit the growth of ice crystals. Here we synthesized poly(ethylene glycol)-poly(L-alanine) block copolymers with various block length. Depending on the block length of the polymers, size of ice crystals varied, and the shape was also diverse from spherical to rod-like sharp shape. Stem cell recovery improved as the size of ice crystal decreased, however it dropped as the ice crystal shape was rod-like shape. The recovered cell exhibited excellent proliferation and underwent into osteo-, chondro-, and adipogenic differentiation. Contrary to dimethysulfoxide (DMSO), current cryoprotectant, PEG-PA proved to be cytocompatible. The paper suggests that PEG-PA (5000-500) can be an excellent cryoprotectant for stem cells to replace cytotoxic DMSO.

1PS-263 박종민

Block Copolymer/Tannic Acid Hydrogel

박종민, 박은숙, 이해신, 서명은† 한국과학기술원

Physical hydrogels consisting tannic acid (TA) and water soluble-polymers such as polyethylene oxide (PEO) have been utilized for drug delivery and hemostatic applications due to their biocompatibility and adhesive properties. The transient supramolecular network held by hydrogen bonding provides modulus to resist external. However, the resulting materials typically behave as viscoelastic liquid with low elastic moduli. Here, we present the preparation of hydrogel via TA-mediated aggregation of amphiphilic and biocompatible block polymer micelles in aqueous solution. Bridging of the micelles the hydrogen bonding between TA and the corona segment renders enhanced mechanical and adhesive properties. We will discuss the structure-property relationship of block polymer/TA hydrogels.

1PS-265 박세진

Development of Polymer Net for Low Sulfur Fuel Oil (LSFO) Remediation at Low Temperature

박세진, 엄준혁, 김현구, 남창우† 전북대학교

저유황유(황 함유량 0.5% 이하)는 기존 HSFO와 같은 선박연료유들과 달리 왁스(wax) 함량이 높아(~5 wt.%) 저온의 해상에 유출될 경우 해수면에서 분산되지 않고 고화되기 때문에 기존의 기계적인 기술만으로는 방제가 어렵다. 따라서, 본 연구에서는 친유성 및 탄성 특성이 우수한 선형저밀도폴리에틸렌(LLDPE)을 톨루엔에 녹인 후, 고화된 저유황유 표면에 분사해 얇은 막 형태의 네트워크를 형성시켜 회수하는 방안을 개발했다. LLDPE의 밀도에 따라 흡착력을 비교하며 최적의 밀도를 확인하고, 용액 내의 LLDPE의 농도에 따라 필름의 형성 속도 및 구조적 안정성을 확인하였다. 또한, 스프레이 형태로 LLDPE를 분사할 경우 필름 두께 조절이 가능해 저유황유 회수 시 필름 두께에 따른 회수 특성 분석이 가능하다. 따라서, 저온의 해상에 저유황유가 유출되더라도 LLDPE-Net을 이용해 쉽게 회수될 수 있을 것으로 판단된다.

1PS-267 박성만

Precise Particle Growth Control of Electrospray-synthesized Polysilazane Films for Improvement of Hydrophobic Properties

박성만, 신교직†, 최경호, 배근열, 이효선, 장기철, 백정주, 허윤정, 김영훈, 송광식, 김영랑 한국생산기술연구원

Perhydropolysilazane (PHPS)은 Si-N의 결합을 갖는 무기화합물로서 용액공정이 가능하고 경화 후 유리(silicon)와 유사한 구조(SiOx)를 형성하여, 고투명성, 고경도 및 절연특성을 요구하는 분야에 응용 범위가 큰 물질이다. PHPS의 코팅 방법으로는 spin coating, spray coating, bar coating 등의 코팅방법이 보고되어왔다. 본 연구에서는 PHPS를 electrospray를 이용하여 코팅을 진행하여 실리카 박막을 형성하였다. 이후 열처리 전 상온에서 방치한 시간에 따라 변화하는 접촉각 현상을 확인하였으며, 이를 통해 최대 137°의 접촉각 수치를 나타내는 우수한 발수성능의 실리카 박막을 제조하였다. 형성된 실리카 박막 표면의 morphology 및 roughness는 FE-SEM를 이용하여 진행하였으며, 발수능력은 접촉각 측정을 통하여 비교 · 분석하였다.

1PS-269 박서린

Fabrication and Optimization of Conductive Paper Based on Screen-printed Polyaniline/Graphene Patterns for Nerve Agent Detection

박서린, 장혜지[†], 조성훈† 영남대학교; [1]영남대학교 화학공학부

In this work, a high-performance sensor capable of effectively detecting nerve gas, a type of chemical warfare agent (CWA), was realized by conductive paper with polyaniline (PANI) nanofiber and graphene sheet. To realize the high-performance nerve gas sensor, DMMP was used as a model gas of nerve gas, and the conductive paper sensor that can detect DMMP at a concentration of ppb within a few seconds. Improvements in electrical properties and sensor performance of conductive papers were realized by the addition of optimized amounts of graphene and PEO. In addition, P(VB-co-VA-co-VAc) copolymer significantly improved the intermolecular forces between PANI nanofiber, graphene sheet, and cellulosic paper. Conductive patterns containing PANI nanofiber/graphene cofillers were fabricated into sensor electrodes of various sizes and shapes by screen printing. The prepared conductive papers were exposed under DMMP at various concentrations of at least 3 to at most 30000 ppb.

1PS-273 박금환

Surface Modification of Silica Micro-particles and Application for Release Coating

장주은, 송예슬, 박금환† 한국전자기술연구원

Release coating material is an important component of adhesive tape products. The release coating surface protects adhesive surface while in contact with the adhesive coating surface, and then easily peeled off from the surface when the adhesive is to be used. In order to prevent the release material from being transferred to the adhesive surface, some polymer or silica micro-particles are coated together on the release surface. However, there is a problem that these particles remain on the adhesive surface and act as foreign substances on the product. In this study, in order to overcome this problem, the affinity between the particles and the adhesive surface was reduced by modifying the surface of silica micro-particles to be

hydrophobic. As a result, it was possible to prevent the transfer of particles, and this phenomenon and the surface modification of the particles were analyzed by SEM and IR-spectroscopy.

1PS-275 박금환

Transfer Method of Amorphous Alloy Thin Layer by Using Hydrophobic Surface

송예슬, 장주은, 박금환† 한국전자기술연구원

Transfer printing of metal thin film is a promising technique for micro/nanofabrication of various electrical devices. In particular, in the case of amorphous alloys, thin film transfer technology is necessary because amorphous thin films can be formed only with limited processes such as sputtering. In this study, amorphous alloy thin films were formed on a substrate having low surface energy and then transferred on the polymer layer such as PEDOT. The transferred amorphous alloy thin film exhibited excellent chemical stability and electrical properties, and showed the possibility of manufacturing a stable electronic device using this technique.

1PS-277 박규태

Fabrication and Electrochemical Properties of Carbon Nanofibers Derived from Polyimide and Lignin

박규태, 정영규† 충남대학교

Recently, carbon nanofibers (CNFs) are attracting lots of attention due to their unique microstructures and electrochemical properties for the electrode material applications of energy storage devices, such as rechargeable batteries and supercapacitors. In this study, to attain flexible and porous CNFs with high energy storage performance, polyimide (PI) and lignin were chosen as the precursors of CNFs. For the purpose, a series of mixed solutions of PI precursor and lignin was electrospun into nanofibers, which were then imidized and carbonized at different temperatures. The microstructural and morphological features of PI/lignin-derived CNFs were characterized by using SEM, TGA, Raman, and XRD. The electrical and electrochemical properties of the CNFs were investigated by using electrometer, cyclic voltammetry, and galvanostatic charge-discharge test.

1PS-279 바돈 이사벨 웬

Multiresponsive Hydrogels via Surface Modification with Spiropyran-conjugated Polymer Network

바돈 이사벨 웬, 문선정, 임희정, 김호중† 조선대학교

Multi-responsive hydrogels were prepared using spiropyran-conjugated chitosan networks. The intra/inter polymerization of methacrylamide chitosan chains, which interpenetrated into pre-formed poly(hydroxyethyl methacrylate) hydrogels, and subsequent modification with spiropyran derivatives resulted in the formation of multi-responsive hydrogels. The photochromic properties of these hydrogels were investigated in response to specific light illumination or acid/base treatment. In this hydrogel system, the colorless spiro form of spiropyran reversibly isomerized into the ring-open, fluorescent merocyanine state upon specific light irradiation. It is expected that the synthetic method for spiropyran-modified hydrogels using novel chitosan networks described herein would contribute greatly to the development of photochromic materials and chemical sensors.

1PS-281 문휘현

Study for Lubricating Properties of Norbornene-Based Bottle-Brush Polymers Synthesized by ROMP and RAFT

문휘현, 송창식† 성균관대학교

Bottle-brush polymers are widely used for the studies of hydration lubrication due to their unique mechanical and rheological properties. By mimicking lubricin we synthesized bottle-brush polymers using two polymerization methods: ring opening metathesis polymerization (ROMP) and reversible addition fragmentation chain transfer (RAFT) polymerization. To do so, norbornene and chain transfer agent (CTA) containing monomers (cationic, anionic, or zwitterionic) were used for ROMP and RAFT, respectively. The reactions were carried out by tuning Grubb's catalyst generation, the concentration of Grubb's catalyst, the amount of initiator, and solvents. The molecular weight of the synthesized polymer was measured by a GPC and calculated percent conversion using NMR. The lubricating properties of the synthesized brush polymers affected by bottle-brush architecture and hydrate state were examined by a ball on disk.

1PS-283 문주용

The Double Comb Copolymer Lithium Ion Polymer-gel Matrix

문주용, 이재연, 박정태† 건국대학교

As needs for sustainable energy becomes a hot issue in international society, supercapacitor is receiving great attention due to its environment friendly and fast charging-discharging energy storage system. Mostly aqueous electrolytes are mainly used as electrolytes for supercapacitors, but there are disadvantages such as limited range of potential windows and electrolyte leakage problem. Therefore, many researches are being held to develop electrolytes using polymers using non-aqueous electrolytes. Using two step ATRP process, PVDC-*g*-PMMA was synthesized and was used for supercapacitor polymer electrolyte with LiTFSI salt for enhancing ionic conductivity. PVDC is the hydrophobic back bone which gives mechanical property that decrease crystallinity with grafting PMMA to PVDC and PMMA possesses the hydrophilic side chain, making electron pathway which raise the electron transport properties. The coin cell structure with two stainless steel were used to measure ionic conductivity.

1PS-285 문강민

염수 조건하에서 폴리우레탄 표면의 개질을 통한 유해 박테리아 오염 방지에 관한 연구

문강민, 조슬기, 오준균† 단국대학교

폴리우레탄을 재료로 하여 만드는 위생 보호구 (e.g., 앞치마, 마스크, 위생장갑)의 경우, 높은 염도조건 하에서는 내구성과 방오성능이 저하될 수 있다. 따라서 본 연구에서는 이러한 문제를 해결하고 나아가 수산업 환경에서의 교차오염과 세균전이를 막기위해 폴리우레탄의 표면을 "fluorinated silica nanoparticles(FSNs)"을 사용하여 dip-coating 방법으로 개질 하였다. 내구성과 방오성을 확인하기 위해, NaCl 현탁액을 사용하여 각각의 염도별 조건에서 물 접촉 각도를 확인하였으며, 그 결과 높은 염도에서도 높은 접촉 각도를 가지는 것을 확인하였다. 추가로 바닷물의 표준 염도 3.5wt%로 고정하고 코팅의 지속성, 온도안정성 및 내마모성을 물 접촉 각도를 통해 확인하였다. 방오성 확인은 대장균(Escherichia coli)부착 실험 후, pour plating method 및 주사전자현미경을 이용하여 직접 박테리아의 수를 세는 방법으로 실시하였다. 그 결과 높은 염도에서도 안정적인 방오성을 유지함을 보였다. 본 연구를 통하여 폴리우레탄의 "FSNs-코팅" 방법이 수산업 취급 및 가공용 위생 보호구에 응용되어 교차오염과 세균전이를 방지할 것으로 보인다.

1PS-287 류한나

Microflow Reactor Process을 이용한 Nanoparticles 합성 및 크기 제어

류한나, 김 윤, 김태동† 한남대학교

기존 batch process에서는 in-situ로 합성이 되기 때문에 제 각각의 nanoparticles 크기를 얻게 되며 오래 걸리고 재현이 어렵다는 단점이 있다. 이와 달리 Microflow reactor process을 이용하게 되면, 간단히 tubing의 직경, 유속, 유량, 용매 비율에 의해 nanoparticles 크기를 손쉽게 컨트롤할 수 있으며, 이로 인해 수율이 높고 재현성이 높으며 몇시간에 걸리는 batch process과는 달리 초고속으로 합성할 수 있다는 장점이 있다. 즉, micro tubing을 사용하여 최적화된 유속을 가하게 되면, inlet부분에서는 interface가 존재하게 되고 interface는 microflow를 통해 complete mixing이 되어 균일한 nanoparticles를 만들 수 있다. 따라서 본 연구는 microflow reactor를 활용하여 hollow silica spheres (HSS)를 합성하고 다양한 조건 변화를 통해 균일한 나노 크기의 입자를 얻고자 한다. 또한 batch process를 통해 얻어진 나노 입자와 비교하고 이를 통해 chemical delivery 응용분야의 가능성을 타진해 보고자 한다.

1PS-289 데미발레스

Development of Chitosan-based Hydrogels Embedded with Poly(N-isopropylacrylamide) Nanogels for Thermoresponsive Controlled Drug Delivery

데미발레스, 정우경, 김호중† 조선대학교

A facile synthetic strategy was developed for the preparation of thermoresponsive nanocomposite hydrogels comprising crosslinked chitosan networks and poly(N-isopropylacrylamide) nanogels. The p(NIPAAm) nanogels were synthesized via emulsion polymerization and introduced into methacrylamide CS (MC) solution. The free-radical initiated crosslinking reaction of MC produced nanogel-embedded hydrogels. Notably, thermoresponsive drug-release was achieved without unwarranted modification of the hydrogel's dimension and shape, although an increase in temperature caused the collapse of the p(NIPAAm)nanogels. The thermoresponsive property of the investigated nanocomposite hydrogel is beneficial and may offer broad opportunities for drug temperature-triggered release for clinical applications.

1PS-291 노미소

Characterization of Silicon Alloy Anode with Alginate Binder for Li-ion Batteries

노미소, 최재학†, 김성수, 지상구 충남대학교

In this study, the electrochemical performance of silicon alloy anode with alginate binder was investigated. Compared to the conventional PVDF binder, the anode with alginate binder showed significant improvement in electrochemical performance, such as cyclability and coulombic efficiency. The interaction between the silicon alloy and the funcational groups on the alginate can be responsible for the improved electrochemical performance. Therefore, the alginate binder can be used as an anode binder for high-performance Li-ion batteries.

1PS-293 남유준

플라스틱 식품 보관 용기 표면의 적용 가능한 기능성 세라믹 나노복합체 제조

남유준, 김성준†, 금헤리 네오플램

주방용품으로 사용되는 플라스틱 식품 보관 용기는 가볍고 저렴하며 투명성이 보장되어 내부 음식물을 볼 수 있는 장점이 있다. 하지만 음식물과 접촉 시 발생하는 환경 호르몬의 용출, 냄새 및 색 배임 현상 등의 문제점들을 가지고 있어 사람들은 유리나 스테인레스 보관 용기를 더 선호한다. 그래서 이러한 단점을 보완하고자 플라스틱 표면의 부착 가능한 기능성 세라믹 도료를 제조하였다. 플라스틱 표면에 polarity를 주기 위해 아민기 실란을 사용하였고 실리카 전구체와의 Sol-gel 반응을 통해 세라믹 나노입자를 형성하였다. 또한, 냄새 및 이염 방지를 위해 PDMS를 도입하여 기능성 세라믹 나노복합체를 제조하였다. 제조된 복합체의 특성은 FE-SEM, TEM, FT-IR로 분석하였고 PDMS와의 결합은 TGA로 측정하였다.

1PS-295 김희상

Preparation and Optical Properties of Charge Transfer Type Dye-dispersed Fluorescent Polyimide Films

김희상, 곽기섭† 경북대학교

Polyimide films have been developed for a variety of uses in many industries due to their high heat resistance and excelling mechanical durability. In general, however, polyimide films have a dark yellow color due to an intrinsic charge transfer characteristic, resulting in little fluorescence by itself. For the purpose of developing a signal output film for automotive interior sensor, we manufactured a fluorescent polymer film that charge transfer dyes are dispersed in a transparent polyimide and

examined fluorescence emission properties. We first prepared a transparent polyimide varnish using a chemical imidization method, and then dispersed charge transfer type dyes to prepare fluorescent polyimide films. The imidization and transmittance were confirmed by infrared spectroscopy and ultraviolet visible spectroscopy, respectively, and quantum efficiency and photooxidative stability were examined using an optical microscope equipped with a photoluminescence spectrophotometer.

1PS-297 김혜진

Synthesis of ABA-type Block Copolymers with Highly Enhanced Self-healing Ability

김혜진, 박희정, 홍성우[1], 이동현† 단국대학교; [1]한국생산기술연구원

Herein, we introduce highly self-healable ABA-type block copolymers by chemical reaction of poly(2-(N-phthalimido) ethyl methacrylate) (PNPEMA) and polyurethane (PU). The 2-hydroxyethyl phthalimide is reacted with methacryloyl chloride in the presence of triethylamine to from the 2-(N-Phthalimido) ethyl methacrylate (NPEMA). Subsequently, RAFT polymerization of the NPEMA previously synthesized is performed at 70 ℃ for 5 hours. Then, by using H_2O_2. The dithiobenzoate end-groups of PNPEMA are substituted with hydroxyl groups. Polyurethanes with isocyanate groups at both chain ends are synthesized via condensation reaction using ethylene glycol and isophorone diisocyanate (IPDI). Finally, ABA-type block copolymers are synthesized by reaction between end-groups of PNPEMAs and PUs. The triblock copolymers are characterized by using GPC and NMR. In addition, the self-healing properties of the block copolymers are characterized by using DMA and DSC experiments.

1PS-299 김혜지

Fabrication of Polymer Particles with Controllable and Sophisticated Structures for High Immobilization of Noble-metal Nanoparticles

김혜지, 현동춘†, 안형주[1], 문건대[2], 박주향, 서호준, 김다인, 홍상기 경북대학교; [1]포항가속기연구소; [2]한국생산기술연구원

This research introduces the fabrication of cationic polymer particles with controllable and sophisticated structures for the high immobilization of noble-metal nanoparticles (NPs). The manipulation includes the use of a cationic extra monomer to synthesize solid spheres polystyrene (PS) with cationic character, followed by their transformation into complex-structured particles via the phase separation route in a seeded dispersion polymerization. Control of the phase separation enable us to obtain PS particles with cage-and bowl-like shapes as well as hollow structures. The large surface areas of the complex-structured particles, as theoretically calculated using simple models, and the electrostatic attraction between them and the negatively charged noble-metal NPs, as experimentally observed, enable the high immobilization of noble-metal NPs onto their surfaces.

1PS-301 김혜지

Microporous Organic Polymers: A Synthetic Platform for Atomic-Level Engineering of Heterogeneous Carbocatalysts

김혜지, 김형우† 전남대학교

Heteroatom dopants in carbon materials allow enhanced catalytic activities, which are essential to open up new applications of carbocatalysts. In this presentation, we present bottom-up design of functional carbon materials using microporous organic polymers that provide thermal stability and synthetic flexibility; thus, sequential heat treatment caused elemental engineering of carbonaceous materials without the need for additives or extra processes. The carbonized materials were found to contain heteroatom dopants originated from the carbon precursors as designed, and to show superior catalytic behavior. As an example, the sulfur atoms could provide reactive sites when doped, which thus imparted the carbonized materials with enhanced performance in hydrogen evolution reactions when compared with un-doped materials.

1PS-303 김혜선

Array of Gold Nanoelectrodes from Nanoporous Block Copolymer Films for Electrochemical Sensing

김혜선, 이동익, 김승현† 인하대학교

Nanoelectrode and its array in electrochemical applications can provide greater advantages compared with its corresponding planar or micro-electrodes due to the enhanced mass transport by the dominance of radial diffusion. As a sensor, both sensitivity and selectivity can be improved in nanoelectrodes to yield enhanced nanoscale electrochemical measurement. The fabrication of nanoelectrode arrays has attracted increasing attention, and has been done by applying various techniques. In this work, we seek to fabricate the nanoporous membranes from the self-assembly of block copolymers (BCPs) and make full use of nanoelectrodes for electrochemical dopamine sensing. The morphologies of the membranes were characterized by AFM and SEM, and the electrochemical analysis of nanoelectrodes from nanoporous membranes were done by cyclic voltammetry measurements. Electrochemical techniques in terms of BCP thin films offer simplicity, rapidity, relative low-cost and high-sensitivity.

1PS-305 김현준

Tuning the Properties of Ionic Elastomer by Molecular Enigneering of Ionic Liquid

김현준, 강지형† 한국과학기술원

Ionic elastomers which composed of polymer and ionic liquid have potential applications in soft electronics, human-machine interfaces and soft robotics. This is because of the materials' special functionalities such as stretchability, self-healing, high ionic conductivity and electrical frequency responses. However, there are some trade-offs among the properties. To compensate these weaknesses, we designed molecules and analyzed diverse mechanical, electrical and checmical properties. Especially, we focused on supramolecular interactions to figure out the ionic elastomer's special funtionalities. Based on these research, we find out combinations of molecules to satisfy desired performances. Consequently, we can apply our model to diverse applications.

1PS-307 김현우

Solid-State Synthesis of Biomass-Derived Network Polyurethanes and Their Vitrimer Properties

김현우, 송창식† 성균관대학교

The demand and production of thermoplastic materials are continually increasing nowadays. The thermoplastic is hard to recycled and becomes a severe environmental issue. In this study, we use biomass-derived alcohol, which is 2,5-bis-hydroxymethylfuran (BHMF), as starting material and solid-state ball-milling synthesis with vitrimer chemistry to solving these problems. Vitrimer chemistry is using reversible dynamic covalent bonding (DCB) to thermally control the molecule bond exchange. Also, we identified the shape memory properties through DCB. We successfully synthesized the network polyurethane (NPU) using solid-state ball milling, which can rearrange the topology through transcarbamoylation of a single bond of urethane moiety. We used dilatometry for detecting topology freezing transition temperature (Tv) and dynamic mechanical analyzer (DMA) under different temperatures for identifying the vitrimer properties of NPU.

1PS-309 김현민

Fabrication of Core-shell Structured $ZnFe_2O_4$/PANI Particles and Their Suspension Dual Response under Electromagnetic Field

김현민, 최형진† 인하대학교

이 논문은 무기입자,징크 페라이트 를 간단한 합성방법으로 합성하고 전도성 고분자, 폴리아닐린 를 코팅하여 코어-쉘 형태의 구형 입자를 성공적으로 합성하였다. 코어입자가 사이즈분포를 가짐에 따라 코팅한 입자 또한 사이즈 분포를 갖는 구 입자로 나타났다. 합성된 입자를 절연성을 띠는 분산매, 실리콘 오일에 5vol%로 동일하게 분산시켜서 전자기 반응성을 분석하였다. 무기입자로부터 갖게 되는 자기적 특성과 전도성 고분자로부터 갖게 되는 전기적 특성을 연구하였다. 입자가 분산된 유체는 전기장 혹은 자기장을 가하지 않았을 때 액체상태로 존재했다. 전기장 또는 자기장 필드를 가함에 따라 입자가 사슬을 형성한 것을 확인하였다. 이 유체는 다양한 세기의 전기 및 자기장을 가함에 따라 순차적으로 필드에 대해 응답하였다.

1PS-311 김현구

폴리올레핀 기반 자성 흡유제를 이용한 기름 유출 회복 방안

김현구, 박세진, 엄준혁, 남창우† 전북대학교

해상에 기름 유출 발생 시 사용되는 흡착제는 기름 제거 성능이 우수하며, 다른 방제 방법들에 비해 쉽게 사용이 가능하다. 하지만, 기존 흡착제는 소규모 기름 유출 방제에만 적합하며, 회수 후 재활용이 어려운 문제점이 있다. 이에 반해 폴리올레핀 기반 흡유제는 흡유 성능이 우수할 뿐만 아니라, 완전 재활용이 가능하다는 장점을 가지고 있다. 하지만, 기계적인 방법 없이 회수 하기가 쉽지 않다. 따라서, 본 연구에서는 기존의 폴리올레핀계 흡유제에 나노자성입자를 담지하여 기계적 방법 없이도 쉽게 회수 가능한 형태의 흡유제를 제조하였다. 소수성기가 기능화 된 산화철 나노 입자를 폴리올레핀계 고분자에 분산시켜 담지 하였다. 제작된 폴리올레핀 기반 자성 표면 구조 및 나노 입자 농도에 따른 자성을 관찰하였으며, 흡유 성능과 나노 입자 농도 간의 상관 관계를 분석하여 최적의 제조 조건을 도출하였다. 이러한 나노자성입자가 담지 된 흡유제는 기름 유출에 대응하여 빠르게 방제할 수 있을 뿐만 아니라, 기계적 방법에 비해 쉽고 빠르게 누출된 기름을 회수할 수 있을 것으로 판단된다.

1PS-313 김한영

Preparation of Silver Nanowire-SBR Composite Conductive Materials Using a Cross-linkable Multifunctional Dispersant

김한영, 권민호, 박용해[1], 백현종† 부산대학교; [1]공주대학교

In stretchable conductive device field, silver nanowire (AgNWs) based rubber composites in particularly have attracted lot of interests. However, the two major challenges associated AgNWs are its poor dispersibility in hydrophobic solvents and polymer matrix, and poor stability of the electrical conductivity of the composite materials under repeated stretching and releasing cycles. In this study, we report a multifunctional polymer to improve the dispersion of AgNWs and thereof the fabrication of styrene butadiene rubber (SBR) composites using the modified AgNWs. In the polymer dispersant, disulfide groups interact with AgNWs (Ag-S bond) while azide groups react with double bonds of SBR through formation of the nitrenes. The modified AgNWs could be dispersed at high concentrations in hydrophobic solvent and mixed easily with SBR and its composite has low electrical resistance.

1PS-315 김태형

Determination of the Hydrogenation State of Benzene by the Thermally Induced Phase Separation of Poly(ethersulfone)s

김태형, 여병욱, 이진희, 박제영, 김상율† KAIST

The thermally induced phase separation of poly(ethersulfone) (PES) in organic solvents is applied as a sensor in detecting the hydrogenation state of benzene. As a non-solvent of PES, the addition of benzene and its reduction products lowers the clouding point temperature (Tcp) of the polymer solution. The Tcp decreases as the number of π electrons decreases, and a linear correlation between the temperature and concentration is obtained. The Tcp of the polymer solution changes quite sensitively even with the addition of a small amount of analyte. In addition, the Tcp

of the mixed system can be predicted according to the proportion of components, and the calculated results are found to be in good agreement with the experimental results.

1PS-319 김태용

Highly Transparent Polymeric Film Based on Colorless Fluorinated Polyimide with Excellent Mechanical Properties for Flexible Displays

김태용, 이예진, 문경민, 고민재[†], 홍성우[†] 한국생산기술연구원; [1]한양대학교

A novel colorless fluorinated polyimide (CfPI) is synthesized and its optical and mechanical properties are characterized in this study. To prepare CfPI, a diamino-terminated oligomer based on amide group and armic acid group (OAA) is synthesized using trimellitic anhydride chloride and OAA is then reacted with 3,3',4,4'-biphenyltetracarboxylic dianhydride (BPDA) and 4,4'-(hexafluoroisopropylidene) diphthalic anhydride (6FDA). As a reference, 2,2'-bis(trifluoromethyl)-[1,1'-biphenyl]-4,4'-diamine (TFDB), BPDA, and 6FDA are polymerized to prepare conventional colorless fluorinated polyimide (cCfPI). Interestingly, the polymeric film based on CfPI exhibits more outstanding optical and mechanical properties than that based of cCfPI. This is ascribed to the unique formation of charge transfer complex (CTC) of CfPI.

포스터 발표 (II)

의료용 고분자 부문위원회

2PS-1 황진영

***In Situ* Crosslinked Chitosan/Poly (ethylene Glycol) Hybrid Hydrogel with Controllable Physicochemical Properties**

황진영, 정하영, 박기동[†], Le Thi Phuong, 황보경희[†], 배진우[†] 아주대학교; [1](주)제노스

Chitosan has been widely used as biomaterials due to versatile properties. However, the inherent brittle properties are still hard to control. To overcome these, PEG has been used for flexible mechanical properties. Although the incorporation of PEG into chitosan has been developed, studies on various parameters of PEG have not been conducted. In this study, we prepared injectable chitosan/PEG hybrid hydrogels using enzyme mediated cross-linking. Physicochemical properties of hydrogel were investigated by varying the parameters of PEG (e.g. content, M.W., geometry). The hydrogels were fully characterized and cyto-compatible. It was found that the various parameters of PEG in hybrid hydrogels could control their physicochemical characteristics. In conclusion, chitosan/PEG hybrid hydrogels with tunable physicochemical properties are expected to be a promising biomaterial for various applications. Acknowledgement: [MOTIE/KEIT] 10062079, 2019R1A6A1A11051471.

2PS-2 황원태

S-Nitrosoglutathione-Releasing Mineralized Nanoparticles Enhance Anticancer Activities of Arsenite by Reversing Drug Resistance

황원태, 이상천[†], 정서영, 이경태, 민경현[2], 이홍재[†] 경희대학교 나노의약생명과학과; [1]경희대학교 치과대학; [2]전북대학교 약학과

Multidrug resistance (MDR) is one of the biggest obstacles for successful therapy of cancers. Thus, overcoming drug resistance is a major challenge for cancer therapy. Of various mechanisms of resistance in tumor cells, we focus on MDR by overexpression of glutathione s-transferases (GSTs). If it is possible to suppress GSTs of MDR cancer cells, drug resistance would be reduced, and therapeutic efficacy of delivered drugs would increase. Herein, we propose a novel strategy to overcome resistance to arsenite by designing mineralized intracellular nanocarriers that simultaneously release a GST inhibitor (S-nitrosoglutathione (GSNO)) and arsenite. In acidic endosomal compartments (~pH 5.0), the mineral phase of the nanoparticles dissolved to release GSNO, which inactivated GSTs, thereby increasing cellular accumulation of apoptotic arsenite. Our mineralized nanoparticles may serve as an efficacious anticancer agent in terms of tumor resistance and selectivity.

2PS-3 황용화

Oral GLP1 Gene Delivery by Bile Acid Based Non Viral Gene Delivery Carrier to Treat Type II Diabetes Mellitus

황용화, 김민준, 오정주, 이승아, 이용규[†] 케이비바이오메드

Genetic therapy is a treatment technique that delivers the target gene based on genetic manipulation which directly delivers the carrier containing the patient's required gene. The concept of oral gene therapy has already been proven, but non-viral gene delivery through gastrointestinal track is experiencing many difficulties due to low gene expression. There are also difficulties in effectively controlling intestinal enzymes and microbes and decomposition by digestive fluids. However, the active transport system by bile acid has the ability to pass through intestinal epithelial cells, which can solve the problem of absorption efficiency such as above because the intestinal epithelial cells have bile acid receptors. We have newly fabricated the oral gene delivery carrier, which promotes absorption into the small intestine by making the gene core using cationic material and calcium salts and coating with an anionic substance which synthesized with chondroitin sulfate A and bile acid.

2PS-4 최주환

Surface Modification of Silicon Implant and Effect of Nanopattern on Fibrosis Suppression

최주환, 이화정, 함정우, 고원건[†] 연세대학교

Implantable silicone medical devices exhibit a fibrous encapsulation by a foreign body response in the implanted body, which results in loss of function or side effects to patients. To suppress the fibrosis, surface modification of breast implants can be applied, one of which is nanopatterned on the implant surface. However, to achieve nanopatterned silicone implants, it is necessary to make a nano-sized mold, which is expensive to manufacture a nano-sized mold. To overcome these shortcomings, nanopatterned breast implants were fabricated using an easy-to-use electrospinning technique and modified imprinting techniques. Also, it has the advantage of non-toxicity by only modifying the physical surface of the breast implant. In addition, nanopatterned breast implants can inhibit the adhesion and activation of fibroblasts and macrophage cells, resulting in the inhibition of fibrosis.

2PS-5 최정연

Healing Effect of Oxygen-releasing Biomaterials for Wound Model

최정연[†], 홍경식[†], 임정옥[†] 한국생산기술연구원; [1]경북대학교

In this study, we developed sustained oxygen-releasing polymeric microspheres and fabricated a sponge type by embedding the microspheres into alginate-based hydrogel that can supply oxygen to wound. Biocompatibility was performed using cell counting kit-8. The oxygen release kinetic study was performed using a hydrogen peroxide assay kit, SOD kit and oxygen meter. In vivo studies were carried out to investigate the safety and efficacy of the oxygen released hybrid scaffods for wound healing. As a result, the hybrid scaffolds demonstrated sustained release of oxygen for seven days in a physiologically favorable range, biocompatibility with HaCaT cells. Furthermore, Oxygen generating hybrid sponge appeared to delay the wound healing. And this may occur through the interference with re-epithelialization, wound contraciton and wound healed. Consequently, this newly manufactured hybrid footplate has great potential as a wound healing material for unique properties.

2PS-6 최연정

Three-dimensional Double-layered Hydrogel Based Stem Cell Co-culture System for Enhanced Cardiovascular Tissue Regeneration

최연정, 국윤민[†], 김영환[2], 임광범[2], 방석호[2], 이강원[†] 서울대학교; [1]한국과학기술연구원; [2]성균관대학교

Stem cell-based co-culture model in 3D scaffold is a promising technology for tissue regeneration. However, the cell-laden efficiency and the immune reaction effect remains as a challenge. We fabricated the multiscale alginate coated fibrin hydrogel incorporating polycaprolactone fibers can enhance the vascular tissue formation with co-culture system and reduce immune reaction by the double-layer system. Triple co-culture of ADSCs, endothelial cells, and C2C12 for cardiovascular tissue regeneration demonstrated that new blood vessel formation and cardiomyogenic differentiation of ADSCs were promoted. Further, the co-culture of ADSCs and endothelial cells without C2C12 in the multiscale hydrogel system also enhanced the angiogenesis efficiency which has the potency to be used in other vascular tissue regeneration. We expect the co-culture multiscale hydrogel system can be applied to the remodeling of several vascular tissues as well as cardiovascular tissue.

2PS-7 최수임

Enhanced Cellular Uptake of Surface-Functionalized Polymer Nanoparticles

최수임, 이근용[†] 한양대학교

Functional polymer nanoparticles have been widely exploited for the treatment of various diseases, including obesity. In this study, we hypothesized that the adipocyte uptake of polymeric nanoparticles could be enhanced using cell-penetrating peptide (CPP). Poly(lactic-*co*-glycolic acid) (PLGA) nanoparticles containing calcium carbonate were fabricated by the double emulsion method as gas-generating polymer nanoparticles, and cell-penetrating peptide (CPP) was then covalently coupled to the surface of the nanoparticles via carbodiimide chemistry. Various characteristics of PLGA nanoparticles, including size, size distribution, loading content of calcium carbonate, cytotoxicity, and intracellular uptake were investigated *in vitro*. This approach of CPP-mediated delivery of functional polymer nanoparticles may be useful in many therapeutic applications.

2PS-8 최민규

Design of Biodegradable Iodinated Polymeric Nanoparticle as CT Contrast Agents

최민규, 안철희[†] 서울대학교

Computed Tomography (CT) is a widely used imaging technique for ischemic stroke with high penetration depth, fine resolution, and short operation time. While conventional molecular CT contrast agents can locate the blocked blood vessel, it is impossible to know the exact size and shape of the clot. Nanoparticle-based contrast agents have shown the possibility of expressing the size and shape, still toxicity of accumulated nanoparticles was unknown. Therefore, we suggest a polymeric nanoparticle as biodegradable CT contrast agents. A water-soluble iodinated monomer was used with a biodegradable linker and degradation products were biocompatible. Imaging was successful showing not only the location but size

and shape of the clot as well, even for a partially blocked blood vessel. In conclusion, we expect the polymeric nanoparticles work as biodegradable CT contrast agents capable of imaging the clot with exact size and shape.

2PS-9 주혜연

Polymeric Sonosensitizer Nanoparticles for *in situ* Cancer Vaccination

주혜연, 엄우람, 고혜원, 박재형† 성균관대학교

Sonodynamic therapy (SDT) is an emerging cancer treatment that utilizes cytotoxic reactive oxygen species (ROS) for eradicating tumors and elicits antitumor immunity via immunogenic cell death. Despite these prominent intrinsic, *in vivo* applications of SDT has been restricted, owing to poor bioavailability of sonosensitizers. Here, we develop biocompatible sonosensitizer nanoparticles (SNPs) that can generate ROS in the presence of US. SNPs were composed of carboxymethyl dextran and chlorin e6 to prepare self-assembled polymeric nanoparticles, and polyethylene glycol was additionally attached to improve *in vivo* stability. In cell experiments, SNPs showed considerable cytotoxic effect through SDT, and SDT-treated cells induced maturation of bone-marrow-derived dendritic cells by releasing pro-inflammatory molecules and tumor-associated antigens. Further, SNPs-mediated SDT showed *in vivo* therapeutic efficacy on metastatic tumors when it applied with anti-PD-L1 immune checkpoint blockade.

2PS-10 조진환

The Hybrid Hydrogel for Sustained Release and Extended Half-life: Albumin Affibody-Conjugated Injectable Gel with Albumin-Conjugated Urate Oxidase for the Treatment of Hyperuricemia

조진환, 권인찬[1,†] 광주과학기술원; [1]광주과학기술원 신소재공학부

The short half-life of therapeutic proteins is usually a bottleneck for their clinical application. Injectable hydrogels have been used as depots for the controlled release of therapeutic proteins. However, the native interactions between therapeutic protein and hydrogel are often not sufficient to achieve extended release of the therapeutic protein. Herein, we investigated whether a pair of HSA and its very strong ligand, albumin-binding peptide (ABP), can be used to achieve substantially extended release of therapeutic protein from injectable hydrogel. HSA was conjugated to a therapeutic protein. The ABP was conjugated to pH- and temperature-sensitive poly(ethylene glycol)-poly(β-amino ester urethane) (PEG-PAEU) copolymer. As a result, the serum activity half-life of the Uox-HSA conjugate loaded in the ABP-modified PEG-PAEU hydrogels was 96 h, which was much longer than those of free native Uox, free Uox-HSA, and Uox-HSA conjugate loaded in the unmodified PEG-PAEU hydrogels.

2PS-11 정혜연

Tuning Surface Functionalities of Sub-10 nm-Sized Nanocarriers to Target Outer Retina in Designing Intravitreal Drug Delivery Agents for Age-Related Macular Degeneration

정혜연, 김보람, 김윤경† 한국생명공학연구원

Age-related macular degeneration (AMD) is one of the leading causes of irreversible blindness, generally affecting people over 50 years of age in industrialized countries. Unfortunately, the anti-vascular endothelial growth factor therapy for AMD rarely showed substantial visual improvements and may result in serious side effects. Combination therapies with a prolonged therapeutic effect and efficient delivery to the intended site are needed, which could be realized through the use of carefully designed nanocarriers. To understand the physicochemical effects of intravitreally administered nanocarriers on their bioavailability, distribution, and targeting efficiency across multiple retinal layers, here we prepared seven different types of surface-functionalized water-soluble dendritic nanocarriers and performed systematic studies. Our findings may provide useful guidelines for the rational design of intravitreal nanocarriers to treat vision-threatening retinal diseases, including AMD.

2PS-12 정인재

Ultrasound-Mediated Enhanced Drug Delivery and Targeted Imaging by Using Microbubble-Self-Aggregate Complex

정인재, 문형원[1], 이학중[1], 안철희† Research Institute of Advanced Materials (RIAM), Department of Materials Science and Engineering, College of Engineering, Seoul National University; [1]Department of Radiology, Seoul National University, College of Medicine and Seoul National University Bundang Hospital

Microbubbles play a role not only ultrasound contrast agent for use molecular imaging but ultrasound mediated drug delivery carrier. Microbubble able to deliver the drug by conjugation of drug delivery carriers like liposome or nanoparticles. Under the intensive ultrasound, microbubble undergoes collapse and release conjugated nanoparticles. Destruction of microbubble produces strong mechanical stress called microjets, it can partially damage blood vessel so a selective increase of permeability is possible. By using this technique, selective expose of ultrasound to target area make a targeted drug delivery. In this study, hydrophobic drug loaded self-assembled nanostructure was chemically conjugated to microbubble. Microbubble and self-assembled nanostructure size distribution were analyzed with dynamic laser scattering (DLS), conjugation ration of microbubble and micelle were examined by UV-vis spectroscopy.

2PS-13 정우엽

Transdermal Delivery of Up-conversion Dye Using HA-based Nanoparticles

정우엽, 박정민, 최혜은, 이도혜, 김재혁, 김기수† 부산대학교

In photomedicine, visible light is used for various applications as is well known. When visible light is irradiated on the skin, the shorter the wavelength of light, the less penetrating. Thus, blue light with the shortest wavelength has limitations in its medical application despite having high energy. In this work, we prepared hyaluronic acid (HA) based nanocarriers for transdermal delivery of up-conversion (UC) dye as light source, which can convert the irradiated light into a shorter wavelength light, and confirmed a blue light emission in the skin. By UC analysis, UC dye loaded NPs emitted stably blue light, and further analysis in porcine skin tissue dispersant showed the applicability of our NPs in skin tissue. In addition, the skin permeation test showed the permeability of the NPs through the variation of blue light intensity in skin cross-section. With these results, our HA-based NPs are suitable for transdermal delivery of UC dye and can be effective phototherapy platform.

2PS-14 정상훈

Supramolecular Injectable Hyaluronate Hydrogels for Cartilage Tissue Regeneration

정상훈, 한세광† 포항공과대학교

Mesenchymal stem cells (MSCs) have been widely investigated to repair damaged cartilage tissues for the treatment of arthritis. Despite these great efforts, the difficulty in the spatiotemporal control of delivered cells has limited the further clinical development with rapid clearance. Here, we developed injectable hyaluronate (HA) hydrogels to encapsulate MSCs for controlled cartilage tissue regeneration based on the supramolecular chemistry between β-cyclodextrin (β-CD) modified HA (HA-CD) and adamantane (Ad) modified HA (HA-Ad). The spatiotemporally controlled delivery of MSCs from the supramolecular HA hydrogels resulted in the statistically significant chondrogenic differentiation and extracellular matrix (ECM) deposition in vitro and in vivo. Taken together, supramolecular HA hydrogels might be successfully harnessed as an injectable delivery system of MSCs for cartilage tissue regeneration and other tissue engineering applications.

2PS-15 전주은

Enhancement of ROS Quantum Yield of Photosensitizer by Chemiluminescence Resonance Energy Transfer for Photodynamic Cancer Therapy

전주은, 유동길, 박재형† 성균관대학교

Chemiluminescence (CL) resonance energy transfer (CRET) based-nanoparticles (CRET-NPs) have studied for cancer imaging. The peroxalate is one of the CL energy donors in responding to H_2O_2-enriched in tumor tissue. As the CRET-NPs can deliver photosensitizer (PS) with peroxalate, which plays a role as CL energy acceptor, much effort has devoted to applying for photodynamic therapy (PDT) by its luminescence property. However, not only the power of CL is not enough to activate PS solely, but O_2-dependency of type II photochemical reaction of conventional PDT also has a limit to applying the hypoxic region of tumor tissue. Thus, it is necessary to develop strategies to enhance ROS quantum yield in an O_2-independent manner for cancer PDT. Herein, we report CRET-NPs to achieve quantum yield-enhanced PS through both electron transfer for an O_2-independent type I photochemical reaction and CL for an O_2-dependent type II photochemical reaction in responding to tumor-microenvironment.

2PS-16 전성익

Biodegradable Polymer-based Radiopaque Micropaticles for Transarterial Chemoembolization

전성익, 제환준[1], 안철희† Research Institute of Advanced Materials (RIAM), Department of Materials Science and Engineering, College of Engineering, Seoul National University; [1]Department of Radiology, Seoul National University College of Medicine, Institute of Radiation Medicine, Seoul National University Medical Research Center, Clinical Research Institute, Seoul National University Hospital

Transarterial Embolization (TAE) is one of the therapeutic methods for hepatocellular carcinoma (HCC), blocking blood vessel in tumor with embolic materials. Conventional embolic beads, however, are usually non-biodegradable and have no x-ray visibility, which cause risk of medical malpractice and difficulty in repetitive injection. Therefore, it is essential to develop advanced embolic bead with biodegradability and radiopacity itself. In this research, well-calibrated microparticles (MPs) were formed. Diameter and size distribution of the final product were analyzed with optical microscope. The x-ray visibility was determined with real-time C-arm device. The diameter of MPs was about several hundred micrometers, and it showed narrow size distribution. MPs were determined to have enough x-ray attenuation property to be visualized with C-arm device. In conclusion, we confirmed the potential of these biodegradable polymeric MPs to be applied to cancer therapy.

2PS-17 임철원

Bone Cancer Targeting Nano-aggregates Prepared from the Self-assembled Polyaspartamide Graft Copolymers for pH Sensitive DOX Delivery

임철원, 김덕준† 성균관대학교

Nanoparticles with bone targeting ability and pH-sensitive were prepared with polyaspartamide (PASPAM) derivatives based on polysuccinimide (PSI) grafted with octadecylamine (C_{18}), hydrazine (HYD) and polyethylene glycol (PEG). For the bone targeting, alendronate (ALN) which has bone affinity was grafted to PEG and doxorubicin (DOX) was conjugated with linkers of hydrazone bond which can be cleaved most effectively in an acidic environment. Under pH 5.0, ~75% of dox was released from the nanoparticles due to the effective cleavage of HYD at the acidic condition. Also, ALN-PEG/C_{18}/HYD-DOX-g-PASPAM particles were more effectively adsorbed on the surface of bone than PEG/C_{18}/HYD-DOX-g-PASPAM. From in vivo antitumor activity test, the volume of tumor treated with ALN-PEG/C_{18}/HYD-DOX-g-PASPAM was decreased (1550 nm^3) when compared with PBS control sample (3850 nm^3), proving ALN-PEG/C_{18}/HYD-DOX-g-PASPAM as effective drug delivery system

for the treatment of bone metastasis of breast cancer.

2PS-18 임용근

Calcium-binding Near-infrared Fluorescent Nanoprobe for Bone Tissue Imaging

임용근, 김현정[1], 김진원[1], 박경순† 중앙대학교; [1]고려대학교 구로병원

We report a self-assembled calcium-binding nanoprobe which emits a near-infrared fluorescence (NIRF) signal. We have designed a calcium-binding NIRF nanoprobe by chemically coupling alendronate (ALN), a specific targeting ligand, and NIRF-emitting Cy5.5-labeled dibenzocyclooctyne, to the two respective ends of azide-polyethylene glycol-NHS ester. Prepared ALN-PEG-Cy5.5 forms the self-assembled nanostructures and has high affinity for calcium phosphates-containing bone minerals. In addition, ALN-PEG-Cy5.5 can be employed to visualize intracellular calcium ion levels in vitro as well as normal bone tissues in vivo. These results suggest that our calcium-binding NIRF nanoprobe has a promising potential for calcium imaging in vitro and in vivo.

2PS-19 임도현

폴리비닐알콜 나노섬유 내부에서의 산화질소방출 나노 입자 분포 연구

임도현, 곽영우, 남창우† 전북대학교

전기방사된 폴리비닐알콜(PVA)기반 나노섬유는 기계적 특성과 표면적이 우수하여 약물이나 치료가스의 매개체로 의료분야에서 사용되고있다. 특히, 산화질소(nitric oxide) 방출용 나노 입자가 포함된 나노섬유는 산화질소 담지 성능이 우수하고, 용도에 맞게 치료 가스 방출을 조절할 수 있다. 하지만 나노 입자를 나노섬유에 균일하게 분산하기 어렵기 때문에 치료 가스 방출량 예측 및 조절이 어려운 문제가 있다. 따라서, 본 연구에서는 나노 입자의 균일 분산을 위해 산화질소를 방출하는 실리카 나노 입자와 PVA의 비율을 조절한 후 전기방사하여 목걸이 형태의 섬유를 제조하였다. 이를 Polycaprolactone (PCL) 용액으로 딥코팅하여 나노 입자가 섬유로부터 떨어지는 것을 방지하였다. 목걸이 형태의 나노섬유 구조를 통해 입자 분산을 고르게 하였고, 이는 일정하고 지속적인 산화질소 방출이 가능해져, 피부 상처 치료에 효과적으로 적용될 수 있을 것으로 판단된다.

2PS-20 이혜원

Adipocyte-targeting Gas-generating Poly(lactic-*co*-glycolic acid) Nanoparticles

한영경, 이혜원, 이근용† 한양대학교

Polymeric nanoparticles have been widely utilized as multifunctional drug delivery systems for the treatment of various diseases, including obesity. Poly(lactic-*co*-glycolic acid) (PLGA) nanoparticles containing calcium carbonate were fabricated by the double emulsion method as gas-generating polymer nanoparticles, and the surface of the nanoparticles were modified with a peptide containing the adipocyte-targeting sequence. Various characteristics of the PLGA nanoparticles, including size, morphology, cytotoxicity, and cellular uptake were investigated *in vitro*. Therapeutic efficacy of the nanoparticles was also evaluated using a high-fat diet induced obese mouse model. Adipocyte-targeting, carbon dioxide-generating PLGA nanoparticles showed a great potential for reduction of adipose tissue *in vivo*.

2PS-21 이혜영

Fabrication and Evaluation of in situ Biodegradable Pullulan Hydrogels as an Injectable Hemostatic Agent

이혜영, 곽동민, 김현서, 이승욱[1], 권오형† 금오공과대학교; [1]VISION SCIENCE CO., LTD.

Injectable, biodegradable pullulan hydrogels offer multiple attractive benefits. In this study, the enzyme-mediated injectable pullulan hydrogels containing human plasma components like thrombin were fabricated to use as a hydrogel type hemostatic agent. Its hydrogel has many advantages such as biocompatibility, flexibility, and blood coagulability. The modified pullulan was characterized by ATR-FTIR, ^{13}C NMR and ^{1}H NMR to confirm introduction of tyramines. Gelation, rheological properties were decided as a function of concentration of horseradish peroxidase and pullulan solutions. The *in vivo* animal testing showed that the modified hydrogel considerably reduced clotting time compared to the unmodified hydrogel. The modified pullulan hydrogel containing blood coagulation agents has adjusted gelation time, biodegradability, hemostatic ability as an effective hemostatic agent of massive blood flow through blood vessels or body parts.

2PS-22 이지나

Catechol-modified Poly(allylamine) Hydrogels with Self-healing and Adhesive Properties

이지나, 이수연, 박원호† 충남대학교

폴리알릴아민은 양이온성을 띠는 수용성 합성고분자의 일종으로, 물리적 성질이 우수하여 제지 및 코팅 분야에 주로 사용되고 있다. 자가치유형 수화젤은 외력에 의해 손상된 계면에서 가교의 가역적 형성으로 인하여 초기 구조와 기능을 회복할 수 있는 수화젤로서, 이온결합과 같은 물리적 결합이나 Schiff base와 같은 화학적 결합에 의해 제조될 수 있다. 따라서, 본 연구에서는 우수한 접착특성을 가지는 카테콜기를 폴리알릴아민 고분자에 도입하였고 Schiff base 형성 반응을 위해 pH 조건을 변화시켜 자가치유형 수화젤을 제조한 후, 이에 따른 유변학적 특성을 분석하였다. 또한, 젤화시간을 줄이고 기계적인 성질을 향상시키고자 라포나이트를 첨가하여 라포나이트의 함량에 따른 수화젤의 기계적 성질 및 자가치유 특성을 검토하였다. 최종적으로, 조직접착력의 측정을 통해 습윤환경에서도 우수한 접착력을 갖는 수화젤을 제조하였으며, 의료용 조직접착제로서의 적용 가능성에 대하여 살펴보았다.

2PS-23 이주화

Optimization of the Preparation Parameters of Escitalopram Loaded PLA/PLGA Microspheres for Sustained Release

이주화, 김혜민, 김보연[1], 신병철[1], 박정숙[2,†] 충남대학교/한국화학연구원; [1]한국화학연구원; [2]충남대학교

We developed escitalopram loaded Poly(D,L-lactide) (PLA)/Poly(D,L-lactide-co-glycolide) (PLGA) microspehres for sustained release of escitalopram (ET). ET is a selective serotonin reuptake inhibitor used to treat major depressive disorder (MDD). In the previous study, 1-hydroxy-2-naphtoic acid was added to solve the problem caused by phase separation between ET and polymer. The purpose of this study is optimization of ET loaded PLA/PLGA microsphere formulation (solvent volume, polymer composition and initial drug loading). The microspheres were prepared by O/W(Oil in water) solvent evaporation method, and were characterized using SEM, HPLC, Optical microscope, DSC and in vitro release test. ETM-3 (solvent volume 1.0 mL, ratio of lactic acid and glycolic acid in polymer 75:25) showed high encapsulation efficiency and sustained release behavior. From the results, ET loaded microspheres are expected to be suitable for deliver ET and the treatment of MDD over long periods.

2PS-24 이정진

Development of Enhanced Cancer Theranostics Based on Perfluorocarbon Loaded Nanosensitizers

이정진, 이기라, 박재형† 성균관대학교

A sonodynamic therapy (SDT) has been investigated as a cancer treatment using ultrasound (US) mediated reactive oxygen species (ROS) generation. However, there is a limit to the development of clinically applied sonosensitizers due to the low ROS quantum yield. In this study, we developed a nanosensitizer (NS) with perfluorocarbon (PFC) to amplify ROS generation with bubble cavitation by US irradiation. The PFC loaded nanosensitizers (PNSs) generated a significant amount of ROS *in vitro* and *in vivo* compared to the bare NSs. As a result, PNSs have effectively inhibited the tumor growth due to cavitation-induced ROS generation under US irradiation. Furthermore, due to the vaporization of the PFC, a strong photoacoustic (PA) signal was generated up to 6h. In summary, PNSs has a great potential as a theranostic agent for cancer treatment.

2PS-25 이윤복

Fabrication of Antigen Associated Poly(lactic-co-glycolic acid) Nanoparticle for House Dust Mite Allergy

이윤복, 강예영, 공민선, 김서영, 이현종†, 이예린 가천대학교

Allergic diseases are growing health concern, and immunotherapy for certain allergens is considered the only fundamental treatment for allergic diseases. The most widespread immunotherapy is a long period of dose escalation with a soluble antigen. Thus, a safer and efficient method is required to enhance the treatment of allergic diseases. In this study, a biodegradable poly(lactic-co-glycolic acid) (PLGA) nanoparticle associated with allergenic antigen was developed, and the house dust mites extract was used as an antigen against the house dust mite allergy. We fabricated two different types of PLGA nanoparticles. The first type was the PLGA nanoparticle coated with the antigen, and another was the PLGA nanoparticle-containing the antigen. We compared the effect of the location of the antigen on the release profile.

2PS-26 이승희

Polydimethylsiloxane(PDMS) Changes in Physical Properties of Polymer Brushes Depending on the Difference in Average Molecular Weight

이승희, 정종진[1,†] 한남대학교; [1]한남대학교 화학과

본 연구의 최종 목적은 심장세포의 박동을 matrigel을 사용하지 않고 인체와 유사하게 재현하는 것이다. 심장 세포가 박동을 원활히 하려면 주변 물질의 저항성이 작아야하며 세포가 잘 부착될 수 있어야 한다. 기존에는 matrigel이라는 물질이 사용되어왔으나 비싼 가격으로 심장 세포 배양에 큰 단점이 되고 있다. 이를 개선하기 위해 세포 주변의 물리적 저항을 줄이는 것을 목표로 고분자 브러시를 matrigel의 대체 물질로 선택하였다. 상대적으로 가격이 저렴한 Polydimethylsiloxane(PDMS)를 이용하여 고분자 브러시를 기판 표면에 합성하고 PDMS의 작용기, 분자량에 따른 고분자 브러시의 표면 상태 차이를 비교할 것이다. Contact angle로 표면의 친수성 정도를 파악하고 AFM을 이용하여 표면 거칠기를 파악할 것이다. 또한 Ellipsometry를 통하여 박막의 두께를 측정하고 이를 이용하여 고분자 박막의 밀도, 개별 고분자 브러시 사이의 거리를 계산할 것이다.

2PS-27 이소윤

Fabrication of Nanofibrous Patch Functionalized with Catechol for Wound Healing

이소윤, 권미나, 김기수† 부산대학교

Electrospun nanofibers are the most promising scaffolds in the field of tissue engineering due to their three-dimensional structure which is similar to the natural extracellular matrix (ECM). Thus, these have been expected for utilizing effective wound treatment. In this study, we successfully prepared the catechol functionalized nanofibrous patch using gelatin and hyaluronic acid for wound healing scaffolds. The physicochemical and mechanical properties and cell attachments were improved by increasing the content of catechol groups in the patch. Moreover, we also could confirm that the patch can reduce the bleeding from wound and accelerate the wound healing process by animal test. Consequently, it is suggested that our catechol functionalized nanofibrous patch can be used as potential candidates for wound healing and other skin.

2PS-28 이미소

chlorin-e6 Conjugated Polydopamine Capped Gold Nanoparticles for Synergy Effect by Combining PDT and PTT

이미소, Wei Mao, 이주원, 박재근, PHAM NGUYEN OANH VU, 조완호, 유혁상† 강원대학교

Photothermal(PTT)와 photodynamic therapy(PDT)를 결합시켜 시너지 효과를 내는 방법이 최근 항암치료에 많이 사용되고 있다. 본 연구에서는, 높은 생체적합성을 가지는 polydopamine(PDA)와 감광제인 chlorin-e-6(Ce6)을 지름 130 nm의 금 나노입자(AuNP)에 차례로 코팅하였다(AuNP@PDA@Ce6). 여기서 금 나노입자 위에 PDA가 코팅됨으로써 Ce6이 입자에 더 많이 붙을 수 있게 하였다. 이 나노입자의 Ce6 탑재 효율과 pH에 따른 방출 양상이 평가되었으며, 근적외선 영역의 빛(650, 808 nm) 하에서의 PDA, Ce6, AuNP의 PTT와 PDT 효과의 결합을 통해 항암효과를 입증하였다. 또한, PDA가 pH에 영향을 받기 때문에, pH가 낮아질수록 Ce6은 나노입자에서 더 많이 방출되었으며, 온도 증가와 더불어 더 많은 Ce6 방출이 세포 괴사를 유발한다는 것을 알 수 있었다.

2PS-29 이미겸

Bioreducible Polymers with Fluorinated Arginine-graft for Efficient Gene Delivery Systems

이미겸, 정소희, 김태일† 서울대학교

In this study, the effect of fluorination to arginine side chains of linear bioreducible polymers were investigated. Heptafluorobutyrated arginine functionalized poly(cystamine bisacrylamide-diaminohexane)s (FR-PCHs) were synthesized. They could form positively charged and nano-sized polyplexes with pDNA. Interestingly, highly fluorinated FR-PCHs could condense pDNA even in reducing conditions, probably due to the hydrophobic interaction of fluoroalkyl chains. FR-PCHs showed comparable transfection efficiency to PEI25k in serum-free conditions and superior efficiency to PEI25k even in serum-containing conditions, indicating the good serum-compatibility. Fluorination could increase the cellular uptake with high membrane permeability of FR-PCHs. Through cellular uptake inhibition analysis, it was suggested that endocytosis of FR-PCH polyplexes would be mediated by multiple pathways.

2PS-30 이기훈

Silk Fibroin Microspheres Prepared in Macromolecular Crowding Conditions

안혁주, 양세준, 이기훈† 서울대학교 농림생물자원학부

In intracellular environments, various macromolecules, such as protein and nucleic acid, are presented at a high concentration. In such macromolecular crowding conditions, the protein folding is more efficient than in dilute conditions. Silk protein (SF) is well known for its biocompatibility and biodegradability having potential for the drug delivery system. In this study, we prepared the silk fibroin microsphere via slow acidification by adding glucono-delta-lactone (GDL). As silk fibroin forms coacervate in poly(vinyl alcohol) (PVA) solution, the beta-sheet transition of SF occurs while maintaining coacervate, and SF microspheres were formed. The coacervates and microspheres were investigated by fluorescence microscopy and scanning electron microscopy (SEM). And for drug release characterization, UV-visible absorbance was performed.

2PS-31 윤 빈

Development of pH-responsive Polymeric Nanocarrier for Delivery of Methotrexate to Rheumatoid Arthritis

윤 빈, 전주은, 박재형† 성균관대학교

In this study, we developed hyaluronic acid (HA) and 5β-cholanic acid-based nanocarriers (HA-NCs) loaded with methotrexate (MTX) for the treatment of rheumatoid arthritis (RA). The HA-NCs are composed of HA for targeting the CD44-overexpressed inflamed synovial environment. Furthermore, HA-NCs have ketal linkage which can be broken down in response to mildly acidic conditions of RA. In in vitro study, we confirmed the MTX released from MTX-HA-NCs when exposed to acidic conditions. Also, MTX-free HA-NCs did not have cytotoxicity to RAW 264.7 cell. In in vivo biodistribution, when Cy5.5-labeled HA-NCs was systemically administered to collagen-induced arthritis mice, the HA-NCs were accumulated in RA lesion by receptor-mediated endocytosis. This biocompatible polymeric NCs have potential as a drug carrier that selectively releases MTX to diseased sites by pH-responsiveness.

2PS-32 안주영

Development and Characterization of Propolis Extract, Camellia Oil Extract, Oil Soluble Licorice Extract Encapsulated Polymeric Micelle Nanoparticle Material

안주영, 조선행[1,†], 김채진[2], 박나래[3], 이은희[4] 한국화학연구원/고려대학교; [1]한국화학연구원; [2]한국화학연구원/중앙대학교; [3]한국화학연구원/충남대학교; [4]고려대학교 약학대학

Propolis extract, Camellia oil extract, and oil soluble licorice extract are difficult to be applied due to its low water solubility despite its well-known efficacy. In this study, polymeric nanomicelle material containing three extracts was prepared using biocompatible polymer. Prepared nanomicelle material was stable when stored at 40 ℃ for 3months and RT for 6 months. The particle size analysed by DLS was 17nm to 21nm. The encapsulation rate of propolis and glabridin analyzed by HPLC were 99.49% and 98.93% each. Total skin permeability after 24 hours was 8.67% for the control group and 18.87% for the polymeric nano micelle material group. Tyrosinase inhibition assay, DOPA oxidation inhibition assay, melanin production test assay, hyaluronic acid test assay in the cell, synthesis of collagen and inhibition of collagenase assay were conducted and the result of nanomicelle group were higher in comparison. This study was funded by Korea Institute for Advancement of Technology(P0006163)

2PS-33 안정만

Oral Delivery of Parathyroid Hormone Using Bile Acid Transport System

안정만, 이동윤, 이용규[1,†] 한양대학교; [1]한국교통대학교

We have designed an oral formulation targeting the bile acid transport system that facilitates a large permeation of rhPTH from the intestine to target sites. In addition, the bile acid transport system possessed both active and passive transport of oral rhPTH formulations using the enterohepatic recirculating system. We have proved that various transport proteins, receptors, physicochemical, and biological factors and mechanisms are involved in this complex recycling route. To date, we have proved the advantages of the bile acid transport system to target delivery of this hormone, the biophysical and biochemical stability of our proposed system.

2PS-34 안재원

In Vitro Photodynamic Effects of Dectin-1 Receptor Targeted-photoactivatable Nanoagents on Atherogenic Cells

안재원, 김진혁, 박경순† 중앙대학교

Atherogenic cells such as macrophages and foam cells have critical roles in the initiaion and progression of atherosclerosis and have been considered an important biomarker for targeted imaging and inflammatory-disease therapy. It is known that these cells express dectin-1 receptos. Here, we prepared the specific dectin-1 receptro targetable and photoactivatable nanoagents by physical loading of chlorin e6 (Ce6) into single strand beta-glucan (Glu). Glu/Ce6 formed nano-sized particles and generate single oxygen under laser irradiation. Also, it was internalized via receptor medicated endocytosis and notably caused apoptosis of activated macrophages and foam cells under laser irradiation.

2PS-35 심재민

Injectable and Self-healing Fmoc-diphenylalanine (Fmoc-FF) Hydrogels for Sustained Drug Release

심재민, 강지선, 조연주, 윤석일† 상명대학교

Self-assembled hydrogels from Fmoc-diphenylalanine (Fmoc-FF) have potential application for drug delivery due to their biodegradability, biocompatibility, injectable and self-healing property. In this study, the hydrogels were prepared via electrostatic interaction between negative charged Fmoc-FF and positive charged glycol chitosan (GC) in physiological pH. GC has excellent advantages for biomedical applications, such as low toxicity, antibacterial, biodegradability. Doxorubicin (DOX) is an anti-tumor drug. indomethacin (IDM) as non-steroid anti-inflammatory drug has low toxicity and synergetic effect with DOX. We investigated morphology, mechanical properties and in vitro release of DOX and IDM were characterized for hydrogels as a function of composition.

2PS-36 신현민

Substrate-Independent Antibacterial Coatings by Zwitterionic L-DOPA

신현민, 조우경† 충남대학교

We synthesized a zwitterionic 3,4-dihydroxy-L-phenylalanine (L-DOPA) derivative (*ZW*-DOPA) containing both catechol and amine groups, and examined its antibacterial effect. $NaIO_4$-induced *ZW*-DOPA coatings could be formed onto various substrates, such as titanium, gold, stainless steel, and nylon. The surface coatings were characterized by ellipsometer, contact angle goniometry, atomic force microscopy, and X-ray photoelectron spectroscopy, demonstrating the successful *ZW*-DOPA coatings. Interestingly, the static water contact angles of the 11°, regardless of the initial values of uncoated substrates. Compared to controls, *ZW*-DOPA-coated substrates strongly inhibited the bacterial adhesion on surfaces, showing the antibacterial effect. Such effect would be induced the strong hydration of the ZW-DOPA coatings

2PS-37 송영준

Optimization of the Preparation and Characterization of Tannylated-Albumin Nanoagent

송영준, 정성윤, 김진혁, 박경순† 중앙대학교

We optimized the preparation of tannylated-human serum albumin (TA-HSA) nanoagents including indocyanine green (ICG) and lobeglitazone-loaded complexes by simple mixing and characterized them. We set the optimal pH at 5 and the optimal weight ratio of [TA]/[HSA] at 1.5 when considering the redispersion of the prepared suspensions in PBS (pH 7.4) and incubation at 37 ℃ for the preparation of ICG and/or Lobe-loaded TA-HSA complexes. The immobilization of methoxy polyethylene glycol (mPEG) molecules on TA-HSA-ICG complexes significantly reduces the mean and Z-average sizes of these complexes from the microscale to the nanoscale. Moreover, the use of ICG increases the drug loading efficiency when preparing mPEG-TA-HSA-ICG/Lobe.

2PS-38 송석호

The pH-Responsiveness of Metal-Phenolic Network-Coated Polymeric Nanoparticles for Targeted Cancer Therapy

송석호, 신정민, 박재형† 성균관대학교

Although polymeric nanoparticles (PNPs) have been studied extensively as a drug carrier for cancer therapy, the phenomena of so-called 'burst release' that the encapsulated drug often released out before they reach targeted loci, prevents translation to clinical application. In this study, we hypothesize that the fabrication of a pH-responsive metal-phenolic network (MPN) can make the PNPs firmly hold the drug until they reach the tumor microenvironments (TMEs). To test this, we prepare MPN-coated PNPs, which contain doxorubicin (DOX) as a model anticancer drug. In the physiological condition (pH 7.4), MPN acted as a diffusion barrier holding DOX inside PNPs. However, the disassemble of MPN led to surface exposure of PNPs in the mildly acidic condition (pH 6.5) mimicking TMEs, resulting in enhanced cellular

uptake and drug release. Therefore, MPN was found out to be an effective barrier for PNPs in a pH-responsive manner, implying their potential use in targeted cancer therapies.

2PS-39 배수빈

Dual-crosslinked Silk Fibroin Hydrogel for Regeneration of Articular Cartilage

배수빈, 박원호† 충남대학교

실크 피브로인(silk fibroin, SF)은 생체적합성, 생분해성, 산소 및 수분 투과성, 기계적 특성이 우수한 천연 단백질이다. SF는 재생과정을 통해 나노입자, 필름, 나노섬유, 하이드로젤 등 다양한 형태로 성형이 가능하지만 용매로 포름산, HFIP 등의 극성 유기용매를 사용하기 때문에 체내 적용에 어려움이 있으며 원래의 SF보다 낮은 기계적 강도를 가진다. 본 연구에서는 SF의 곁사슬에 butyl glycidyl ether(BGE)를 반응시켜 증류수에 용해가 가능한 SF 유도체를 제조하였다. SF 수화젤의 기계적 강도를 개선시키기 위해 SF 내 티로신 잔기를 활용하여 광에 의한 화학적 가교를 형성하였으며, 알코올 수용액 처리를 통해 베타시트 구조를 형성시켜 물리적 가교를 도입하였다. 따라서, 본 연구에서는 유변학적 특성이 향상된 이중가교 시스템의 관절 연골 재생을 위한 하이드로젤을 제조하였고, 그에 따른 물리/화학적 특성분석을 수행하였다.

2PS-40 박지호

Design and Synthesis of Methylene Malonate Compound for Liquid Embolic Material

박지호, 안철희† 서울대학교 재료공학과

Endovascular embolization is the occlusion of target blood vessels with embolic materials for therapeutic purposes. By blocking the abnormal and weak blood vessels, the vascular rupture and inner bleeding can be prevented. Liquid embolic materials for endovascular embolization are usually liquid state at normal conditions and solidified when they are injected into the blood vessel. Cyanoacrylate monomer is one of the most commonly used liquid embolic materials in the clinic. Methylene malonate is one of the highly reactive monomers that can be rapidly polymerized by weak bases or nucleophiles. Methylene malonate has been applied as adhesives and coating materials but it has not been studied as a liquid embolic material so far. herein, we designed and synthesized the methylene malonate monomer for liquid embolic materials. Methylene malonate is expected to be a meaningful candidate for liquid embolic material due to the rapid polymerization in blood and tunability of chemical structure.

2PS-41 박지슬

Injectable Shear-thinning Hydrogels Induced by Host-Guest Interaction as the Chemoembolization Agents

박지슬, 박기동†, 이효진, 전여진, Phuong Le Thi 아주대학교

Although various transcatheter embolic agents have been developed, they still have challenges such as injectability and migration. To overcome these, shear-thinning hydrogels *via* host-guest interaction between β-cyclodextrin (β-CD) and adamantane (Ada) have been studied, allowing injection through a syringe or catheter due to viscous flow under shear stress. Herein, we developed an injectable hydrogel composed of Tetronic-Ada (Tet-Ada) and poly(β-CD) for effective embolization and release of a hydrophobic drug, Doxorubicin (DOX). The viscosity of the hydrogel, according to the shear rate, can be controlled by varying the polymer concentrations (7.5-12.5 wt%). The cyclic deformation test showed shear-thinning and rapid recovery properties. Moreover, the sustained release of DOX (~57% in 30 days) was investigated *in vitro*. In conclusion, we expect Tet-Ada/poly(β-CD) hydrogel can be a promising embolic material. Acknowledgement: [MOTIE/KEIT] 10062079 & 2018M3A9B5021319

2PS-42 박수용

Gene Delivery and Drug Delivery Study Based on Synthesized Biodegradable and Biocompatible Polyurethane Double Emulsion Nanoparticles

박수용, 정일두[1,†] 부산대학교; [1]부산대학교 고분자공학과

In this study, gene carrier nanoparticles with minimal toxicity and high transfection efficiency were fabricated from biodegradable polymer (L-tyrosine polyurethane, LTU), which was pre-synthesized from desaminotyrosyl tyrosine hexyl ester (DTH), and polyethylene glycol (PEG) and used to evaluate their potential biological activities molecular controlled release and transfection studies in LX2, HepG2, MCF7 cells. And the second study was progressed with biodegradable polyfumarateurethane (PFU) for use as a bupivacaine delivery vehicle, synthesized using di-(2-hydroxypropyl fumarate) (DHPF), polyethylene glycol (PEG) and 1,6-hexamethylene diisocyanate (HMDI), was designed to be degradable through the hydrolysis and enzymatic degradation of the ester bonds in its polymer backbone. Using double emulsion techniques, both nanoparticles were fabricated encapsulating the drug (gene), to avoid the immune system their surface was modified with PEG.

2PS-43 박세계

Effects of Electron-beam Irradiation and Poly Ethylene Glycol (PEG) Contents on Porous Polysaccharide Based Coating for Interventional Medical Devices

박세계, 김자록, 최동윤, 이동윤[1], 유승화[2,†] 한국생산기술연구원; [1]경북대학교; [2]전북대학교

The hydrophilic polymer coating of interventional medical devices is one of the important surface treatment technologies that minimizes damage to the patient's body by increasing lubricity on the surface. Since medical grade polymers are mostly hydrophobic, they have poor adhesion with hydrophilic polymer coating layer. In this study, poly(ether block amide) (PEBAX), a thermoplastic elastomer, was coated with a O-carboxymethyl chitosan (CMC). In order to improve the interfacial adhesion, the PEBAX surface was modified with acrylic acid (AAc) by electron-beam induced graft polymerization. Based on the results of Grafting yield, IR spectrum, it was confirmed that AAc was successfully graft polymerized onto the PEBAX, thereby stably bonding the CMC layer to the substrate. Furthermore, we prepared a porous coating layer by adding PEG into the CMC coating solution. The effects of process variables on the surface hydrophilic property were investigated by measuring SEM, water contact angle.

2PS-44 박수용

Synthesis and Characterization of Thermoresponsive Hollow – Shell Polymeric Nanocapsules Based on Colloidal Silica

박수용, 정일두[1,†], 이유진[1] 부산대학교; [1]부산대학교 고분자공학과

In this study, thermoresponsive polymeric hollow-shell nanoparticles with a hole connecting the outside with the inside were synthesized from colloidal silica (CS) and poly(ethylene glycol) methyl ether-3-(triethoxysilyl)propyl isocyanate (PEGME-IPTES) as templates. PEGME-IPTES was synthesized using a 3-(triethoxysilyl) propyl isocyanate (IPTES) with poly(ethylene glycol) methyl ether (PEGME) in the presence of dibutyltin dilaurate. The nanoparticles were prepared by modified silica with 3-methacryloxypropyltrimethoxysilane (MPS) and PEGME-IPTES by the polymerization of poly(N-isopropylacrylamide) (PNIPAAm), then the silica core and PEGME-IPTES chain were removed by etching with hydrofluoric acid. Thermoresponsive polymeric hollow nanoparticles were characterized by ^{1}H NMR, ^{13}C NMR, UV-vis and FT-IR spectroscopies. The particle size distribution was also determined with DLS, TEM images.

2PS-45 박미란

Development of Glutathione Depleting Pro-oxidants for Oxidative Anticancer Therapy

박미란, 정은경, 신현빈, 이영종, 이동원† 전북대학교

Drug delivery systems play a important role to maximize the therapeutic efficacy of drugs. Cancer cells need to maintain a higher level of reactive oxygen species for metabolic and signaling aberrations and unrestrained growth. This altered redox balance makes a clear distinction between cancer cells and normal cells. In this work, we developed a B2C as a glutathione (GSH) depleting pro-oxidants by releasing quinone methide (QM) through esterase-mediated hydrolysis. So, B2C makes a higher oxidative stress than the threshold level which cancer cells can survive. High-degree of oxidative stress provoke mitochondrial disruption, activation of procaspase-3 and PARP-1, and cleavage of Bcl-2. In the animal study, intravenously injected B2C showed apoptotic cell death in tumors and greatly suppressed tumor growth. Given its cancer cell preferential toxicity and highly potent anticancer activity, B2C could be a potential candidate for oxidative anticancer therapy.

2PS-46 박도연

Micropattern-based Multichannel Nerve Conduit with Stem Cell Recruitment Ability

박도연, 김수현† 한국과학기술연구원

Guided regrowth of thousands of nerve fibers in a regenerative environment improves regeneration of peripheral nerve and spinal cord injury. Although current clinical treatments and a variety of studies exist, the development of nerve-guided conduits with desirable properties, including controllable size, hundreds of micro-channels of neural tissue-like and host stem cell recruitment, is still a challenge. In this work, micropattern-based manufacturing methods work with fixation on key materials of stem cell recruitment factors to produce hundreds of microchannels with stem cell recruitment ability and resizable nerve-guided conduits. A number of functionalized microchannels implanted in peripheral nerve damage and spinal cord injury in rats align the regrowth of nerve fibers and mobilize more host stem cells to improve functional regeneration capacity.

2PS-47 박나래

The Preparation and Evaluation of Apigenin Nanoparticles for Antioxidant

박나래, 조선행[1,†], 안주영[2], 김채진[3], 구태성, 이재휘[3], 신병철[1] 충남대학교; [1]한국화학연구원; [2]고려대학교; [3]중앙대학교

One of the flavonoids, apigenin, has a strong antioxidant efficacy. However, it is difficult to develop this material due to its low solubility. The purpose of this study is to increase the solubility by developing apigenin as micelle using biocompatibility polymers, and to evaluate stability, particle size, skin transmittance, and efficacy. Long-term stability was performed by HPLC, particle size was analyzed by ELS, and skin transmittance was performed by Franz diffusion cell for 24 hours. And proceed with an in vitro test (DCF-DA assay). As a result, apigenin nanoparticles were stable for six months, and the particle size was 20 to 80 nm, and the skin transmittance was about 3%. Antioxidant efficacy was also confirmed by in vitro test. Therefore, the apigenin nanoparticle is expected to be used as antioxidant materials that can be applied to various formulations. This research was carried out with the support of the Ministry of Science and ICT (Project No:2019-DD-RD-0164).

2PS-48 몬 달

Hypoxia Targeting Smart Nanoconstructs with Dual Photothermal Cancer Therapy and T1 MRI Imaging

몬 달, 이용규[1,†] 한국교통대학교; [1]Department of Green Bio Engineering, Korea National University of Transportation

Tumor hypoxia is an inadequate supply of oxygen surrounding solid tumors which only integrate cancer cells with therapeutic drug resistance but also facilitate conducive environments for cancer cell proliferation and metastasis. Manganese oxide (MnO_2) nanoparticles have been utilized extensively for alternating tumor hypoxia. On contrary, it enhanced generation of O_2 by MnO_2 in presence of H_2O_2 which improve

the radiation therapy efficacy and magnetic resonance imaging (MRI) as a T1 contrast agent. Here we present novel hypoxia responsive and simultaneous localized oxygen generating hybrid manganese oxide nanoconstructs (MNCs) to treat cancer. The selective interaction of MNCs with hydrogen peroxide which is vividly present in the cancer cells resulted in reducing the expression of hypoxia inducing factor 1–Alpha (HIF) in the tumor tissues.

2PS-49 나행요
Adhesive and Tough Hydrogel Based on Mussel-Inspired Copolymer
나행요, 손정선†, 최재곤 조선대학교
ydrogels are three-dimensional hydrophilic polymeric networks that can absorb a large amount of water or biological fluids. Hydrogels are attractive biomedical applications, such as drug delivery and tissue engineering. However, it is known that the fabrication of hydrogels with both adhesiveness and excellent mechanical properties is difficult. Biomimetic mussel-inspired adhesive hydrogel was shown to have promising potential as an adhesive. In this study, copolymers based on mussel inspired DOPA derivatives-PAM hydrogel was fabricated by the polymerization of acrylamide monomers at the presence of initiator and cross-linker without the assistance of external stimuli. These copolymers have various acrylate functional groups in the DOPA derivatives, which have been prepared by radical polymerization. IPN structured hydrogels with copolymers based on DOPA derivatives and PAM exhibit highly elastic properties, toughness and adhesiveness.

2PS-50 김혜민
Sustained Release Characterization of Donepezil-loaded PLGA Microspheres Addition to Glycolic Acid as a Release Retardant
김혜민, 이주화, 김보연[1], 신병철[1], 박정숙[2,†] 충남대학교/한국화학연구원; [1]한국화학연구원; [2]충남대학교
Donepezil(DP) is an esterase inhibitor and is widely used in Alzheimer's disease. Donepezil loaded Poly (D,L-lactide-co-glycolide) (PLGA) microsphere has a problem in that the drug is rapidly released at an early stage. The purpose of this study is to find the optimal conditions for the release of donepezil loaded microspheres by adding glycolic acid, one of the salts that can be used as a release retardant. PLGA microspheres were prepared using O/W emulsion solvent evaporation, and were prepared by glycolic acid molar ratio, initial drug content, and polymer type. Quantitative analysis was performed using HPLC, and morphological observation was performed using an optical microscope and SEM. Release behavior was confirmed by an in vitro test. As a result, DP75/GA(0.4)-753H showed high encapsulation efficiency and sustained release behavior. Therefore, it is expected that glycolic acid could be used for the development of PLGA sustained-release microsphere injection.

2PS-51 나행요
Interaction of Protein with a Modified Drug Conjugate
나행요, 손정선† 조선대학교
We have developed the water-soluble paclitaxel based on PEG conjugates with a newly developed self-immolating group. A study on water-soluble derivatives that improve the solubility of various poorly soluble drugs including paclitaxel is very effective through polymer-modification. It is very important for intravenous drug administration. The conformation and mobility of the polymer chains have an important effect on the transport properties of the polymer-drug conjugates in aqueous solution. To improve the efficacy and the bioavailability of paclitaxel, it is very important to investigate the interaction between modified drugs and serum proteins. Therefore, we have investigated the interaction of water-soluble paclitaxel conjugate, 7-mPEG5,000-succinyloxy methyloxycarbonyl-paclitaxel and serum proteins by pulse-gradient field NMR. Diffusion coefficient was measured as a function of paclitaxel conjugate and albumin concentration at different temperatures.

2PS-52 김현승
Dual-crosslinkable Self-healing Hydrogel for 3-D Bioprinting
김현승, 문창욱, 노현호, 이근용† 한양대학교
Three-dimensional (3-D) bioprinting has developed as an important tool for tissue regeneration. Hydrogels for 3-D bioprinting should have low viscosity that can be printed efficiently but simultaneously can form solid or semi-solid structure. Herein, dual cross-linkable hydrogels with self-healing ability are proposed for 3-D bioprinting. Oxidized hyaluronate (OHA), glycol chitosan (GC) and adipic acid dihydrazide (ADH) can form self-healing hydrogel via competitive reaction between imine bond (OHA/GC) and acylhydrazone bond (OHA/ADH). Hyaluronate-alginate hybrid (HAH) polymer was added to the self-healing gel for dual-crosslinking with calcium ions after the printing process. Dual-crosslinking significantly enhanced the stability of printed 3-D constructs and maintained their structure. Various characteristics of OHA/GC/ADH/HAH hydrogels including the mechanical properties, stability, chondrogenic differentiation of chondrocytes encapsulated within the gels were investigated in vitro.

2PS-53 김현서
Fabrication of Biomass-based Anti-Microbial Carbon Composites PU Foam Dressings for Functional Wound Healing
김현서, 고윤제, 신인해, 조동환, 박원호[1], 권오형† 금오공과대학교; [1]충남대학교
Developement of advanced wound dressings that possess antimicrobial properties for wound surface and absorbed exudate is challenging study and it facilitate effective wound healing. The polyurethane (PU) foam is one of the widely used moisture dressing that has superior ability to absorb exudate from wounds. In this study, we fabricated biomass-based antimicrobial PU foams containing silver nanoparticles and activated carbon. The mechanical property, moisture absorption speed, absorptivity, morphology and cell viability of the composite foam were characterized. Biomass-based antimicrobial carbon composites PU foam dressings showed significantly effective wound healing compared to controls.

2PS-54 김하연
The Drug Loading/Releasing Capability of Glutathione-responsive Peptide Amphiphile Vesicles Controlled by Positionable Disulfide-bridges
김하연, 김인혜, 황준호, 이은지† 광주과학기술원
In anticancer drug delivery system, delivering and releasing the drugs to the target tumor cells is challenging due to systematic toxicity and side effects on normal cells. The self-assembly of peptide amphiphiles (PAs)-based vehicles have garnered attention due to their biocompatibility and a dual loading capability for hydrophilic and hydrophobic payloads. However, controlled stability in physiological media remains a challenge for efficient drug encapsulation and release. Here, the glutathione-responsive drug-releasing vesicles were developed by self-assembly of PA with cysteine which can form disulfide-linkages. The PA vesicles demonstrated different drug loading capacities and releasing efficiencies as functions of the location and number of disulfide-linkage during assembly. This research provide a biocompatible peptide design for the synthesis of efficient drug-delivery vehicles and serve as a solid foundation for further nanocarrier developments for biomedical applications.

2PS-55 김충구
Fabrication of Gas-generating Polymer Micelles for Fat Reduction
김충구, 이근용† 한양대학교 생명공학과
Polymer nanoparticles have been widely used in various biomedical applications including local fat reduction. Poly(ethylene glycol) (PEG) has been also extensively exploited in the fabrication of polymer micelles. We hypothesized that the cellular uptake of PEG-based micelles modified with cell-penetrating peptide could be enhanced when locally delivered to the adipocytes. PEG-alkyl carbonate was first synthesized via alkyl halide reaction as a carbon dioxide-generating polymer, and cell-penetrating peptide (9r) was next coupled to the polymer. Polymer micelles were then prepared by solvent evaporation method and their various characteristics such as morphology, size and size distribution, and gas-generating capability were investigated. The cytotoxicity and cellular uptake of micelles were also investigated in vitro. This approach may provide a useful means for the local fat reduction.

2PS-56 김지흥
Synthesis and Properties of Novel Multiple-hydroxy Polyaspartamide and Its Cross-linked Gels
김지흥†, 문종렬, Dat Quoc Dang 성균관대학교
In this work, the synthesis and characterization of multiple-hydroxy polymer, poly(N-2,3-dihydroxypropyl aspartamide) (PDHPA), and its crosslinked gels are discussed. PDHPA has several valuable properties including biodegradability, high water-solubility, excellent biocompatibility, and good adhesive property. Additionally, the vicinal dihydroxy functional group can be oxidized and coordinate with some metal cations to form complexes. Owing to its unique chemical structure, PDHPA features a useful platform to combine with other materials and to prepare different sort of hydrogels. Here, PDHPA was crosslinked by using several different reaction mechanism and the characteristics of resulting gels were elucidated. This newly developed multi-hydroxyl polymer and gels, having non-toxic biocompatible nature, have potential uses in biomedical application fields.

2PS-57 김지연
Tannin-based Nanoformulation for Stabilization of Paclitaxel in Aqueous Medium
김지연, 홍선기† 대구경북과학기술원
Nanoformulation of anti-cancer drugs with polymeric carriers has shown great promise to improve the biostability and therapeutic efficacy. In this study, we utilized one of abundant tannin, tannic acid (TA), to solubilize a chemotherapeutic agent, paclitaxel (PTX), in aqueous medium. The TA/PTX complex further formulated with a hydrophilic biopolymer, poly(ethylene glycol) (PEG) to increase the biostability. We found that stable colloidal nanoparticles with a hydrodynamic size of ~150 nm in diameter was successfully formed, which was water-dispersed up to 7 days without changes in size. We expect the synthesized nanoformulation of PTX can be an effect therapeutics in chemotherapy. *This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ01323201)" Rural Development Administration, Republic of Korea.

2PS-58 김수현
근적외선 조사에 의해 산화질소 방출 제어가 가능한 폴리도파민 코팅 연구
김수현, 정환희, 예영신, 남창우† 전북대학교
산화질소(nitric oxide, NO) 등을 기반으로 한 가스 치료법은 종양 및 피부질환 치료에 효과적인 방법으로 사용되고 있다. 하지만 NO와 같은 가스 치료는 가스 방출 양을 조절하거나, 일정 농도로 장시간 방출하기 어렵다. 최근 들어 근적외선(NIR)과 같은 외부 자극을 통한 NO 방출 제어 연구들이 많이 진행되고 있지만, on-off 형태의 방출 조절은 여전히 어려운 문제가 있다. 따라서 본 연구에서는 폴리도파민 코팅에 싸이올기(-SH)를 도입하여 NO를 효과적으로 결합하고, 열에 민감한 특성을 가지는 S-니트로소티

올 (S-nitrosothiol)을 NO 전구체로 사용하여 on-off 형태로 NO 방출을 제어할 수 있는 폴리도파민 코팅을 제조하고자 한다. 또한, 폴리도파민 코팅 두께에 따른 광-열변환특성을 분석하고, 근적외선 조사 시 폴리도파민 코팅의 광-열변환특성에 의한 NO방출 거동 분석을 통해 방출 특성을 분석하고자 한다. 이처럼 NO 방출이 효과적으로 제어되는 폴리도파민 코팅은 종양 및 피부 치료에 효과를 나타낼 것으로 판단된다.

2PS-59 김수연

Development of Antifouling Coatings Using Diverse Polymers and the Comparative Study

김수연, 박상정, 서현지, 김선희, 조우경† 충남대학교

Non-specific adsorption of protein on biomedical equipments, which are used for therapeutic and diagnosis purpose, can cause infection, blood coagulation, and sensitivity degradation. Lots of researches on antifouling coatings have been proceeded to solve these problems, however, researches on the mechanism were still elusive. In this study, we hypothesized that non-specific adsorption would be affected by surface energy. Polymers using oligo(Ethylene glycol)methacrylate, Hydroxyethlymethacrylate, 2-(dimethlyamino)ethlymetacrylate and (3-methame-thaacryloylamino)propyl-dimethyl (3-sulfopropyl) ammonium hydroxide, 3-sulfopropyl methacrylate potassium monomers were introduced to silicon metal surface by using Surface Initiated Activator Regenerated by Electron Transfer Atom Transfer Radical Polymerization (SI ARGET ATRP). The correlation between surface energies of the polymer-coated surfaces and antifouling effect has been investigated through an enzyme-linked immunosorbent assay.

2PS-60 김성준

Develpment of Multi-functional NK Cell Coating Materials for Enhanced Anti-cancer Efficacy

김성준, 김교범† 동국대학교

We designed multifunctional cell coating materials to improve anticancer efficacy of NK cell. In order to NK cell coating, 2 mg/mL of materials were treated to cells and incubated at R.T. for 15 min. Lipid chains within this platform can penetrate cell membrane and can be anchored without intracellular penetration by PEG. Moreover, NK cell aggregation was inhibited after cell coating. These results demonstrated that when the surface-engineered NK cells are administrated into the body through a syringe, they couldn't obscure the needle and could facilitate blood vessel escape. In addition, proliferation and function of NK cells were not inhibited after cell coating. The pH responsive S-S bond was dissociated in cancer microenvironment like acidic condition and released antifolate. Furthermore, cancer targeting ability of NK cells was enhanced by folate mediated cancer recognition. Therefore, NK cell coating technique could be used as an anti-cancer therapy with enhanced efficacy.

2PS-61 김성종

Barium Titanate Nanoparticles/Hyaluronate-Rose Bengal Conjugate for Noninvasive Photochemical Tissue Regeneration

김성종, 한세광† 포항공과대학교

Barium titanate nanoparticles (BTNP) are widely used in the field of photomedicines, because they can convert near infrared (NIR) light into visible light owing to second harmonic generation (SHG). However, finite depth of light penetration limits the treatment of deep skin wounds. Here, we developed barium titanate nanoparticle/hyaluronate-rose bengal (BTNP/HA-RB) conjugates for deep tissue regeneration with NIR light illumination. Compared to invasive tissue treatments, BTNP/HA-RB could be delivered noninvasively into the collagen layer of the dermis and provide visible green light upon NIR light. The activated RB by the green light induced radicals for crosslinking of dissected collagen matrix. The formation of BTNP/HA-RB conjugates were characterized by Absorbance spectrum and Photoluminescence measurement. An in vitro tensile strength test of incised skin tissues and an in vivo animal wound closure rate test confirmed the efficient tissue regeneration effect of BTNP/HA-RB conjugates.

2PS-62 김서영

Treatment of Riboflavin Phosphate to a Collagen Matrix and Effects of Blue Light Irradiation

김서영, 강예영, 이윤복, 공민선, 강연태, 이현종† 가천대학교

Riboflavin phosphate (RFP) is a biocompatible and non-toxic natural photo-initiator. RFP has been used with UV irradiation to strengthen cornea in the ophthalmology. Here, the effects of RFP to collagen matrix was assessed with visible light instead of UV. After the treatment of RFP and irradiation visible light, FT-IR and SEM were utilized to characterize chemical and morphological change. Also, the tensile strength of the collagen matrix was measured with variable RFP concentration and irradiation time. The biocompatibility of the treatment of RFP was evaluated by cell proliferation.

2PS-63 김민지

Development of Cell Spheroid System Based on Porous Microparticles for Cell Survival and Bone Regeneration

김민지, 정영조[1], 이진호[1], 오세행† 단국대학교; [1]한남대학교

In recent years, a cell spheroid system is considered as most common way to culture cells in 3D. However, limited size, structural stability and heterogeneous cell differentiation due to the insufficient supply of oxygen/nutrients into the central region are still remained as challenges. In this study, we fabricated porous leaf-stacked structure particles throughout entire matrix (LSS) which can provide space for sufficient supply of oxygen/nutrients, act as improved structural stability, and allow sustained release of signaling molecules for induction of differentiation throughout whole cell spheroids. A cell spheroid system was prepared using the LSS particles and human bone marrow-derived mesenchymal stem cells (*h*BMSCs). The morphology, release pattern of signaling molecules from LSS particles, cell survival/structural stability/osteogenic differentiation of *h*BMSCs/LSS particle spheroid were observed. We also evaluated *h*BMSCs/LSS spheroid for promoting bone regeneration in vivo.

2PS-64 곽민아

Enhancement in Tissue Adhesion of Catechol-modified Hyaluronic Acid Hydrogels by Tannic Acid Treatment

곽민아, 홍보민, 박원호† 충남대학교

히아루론산(hyaluronic acid, HA)은 인체의 피부나 연골에 존재하는 음이온성의 천연고분자로 우수한 생체적합성, 생분해성, 무독성, 및 보습성 등의 특성으로 조직공학 및 의약학 분야에서 다양하게 응용되고 있다. 특히, 사슬의 친수성 및 유연성이 우수하여 수화젤 형태로의 적용을 위한 연구가 많이 진행되고 있는 추세이다. 본 연구에서는 HA의 의료용 조직접착제로의 적용 가능성을 알아보기 위하여 다음과 같이 실험을 진행하였다. HA에 접착력을 부여하기 위하여 다양한 기질에 우수한 접착력을 발현하는 카테콜기를 도입하였으며, 제조된 카테콜 유도체(HA-Cat)를 기반으로 $NaIO_4$를 사용하여 산화가교에 의한 수화젤의 형성거동을 분석하였다. 이후, 접착력 및 응집력을 향상시키기 위해 식물에서 추출한 폴리페놀 성분인 탄닌산(tannic acid, TA)을 첨가하였으며 TA 첨가에 따른 HA-Cat 수화젤의 물리/화학적 특성 및 조직접착력 등의 변화를 관찰하여 상처봉합용 조직접착제로의 적용 가능성을 살펴보았다.

2PS-65 곽동민

Guiding Tissue Regeneration of Rabbit Bone Defects Using Silk Fibroin-Poly(glycolic acid) Hybrid Scaffolds Fabricated by Electrospinning and 3D Printing Techniques

곽동민, 고영광, 권오형† 금오공과대학교

Tissue engineering aims regeneration of defected biological tissues and organs by combining cells, scaffolds, and growth factors. We prepared patient-customizable guided bone regeneration (GBR)/guided tissue regeneration (GTR) hybrid scaffolds by electrospinning and 3D printing techniques. Poly(glycolic acid) (PGA) scaffolds were fabricated using a 3D printer. The microstructure of silk fibroin and PGA hybrid scaffolds was observed by SEM. Cell proliferation of osteoblasts on a PGA scaffold was analyzed. Rabbit bone defect model was used for animal test. Regenerated tissues were analyzed by H&E staining and micro-CT. Silk fibroin nanofiber-PGA scaffold groups showed significant regeneration of bone compared to control groups. The silk fibroin nanofiber-PGA scaffold construct will provide a prospective approach for regeneration of bone defects.

2PS-66 공민선

Fabrication of Injectable Hydrogel via Visible Light-crosslinkable Furfuryl-modified Gelatin

공민선, 강예영, 이윤복, 김서영, 임새빈, 이현종† 가천대학교

Injectable hydrogels can be utilized as versatile therapeutic factors carriers. Gelatin is derived from collagen by hydrolysis, and the material is commonly used to fabricate hydrogel. In this study, we modified gelatin by furfuryl glycidyl ether, and the resultant furfuryl-modified gelatin (f-gel) formed hydrogel via visible light-induced photo-crosslinking. The physical properties and protein release profiles were assessed depending on the concentration of f-gel and riboflavin phosphate.

2PS-67 강전일

Catalase-immobilized Syringes to Create Oxygenated Hydrogels for Boosting Wound Healing

강전일, 박경민[1,†] 인천대학교; [1]인천대학교 생명공학부

The emerging trend in designing polymeric hydrogels is to create a bioactive matrix stimulating the native tissues by physicochemical and biological stimuli. Among these factors, hyperoxia (over 21% pO_2) has been demonstrated to facilitate wound healing *via* acute oxidative stress. While various peroxides with catalase have been used as oxygen (O_2)-generating agents, it is still challenging to improve their cytotoxicity caused by excessive oxidative stress or cellular signaling suppression. Herein, we develop a catalase-immobilized syringe (Oxyringe) to create cytocompatible and oxygenated hydrogels. The hydrogels released O_2 up to hyperoxic levels (47.9% pO_2) *in vivo*. We found that the hydrogels boosted initial macrophage recruitment, cell proliferation, and neovascularization, which are related to wound healing. In conclusion, Oxyringe has great potential as an advanced O_2-supplying platform to generate O_2-delivering biomaterials for improved wound healing and tissue regeneration.

2PS-68 강예영

Preparation of Biodegradable Poly(lactic-co-glycolic acid) Micro/nanoparticles for Vaccination

강예영, 김서영, 김재학, 공민선, 이윤복, 이현종† 가천대학교

Poly(lactic-co-glycolic acid) (PLGA) is a biocompatible and biodegradable polymer, and PLGA particles have been used extensively for the controlled release of various drugs. In terms of the drug delivery system, PLGA particles can improve vaccinations, cancer treatments, cardiovascular treatments, and regenerative medicine. In diverse applications, the size of the PLGA particle is a major factor for effectiveness depending on the purposes. In this study, PLGA-poly(ethylene-alt-maleic anhydride) (PEMA) micro/nanoparticles were prepared using a double emulsion-solvent evaporation method, and the particle size was controlled by the composition of PLGA and PEMA.

The effect of the size of PLGA micro/nanoparticles on vaccination efficiency will be evaluated using the diverse size of PLGA particles.

2PS-69 강문성

Cytotoxicity and Potential Applicability of Polyethyleneimine-coated Eu_2O_3 and Dy_2O_3 Nanoparticles as X-ray CT Contrast Agents

강문성, 이석현, 이지은, 김춘태, Timur Sh. Atabaev[1], 한동욱† 부산대학교; [1]Nazarbayev University

Rare-earth metal oxide nanoparticles considered promising contrast agents for X-ray computed tomography (CT) and magnetic resonance imaging (MRI). The main purpose of this study is to investigate the potential applicability of polyethylenimine (PEI)-coated Eu_2O_3 and Dy_2O_3 nanoparticles (NPs) for CT X-ray attenuation. Morphology and other physicochemical properties of prepared samples were systematically investigated using a range of characterization tools. Preliminary cytotoxicity experiments with L-929 fibroblastic cells suggested that both samples have no significant toxicity at concentrations below 50 μg/ml. Clinical CT analysis shows that PEI@ Eu_2O_3 NPs exhibit higher X-ray attenuation efficiency (∼ 8 HU/mM) compared to PEI@Dy_2O_3 NPs (∼ 5 HU/mM).

2PS-70 Tung Pham

Surface-triggering in situ Gelation (STIG) Technology for Individual Encapsulation of Therapeutic Cells

Tung Pham, Phuong Le Tran, Jee-Heon Jeong† Yeungnam University

The clinical applications of cell microencapsulation have been hampered due to inadequate construction of microcapsules such as off-center encapsulation, a low fraction of cell-laden capsules, immense volume, and lack of controls over the thickness of capsules. In this study, we sought to develop a novel encapsulation method for complete, cell-center, and individual cell encapsulation by growing hydrogel from the cell surface. The results suggest that our technique potentially represents a simple means to overcome inevitable issues in cell encapsulation field.

2PS-71 Phuong Tran

Post-transplantation Tracking of the Pancreatic Islets by Magnetic Resonance Imaging Using Iron Oxide Nanoparticles Loaded Tissue-adhesive Microparticles

Phuong Tran, Tung Pham, Jee-Heon Jeong† Yeungnam University

The visualization of islet post-transplantation is necessary to improve the clinical outcomes of cell therapy for type 1 diabetes treatments. However, long-term and precise tracking of islets is still challenging. To address this issue, we developed a novel labeling method to track the pancreatic islet transplantation using T2 contrast agent-loaded tissue-adhesive microparticles. The results reveal that conjugation of our particles could be a promising strategy to improve the visualization of pancreatic islets in clinical applications.

분자전자 부문위원회

2PS-72 황인국

Reverse Offset Printed Silver Nanowire Electrodes with Large-Area and Fine Micro-Patterning

황인국, 김종윤, 박규태, 이윤구† 대구경북과학기술원

Silver nanowire (AgNW) is a promising candidate of replacing indium tin oxide because of their outstanding electrical, optical properties and flexibility. Previous printing technologies such as inkjet, screen, gravure printing have been used to fabricate AgNW electrodes for various optoelectronic devices. However, achieving fine line width, uniform thickness, sharp line edge and patterning of various shapes is difficult with conventional printing processes. Here, we report a high-resolution and large-area patterning of highly conductive AgNW transparent electrodes (TCEs) by reverse offset printing and intense pulsed light (IPL) irradiation for flexible integrated electronic devices. The reverse offset printed AgNW TCEs exhibit fine line widths (up to 6 μm) and outstanding pattern quality. After IPL irradiation AgNW TCEs show excellent optical, electrical and mechanical properties. Finally, flexible OLEDs and heaters were successfully fabricated with reverse offset printed AgNW TCEs.

2PS-73 황대호

Stabilization of Quantum Dots in Water/Alcohol by Ligand Exchange

황대호, 황동렬†, PREM PRABHAKARAN 한남대학교

Achieving orthogonal solubility is a key issue in solution-processed multilayer quantum dot light-emitting devices. On the basis that conventional organic layers are resistant to water/alcohol, we demonstrate here orthogonal process of water/alcohol soluble quantum dots as an upper layer. Postsynthetic ligand exchange with dihydrolipoic acid offers stabilization of the quantum dots in water/alcohol without changing their photophysical properties.

2PS-74 홍수진

Stability Cesium Lead Halide Perovskite Quantum Dots Obtained by Amino Acid Mediated Synthesis

홍수진, 이광섭†, PREM PRABHAKARAN, 김경주 한남대학교

Cesium lead trihalide perovskites ($CsPbX_3$, X=Cl^-, Br^-, I^-) quantum have a unique crystallization behavior and a high extinction coefficient in the visible light range and excellent photoelectric conversion efficiency. Because of these unique optical properties, perovskite quantum dots (PeQDs) have been widely studied in recent years. PeQDs are inexpensive and easy to manufacture with potential applications into various fields such as display, UV sensor, solar cell, and X-ray scintillation based on these advantages. Our research is focused on improving light stability of PeQDs. Here we present the results from synthesis of PeQDs in presence of amino acid. Optical properties and stability of the amino acid functionalized PeQDs are described in this poster.

2PS-75 호동해

3D-Printed Sugar Scaffold for High-Precision and Highly-Sensitive Active and Passive Wearable Sensors

호동해, 홍판욱[1], 한중탁[2], 김상연[3], 권석준[4], 조정호† 연세대학교; [1]성균관대학교; [2]KERI; [3]한국과학기술교육대학교; [4]KIST

We introduce a pairing of a previously unidentified 3D printing technique and soft materials in order to achieve not only high-resolution printed features and flexibility of the 3D-printed materials but also its light-weight and electrical conductivity. On-demand personalized wearable sensors made of the 3D-printed soft and conductive materials were fabricated. These sensors successfully detected both actively changing body strain signals and passively changing signals such as EMG (electromyography), EDA (electrodermal activity) and EEG (electroencephalogram). The accurately tailored subject-specific shape of the developed sensors exhibited higher sensitivity and faster real-time sensing performances in the monitoring of rapidly changing human body signals.

2PS-76 허성민

Enhancement-mode OECTs with a Large Volumetric Capacitance

허성민, 권지민, 노용영† 포항공과대학교

The Organic electrochemical transistors (OECTs) have been received a lot of attentions in bioelectronic devices. [1] Poly(3,4-ethylenedioxythiophene) and poly(styrene sulfonate) (PEDOT:PSS) is the most typical material in OECTs due to its high transconductance and processability. [2],[3] One of the its main drawbacks is that operates in depletion-mode. Here, we have utilized fluorinated benzothiadiazole (BT) groups polymer to demonstrate enhancement-mode OECTs with intrinsic semiconductors by using printing process. We uncover the mechanism that cause the difference in volumetric capacitance due to fluorinated functional group. Then, we investigate how to enhance the ion mobility in the organic semiconductor films.

2PS-77 허선형

Synthesis, Electrochemical and Photophysical Properties of Nitrogenous Heterocyclic Green Fluorophores

허선형, 우한영† 고려대학교

Since triplet excitons can't be directly utilized via fluorescence process, fluorescent organic light-emitting diode (OLED) has low efficiency using only 25% excitons. However, it has a good advantage such as high color purity, cost-efficiency and stability, so it is necessary to develop. Donor-acceptor molecular structure with large dipole moment can induce effective charge transfer (CT) character along with HOMO (highest occupied molecular orbitals) and LUMO (lowest unoccupied molecular orbitals) separation. It results in large stokes shift and broad emission spectrum. Ultimately, it has a damaging effect on color purity for high-resolution OLED display applications. So, it is important that there is no CT character for high color purity. In this study, new nitrogeneous heterocyclic structures were synthesized and CT characters were investigated by DFT calculation. According to the CT character of the structures, it showed the effect on stokes shift and FWHM (full width at half maximum).

2PS-78 함효빈

Synthesis and Characterization of a Wide-bandgap Polymer Based on Perfluorinated and Alkylthiolated BDT with a Deep HOMO Level for Organic Photovoltaics

함효빈, 김희수[1], 황도훈[1], 강인남† 가톨릭대학교 성심교정; [1]부산대학교

A perfluorinated and alkylthiolated BDT-ttTPD-based donor polymer (P2FS-ttTPD) was synthesized via a Stille polymerization, and found to have a number average molecular weight (Mn) of 13,000 g/mol (Đ = 2.3). P2FS-ttTPD has a wide bandgap (1.96 eV) and a deep highest occupied molecular orbital (HOMO) level (−5.70 eV). The perfluorination and alkylthiolation of the polymer backbone lower the polymer's HOMO level significantly. The hole and electron mobilities of P2FS-ttTPD were determined to be 1.12×10^{-4} and 9.38×10^{-7} cm^2/Vs respectively. Polymer solar cell devices prepared with a P2FS-ttTPD:IT-4F (1:1) blend as the active layer were found to exhibit power conversion efficiencies of 4.15%, a short-circuit current density (JSC) of 10.29 mA/cm^2, an open-circuit voltage (VOC) of 0.97 V, and a fill factor (FF) of 41.6%. The (1:1) blend devices were found to exhibit high VOC and low Eloss values.

2PS-80 한혜미

High-Performance Near-Infrared Circularly Polarized Light-Sensing Organic Phototransistors with Conjugated Polymer Layer and Cholesteric Liquid Crystal Network Film for Optoelectronic Encryption

한혜미, 이유진[1], 정재승, 한재훈, 주현수, 안석균[1], 임정아† 한국과학기술연구원; [1]부산대학교
Recently, chiral photonics using circularly polarized (CP) light have led to the growing interest in applications such as quantum communication and optical encryption. The central challenge for achieving such chiral optoelectronics is to develop the electronic devices that are capable of detecting distinguishingly the handedness of incident CP light. Furthermore, the CP light detectors responding to the wavelengths in the near-infrared (NIR) region are required in order to fully extend their practical applications. In this regard, we have demonstrated high-performance NIR CP light-sensing organic phototransistors based on a conjugated polymer by integrating a selective NIR-reflecting cholesteric liquid crystal network film. In this presentation, we will show our facile strategy for developing the NIR CP light-sensing chiral optoelectronic devices as well as demonstrate their actual application to a cryptographic authentication key utilizing the physically unclonable function arrays.

2PS-81 한세교

Photomultiplication-type Organic Photodetectors with Fast Response Time Enabled by the Controlled Charge Trapping Dynamics of Quantum Dot Interlayer

한세교, 최욱진, 이한솔, 조길원† 포항공과대학교
We demonstrate a high performance photomultiplication-type organic photodetector (PM-OPD) based on a bulk heterojunction (BHJ) of donor and acceptor materials and a core-shell quantum dot (QD) interlayer. The PM-OPD shows high specific detectivity, external quantum efficiency (EQE), and fast response time compared to other PM-OPDs, resulting in large EQE-bandwidth product (〉10^5). This notable performance is enabled by the novel device structure (ITO/ZnO/donor-acceptor BHJ/QD/Ag), where fast charge trapping of photo-generated electrons at the QD interlayer induced fast charge injection from the electrodes. This is distinguished from conventional PM-OPDs, which usually suffer from slow response time due to the relatively long charge accumulation time required for the charge injection from the electrodes. This work offers a new insight on the design of device structure for fast-response and high-performing PM-OPDs and provides comprehensive understanding of underlying device physics.

2PS-82 한나라

Slot-Die Coated Organic Solar Cells with Improved Device Performance and Stability by Introduction of Unusual Additive

한나라, 허윤정[1], 김동유† 광주과학기술원; [1]한국생산기술연구원
In recent years, power conversion efficiency (PCE) of organic solar cells (OSCs) has increased and reached up to 16% for the single-junction structure. However, many issues of efficiency and stability of bulk heterojunction OSCs are still controversial. In particular, the optimization of the film morphology is very important for high performance and long-term stability because the device efficiency is determined by the three-dimensional structure in the donor-acceptor blended system. In this study, we fabricated the slot-die coated OSCs by introducing water as an unusual additive. Furthermore, we confirmed that the bulk heterojunction morphology and device performance depend on the quantity of water introduced in active solution. The changes by water addition were analyzed by using UV-Vis absorption, AFM, TEM and 2D GIWAXS measurements. As a result, 13% (ref-1; PTB7-Th:IDTBR) and 26% (ref-2; PTB7-Th:PCBM)-improved PCEs compared with as-cast cells were achieved from the water addition.

2PS-83 타바마니 구굴라한트

High Performance All-Polymer Solar Cells with 11.66% Efficiency and Long-Term Stability by Employing Novel π-Conjugated Donor Polymer with Nonhalogenated Green Solvent

타바마니 구굴라한트, 성경민, 박형진, 제갈영순[1], 진성호† 부산대학교; [1]경일대학교
All-polymer solar cells (All-PSCs) exhibit excellent long-term device stability and tunable good active layer morphology processed from different nonhalogenated solvents by different conditions. In this work, we found that the photovoltaic performance of all-PSCs can be further developed to a benchmark PCE of 11.66% using novel p-type π-conjugated donor polymer (Nap-SiBTz) and n-type acceptor polymer (N2200). This strategy of novel π-conjugated donor polymer enhancing the absorption coefficient, increasing the charge carrier mobility, and elements distribution are beneficial in achieving high photovoltaic performance with thick active layer. Notably, to overcome the severe charge recombination and energy losses, a 1-phenylnapthalene (1-PN) additive is used to well-ordered micro-structure, molecular packing that inherently suppresses the optoelectronic defects. Importantly, this is the highest reported PCE for a nonhalogenated solvent-processed all-PSCs so far.

2PS-84 최현태

Highly Efficient and Stable Hybrid Perovskite Solar Cells by Introducing Novel IDTT-based Small Molecule Additive

최현태, 류승운, 이대환, 민지현, 윤선희, 박태호† 포항공과대학교
The defects existing in the organic-inorganic halide perovsktie films could bring about an adverse effect to both stability and efficiency of perovskite solar cells (PSCs). Here, the novel indacenodithieno[3,2-b]thiophene-based small molecule, IDTT-ThCz, was introduced into the perovskite film during antisolvent treatment step. The *p*-type characeteristics of the IDTT-ThCz molecule and smooth perovskite film contributed to efficient charge extraction from perovskite. In addition, the IDTT-ThCz molecule interacted with perovskite precursors and suppressed the decomposition of perovskite, passivating the defect states and reducing the defect density. As a consequence, the highest PCE of 22.5% was achieved for IDTT-ThCz treated PSCs owing to these improvements. Furthermore, the stability of PSCs improved as well, maintaining up to 90% of their initial efficiencies after 458h storage in thermal condition (85 degree) and up to 70% after 25000s of continuous illumination.

2PS-85 최한빈

Visco-Poroelastic Ionic Pump Based Mechanical Selective Sensor

최한빈, 권혁민, 김도환† 한양대학교
Recently, many studies on electronic skins (E-skins) is spotlighted as a promising candidate of selective sensor that emulate sensing capabilities of human skin distinguishing various mechanical stimuli such as pressure, tension, torsion. However, previous reports still suffer from the ability to distinguish and recognize two or more mechanical stimuli including pressure, tension, and torsion. In this talk, we describe E-skin recognizing two mechanical stimuli such as pressure, strain using visco-poroelastic behavior of ionic pump. The visco-poroelastic behavior of ionic pump have not only the viscoelastic behavior by the polymer matrix deformation, but also the poroelastic behavior due to the diffusion of the ions inside the polymer matrix. As a result, our E-skin based on ionic pump is capacitive mechanical sensors of vertical and coplanar structure. These can distinguish pressure and strain by using the same direction of diffusion of ions in response to mechanical stimuli.

2PS-86 최정민

Fluorene-based Organic Hole Transporting Material for Improved Stable Perovskite Solar Cell

최정민, 비라 무루간 아리부니티, 도영주, 라자라파티 두르가 가야뜨리, 제갈영순[1], 진성호† 부산대학교; [1]경일대학교
Hole transporting materials (HTMs) play a significant role in enhancing the power conversion efficiency (PCE) and stability of perovskite solar cells (PSCs), for their commercialization an effective design strategy is required. Herein, we have designed and synthesized a new class of HTM F2DT based on 2',7'-dibromospiro [cyclopenta[1,2-b:5,4-b'] dithiophene-4,9'-fluorene] and dimethyl-9H-fluoren-2-amine core, respectively. We have systematically investigated the thermal, photophysical, electrochemical properties and found that it has potential to utilize as an HTM perovskite solar cell (PSC) device applications. The new HTM F2DT was introduced for PSCs and fabricated with a device configuration of FTO/TiO_2/Perovskite/HTM/Au. The F2DT based HTM device has shown significant device performance in solution-process with a power conversion efficiency (PCE) of over 16.0%. It clearly indicates that F2DT can replace regular Spiro-OMeTAD which is also expensive.

2PS-87 최예림

Controlling Random Configuration of Thiophene Units for Mechanically Stable Solar Cells

최예림, 박상아, 이대환, 정우택, 윤선희, 박태호† 포항공과대학교
In this study, we study on the relationship between morphologies and optoelectronic/mechanical properties of polymer solar cells. Introducing thiophene unit as a regular (PffBT-4T) or random (PffBT-RT4) is needed for the study of developing flexibility. The difference of the PffBT-4T and PffBT-RT4 is only configuration, so the energy level, which has effect on charge transport and recombination in the device, of both polymers are equal. PffBT-RT4 exhibits low crystallinity and shorter π-π distance than PffBT-4T, and it leads to the high efficiency of 8.84% comparing to PffBT-4T (7.25%) due to improved interchain charge transporting abilities. In addition, PffBT-RT4 based flexible solar cells showed better mechanical robustness, maintaining its initial level after 100 bending cycles at a bending radius of 4.5 mm. Moreover, for the PffBT-RT4:PC71BM film, the out-of-plane (100) peak intensity decreased only slightly even after 100 stretches.

2PS-88 최민수

Ancillary Ligand Effects on Heteroleptic Ir(III) Dye in Dye-Sensitized Photocatalytic CO_2 Reduction: Aryl-Substitution on Bipyridine Ligand and Its Control on Catalytic Performance

최민수, 이대한, 나수원, 최성한, 김철훈, 조대원, 박종진, 강상욱, 손호진† 고려대학교
We report the synthesis and photochemical and –physical properties as well as the catalytic performance of a series of heteroleptic Ir(III) photosensitizers (IrPS), $[Ir(C^{\wedge}N)_2(N^{\wedge}N^{Aryl})]^+$, possessing ancillary ligands which are varied with aryl-substituents on bipyridyl unit [C^N = (2-pyridyl)benzo[*b*]thiophen-3-yl (btp); $N^{\wedge}N^{Aryl}$ = 4,4′-Y_2-bpy (Y = -Ph or -$PhSi(Ph)_3$]. Ancillary ligand effect was dominant in the light driven energy transfer process. Their photosensitizing abilities were tested in a homogeneous condition for CO_2 reduction (IrPS + Re(I) catalyst) as well as a semi-heterogeneous photocatalytic system consisting of Ir(III) photosensitizer and Re(I) catalyst supported on TiO_2 semiconductor (IrPS + TiO_2/Re(I). We found that the π-extension of bipyridyl ligand by aryl-substitution puts bipyridyl ligand in use as an electron relay unit performing charge accumulation before delivering to the catalytic center, greatly improving the overall CO_2-to-CO conversion activities.

2PS-89 최건오

Facile and Microcontrolled Blade Coating of Organic Semiconductor Blends for Unialxial Crystal Alignment and Reliable Flexible Organic Field-Effect Transistors

최건오, 김경훈[1], 안태규† 한국교통대학교; [1]포항공과대학교
최근 유연한 전자기기가 주목받으면서 유기 전자기기의 구동회로에 사용될 수 있는 유기트랜지스터에 대한 관심이 높아지면서 유기트랜지스터의 제작방법을 개선하기 위한 노력을 꾸준히 하고 있다. 일반적인 스핀코팅은 간단하지만 용액을 많이 소모하는

단점을 갖고 있다. 본 연구에서는 UV 경화가 잘 일어나는 Polyurethane acrylate를 이용하여 젖음성 차이로 간단하게 패턴 하여 용액을 스핀코팅보다 덜 소모하는 블레이드공법을 개발하였다. 반도체의 특성을 높이기 위해 고분자와 저분자를 섞어 상 분리를 유도하여 저분자반도체의 자가조립을 더 강하게 만들고 고분자로는 Polystyrene(PS)와 저분자로는 6,13-Bis(triisopropylethynyl)pentacene(TIPS-PEN)를 이용하였다. 최적화된 패터닝 공정을 통해 제작한 유기트랜지스터는 이동 값이 1.63 $cm^2/v \cdot s$이였고 이는 패턴하지 않은 TIPS-PEN의 이동 값인 0.70 $cm^2/v \cdot s$보다 높은 값을 보였다. 2020년 한국교통대학교 지원을 받아 수행하였음

2PS-90 천형진

Synthesis of Donor-Acceptor Polymer for Transistors and Gas Sensors

천형진, 김윤희†, 권순기, 정용진[1], 성민재, 안태규[1], 김세현[2], 전인하[1] 경상대학교; [1]한국교통대학교; [2]영남대학교

We designed novel donor-acceptor π-conjugated polymers whose backbones and side chains were engineered to ensure stable solution-based printing. As Se has a larger p orbital than that of S, the replacement of sulfur by selenium in the thienothiophene electron-donating unit leads to a minimal change in backbone planarity, which can improve the solubility, while maintaining the high crystalline ordering of the polymeric chains. We then demonstrated their application feasibility for the formation of high-performance semiconductor films by solution-process printing.

2PS-91 지동섭

Sorting of Large-diameter Semiconducting Carbon Nanotubes for Near-infrared Phototransistors

지동섭, 정학순, 김순효, 권지민, 노용영† 포항공과대학교

Single-walled carbon nanotube (SWNT) is a promising building block for infrared (IR) detectors due to its strong optical absorption in IR wavelength region, excellent charge carrier mobility and solution processability. Since the optical band gap and exciton binding energy of semiconducting SWNTs (s-SWNTs) are inversely proportional to its diameter, it is advantageous to utilize large-diameter SWNTs for IR detectors. For the use of s-SWNTs, it is necessary to separate tubes with identical electrical properties (metallic or semiconducting) from as-synthesized SWNTs bundles. Here, we report the sorting technique of large-diameter s-SWNTs by conjugated polymers and high performances of SWNT IR phototransistors.

2PS-92 주현서

Flexible and Enhanced Performance of Thermoplastic Polyurethane Based Triboelectric Nanogenerator

주현서, 이주혁† 대구경북과학기술원

Triboelectric nanogenerator (TENG), which has the characteristics of simple structure, high output power, and diverse energy sources, has received increasing interest as highly efficient and sustainable power sources. To improve the output performance of TENG systems, development of the various high-performance material is needed. Furthermore, nowadays flexibility and biocompatibility are also required for advances in the TENG. Thermoplastic polyurethane (TPU) which has a good durability, flexibility and abrasion resistance can be used as a TENG material suitable for these needs. We used PCL diol as a soft segment due to their biodegradability and biocompatibility. Also, we used 4 different chain extenders to investigate the influence of different number of fluorine units. Incorporating fluorine unit during the synthesis made chemical modification of fluorination and physical modification of morphology possible. Through this process, we could enhance the output performance of TENG.

2PS-93 조현우

Coplanar Floating Gates Connected with Ionic Bridges for Remote Gating Graphene Transistors

조현우, 강문성† 서강대학교

Exploiting the long range polarizability of an electrolyte based on ion migration, electric double layer transistors (EDLTs) can be constructed in an unconventional configuration in which the gate electrode is placed remotely from the device channel with finite distance. The dynamic characteristics of remote-gated EDLTs, however, degrades with this distance, because the formation of EDL relies on the travel distance of ions under gate field. To maintain the dynamic characteristics, we present multiple coplanar floating gates bridged through short ionic dielectric layers. Unlike a remote-gated EDLTs employing a single, extended electrolyte layer, the devices with multiple, short electrolyte layers operate promptly even when they are gated from a distance. The results indicate that the distance-dependence degradation on the dynamic characteristics of the remote-gated EDLTs can be eliminated. The new device architecture provided here shows new opportunities to exploit graphene EDLTs.

2PS-94 조재상

Sputtered Metallic Glass Thin Film Electrodes for Flexible Strain Sensors and Organic Photovoltaics

조재상, 장웅식, 박금환[1], 왕동환† 중앙대학교; [1]전자부품연구원

In this research, metallic glasses (MGs), with various compositions are sputtered into thin films for thin film devices' electrodes. MG is an amorphous metal without long-range crystalline structure, compared to conventional polycrystalline metals. Due to absence of grain boundaries, MG possesses remarkable mechanical and chemical stability, which is advantageous for thin film flexible devices such as strain sensors and organic photovoltaics. Specifically, electrical properties of the sputtered MG films were investigated, and we found that fabricating MG with Zr-based atomic composition is suitable for fabrication of bending sensor with high reliability, and with high stability against oxidation. Furthermore, Al-based MG thin film exhibited appropriate conductivity and work function, which allowed the fabrication of chemically stable electrode for organic photovoltaics.

2PS-95 조일영

Flexible and Semi-transparent Organic Electrochemical Transistors Based on Ultra-thin Au-PEDOT:PSS Hybrid Electrode for Human Skin Electronics

조일영, 김건우, 김영석, 윤명한† 광주과학기술원

Organic electrochemical transistors (OECTs) are one of the most promising device platforms for the field of bioelectronics. In comparison to other organic-based electronics, OECTs have several advantages including high transconductance, low voltage operation, and long-term stability. Here, we suggest an ultra-thin hybrid electrode was fabricated by thermally depositing ultra-thin sub-nano thickness Au electrode on crystalline poly(3,4 ethylene dioxythiophene): poly(styrene sulfonate) (PEDOT:PSS) thin film, which has a transmittance of 56% at visible range wavelength and low sheet resistance of 39.13 Ω/sq. Based on this structure, a semi-transparent and flexible top-contact structure OECT was fabricated that shows a transconductance of 2.5ms, and the performance was maintained even in the bending state(r=9mm). Finally, this semi-transparent OECT is attached to human skin to successfully perform electromyography (EMG) measurements.

2PS-96 정현우

Novel Random Terpolymers Composed of Benzodithiophene, Benzodithiophene-4,8-dione and Difluorobenzothiadiazole Units for High-Performance Polymer Solar Cells

정현우, 유경화, 이윤구† DGIST

Polymer solar cells (PSCs) have received great attention due to their various advantages such as light weight and flexibility. D-A copolymers which consist of electron donor (D) and acceptor (A) units have widely developed for high performance PSCs. However, only a limited number of D-A combinations showed high performance and they exhibited poor solubility in non-halogenated solvents. Recently, 1D/2A random terpolymers composed of one electron donor and two electron acceptor units have emerged as promising p-type polymer because of their merit to easily control their morphological properties by adjusting composition of two different acceptor units. Here, we synthesized 1D/2A random terpolymers with different ratio of benzo[1,2-b:4,5-b'] dithiophene-4,8-dione and 5,6-difluoro-benzo[c][1,2,5] thiadiazole. It displayed homogenous film with favorable face on orientation. As a result, the inverted PSCs based on PBDTBD50/IT-4F processed with non-halogenated solvents showed a PCE of 10.03%.

2PS-97 정우택

Improving the Mechanical Properties of Fluorinated NDI-based Conjugated Polymer via Forming Short-range Ordered Segments

정우택, 류승운, 민지현, 김성룡, 박태호† POSTECH

Naphthalene diimide (NDI)-based conjugated polymers produce a strong π-π stacking interaction through NDI-driven self-assembly. Through the formation of interconnected networks in large crystalline domains, NDI-based conjugated polymers are widely used in n-type organic devices. However, due to the limitation of macromolecular morphologies of polymer chain (e.g., chain-folding, loose loops, dangling segments, and tie molecules), little mechanical and electrical properties are guaranteed. In this study, we controlled the intermolecular interactions by introducing a fluorinated copolymer of NDI and (E)-1,2-bis(3-fluorothiophen-2-yl)ethene (FTVT) (PNDI-FTVT). PNDI-FTVT shows short-range ordered segments compared with PNDI-TVT owing to its strong intermolecular interactions. Also 81% of its initial performance is maintained at a bending radius of 8.0mm after 1000 bending cycles.

2PS-98 정영헌

An Oligomer Semiconductor with an Asymmetric End Group for Solution-processed OFETs

정영헌, 김윤희†, 이민조[1], 이민정, 정선영[1], 정용진[1], 안태규[1] 경상대학교; [1]한국교통대학교

We report on the synthesis of an oligomeric semiconductor, C-HNA, and study their potential application as a thin-film active layer for organic field-effect transistors (OFETs). The measured field-effect mobility of the spin-coated C-HNA films for OFETs was 2.3×10^{-2} $cm^2/(V \cdot s)$. The performance of the resulting OFETs is due to the tendency of packing asymmetric oligomers in which asymmetric cyclohexylated alkyl chains are aligned vertically to the substrates, which contributed to favorable charge transfer.

2PS-99 정세인

Regioregularity Effect of Chlorine Substituted Conjugated Copolymers on Charge Transport in Organic Field-effect Transistors

정세인, 조용준[1], 양창덕[1], 조길원† 포항공과대학교; [1]울산과학기술원

Introducing more electron withdrawing groups in acceptor unit at D-A type conjugated polymer boosts the effect of fast charge carrier transport. However, there has been a lack of understanding the correlation between the halogen substituted molecular structure and solid-state packing status on the charge transport, particularly with conjugated polymer containing benzo[2,1,3]thiadiazole (BT) as the acceptor moiety and 4,4-dihexadecyl-4H-cyclopenta[1,2-b:5,4-b']dithiophene (CDT) as a donor moiety. Moreover, the chain alignment method using nanogroove facilitates hole mobility into 10 times faster than the pure system by grooving them. Also, different

regioregularity induces the significantly dissimilar effect of the nanogroove and capillary force on the orientation of fibers and charge transport of the polymers. These results represent important progress to comprehend the interplay between molecular structure and solid-state packing and their effects on the charge carrier transport.

2PS-100 정미진

Small-Molecule Electrolytes as a Cathode Buffer Layer for High Performances Polymer Solar Cells

정미진, SABRINA AUFAR SALMA, 이준호, RAHMATIA FITRI BINTI NASRUN, 손동환, 아날리아 도라지오 컬만, 김주현† 부경대학교

Electrolytes as a cathode buffer layer (CBL) have affected a favorable interfacial dipole in polymer solar cells (PSCs). This can decrease the charge collection barrier at the cathode interface. New small molecular electrolytes (**2EBr** and **4PBr**) were introduced as the CBL to generate the interface dipole and reduce the energy barrier. These electrolytes have an easy synthesis procedure and low processing costs. Furthermore, **2EBr** and **4PBr** have different ionic functionalities to tune the magnitude of the interfacial dipole. **2EBr** has two benzyl trialkyl ammonium salts and **4PBr** has a phenyl core with four benzyl triphenylphosphonium salts. The power conversion efficiencies (PCEs) of the devices based on **2EBr** and **4PBr** reached up to 9.56% (J_{sc} = 19.7 mA/cm^2, V_{oc} = 0.80 V, and FF = 61.1%) and 10.63% (J_{sc} = 20.2 mA/cm^2, V_{oc} = 0.79 V, and FF = 66.6%), respectively, which are superior than the PCE of the device based on pristine ZnO.

2PS-101 정다현

Water/Ethanol Processable N-type Semiconducting Polymers for High Mobility Electrolyte-gated Transistors

정다현, 김민제[1], 이승진, 김영웅, 조정호[1], 김범준† KAIST; [1]연세대학교

Replacing toxic processing solvents with eco-friendly ones is one of the most pressing challenges for commercialization. Herein, we demonstrated water/ethanol-processed n-type organic electrolyte-gated transistors (OEGTs), utilizing naphthalene diimide-thiophene (NDI-T)-based polymers with the different side chains. To impart the ease of processability in the mixture of ethanol and water, oligo ethylene glycol (OEG) side chains were attached to the NDI backbone. Depending on the length of side chains, aggregation and crystalline behaviors of the polymers could be finely controlled. As a result, the highest electron mobility of almost 0.1 $cm^2V^{-1}s^{-1}$ was obtained in P(NDITEG-T)-based OEGT, which is one of the best performances of n-type aqueous-processed organic transistors.

2PS-102 장소영

Enhanced Device Performance Using Quinoxaline-based Polymer Donors by Thiophene Bridge Engineering for NFA Solar Cells

Vellaiappaillai Tamilavan, 장소영, 이성범, 김주현, 진영읍, 박성흠† 부경대학교

A series of new alternating polymers, based on electron-rich benzodithiophene (BDT) derivatives, namely butyloctyloxybenzodithiophene (BDTO), butyloctylthiophen-benzodithiophene (BDTT), and triisopropylsilylethynylbenzodithiophene (BDTSi), as well as electron-deficient hexylthiophen-2-yl)thiophendidodecyldifluoroquinoxaline (TTFQ) units were prepared. The various physical and chemical properties of the new polymers were investigated and compared with reported TFQ-based polymers containing BDTO, BDTT, and BDTSi. This study confirmed that the additional π-bridges between the BDT and TFQ units of new polymers do not critically alter its properties, but do alter the properties of P(BDTSi-TFQ) only. Consequently, the polymers P(BDTO-TTFQ) and P(BDTT-TTFQ) exhibit comparable power conversion efficiencies (3.99% and 6.69%) compared to those of P(BDTO-TFQ) and P(BDTT-TFQ) (3.49% and 7.06%), but P(BDTSi-TTFQ) shows a improved from PCE of 6.21% to 0.75% from P(BDTSi-TFQ).

2PS-103 임효진

Synthesis and Characterization of Fluorinated Donor Polymer Organic Solar Cells Materials

임효진, 우한영† 고려대학교

We designed and synthesized new polymer material as a donor polymer, Poly{4,8-bis(5-(2-ethylhexyl)-3-fluoro-4-hexylthiophen-2-yl)benzo[1,2-b:4,5-b']dithiophene-co-1,3-bis(2-ethylhexyl)-5,7-di(thiophen-2-yl)-4H,8H-benzo[1,2-c:4,5-c']dithiophene-4,8-dione}, for solar cell materials. By changing the position of the F atom on the BDT moiety, not only high HOMO level was observed but also the interaction between C-F···H and F···S through non-covalent bonding was enhanced. In addition, another alkyl chain was incorporated to solve the solubility problem introduced by F atom. Also, by introducing the Dithieno[2,3-d:2',3'-d'']benzo[1,2-b:4,5-b']dithiophene (DTBDT), which has a more resonant structure than BDT, The polymer is intended to have better π-π stacking, higher charge-carrier mobility and broader absorption region.

2PS-104 임지현

Triazine-based Porous Organic Polymers for Building Electron Transport Pathways in Perovskite Solar Cells

임지현, 김민성[1], 장웅식, 박진균[1], 왕동환† 중앙대학교; [1]한국외국어대학교

Porous organic polymers materials are three-dimensional structures formed through covalent bonds and have been applied in various fields by inducing effective charge extraction via large contact areas. In this study, by adjusting the synthetic strategy for porous organic polymers, excellent soluble, hypertonic and crosslinked polymers with triazine ring-based alkyl-modified perylene motifs (T-POP) were produced. Because of the large surface area of this polymer, the frequency of intermolecular contact between optically active units, such as the perylene motif of the skeleton, increases and the π-π stacking becomes stronger. The T-POP interlayer improves the morphology of the $PC_{70}BM$ layer in inverted perovskite solar cells, inducing efficient current flow and stack three-dimensional vertical structures to form electron carrier pathways. As a result, the power conversion efficiency of the T-POP applied device was increased by 13% and the stability of the device was improved.

2PS-105 임재민

Intrinsic Mobility-Strain Relationship in Flexible Organic Semiconductor Crystals via Hall Effect and Raman Spectroscopy

임재민, 한송연, 김수진, 정유정, 최현호† 경상대학교

Here we report the first measurements of Hall effect and low-frequency Raman modes of a crystalline organic semiconductor (rubrene) as a function of calibrated uniaxial mechanical strain. Our measurements reveal a strong and reversible modulation of the intrinsic (trap-free) charge carrier mobility of crystalline rubrene with strain, showing that the effective mobility can be enhanced by 70 – 110% with only 1% of compressive strain. Consistently, Raman spectroscopy reveals shifts of the low-frequency Raman modes to higher (lower) frequencies with compressive (tensile) strain, which is in line with the strain-dependent carrier mobility measurements. These studies significantly contribute to our fundamental understanding of the relationship between the carrier mobility, molecular vibrations and strain in organic semiconductors and are thus important for the foundations of strain engineering and flexible organic electronics.

2PS-106 임동언

Percolation-Limited Dual Charge Transport in Vertical p-n Heterojunction Schottky Barrier Transistors

임동언, 조새벽, 조정호† 연세대학교

Solution-processed, high-speed, and polarity-selective organic vertical Schottky barrier (SB) transistors and logic gates are presented. The organic layer, which is a bulk heterojunction (BHJ) composed of PBDB-T and PC71BM, is employed to simultaneously realize vertical electron and hole transports through the separate p-channel and n-channel. The gate-modulated graphene work functions enable broad modulation of SB heights at both the graphene-PBDB-T and graphene-PC71BM heterointerfaces. Interestingly, the fine-tuned energy-level alignment enables an exclusive injection of holes or electrons unlike conventional BHJ-based ambipolar transistors, leading to a clear transition between p-channel and n-channel single-carrier-like transistor characteristics. Furthermore, the improved percolation-limited dual charge transport in vertical architecture results in high charge carrier density and high-speed on-off switching characteristics.

2PS-107 인예령

Ultra-Low Power Electrochemical Heat Shutters Based on Diffusion-controlled Electrochromic Behaviors

인예령, 김용민, 이유정[1], 김세현[1], 이승우[1], 문홍철† 서울시립대학교; [1]영남대학교

Herein, we propose low-power consumption, all-in-one type electrochromic devices (ECDs) for effective heat shutters. Considering diffusion-controlled device operation, polymeric viologens (poly-viologens) are synthesized to lower the diffusivity of EC chromophores and to minimize self-bleaching. In comparison with devices based on mono-viologens corresponding to the monomer of poly-viologens, poly-viologen-containing ECDs exhibit advantages of lower coloration voltage and higher coloration/bleaching cyclic stability (> 90,000 s). In particular, poly-viologen ECDs show remarkably reduced self-bleaching with an extremely low-power consumption (~8.26 μW/cm^2) to maintain the colored state. Moreover, we successfully demonstrate solar heat shutters that suppress the increment of indoor temperature by taking advantage of NIR absorption of the colored ECDs.

2PS-108 이혜기

Synthesis and Characterization of Photo-Responsible LCEs Containing Hockey-stick-shaped Mesogen

이혜기, 최이준[1], 김학린[1] 금오공과대학교; [1]경북대학교

Recently, numerous studies have been made on soft actuators whose shape is reversibly changed by external stimulation. In particular, photosensitive liquid crystalline elastomers containing photochromic compounds such as azobenzene or spiropyran groups are attracting attention. Remote and local operation can be controlled via light without changing the surroundings. In many studies, acrylate-based LCEs mainly containing RM257 and azobenzene derivatives have been reported. In this study, the hockey-stick-shaped mesogenic group was introduced to maximize the volume change of the LCE film. Concretely, azobenzene-based, rod-like, and hockey-stick-shaped reactive mesogens were synthesized. The structure of obtained RMs was identified by FTIR and 1H-NMR spectrometry. Thermal and liquid crystal properties were investigated by using DSC and POM. To evaluate the photo-response properties, LCE films were prepared by surface alignment and photocuring in appropriate mixing ratios of the RMs.

2PS-109 이철재

Microporous-pyramid Patterned Hybrid Structure Based Highly Sensitive Triboelectric Nanogenerators

이철재, 이주혁† 대구경북과학기술원

Triboelectric nanogenerators (TENGs) are promising energy conversion devices that transduces mechanical energy into electrical energy based on contact electrification and the electrostatic effect. For practical electronics sensor applications, the high output performance of the TENG's is required. The output performance of the TENG is dependent on the surface area and type of contact material. Therefore, development of the surface structure that has large surface area is an encouraging way to improve the output performance of TENG. In this work, we fabricated highly sensitive TENG based on microporous-micropatterned Poly(dimethylsiloxane) (PDMS). We fabricated TENG with various micro-pattern, micro-pore size, and the density of micro-pore using Si mold and polystyrene (PS) microsphere. The patterned PDMS morphology has been investigated through scanning electron microscopy (SEM). The electrical output performance of the TENGs was measured under various compressive force and frequency.

2PS-110 이철연

Semiconducting Polymers with Sulfur-Containing Heterocycles and Their Phototransistor Characteristics

이철연, 문예진, 박지수, 이새봄, 이웅기, 김화정, 김영규† 경북대학교

Conjugated polymers have been recognized as a fascinating semiconducting material for next-generation flexible and wearable devices thanks to their inherently soft and tough characteristics compared to inorganic materials. The core benefit of conjugated polymers includes low-temperature solution processes which can deliver continuous roll-to-roll fabrications based on large-area flexible film substrates. Recently, new category of conjugated polymers has been reported by employing heterocycles with extended conjugation lengths. These new types of conjugated polymers have been used for organic solar cells and could improve power conversion efficiency. However, less attention has been paid to their applications for organic phototransistors. In this work, we tried to synthesize four different conjugated polymers with sulfur-containing heterocycles (seven-membered etc.) and investigated their photoensing characteristics by fabricating organic phototransistors.

2PS-111 이준호

Tuning Interfacial Properties with the Dipole Moment of Conjugated Polyelectrolytes

이준호, 손동환, 정미진, SABRINA AUFAR SALMA, 아날리아 도라지오 컬만, RAHMATIA FITRI BINTI NASRUN, 김주현† 부경대학교

Polyfluorene (PF) and its derivatives have been improved not only in organic light-emitting diodes (OLEDs) but also in organic solar cells (OSCs). Polyfluorene also applied as a buffer layer of OSCs for enhancing the electron mobility, charge collection, charge separation. Among these properties, we focused on electron mobility, which can be changed with various methods. In this study, The devices were fabricated by using the polyfluorene derivatives has different backbone structure which named as PFB-Br, PFT-Br, and PF2T-Br. Through investigating the devices, the electron mobility of polyelectrolytes induced from the conformation and dipole moment of polyelectrolytes was enhanced compared with the ZnO monolayer, which using as a reference of the device. As a result, the power conversion efficiency(PCE) was increased through the improvement of short-circuit current(Jsc) and fill factor derived from the developed properties of polyelectrolytes.

2PS-113 이재원

Design and Synthesis of Narrow Bandgap Nonfullerene Acceptors for Low Energy Loss Near-Infrared Organic Solar Cells

이재원†, 오필건[1] 충남대학교; [1]부경대학교

Narrow bandgap organic semiconductors are relevant as key materials components for the fabrication of near-infrared (NIR) organic solar cells (OSCs) and organic photodetectors (OPDs). Much of the interest arises due to the tunability of their energy levels and absorption properties through designing the molecular architecture, especially for nonfullerene acceptors. However, the benefits of NIR organic semiconductors remain comparatively unexplored in the context of OSCs and OPDs. A critical challenge arises as one decreases optical bandgaps (Egopt) with respect to the counterbalance between the driving force for charge separation and voltage loss in the solar cell devices. The structure-property relationships in NIR nonfullerene solar cells and photodetectors were studied.

2PS-114 이일금

Fluorinated Organic-Inorganic Hybrid Polymer Gate Dielectrics for High Performance Metal Oxide Thin-Film Transistors

이일금, 엽하경[1], 김나혜[2], 김주영[2], 김세현[1], 남수지† 한국전자통신연구원; [1]영남대학교; [2]강원대학교

Fluorinated organic-inorganic hybrid polymer (FAGPTi) was introduced as a gate dielectric layer in In-Ga-Zn-O (IGZO) thin film transistors (TFTs). FAGPTi film showed improved insulating properties after thermal annealing process. After the optimized post treatment process, the IGZO TFTs with FAGPTi gate dielectric exhibited excellent electrical performance with mobility of 3 $cm^2 V^{-1} s^{-1}$ and operational stability against external gate bias stress.

2PS-115 이웅기

Polyimide Interfacial Layers for Organic Solar Cells with Polymer:Nonfullerene Bulk Heterojunction Layers

이웅기, 김도한, 서주역, 이철연, 이수용, 이새봄, 박지수, 김화정, 김영규† 경북대학교

Organic solar cells based on conjugated polymers have been extensively studied for the last two decades and their power conversion efficiencies have been gradually improved up to ca. 18%. Both synthesis of new organic materials and invention of new device structures can be mainly accountable for such improvement in organic solar cells. Of various innovative approaches in terms of device architectures, interfacial layers have attracted keen attention because they could enhance the efficiency of organic solar cells with the same active layers in the absence of introducing new organic materials. Our group tried to invent various types of interfacial layers for organic solar cells and reported their obvious effects in enhancing the power conversion efficiencies. This presentation reports three types of polyimide-based interfacial layers, which have been designed for achieving good thermal and mechanical stabilities, for high efficiency organic solar cells with bulk heterojunction layers.

2PS-116 이영재

3차원 Direct-Ink-Writing을 위한 고전도성 나노복합체 잉크 및 유연/인쇄 전극 제조기술

이영재, 백강준† 부경대학교

Direct-Ink-Writing (DIW)은 액상 기반 잉크의 사출을 통해 사용자가 원하는 2차원 혹은 3차원 전극 패턴을 인쇄 회로 기판 상에 제조하는 직접 인쇄 기술이다. 작은 크기의 노즐을 통해 방출되는 잉크 또는 페이스트의 성분과 유체의 거동 등을 제어함으로써 차세대 유연/인쇄 전자 기기의 인쇄회로 기판을 손쉽게 제조하여 활용 가능하다. 본 연구에서는 전도성 고분자인 PEDOT:PSS와 그래핀, 탄소나노튜브 등의 전도성 나노 소재의 복합화와 나노 셀룰로오스 소재의 융합을 통해 DIW 기술에 적합한 잉크를 제조하였으며, 이를 활용하여 웨어러블 디바이스에 활용하고자 하는 연구를 수행하였다. 셀룰로오스 소재를 기재로 활용하여 하이드로젤 특성을 활용한 친환경적이며 자가 치유 가능한 전극으로 제조하였다. 따라서 본 연구에서 개발된 고전도성 고분자 하이드로-젤 전극은 DIW 인쇄 기술을 통한 인체신호 감지용 센서 및 다양한 광전자 소자에 유용하게 사용될 수 있을 것으로 기대된다.

2PS-117 이영우

ETL 표면 평탄도 개선 및 inkjet printed QD EML이 적용된 inverted QLED 소자 특성 연구

이영우, 정용철† 한국생산기술연구원

Quantum dot(QD)은 높은 색순도, 넓은 색영역, 낮은 발광 전압의 특성을 가지고 있는 재료이다. 또한 용액형태로 존재하기 때문에 inkjet을 이용한 화소 형성에 장점을 가지고 있다. 또한 ZnO NPs 전자수송층은 높은 전자이동도로 광범위하게 연구되고 있다. 상기 두 재료가 적용된 Quantum dot light emitting diode(QLED) 소자는 다층의 나노 박막으로 구성되어있기 때문에 하부막의 표면 모폴로지에 따라 이후 적층되는 박막의 표면 모폴로지가 결정된다. 따라서, 본 연구에서는 80 PPI 화소를 갖는 pixel을 이용하여 inverted QLED 소자를 제작하였으며, 처음 적층되는 재료인 ZnO layer의 표면 flatness를 개선하고 inkjet printing 공정을 이용하여 QD EML 층을 제조하였다. inverted QLED 소자의 특성평가를 통해 ZnO 표면 flatness 개선 효과를 확인하였다.

2PS-118 이연주

Photovoltaic Performance of Solid State Dye-sensitized Solar Cells with Poly (3-hexylthiophene) as Hole Transporting Material

김진아, 오다현, 이연주, 권영환[1], 한윤수† 대구가톨릭대학교; [1]대구대학교

Much attention to dye-sensitized solar cells (DSSCs) has recently been paid by their advantages for real-world applications such as transparency and/or multicolor options, easy integration into building architecture and short energy payback time. In this study, solid-state DSSCs with poly(3-hexylthiophene) (P3HT) as a hole transporting material (HTM) were fabricated, and their photovoltaic properties were investigated. When the P3HT was applied as HTM, a solid state DSSC showed a power conversion efficiency (PCE) of 0.77%, resulting from 1.63 mA/cm^2 of the short-circuit current (Jsc), 0.682 V of the open-circuit voltage (Voc) and 69.32% of fill factor (FF). On the other hand, a device with the doped P3HT layer showed a photovoltaic performance of 6.25 mA/cm^2 for the Jsc, 0.642 V for the Voc, and 62.59% for the FF, which led to a PCE of 2.51%.

2PS-119 이승진

Water/Ethanol-Soluble NDI-Based Polymer Acceptors for Eco-Friendly and Air-Stable All-Polymer Solar Cells

이승진, 김영웅, Ziang Wu[1], 이창연, 오승진, Nguyen Thanh Luan[1], 이준복, 정다현, Kai Zhang[2], Fei Huang[2], Taek-Soo Kim, 우한영[1], 김범준† KAIST; [1]고려대학교; [2]South China University of Technology

Aqueous-processed all-polymer solar cells (aq-APSCs) are reported for the first time by developing a series of water/ethanol-soluble naphthalene diimide (NDI)-based polymers P(NDIDEG-T), P(NDITEG-T), and P(NDITEG-T2). The polymers were designed by attaching hydrophilic oligoethylene glycol (OEG) side chains to facilitate processability. The P(NDIDEG-T) polymer with shortest OEG side chains exhibited the highest performance with a power conversion efficiency (PCE) of 2.15%. Furthermore, these aq-APSCs showed an outstanding air-stability as evident by maintaining more than 90% of the initial PCE in air after 4 days. Double cantilever beam tests revealed that the high interfacial adhesion properties between the OEG-based active layer and hydrophilic electron/hole transporting layers may be the origin of the enhanced durability under ambient conditions. Both the good device stability and eco-friendliness make the aq-APSCs worthy candidates for continued development of scalable PSCs.

2PS-120 이수안

Introducing Neutral Layer Design to Supressed Deformation in Stretchable Display

이수안, 신준혁, 최수석† 포항공과대학교

The cutting edge technologies of display have been rapidly progressed in terms

of foldable and rollable display technology. Also, the form factor paradigm of the display is moving into the next level deformable display, which is also known as the stretchable display technology. Developing on to the next generation technology, unlike previous flexible technology, stretchable display technology requires not only microscopic but also macroscopic deformation behavioral studies. Once the display panel is stretched toward the vertical axis, deformation such as wrinkle and distortion are inevitable due to differences in Young's modulus and Poisson ratio. In order to relieve this vertical shape distortion, we introduced a new stretchable display vertical panel structure design with a strain neutral zone. Through this study, we could observe significant suppression of shape distortion under a stretching display environment.

2PS-121 이세욱

High Efficiency Perovskite Solar Cell with a Defect-passivating Organic Hole-transport Material

이세욱, 이종민, 박상혁[1], 박희준[†] 한양대학교 유기나노공학과; [1]공주대학교 화학과

Organic-inorganic hybrid perovskite solar cells (PSCs) have attracted great attention due to their fascinating optical and electrical properties. Furthermore, their cost-effective low-temperature solution-processability has led extensive researches on low-cost flexible PSCs. However, low-temperature solution processed perovskite thin films generally contain the vacancies and defects in their surface and grain-boundary, and those imperfections induce the trap-assisted nonradiative recombination losses, decreasing their device performances. In this work, we develop a symmetrically-functionalized oxadiazole derivative molecule that can simultaneously work as an efficient hole transport layer of perovskite solar cell and passivate the defects in the perovskite photoactive layer by forming Lewis-adducts.

2PS-122 이석우

Quinoxaline-based Polymers with Strong Electron-Withdrawing Cyano Groups for Photovoltaic Applications

이석우, 정미진, 김주현, 장동욱[†] 부경대학교

We have synthesized three D-A type quinoxaline-based conjugated polymers for organic photovoltaic cells (OPVs). To construct the D-A architecture, the electron-accepting di(m-hexyloxy) phenyl-substituted quinoxaline (m-HoDPQ) unit was linked to electron-donating 2-ethylhexyloxy benzodithiophene (BDT) unit. Furthermore, the strong electron-withdrawing cyano-group was incorporated into the m-HoDPQ unit. In addition, the combination of fluorinated-alkylthienyl substituted BDT unit yielded another target polymer. A typical inverted-type device with the configuration of ITO/ZnO/Polymers : Acceptor/MoO_3/Ag was fabricated and examined. Therefore, this study can provide insights into the design and structure-property correlation of cyano-substituted quinoxaline-based polymers for organic photovoltaic cells.

2PS-124 이석우

The Study on Photovoltaic Properties of Fluorine-Substituted Quinoxaline-Based Conjugated Polymers

이석우, 정미진, 김주현, 장동욱[†] 부경대학교

Quinoxaline-based conjugated polymers have been successfully synthesized by Stille coupling reaction and used for photovoltaic applications. The electron-donating indacenodithiophene (IDT) unit was linked to the quinoxaline (Qx) which consists of fluorine group. After the confirmation of the structural features, the optical and electrochemical characteristics and the photovoltaic properties of the polymers were investigated. These all polymer devices were fabricated based on an inverted-type structure with ITO/ZnO/Polymer : Acceptor/MoO_3/Ag configuration. As a result, incorporation of fluorine into the quinoxaline significantly affected the photovoltaic properties. Therefore, this study can explain the correlation with fluorine substituent in the quinoxaline structure.

2PS-125 이명재

Universal 3D-crosslinker for Solution-processed Electronics

이명재, 김봉수[1,†] 고려대학교; [1]울산과학기술원

Solution-processed electronics demands multiple steps of patterning and stacking of diverse device components. Here, we show the fabrication of greatly combined arrays of electronic devise (organic transistors and logic gates) entirely through a series of solution processes. The fabrication is done using a tetrahedral geometry containing a perfluorophenyl azide moiety, referred to as 4Bx. 4Bx can be mixed with a variety of solution-processable electronic materials and generate cross-linked network under exposure to UV. Fully crosslinked network film can be formed at a tiny 4Bx amount, which enables preserving the inherent electrical and structural characteristics of host material. Because the cross-linked network layer is strongly resistant to chemical solvents, micropatterning the layers at high resolution as well as stacking the layers on top of each other by series of solution processing steps is possible.

2PS-126 이대한

Highly Efficient Porphyrin-Driven CO_2 Reduction via Hetero-Collisional Electron Transfer Route between Homogeneous Porphyrin and TiO_2 Semiconductor

이대한, 최민수, 나수원, 최성한, 김철훈, 강상욱, 손호진[†] 고려대학교

A zinc porphyrin complex (ZnP) was applied as visible-light photosensitizer in solution to the selective CO_2 reduction to CO in the presence of an electron donor (BIH) and a hybrid catalyst (TiO_2/ReC) prepared by anchoring of $Re(4,4'-Y_2-bpy)(CO)_3Cl$ ($Y = CH_2PO(OH)_2$) on TiO_2 particles. LED irradiation in N,N-dimethylformamide (DMF) at $>$ 500 nm resulted in the successful reduction of CO_2 to CO. The systems efficiently proceeded CO_2 to CO conversion during photocatalysis. Under lower energy irradiation ($>$ 500 nm) with added 3 vol% water in DMF solvent, the ZnP hybrid showed a TON_{Re} of ~2000 over an extended time-period of 50 h. It was found via in-situ UV-Vis absorption spectroscopy that the added porphyrin photosensitizers experience a significant photomodification during photolysis. Detailed in-situ mass analysis of supernatant after photocatalysis revealed that the original structure of porphyrin derivatives was significantly modified.

2PS-127 이기원

User-Interactive Thermotherapeutic Stretchable Strain Sensor Based on Thermochromic Property

이기원, 이시영, 조길원[†] POSTECH

User-Interactive stretchable devices act as a significant role to transform an appearance of their color and/or transparency when the mechanical stimuli apply, making them useful for various applications such as electronic skin (e-skin), smart windows, and soft robotics. Moreover, researches about the stretchable devices have recently been widely studied on thermal application for thermotherapy. We fabricate a versatile stretchable device consisting of strain-responsive silver nanowire networks on randomly patterned wrinkles and thermochromic layer being coated on the surface. The prepared stretchable strain sensor exhibits high stretchability with a linear sensitivity. The stretchable sensor can be used as a Joule-heating device with a simply tunable heat generation by utilizing the tensile strain. A user-interactive strain sensor was demonstrated to confirm the usefulness of our approach to the application including skin-attachable motion detection and thermotherapy.

2PS-128 이대한

Electron Injection Process of Porphyrin Dye into Heterogeneous TiO_2/Re(I) Photocatalyst

이대한, 최민수, 백창현, 최성한, 신재윤, 김철훈, 박종진, 강상욱, 손호진[†] 고려대학교

The net hetero-collisional electron transfer from the non-anchored fluorescent porphyrin sensitizer to the TiO_2 catalytic particles was a major event during the initial stage of the catalysis. According to *in situ* UV-Vis absorption spectroscopy and mass analysis of dye solution filtered after photolysis, the initially added porphyrin dye experienced a significant photodegradation accompanied by a breakage of π-conjugation and loss of the bulky substituents. Acetyl- or ethyl-group modified porphyrins were prepared, respectively referred to as **ZnP_{Acet}** and **ZnP_{Et}**, and this modification elevated the corresponding excited-state energy levels when comparing **ZnP** with **ZnP_{Et}**, consequently shortening the activity delay at the early stage of photolysis. Thus, chemical modification had a favorable effect on the photosensitizing and electron transportation abilities of the dye.

2PS-129 이규민

Effects of Electron Withdrawing Pendant Groups on Thiophene Backbone-based Polymers for Organic Thin-film Transistors

이규민, 정문기[1], 강진현[1], 정인환[1], 장재영[†] 한양대학교; [1]국민대학교

Two thiophene backbone-based p-type conjugated polymers with a benzodithiophenedione (BDD) moiety were synthesized with and without fluorination: fluorinated one (PF2-BDD) and non-fluorinated one (PT2-BDD). Both polymers were found to have planar backbones with efficient π conjugation, which can facilitate hole transports in organic thin-film transistors. By introducing fluorine atoms as pendant groups on the thiophene backbone, intra- and intermolecular dipole-dipole interactions (F···S and/or F···H) can be induced. As a result, PF2-BDD showed better backbone planarity and stronger intra- and intermolecular interactions than PT2-BDD. However, we found that PF2-BDD showed poorer hole mobilites than PT2-BDD, owing to solvent resistance, electron negativity, and random orientation. We think that our study can help to understand the relationship between the hole transport properties and molecular structures for designing thiophene-based p-type polymers with BDD moieties.

2PS-130 이경석

Reasearch of New Anthracene Cored Molecules for Efficiency Enhancement Layer (EEL) in Blue Fluorescent Organic Light Emitting Diodes (OLEDs)

이경석, 천형진[1], 임형철[2], 김미경[3], 김장주[2], 김윤희[1,†] 경상대학교 유기반도체 재료연구실; [1]경상대학교; [2]서울대학교; [3]삼성디스플레이

Three new anthracene cored molecules, AP3Py-Na, AP3Py-2Na and ADP3Py were designed and synthesized to use as an efficiency enhancement layer (EEL) in blue fluorescent organic light emitting diodes (OLEDs). Insertion of a very thin EEL (3 nm) between the deep blue the electron transport layer (ETL) and emitting layer (EML) improved the external quantum efficiency (EQE) of the blue device by 44% compared to the device without the EEL, resulting in external quantum efficiency of 7.9% and a current efficiency of 9.0 cd/A at 1,000 cd/m^2.

2PS-131 윤선희

Achieving High Jsc by Reducing Optical Interference Effects in PbS Colloidal Quantum Dots Solar Cells

윤선희, 최현태, 임세영, 최예림, 박태호[†] 포항공과대학교

The efficiency of previous solar cells has been limited by improper active layer thickness and the refractive index difference at p-n interfaces. In this report, we successfully designed, fabricated, and theoretically simulated PbS CQD solar cells using a textured ZnO layer. The interference effects on PbS CQD solar cells were

estimated and analysed both experimentally and theoretically, depending upon active layer thickness. As a result, by removing the interference effect with a textured ZnO layer, the PbS CQD solar cells with active layer thicknesses greater than 400 nm achieved a 25 mA/cm^2 Jsc and 11.1% PCE. This results help to reveal the effect of the optical characteristics on the charge carrier extraction efficiency of the entire device. As a basis for future work, this study provides critical insight and a strategy to design efficient emerging solar cells.

2PS-132 윤남선

Effects of Substitution on Photovoltaic Performance in Benzothiadiazole-based NIR-absorbing Small-Molecule Acceptor Solar Cells

윤남선, 송창은, 이행근, 이종철, 문상진, 신원석, 이상규† 한국화학연구원

Non-fullerene small-molecule acceptors (NFAs) have attracted considerable attention in organic solar cells with excellent performence. However, large fused-ring NFAs involves synthetic complexities. A-D-A'-D-A type non fused ring NFAs have received extensive attention due to the potential to synthetic simplicity, promising sunlight harvesting capability. Despite these advantages, less attention has yet been paid to the study of substitution on A' core. In this presentation, to deeply understand the effects of electron-donating and electron accepting substitution on the A' core, three A-D-A'-D-A type NFRAs with different substitutions on benzo[c][1,2,5] thiadiazole core, as hydrogen, alkoxy, and fluorine groups, respectively. The NFAs showed considerable variations in optical, electrochemical, and morphological properties Among the NFAs, alkoxy substituted NFA showed a high-lying frontier energy level and a well-mixed morphology with suppressed charge recombination.

2PS-133 유호선

Simple Modification of Alternating Copolymer Donor with Complementary Light Harvesting for High Performance All-Polymer Solar Cells

유호선, 마부수, 김건우, 김택수, 김범준† KAIST

In this study, two wide band gap derivatives of PM7, which are structurally simplified by ester alkyl side chains on trithiophenes instead of fused accepting unit, were utilized as donor in NDI-based all-PSCs. Two different derivatives are investigated depending on the different position of ester alkyl side chains, i.e., two ester groups on first and third thiophenes, respectively, (PM7 D1) and two ester groups on central thiophene (PM7 D2). This simple chemical modification enables light absorption to be effectively blue-shifted maintaining low HOMO energy level. As a result, the highest performance of 9.1% is achieved in PM7 D1 blend film mainly ascribed to the better complementary light harvesting. Additionally, when we examine mechanical properties, elongation property of PM7 D1 and PM7 D2 pristine and blend films is improved compared to that of PM7. This result is mainly attributed to flexible ester groups which are able to release applied stress before the film breaks.

2PS-134 유성훈

Breath-Figure Molding of Polymer Transistors to Implement Low Power, Flexible, and Highly Selective NO_x Sensors

유성훈, Henok Hetachew Girma[1], 심규민, 윤성원[2], 안상혁, 박종목[1], 공호열[1], 정대성† 포항공과대학교; [1]Research Center for Green Fine Chemicals, Korea Research Institute of Chemical Technology; [2]KIST

Strategically designed polymer semiconductor thin film morphology with both high reactivity to the specific gas analyte and high signal transport efficiency is reported to realize highly selective/sensitive flexible NO_x transistor sensors. Breath-Figure (BF) molding of polymer semiconductors enables a finely defined degree of nano-porosity in polymer films with high reproducibility while maintaining a high charge carrier mobility characteristics of organic field effect transistors (OFETs). The optimized BF-OFET with a donor-acceptor copolymer exhibits a maximum responsivity of over 10^4%, sensitivity of 774%/ppm, and limit of detection of 110 ppb against NO. Selectivity to NO_x analytes is tested by comparing the sensing ability of BF-OFET to other reducing gases and volatile organic compounds; the BF-OFET gas sensor platform monitors specific gas analytes based on their polarity and magnitude of sensitivity.

2PS-135 유성미

A Multifunctional Aromatic Polythiourea Gate Insulator with Dual Cross-linking Network for Organic Field-effect Transistors

유성미, 박현진, 원종찬, 김동균, 김윤호† 한국화학연구원

We synthesized a multifuntional aromatic polythiourea (PTU) gate dielectric with dual covalent and noncovalent interactions for organic field-effect transistors (OFETs). Aromatic PTU was successfully polymerized using condensation reaction of 1,1'-thiocarbonyldiimidazole and 4,4'-oxidianiline monomers. For crosslinking network, photo-radical reaction is possible between thiyl radical group in crosslinker, pentaerythritol tetrakis(3-mercaptopropionate), and thiourea group in PTU, and micrometer-sized patterns can be fabricated using a conventional photolithography process. Crosslinked PTU (c-PTU) thin film exhibited dielectric constant of 4.10 at 1 kHz and excellent leakage current density properties. We fabricated dinaphtho[2,3-b:2',3'-f]thieno[3,2-b]thiophene (DNTT) OFETs with the 200 nm-thick c-PTU gate insulator. DNTT OFETs with metal-oxide assisted surface treatment (MAST) of c-PTU gate insulator showed enhanced transfer properties of 1.03 cm^2/Vs and an on/off ratio of 1.48 x 10^6.

2PS-136 유경화

Morphology Optimization for High-performance Ternary Organic Solar Cells Using Non-halogenated Solvent

유경화, 정현우, 이윤구† DGIST

Ternary organic solar cell (OSC) is one of the effective strategies to improve a power conversion efficiency (PCE). Especially, selecting a third component, which has complementary absorption spectra with a host blend is significantly important to absorb light effectively in various wavelength. However, despite the potential of ternary OSCs, it is not widely used for OSCs because most device has been shown to reduce fill factor (FF). Therefore, using the third component that maintains the film morphology and forms homogeneous phases with host blend is essential. In addition, most of OSCs were processed in halogenated solvents, which can have an environmental problem. Here, ternary OSCs composed of a PBTPBD75, a IT-4F and a $PC_{71}BM$ were fabricated using non-halogenated solvent, *o*-xylene. The fabricated ternary OSCs showed improved photovoltaic performance compared to the binary OSCs.

2PS-137 원유상

High-performance Dual Hybrid Perovskite Photodetectors Utilizing Graphenes and Gold Nanostars

원유상, 이윤호[1], 박승영[2], 문정호[3], 하재환[3], 이정훈, 노준석[3], 고현협[4], 오준학† 서울대학교; [1]삼성디스플레이; [2]KRICT; [3]포항공과대학교; [4]울산과학기술원

Hybrid materials in optoelectronic devices can provide synergistic effects that enhance the properties of each component. Here, flexible high-performance perovskite hybrid photodetectors utilizing gold nanostars and graphenes are developed for strong light trapping with hot electron transfer and efficient light harvesting characteristics, respectively. While pristine perovskite photosensors do not exhibit discernible photodetecting properties because of low photon absorption and fast charge carrier recombination, graphene photosensors functionalized with GNSs and densely covered perovskite layer exhibit extraordinary photo-responsive properties with a photo-responsivity (R) of 5.90 × 10^4 AW^{-1} and specific detectivity (D^*) of 1.31 × 10^{13} Jones, which are the highest among graphene-functionalized perovskite photosensors reported so far. This work provides a new design platform for flexible and high performance photo-detecting systems.

2PS-138 오종규

A Novel Synthetic Strategy of Thienothiophene-benzotriazole-based Polymers for Field-effect Transistor Applications

오종규, 조요한[1], 김철환[1], 안태규[1], 이지훈[1], 장재영† 한양대학교; [1]한국교통대학교

Thienothiophene-benzotriazole-based polymers were systematically designed and synthesized. The backbone planarity was increased by conformational locks (F···S, F···H-C, and C-F···πF) and solubility was increased by siloxane-terminated side chains. The polymers were utilized as active layers in organic field-effect transistors, and the effects of thermal annealing on the crystallinity of polymers and their electrical characteristics were studied. Octyl-PTTBTz-F showed a hole mobility of up to 4.2 × 10^{-3} $cm^2V^{-1}s^{-1}$ with enhanced molecular orientation but it did not dissolve well in common organic solvents. The Si-PTTBTz polymer showed good solubility but inferior device performance with a hole mobility of up to 2.2 × 10^{-4} $cm^2V^{-1}s^{-1}$. The rationally designed Si-PTTBTz-F, which contains both conformational locks and siloxane-terminated side groups, exhibited a superior hole mobility of 0.11 $cm^2V^{-1}s^{-1}$ and good solubility in common organic solvents.

2PS-139 오소라

The Impact of Controlled Side Chains on the Morphology, Molecular Orientation of Small Molecule Based Photovoltaic Devices

오소라, 송창은, 이행근, 이종철, 신원석, 이상규† 한국화학연구원

A series of bis-benzodithiophene with different alkyl side-chain on thienyl group is synthesized for application as a photoactive material and hole transport layer in high-performance organic photovoltaics and perovskite solar cells. The designed small molecules provide totally different properties such as not only the optoelectronic, electrochemical and physical properties but also molecular packing/ordering and orientation. Surprisingly, when replacing alkyl side-chain, the well-ordered structure, high/balanced charge carrier mobility and favorable nanomorphology with preferable face-on orientation are developed, which are beneficial for charge transfer, transport and recombination properties in photovoltaic cells.

2PS-140 여상민

Zn1-XMgXO-based Electron Transport Layer to Promote Charge Balance for Quantum Dot Light-emitting Diodes

여상민, 이도창† 한국과학기술원

ZnO nanoparticles (NPs) are widely used for electron transport layer (ETL) of quantum dot (QD) light-emitting diodes (LEDs). Because of high electron conductivity and low electron injection barrier, excess electron injection induces charge imbalance in QD emitting layer. In this respect, we employ magnesium-doped ZnO, Zn1-XMgXO (x = 0.05, 0.1, 0.15) nanoparticles (NPs) to reduce electron mobility and broaden band gap by increasing Mg doping ratio. The inverted red QLEDs with Zn0.9Mg0.1O ETL exhibits the maximum current efficiency of 6.57 cd/A and external quantum efficiency of 5.52%, exhibiting a 76% and 79% enhancement compared to the device with ZnO ETL, respectively.

2PS-141 양회창

Backbone Tuning of Diketopyrrolopyrrole-Based Copolymer Semiconductors for High-Performance Thin Film Transistors

양회창†, 김윤희[1] 인하대학교; [1]경상대학교

Electrical properties of diketopyrrolopyrrole donor−acceptor copolymer semiconductors

are tuned via controlling the backbone building blocks with thiophene and/or selenophene moieties connect to vinylene groups, and these conjugated structures related to the charge-transport behaviors are systematically studied. We synthesize 29DPP-based copolymer derivatives with vinylene linkage between thiophene-thiophene, selenophene-selenophene units, respectively. Among the solution-processed semiconducting films, 29DPP-TVT film-based transistors show the highest charge-carrier mobility values of up to 11.1 $cm^2V^{-1}s^{-1}$ without any hysteresis. To determine the fine molecular tuning-dependent electrical properties of these semiconducting polymers, morphological and grazing-incidence X-ray diffraction are performed on the cast films. Also, via blending of these semiconducting polymers and deformable polymers, we can demonstrate the stretchable TFTs.

2PS-142 안평강

Influence of 3D Morphology on the Performance of All-polymer Solar Cells Processed Using Environmentally Benign Nonhalogenated Solvents

안평강, 이은지[I], 김봉수[†] 울산과학기술원; [1]광주과학기술원

We studied the effect of processing solvents on the photovoltaic properties and the morphology of PTB7-Th:PNDI2OD-T2 blend films. The blend films prepared by toluene and *o*-xylene showed power conversion efficiencies (PCEs) of ~4%, while those prepared by halogenated solvents showed PCEs of ~3%. Using *N*-dimethylformamide, *N*,*N*-dimethylacetamide, or *N*-methyl-2-pyrrolidone as a solvent additive in *o*-xylene solution resulted in a significant improvement of the PCEs to 6.1%. Three-dimensional (3D) transmission electron microscopy tomography (TEMT) revealed the correlation of the 3D morphology and photovoltaic performance of the PTB7-Th:PNDI2OD-T2 blend films. This experiment suggests that all-polymer solar cells (APSCs) prepared by benign nonhalogenated solvents with appropriate additives can outperform ASPCs prepared by toxic halogenated solvents and 3D TEMT imaging is a useful analysis for characterizing the morphology of photoactive layers.

2PS-143 양회창

Dopant-Enhanced Ordering and Conductivity of Solution-Processed Semiconducting Polymer Thin Films

양회창[†] 인하대학교

The impact of dopant loading into semiconducting polymer solutions is investigated to control the optoelectrical properties of poly(3-hexyl thiophene)s. PHT system doped with different F4TCNQ dopant loadings shows controllable conjugated structures in both solutions and spun-cast films. Via simple blending of RR PHT and F4TCNQ solutions, the nucleation and growth of PHT aggregates are with an increase in molar dopant ratio (MDR). Also, it is found that some dopants can be positioned to the intermolecular backbones of RR PHT and form a mixed crystalline structure, which has a shorter π-π overlapping distance, in comparison to the pure polymer system. At low-level of MDR = 0.005 (or 0.015) the conjugated crystallinity of the doped RR PHT self-assembled film has been greatly improved, and the carrier mobility (0.1 $cm^2V^{-1}s^{-1}$) of resultant OTFTs has increased by more than 100 times compared to neat RR PHT.

2PS-144 안태규

Facile Photo-crosslinking System for Polymeric Gate Dielectric Materials toward Solution-processed Organic Field-effect Transistors: Role of Crosslinker in Various Polymer Types

안태규[†], 권혁진[I], 정용진 한국교통대학교; [1]포항공과대학교

Solution-processed organic field-effect transistors (OFETs) are highly sought after in the low-cost printing industry as well as for the manufacture of flexible and other next-generation devices. The fabrication of such electronic devices requires high functioning insulating materials that are chemically and mechanically robust to avoid lowering insulating properties during device fabrication process or utilization of devices. In this study, we report facile, fluorinated, UV-assisted crosslinker series using a fluorophenyl azide (FPA), which reacts with the C-H groups of a conventional polymer. This demonstrates the application of the crosslinked films in OFET gate dielectrics.

2PS-145 아티싼 마헤쉬와란

Deep-Blue Phosphorescent Organic Light-Emitting Diodes with Excellent External Quantum Efficiency up to 24% with CIEy Value of 0.08

아티싼 마헤쉬와란, 박호열, 제갈영순[I], 진성호[†] 부산대학교; [1]경일대학교

Deep-blue triplet emitters remain far inferior to standard red and green triplet emitters in terms of exhibiting high color purities Commission International de l'Éclairage (CIE y values of ≤ 0.1), external quantum efficiencies (EQEs), and high electroluminescent brightnesses in phosphorescent organic light emitting diodes. In this study, *mer*-tris(N-phenyl, N-benzyl-pyridoimidazol-2-yl)iridium(III) (*mer*-Ir1) is developed, which meets the requirements of the National Television System Committee CIE (x, y) coordinates of (0.149, 0.085) with an extremely high EQE of 24.8% and maximum brightness (L_{max}) of 6453 cd m^{-2}, by device C with a 40 vol% doping ratio. Moreover, the device A fabricated an EQE_{max} of 21.3%, an L_{max} of 5247 cd m^{-2}, and CIE(x, y) coordinates of (0.151, 0.086) at a 30 vol% doping ratio. This is the first report of high performance, deep-blue phosphor, carbene-based Ir(III) complex device with outstanding CIE(x, y) color coordinates and a high EQE.

2PS-146 안태규

Surface Modification of CdSe Quantum Dot Floating Layers in Light-responsive Organic Flash Memory

안태규, 김재영, 이지훈, 정용진[†] 한국교통대학교

In this work, we processed the surface modification of CdSe quantum dot floating layers toward the fabrication of organic field-effect transistors (OFETs) and discussed the feasibility of the light-responsive flash memory devices. A new functional thiol with pentafluorophenyl group was synthesized to control dipole moment and surface properties, all of which could affect the transistor operation when they are used as surface modifiers on the CdSe quantum dot floating layers in the OFETs. This new functional thiol exhibited larger dipole moments compared to the commercial 2,3,4,5,6-pentafluorothiophenol. The resulting OFETs showed normally-on transistor operation and sensitive response upon the voltage bias and white-light bias, and could be utilized in non-volatile flexible memory device applications.

2PS-147 아날리아 도라지오 컬만

Synthesis and Characterization of IDTT Derivatives for Organic Solar Cell

아날리아 도라지오 컬만, SABRINA AUFAR SALMA, 정미진, RAHMATIA FITRI BINTI NASRUN, 손동환, 이준호, 김주현[†] 부경대학교

New acceptor-donor-acceptor (A-D-A) type conjugated small-molecule-dyes, based on indacedithieno[3,2-b]thiophene (**IDTT**), named **IDTT-OX** and **IDTT-EPMP-IDC** have been synthesized and characterized for solution-processed bulk heterojunction organic solar cells (OSCs). These molecules contain **IDTT** as the donor moiety, **OX** (phenylisoxazolone) and **EPMP-IDC** (malononitrile derivatives) as the acceptor moeity. **IDTT-OX** exhibits a strong self-aggregation behavior and broad absorption with an optical band gap of 1.88 eV. While **IDTT-EPMP-IDC** shows effectively restricted self-aggregation due to the presence of the alkyl group at **EPMP-IDC** and it has 1.60 eV optical band gap. To evaluate the performance of these molecules as a donor, inverted-type OSCs based on the blend of **IDTT-OX** (or **IDTT-EPMP-IDC**) and $PC_{71}BM$ as an acceptor were fabricated. The power conversion efficiencies (PCEs) of the optimized OSCs for **IDTT-OX** and **IDTT-EPMP-IDC** reached up to 0.29% and 2.07%, respectively.

2PS-148 안태규

Improved Contact Properties of Spray-Coated AgNWs Source and Drain Electrodes in Oxide Thin-Film Transistors

안태규, 정선영, 정용진[†] 한국교통대학교

In this study, source and drain electrodes were prepared with silver nanowires (AgNWs) using spray coating and hot press techniques. Though the spray coating allows AgNWs patterns to be functioned as electrodes in oxide TFT, but as-sprayed films do not have good physical contact with oxide semiconductors but form an interspace that impedes electron injection into the semiconductors. Hot press produces denser AgNWs networks that were tightly contacted with the oxide semiconductors, where the hot-pressed films are considered as satisfactory source and drain electrodes for high-performance oxide TFTs with providing an easy electron injection. Finally, the resulting oxide TFTs with hot-pressed AgNWs electrodes are found to exhibit field-effect mobility up to 4.75 ± 1.5 cm^2/Vs, much better than those of the TFTs with as-sprayed AgNWs electrodes. This was supported by Korea National University of Transportation in 2020.

2PS-149 심규민

Colloidal Synthesis of Cu_2BaSnS_4 (CBTS) for Hole Transport Layer Applications of Organic Photodiode

심규민, 정대성[I,†] 대구경북과학기술원; [1]포항공과대학교

Cu_2BaSnS_4 is an earth-abundant and environmentally benign semiconductor. However, there has been no prior report of colloidal CBTS nanocrystals. For that reason, we developed a colloidal synthesis of CBTS nanocrystals by rational design. Finally, thin films of CBTS nanocrystals grown at room temperature are used as a hole transport layer (HTL) in an organic photodiode yielding a high peak specific detectivity with low noise equivalent power. These results suggest that our colloidal CBTS nanocrystals have potential for optoelectronic applications.

2PS-150 신인수

Effect of Structural Modulation of Polymeric 3rd Component on the Performance of Polymer Solar Cells

신인수, Vellaiappillai Tamilavan, 김단비, 양현석, 정윤경[I], 정중현, 이보람, 김주현[2], 손세모[3], 박성흠[†] Department of Physics, Pukyong National University; [1]School of Biomedical Engineering, Inje University; [2]Department of Polymer Engineering, Pukyong National University; [3]Department of Graphic Arts Engineering, Pukyong National University

The properties of co-absorbing wide band-gap polymers re fine-tuned via the insertion of two different appropriate electron-acceptor units on their backbone in different ratios, and the resulting polymers are utilized as a co-absorbent on ter-PSCs. The copolymerization of benzodithiophene, pyrrolopyrrole-1,3-dione, and difluoro-benzothiadiazole derivatives at three different ratios, 1.00:1.00:0.00, 1.00:0.50:0.50, and 1.00:0.25:0.75, produces the polymers P1-P3. The crystallinity of the polymers is increased in the order of P1 < P2 < P3. The inclusion of 20 wt% of each of P1, P2, and P3 on a P4 (=PTB7-Th):PC70BM blend offers PCEs of 9.31%, 9.60%, and 9.85%, respectively, which are higher than that of the bi-PSC made using a blend of P4:PC70BM (PCE = 8.20%). The improved absorption, crystallinity, and carrier mobilities of the ternary blends are the main reasons for their enhanced photovoltaic performance compared with the binary blends.

2PS-151 신우현

Three-dimensional Artificial Skin Device with Self-healing and Tactile Sensing Functionality

신우현, 김준섭, 최희주, 김희성, 이희정, 정경운† 한국기계연구원 부설 재료연구소(KIMS)
Human skin completely covers body parts with diverse shapes, can cure physical injury spontaneously, and sensitively detects a touch. Researchers have investigated e-skin devices, concentrating on the sensing functionality of the skin. Still, most e-skin devices have restrictions in their shapes and in realizing multiple functionality in one device. Here, application-oriented 3-dimensional hydrogel device which can heal mechanical damage spontaneously and detect accurate touch point are demonstrated as a new artificial skin devices. The 3-dimensional ring and fingertip-shaped artificial skin devices are successfully prepared to fit completely on finger models. Upon a human finger contact, the devices provide the accurate positional information of an arbitrary touch point even on a complex-shaped 3-dimensional artificial skin device without complicated device preparation or data processing.

2PS-152 손선영

Hybrid Organic Photovoltaic Cells Integrated with Liquid Contact Triboelectric Nanogenerator for Energy Harvesting

손선영, 유동현, 김동성, 정성준† 포스텍
Although the OPV device has many advantages, it is hard to produce energy on cloud or rainy days. For realize energy harvesting regardless of the weather, we have developed the liquid contact TENG integrated OPV hybrid cells. The hybrid cells have made possible to produce energy in a bifacial structure due to the transparent TENG, which does not affect the light absorption and the semi-transparent OPV. The current-energy production of hybrid cell was nearly zero ($\sim10^{-5}$ mA) when dust accumulated on the device surface, whereas the hybrid cell exhibited a self-cleaning effect about 70% recovery from 34 mA to 23 mA due to the high water repellency of TENG surface. This research was supported by Korea Electric Power Corporation (Grant Number: R18XA06-11).

2PS-153 손동환

Photovoltaic Properties of A-D-A Small molecule-based on Indacenodithieno [3,2-b]thiophene with Chromone Derivative For Organic Solar Cells

손동환, 아날리아 도라지오 컬만, SABRINA AUFAR SALMA, 정미진, 이준호, RAHMATIA FITRI BINTI NASRUN, 김주현† 부경대학교
We designed conjugated small-molecule-donor materials based on Indacenodithieno [3,2-b]thiophene (IDTT) and chromone derivatives, named SMD1 (without fluorine) and SMD2 (with fluorine) for organic solar cells. Effective ICT came from the powerful push-pull structure and when chromone derivatives as an electron-accepting group combined with IDTT increased optical absorption. The device performance of the small molecule end-capped with chromone derivatives with fluorine exhibits higher efficiency than the other one. When the devices processed additive DIO, the performance was decreased. The SMD1 energy levels were -5.33 eV and -3.56 eV, The SMD2 energy levels were -5.39 eV and 3.50 eV. The devices PCE of SMD1/PC71BM and SMD2/PC71BM without the addition of DIO were 1.03% and 2.23%.

2PS-154 손선영

Highly-Efficient Phosphorescent Organic Light-Emitting Diodes with Horizontal Oriented Iridium(III) Complexes

손선영, 전현진[1], 안형주[2], 정성준, 권순기[3], 김윤희[1,†] 포스텍 창의IT융합공학과; [1]경상대학교 화학과; [2]포항가속기연구소; [3]경상대학교 나노신소재공학부
The synthesized green iridium(III) complex dopants with ancillary ligands of homoleptic or heteroleptic structure were characterized. The green phosphorescent OLEDs with 2,2',6,6'-tetramethylheptanedionate (tmd) dopant exhibit higher device efficiencies of 20.9%, 77.8 cd/A, 69.8 lm/W than that of the conventional Ir(ppy)3 emitter of 17.6%, 60.2 cd/A, 52.6 lm/W. The high efficiency OLEDs containing tmd ligand can be explained due to preferred dipole orientation in horizontal direction which shows the relatively strong intensity at χ=0 and narrow azimuthal intensity distribution in 2D-GIWAXD. This research supported by NRF-2019R1I1A1A01064203 of Korea grant.

2PS-155 백창현

The Substituent-Effect of Deep-Blue Phosphorescent N-Heterocyclic Carbene (NHC) Ir(III) Complexes and the Application in OLED Devices

백창현, 나수원, 최민수, 김진형, 조대원, 강상욱, 손호진† 고려대학교
To evaluate the efficacy of ortho-aryllation in the second coordination sphere of octrahedral iridium complex, a series of homoleptic NHC-based $Ir(C^{\wedge}C^{R})_3$-type complexes were desgined and prepared by introducing various substituents (R = H, Me, Ph, MePh, and diMePh) at the ortho-position of the aryl unit of orthometalling phenyl group. In solution, unnoticiable increase of emission quantum yields was observed within the variation of the ortho-substituent of sterically demanding side-branch, a -diMePh group, showing the radiative quantum yield of *m*-$Ir(C^{\wedge}C^{diMePh})_3$ (Φ_{PL} = 1.9%) being higher than that of the pristine carbene-based *m*-$Ir(C^{\wedge}C^{H})_3$ (Φ_{PL} = 1.2%).

2PS-156 박춘희

Synthesis of Highly Fluorinated Polymer Photoresist for Photo-patterning of Organic Light Emitting Diode (OLED) Displays

박춘희, 이진규† 인하대학교
A highly fluorinated polymers for non-chemically amplified resists (non-CAR) were prepared, and micro-scale photo-patterning process by photolithography for organic light emitting diode (OLED) pixels was proposed. 'The highly fluorinated photoresist', poly(FOMA-r-SPMA-r-αBMOMA-r-IBMA) was synthesized. It was composed of 1H, 1H, 2H, 2H-perfluorooctyl methacrylate (FOMA), isobornyl methacrylate (IBMA), spiropyran methacrylate (SPMA) and alpha-benzil monoxime methacrylate (α-BMOMA) as monomers. The copolymer was synthesized via reversible addition-fragmentation chain-transfer (RAFT) polymerization or free radical polymerization. When the polymer photoresist is irradiated by UV exposure (wavelength : 365 nm), the solubility of the exposed portion is increased due to a change in chemical structure to form a positive-tone pattern. Furthermore, An OLED pixel was manufactured using this highly fluorinated photoresist and a 15 μm half-pitch green phosphorescent OLED pixels was confirmed.

2PS-157 백창현

Photophysical Properties of Structural Isomers of N-Heterocyclic Carbene Iridium(III) Complexes Derived from Xylene Substitution

백창현, 나수원, 이대한, 윤보선, 조대원, 강상욱, 손호진† 고려대학교
We investigated the photophysical properties of ***fac*-Ir(pmp)$_3$**, ***mer*-Ir(pmp)$_3$**, ***fac*-Ir(dmpmp)$_3$**, and ***mer*-Ir(dmpmp)$_3$** (where pmp = 3-methyl-1-phenyl-2,3-dihydro-1H-imidazo[4,5-*b*]pyridine and dmpmp = 1-(2',6'-dimethylbiphenyl-2-yl)-3-methyl-2,3-dihydro-1H-imidazo[4,5-*b*]pyridine). At 77 K, the *fac*-isomers showed blue emission with a vibronic structure, while the mer-isomers showed less structured emissions. At 300 K, all complexes showed broad and markedly red-shifted emission spectra compared to those at 77 K. The quantum yields of the **Ir(dmpmp)$_3$** isomers were very low, and their emission lifetimes were very short compared to those of **Ir(pmp)$_3$**. In order to understand the large differences between the photodynamic properties of **Ir(pmp)$_3$** and **Ir(dmpmp)$_3$**, we performed femtosecond time-resolved transient absorption (TA) spectroscopic measurements. The TA spectra of **Ir(dmpmp)$_3$** were almost the same as those of **Ir(pmp)$_3$** at a short delay time.

2PS-158 박진수

Elucidating Important Roles of Polymer Donor Aggregation in Blend Morphology and Device Performance of Different Types of Non-Fullerene Polymer Solar Cells

박진수, 최나연, 이창연, 이승진, 하종운[1], 황도훈[1], 김범준† KAIST; [1]부산대학교
We report the first comparative study of polymer donor (PD) aggregation effects in all-polymer solar cells (all-PSCs) and non-fullerene small molecule acceptor (NFSMA)-PSCs based on BDT-ttTPD-based polymer donor series with different aggregation behaviors. It is observed that PD aggregation is a decisive factor in both systems, but its impact is more significant in all-PSCs. The P-Si PD with the strongest aggregation yields severe phase separation in the all-polymer blend, resulting in low power conversion efficiencies (PCEs) of corresponding all-PSCs. In contrast, the P-Si based NFSMA-PSC shows a well-mixed blend morphology, leading to the highest PCE of 12%. These different roles of PD aggregation originate from different entropic contributions to the mixing of two materials, which is inversely related to the molecular size of the acceptor. Thus, our work provides a comprehensive understanding of the PD aggregation-blend morphology relationship in two non-fullerene PSC systems.

2PS-159 박지현

Synthesis of New Donor-Acceptor Copolymer for Organic Thin Film Transistor (OTFT)

박지현, 김윤희†, 권순기 경상대학교
PTesADT-BTz is the new donor-acceptor copolymer, which was synthesized through stille coupling. And PTesADT-BTz has triethylsilylethynylanthradithiophene as donor and bithiazole as acceptor. The structure and properties of synthesized polymer was characterized and identified by H-NMR and FT-IR. The measured number average molecular weight (Mn) of obtained polymer was 13000 and the weight average molecular weight (Mw) was 23000. UV-visible spectroscopy, cyclovoltammetry, thermogravimetric analysis, and differencial scanning calorimetry were used to analyze characteristics of PTesADT-BTz. The OFET employing PTesADT-BTz spin-cast from chloroform solutions at 100 ℃ annealing showed the mobility of 4.93×10^{-6} $cm^2/V \cdot s$, subthreshold slope of 29.7 V, and an on/off ratio of 2.20×10^2.

2PS-160 박종호

Design and Synthesis of Imidazole Coupled Diphenylamine Derivatives as Hole-transport Materials for Perovskite Solar Cells

박종호, 박상혁† 공주대학교
Hole transport materials are the key material for preparing high performance perovskite solar cells (PSCs). Herein we present three novel and efficient compounds, DPA-TPIC-OMe, 3DPA-TPIC, 3DMDPA-TPIC are synthesis via Buchwald-Hartwig amination reaction and used as hole transport materials for perovskite solar cell. The relationships between molecular structure, electronic properties of the semiconductor and eventually photovoltaic performance are investigated. Further, DPA-TPIC-OMe exhibits a deeper highest occupied molecular orbital (HOMO) energy lever of -5.27 eV, high hole mobility and high glass transition temperature (T_g) than spiro-OMeTAD indicating a potential HTM for PSCs.

2PS-161 박종민

Cross-Linked Polymer Semiconductor-Based OFET Sensors for Direct Detection of Organic Solvent

박종민, 이무열[1], 김형준[2], 정관영[3], 한아름[3], 곽상규[3], 김범준[2], 오준학† 서울대학교; [1]KIST; [2]KAIST; [3]UNIST
Organic field-effect transistors (OFETs) sensor has attracted attention due to its various advantages including easy fabrication, low cost, lightweight, processibility, and flexibility. Though organic field-effect transistors can easily fabricate by using the solution process, it can also easily be damaged by organic solvents. The poor chemical

resistance applicability of OFETs sensor limits commercial. Herein, we report about OFET sensors which can directly detect organic solvent due to its cross-linkable azide functional group. Also, we improve the sensitivity of OFET sensors by depositing calixarene derivatives. Various liquid-phase analytes have been detected successfully and reliable sensing responses have been obtained. Our research demonstrates a novel methodology for the fabrication of high-performance organic sensors and could extend the practical applications of OFET-based sensors.

2PS-162 박영상

친환경 양자점 InAs 기반 고효율 고안정성 태양전지 소자 연구

박영상, 배성용[1], 박성민[2], 김태완[2], 최효성[1], 김영훈[3], 정소희[2,†] 한국과학기술원; [1]한양대학교; [2]성균관대학교; [3]대구경북과학기술원

Colloidal quantum dot solar cell is one of the attractive next generation solar cell based on low-cost, simple solution process. However, most of solar cell include Pb element, which has been an obstacle for commercialization. InAs, one of the eco-friendly materials, has tunable band gap from visible to near infra-red with large bohr radius. Also level of energy is readily shifted depending on surface ligands. Here, we introduced continuous injection so that synthesized the quantum dot with desirable size. Then, we controled the surface ligands with two-step treatment for the preferred energy level. Lastly, we applied it to solar cell, and demonstrated high-efficient, stable properties.

2PS-164 박성빈

Breath Figure Patterned Light Extraction Structures for High Performance Organic Light-Emitting Diodes

박성빈, 한주원, 주철웅[2], 이종희[2], 김용현[†] 부경대학교; [1]한국전자통신연구원(ETRI); [2]한밭대학교

We report light extraction efficiency enhanced organic light-emitting diodes (OLEDs) using microlens array films prepared by a simple solution-processed imprinting technique with breath figure patterns. The characteristics of angle-dependent spectrum stability for OLEDs with the breath figure extraction film have not been studied so far. The films with breath figure micro-patterns (BFMP) effectively extract confined light in the glass substrate, which leads to the greatly improved light extraction performance of OLEDs. We observe the enhancement of external quantum efficiency of the OLEDs employing the BFMP extract film is about 1.51, corresponding to the enhancement of the power efficiency by a factor of 1.65. Moreover, the device with the light extraction film shows the limited angle-dependency of emission spectrum over viewing angles. The BFMP films prepared with a low-cost, simple, and solution-processable fabrication process can pave the way to achieving high-performance OLEDs.

2PS-165 박상아

Green-Solvent-Processable Hole Transport Polymers with Lead-Capturability in Perovskite Solar Cells

박상아, 이준우, 최현태, 이대환, 최예림, 김성룡, 박태호[†] POSTECH

As hole-transporting materials (HTM) of perovskite solar cells (PSCs) are developed, diverse functionalities are required for next-generation devices. A novel semiconducting polymer, alkoxy-PTEG, can be soluble even in nonaromatic and polar solvents, such as 3-methylcyclohexanone (3-MC), and can chelate with lead ion in perovskite which is harmful chemical. Finally, alkoxy-PTEG device without any dopants processed with 3-MC shows power conversion efficiency (PCE) of 19.9% and a device with 2-methyl anisole, which is also known as aromatic solvents, exhibits PCE of 21.2% in a tin oxide planar structure. The chelating ability of TEG groups with lead ions shows moderate strength (Kbinding = 2.76) which is measured by nuclear magnetic resonance. This is the first report providing the solutions of lead leakage.

2PS-166 민지현

Surface Modified Fullerene Electron Transport Layers for Stable and Reproducible Flexible Perovskite Solar Cells

민지현, 최경원, 최현태, 임세영, 윤선희, 박태호[†] 포항공과대학교

The need for high temperature to proceed with TiO_2 based electron transport layer (ETL) prevents the utility of perovskite solar cells. Recent development on other ETLs makes it possible to process in low temperature, but such ETLs cannot endure external bending, which means low flexibility. Herein, we report a low temperature processed ETL which enables the flexible planar perovskite solar cells. A poly(allylamine) (PAA; 0.08 wt%) solution was deposited on a C60 layer and heated at 150 ℃ for 60 s, resulting in the formation of an insoluble robust C60-PAA ETL on the flexible substrate. The flexible planar perovskite solar cell with the C60-PAA ETL exhibited excellent properties with 83% efficiency retention as well as high efficiency (15.2%) without any hysteresis after 600 cycles of bending. This kind of strategy would positively affect the photovoltaic market.

2PS-167 로 반

The Surface Modification of CdS Photocatalyst by Inorganic Ions for the Improvement of CO_2 Reduction

로 반, 이도창[†] 한국과학기술원

Carbon dioxide (CO_2) conversion has been attracted many concerns due to the high greenhouse gas level in the atmosphere. The photocatalytic reduction of CO_2 is an attractive technology that uses directly solar energy to convert CO_2 into valuable chemicals in an environment-friendly way. However, the effective reduction process is not easy because the cathodic process has a high overpotential barrier with low selectivity to a certain product. Recent research focused on the utility of co-catalyst to improve the photocatalytic performance, while effect of inorganic surface ligand remained largely unexplored. To the best of our knowledge, the only example where the inorganic ligands was used for photocatalytic CO_2 reduction is the use of Tetrafluoroborate (BF_4^-) for the enhancement of yield. In this study, the effect of not only the capping ionic ligands but also the cation ions on the photocatalysis will be studied.

2PS-168 라자 쿠마레즌

Highly Efficiency Green Ir(III) Complexes with External Quantum Efficiency Over 20% in Green Solvent Processed Phosphorescent Organic Light-Emitting Diodes

라자 쿠마레즌, 박호열[1], 아티싼 마헤쉬와란[1], 제갈영순[2], 진성호[1,†] 부산대학교 화학소재학과; [1]부산대학교; [2]경일대학교

Three new highly efficient green-emitting heteroleptic Ir(III) complexes based on naphthyridin-one core were designed and synthesized. The complex Ir1 consists of multifunctional 4-(2-ethoxyethoxy)picolinate as ancillary ligand whereas Ir2 and Ir3 have conventional ancillary ligand such as picolinate. Their photophysical, thermal and electrochemical properties were fully investigated. All the three complexes exhibited intense green emission in solution at room temperature. Interestingly, the Ir(III) complexes exhibited high PLQY over 70% in solution. The high-performance green-solvent processed PHOLEDs with Ir1 exhibits the maximum external quantum efficiency (EQE_{max}) of 23.60% and maximum current efficiency (CE_{max}) of 85.22 cd A^{-1} among this is highest reported CEs and EQE in green-solvent processed PHOLEDs. Additionally, the green PHOLEDs with Ir2 and Ir3 shows the EQE_{max} and CE_{max} of 21.54, 22.40% and 77.92, 81.63 cd A^{-1} at 1000 cd m^{-2}, respectively.

2PS-169 노유진

Doping or Mixing: Role of Monovalent Metal Iodide in Two-Dimensional Perovskite Transistor

노유진, HUIHUI ZHU, AO LIU, 고지영, 최태수, 노용영[†] 포항공과대학교

The application of organic-inorganic perovskite on thin-film transistors (TFTs) is recently gaining significant attention due to their intrinsically high carrier mobility. Research on perovskite TFT has been focused on engineering approaches, while study on doping is crucial, but yet to be investigated. In this study, we report the combined theoretical and experimental approaches to investigate the structural variation of phenethylammonium tin iodide ($(PEA)_2SnI_4$) perovskite before/after doping and the resultant device performance. Theoretical studies demonstrate that perovskite structure was destroyed after incorporation of the chosen monovalent cations, Cu^+, Na^+ and Ag^+. A series of experiments with CuI, NaI and AgI on transistors and phototransistors revealed enhanced device performance with increased mobility, reduced hysteresis and enhanced detectivity. Especially, heterostructure of CuI-$(PEA)_2SnI_4$ film showed best performance, due to its excellent hole transporting property.

2PS-170 남건희

친환경 수성 콜로이드를 이용한 열전소자의 제작

남건희, 하재언, 심혜륜[1], 정대성[1,†] 대구경북과학기술원; [1]포항공과대학교

유기 용매에 용해된 고분자 반도체를 계면 활성제를 사용하여 수성 매체로 전달하기 위해, 미니 에멀젼 합성을 기반으로 고분자 열전소자 제작을 위한 친환경 공정이 사용되었다. 콜로이드의 입자 크기와 계면활성제 마이셀의 농도가 콜로이드 용액에서 제작된 필름의 최종 형태에 영향을 미칠 수 있다는 점을 고려하여, 콜로이드 용액에서 계면 활성제를 추출하는 투석 시간을 변화시켜 PBTTT-C_{14} 필름의 다양한 모폴로지를 구현하였다. 박막 형성 전 콜로이드 용액에서 이러한 현상은 투석 시간이 증가함에 따라 더 부드럽고 연속적인 필름 형태를 나타내었다. 전하 캐리어 이동도와 전기전도도는 필름 형태가 부드러워 짐에 증가했지만, 상태 밀도가 낮아짐 따라 결정질 장애가 증가하여 Seebeck 계수가 증가하는 경향을 보인다. 최적화된 필름 형태를 가진 유기 열전소자를 통해 495.96 μV K^{-1}의 높은 Seebeck 계수와 54.89 μW m^{-1} K^{-2}의 power factor를 달성하였다. 이러한 접근 방식은 물을 용매로 사용하여 고성능 유기 열전소자를 제조 할 수있는 가능성을 보여준다.

2PS-171 나수원

Influence of Bulky Substituents on the Photophysical Properties of Homoleptic Iridium(III) Complexes

나수원, 백창현, 최민수, 김진형, 조대원, 강상욱, 손호진[†] 고려대학교

A new series of homoleptic cyclometalated iridium(III) complexes based on a phenylpyridine (ppy) ligand containing bulky substituents have been synthesized and characterized. Comparison of the results with those of the reference $Ir(ppy)_3$ reveals that the emission color and photophysical properties of other Ir complexes are influenced by the electron-donating groups attached to the ppy ligand. The emission spectrum of $Ir(Me-ppy)_3$, having $-CH_3$ group, is red-shifted; however, the emission quantum yield is low and the nonradiative decay constant is large. On the other hand, although bulky phenyl derivative-adducts ($Ir(Ph-ppy)_3$, $Ir(MePh-ppy)_3$, and $Ir(diMePh-ppy)_3$) also exhibit red-shifted emission, their kinetic and photophysical behaviors are more optimal than those of $Ir(Me-ppy)_3$, whose behavior does not follow the energy gap law. This deviation may be attributed to the orthogonal structure associated with the steric hindrance of bulky substituents.

2PS-172 김희재

Design of Deep Blue Thermally Activated Delayed Fluorescence Materials

김희재, PREM PRABHAKARAN, 황동렬[†] 한남대학교

Organic light-emitting diodes (OLEDs) using thermally activated delayed fluorescence

(TADF) has been attracted many researchers since they can utilize both singlet and triplet excitons, thus theoretically can reach 100% internal quantum efficiency. Developing blue emitting TADF material is still challenging since they often suffer from low stability and broad emission spectrum. Here we report rationally designed TADF emitters with donor–acceptor configurations. Density functional theory (DFT) based calculations reveals spatially well separated highest occupied and lowest unoccupied molecular orbitals, resulting in small singlet–triplet splitting of ~10 meV. Spectroscopic measurements confirm their room–temperature TADF behavior with emission maximum ranging from 464–471 nm. Simple and rigid molecular structure further gives their chemical/electrochemical stability.

2PS-173 김태욱

One–dimensional Organic Artificial Multi–synapses Enabling Electronic–textile Neural Network for Wearable Neuromorphic Applications

강민지, 함성길[1], 장성훈[1], 장진곤[1], 왕건욱[1], 김태욱† 전북대학교; [1]고려대학교

One–dimensional (1D) devices are becoming the most desirable format for wearable electronic technology because they can be easily woven into electronic (e–)textile(s) with versatile functional units while maintaining their inherent features under mechanical stress. In this study, we designed 1D fiber–shaped multi–synapses comprising ferroelectric organic transistors fabricated on a 100 m Ag wire and utilized them as multi–synaptic channels in an e–textile neural network for wearable neuromorphic applications. The device mimics diverse synaptic functions, including short– and long–term plasticity with 80 states and spike rate– and timing–dependent plasticity. It exhibited excellent reliability even under 6,000 repeated input stimuli and mechanical bending stress. Various NOR–type textile arrays are formed simply by cross–pointing 1D synapses with Ag wires.

2PS-174 김태연

Smart Contact Lens with Silver Nanowire Sensor for Continuous Intraocular Pressure Monitoring

김태연, 한세광† 포항공과대학교

Continuous intraocular pressure monitoring has been extensively investigated as a new paradigm in the management of patients with glaucoma. Despite these efforts, the sensitivity and stability of strain sensors operated by wireless power and communication systems in smart contact lenses have limited the practical applications for IOP monitoring. Here, we have developed a smart contact lens integrated with a transparent AgNW IOP sensor and wireless circuits for continuous, non–invasive IOP monitoring. After confirming the robust stability of the IOP sensor in the smart contact lens in the presence of tears and repeated eyelid blink model cycles, we were able to monitor IOP changes on PDMS model eyes in vitro. In vivo tests demonstrated that our fully integrated, wireless smart contact lens could successfully monitor the change of IOP in living rabbit eyes. Taken together, we could confirm the feasibility of our smart contact lens as a non–invasive platform for monitoring changes in IOP.

2PS-175 김창균

C70–based Aqueous–Soluble Fullerene Acceptor for Eco–Friendly Polymer Solar Cells with Water Composition–Tolerant Performance

김창균, 강현범, 최나연, 이승진, 김영권, 김진우, 우한영[1], 우즈앙[1], 김범준† 한국과학기술원; [1]고려대학교

Eco–PSCs based on aqueous–soluble conjugated materials have recently received great attention. In this work, the development of an aqueous–processable C70–based fullerene (PC71BO15) is reported. The PCEs of PC71BO15–based eco–PSCs up to 2.51%, which is the highest value for aqueous–processed PSCs, was achieved. At the optimized condition, the PCE of the PC71BO15–based eco–PSCs is 73% higher than that of the PC61BO15–based counterparts, as a result of enhanced light absorption. More importantly, the PC71BO15–based eco–PSCs show much greater tolerance in their PCEs to the solvent composition. PC71BO15–based eco–PSCs at a 30% water ratio maintain 89% of the optimal performance at a 15% water ratio. Different aggregation behaviors induced large difference in terms of water–tolerant behavior, which is carefully explored by electrical, optical and morphological characterizations. The PC71BO15–based eco–PSCs is able to have excellent reproducibility due to the high water content–tolerance.

2PS-176 김지환

Decoupling Critical Parameters in Large–range Crystallinity Controlled Polypyrrole–based Organic Electrochemical Transistors

김지환, Zubair Ahmad, 김영석, 김원빈, 안형주[1], 이재석, 윤명한† 광주과학기술원; [1]포항가속기연구소

The correlation between the structure of organic mixed conductors and electrochemical device performance/stability has attracted much attention. In this research, we investigated the structure and properties of polymeric mixed conductors by fabricating the large–range crystallinity controlled polypyrrole via oxidative polymerization of two–monomer–connected precursors. The mixed conductivities and electrochemical characteristics were controlled by adjusting the stoichiometry of the connector versus the pyrrole monomer, and the results suggest that there exist two distinct domains: the low crystallinity domain where carrier concentration is well controlled, and the high crystallinity domain where hole mobility and ion mobility is finely tuned. We believe that our study can provide the general insight into the structure and properties of polymeric mixed conductors as well as the design principles governing OECT device performance and stability.

2PS-177 김지현

Synthesis of Naphthalene–Diimide (NDI) Based N–Type Small Molecules for Organic Field–Effect Transistors

김지현, 김윤희†, 권순기, 하연희, 오정규[1], 박세진[2], 안태규[2], 장재영[1] 경상대학교; [1]한양대학교; [2]한국교통대학교

Many researchers are reporting on the synthesis of N–type organic molecular semiconductors based on naphthalene diimide (NDI). NDI molecules have their own receptor properties, and they also have the advantage of being able to form a D–A (Donor–Acceptor) type with numerous types of donors. And through the modulation of these donor parts, the physical, optical and electrical properties of semiconductor materials can be controlled. We report on the synthesis and characterization of two newly naphthalene diimide (NDI)–based small molecules for active materials of n–type organic field–effect transistors (OFETs). These NDI based small molecules designed to investigate the effect of donor type on materials and to improve the transport of charges for both materials.

2PS-178 김주희

Doping–dedoping Interplay for Fine Patterning/stacking of All–polymer Optoelectronic Devices

김주희, 정대성† 포항공과대학교

The remaining key for success of polymer electronics is to precisely pattern/stack polymer semiconductors. The precise patterning and stacking of various polymer semiconductors can be realized with the assistance of molecular oxidizing and reducing agents for donor and acceptor semiconductors, respectively. To pattern/stack various polymer semiconductors, there are two important strategies: doping method for desolubilizing polymer semiconductors and dedoping method for recovering the genuine characteristics of each polymer semiconductor. Based on this systematic approach of doping–dedoping interplay, various all–polymer optoelectronic devices are demonstrated with high–performances: 1) complementary inverter with high gain of 176, 2) planar heterojunction photodiode with high detectivity over 10^{12} Jones, and 3) ambipolar transistor with balanced hole and electron mobilities.

2PS-180 김정하

Improved Light Extraction Efficiency in Organic Light–Emitting Diodes Using Phase–Separated Polymer Films

김정하, 홍주희, 한주원, 박성빈, 김용현† 부경대학교

We report high performance internal light outcoupling films based on phase–separated polymers for indium tin oxide–free organic light emitting diodes (OLEDs). The two immiscible polymers of poly(amic acid) and polyimide in a blend film result in nanoporous structures after spin–coating by self–assembly process. The phase–separated films prepared between the glass substrate and the PEDOT:PSS transparent electrode remarkably improve the outcoupling performance of OLEDs. The poly(methyl methacrylate) (PMMA)–assisted phase–separated films significantly improve the current efficiency and power efficiency of OLEDs by a factor 1.82 and 2.06, respectively, compared to the reference device without any outcoupling structure. Our results demonstrate that phase–separated films developed here offer new opportunities in improving the outcoupling efficiency in OLEDs.

2PS-181 김정아

Synthesis of Carbazole Based p–type Polymers for Indoor Photovoltaics

김정아, 이원호† 금오공과대학교

태양전지는 차세대 에너지원으로 주목받고 있다. 그 중 유기태양전지는 빛 흡수 파장 조절 능력과 저렴하면서 대면적화가 가능한 장점을 지니고 있지만 낮은 효율 때문에 상업화되지 못했다. 최근, IoT와 같은 실내 저전력 기기의 전력 공급을 위해 실내조명에서 태양전지 응용에 대한 연구가 활발히 이루어지고 있는데, 유기태양전지가 기존의 무기태양전지에 비해 성능이 우수하다는 사실이 밝혀졌다. 실내조명에서 효율적인 태양전지를 개발하기 위해서는 기존 태양전지와는 다르게 빛 세기의 감소로 전하의 농도가 낮고 개방전압이 감소하는 현상을 고려하여 광활성층 및 디바이스 구조를 디자인해야 한다. 본 연구에서는 실내조명에서 우수한 효율을 보이는 PCDTBT 고분자를 기반으로 알콕시기와 bridge moiety의 π–conjugation 길이를 변화시킨 고분자를 디자인하여 분자 구조에 따른 실내조명에서 태양전지의 효율 변화 현상을 규명하고자 한다.

2PS-182 김윤아

Artificial Synaptic Tactile Transistor Based on Hydrogen Bond–Triggered Ion Pump

김윤아, 김주성, 권혁민, 정윤선, 김도환† 한양대학교

Recently, the development of tactile interface for a neuromorphic system has attracted attention as a promising next–generation e–skin such as artificial sensory nervous system. However, previous researches have encountered mechanotransduction sensitivity and restricted plasticity, which are caused by the integration of tactile sensors and synaptic transistors in parallel. We demonstrated a synaptic tactile transistor (STT) based on hydrogen bond triggered ion pump capable of ion migration which is due to the reversible H–bond breakage of ion pairs on silica particles surface under mechanical stimulus. The released free ions are penetrated into the bulk regime of polymer semiconductor, hence, mobile hole charges can be produced. As a result, the STT realized both short and long term plasticity (LTP > 200 sec) according to the applied amplitude of pressure. We believe this system will provide new insight into developing synaptic electronics for neuroprosthetics and soft robotics.

2PS-183 김승현

Effect of Low Molecular Weight Fraction on Charge Transport Behavior of Conjugated Polymers

김승현, 박상식, 조용준[1], 양창덕[1], 조길원† 포항공과대학교; [1]울산과학기술원
Recently, significant progress has been made in conjugated polymer-based organic transistors by enhancing the intra-/inter-grain charge transport in conjugated polymer thin films. Here, we investigated the effect of molecular weight (MW) distribution on the charge transport property by controlling the fraction of low MW and high MW through the polymer purification. The electrical properties of a novel n-type naphthalenediimide-based copolymer were explored to study the correlation between the MW distribution of conjugated polymer and the charge transport property of an OFET. The P(C5NDIDTD-Se-BT-Se) thin films containing larger fraction of low MW polymers exhibited superior electron charge carrier mobility compared to films without low MW polymers. Additional experimental result showed that the low MW polymers in P(C5NDIDTD-Se-BT-Se) thin films provided charge transport bridges to extend the pi conjugation between adjacent grains and reduced the activation energy for charge hopping.

2PS-184 김수진

Enhanced Endurance in Organic Electrochemical Neuromorphic Transistors Based on Polythiophene Containing Protonating Groups for Spiking Neural Network Computing

김수진, 정재승[1], 장호원[2], 주현수[1], 임정아[1,†] 한국과학기술연구원, 서울대학교; [1]한국과학기술연구원; [2]서울대학교
As a flavorable candidate for bio-inspired neuromorphic devices, iongel gated electrochemical transistors (ECTs) based on polythiophene (PT) have been demonstrated with the high performance in synaptic behaviors. However, the endurance characteristics of the ECTs with constant current level under programming and erasing (P/E) cyclability which are basic requirement for learning process have not been fully investigated. We found that ECT based on typical PT showed poor endurance with unstable memory state due to an undesirable electrochemical doping in PT by anion. Therefore it was not adoptable for iterative learning in neuromorphic computation. In this work, we propose functionalized PT (Func-PT) with protonating group to stabilize anion by reversible electrochemical reaction according to the applied bias. As a result, the ECT based on Func-PT showed constant memory state under cycling test and high classification accuracy on speech recognition as an iterative learning simulation.

2PS-185 김수진

Analysis and Prediction of Perovskite Solar Cells Database

김수진, 박재성, 최우진, 이재흥† 한국화학연구원
Perovskite solar cells (PSCs) have received considerable attention because they have relatively simple processes, flexibility, low cost, and excellent efficiency compared to previously developed solar cells. The materials and process of each layer in the multi-layered structure of PSCs are key characteristics of the performance of PSCs. Therefore we have collected the detailed information of each layer and the performance data points of PSCs from literature by selection various topics and journals. The PSCs database contains about 2,900 cell information from 688 literatures, also can be easily accessed through a web-based system (URL: www.perovkstie.info). The aim of database is to analyse major patterns from the past research and predict the performance of PSCs using statistical methods and machine learning (ML) tools. In particular, the ML approach to predict performance is expected to be help design of experiments as well as improving the research efficiency.

2PS-186 김성룡

Improvement of Ionic Gel's Thermal Stability, Stretchable and Self-healable Properties through an Ionic Side Chain

김성룡, 이준우, 박상아, 류승운, 정우택, 박태호† POSTECH
Recently, demands for stretchable, biocompatible and wearable devices are increased. In this situation, many researchers tried to synthesize stretchable materials. Ionic gel has intrinsic stretchability via crosslinking between polymer chains and transparency. Therefore, stretchable ionic gel research is on-going. General ionic gels have ions inside polymer networks without interaction. Ions mobile in polymer networks by thermal energy. In this result, ions interact with the other ions and formed ion bulks. However, in this literature, polymer chains with ionic side chains form polymer networks. Thus, thermal stability was improved up to 100 ℃. In addition, physical crosslinking between ionic side chains gives 2636% stretchability and 98.3% self-healing in 3 hr to ionic gel. Thermal sensor and actuator with this ionic gel were fabricated. These devices showed high stability and maintained almost initial performance despite repeated bending, stretching and damage by external force.

2PS-187 김선영

Metal-doped Nickel Oxide Thin Film Electrodes for High Performance Electrochromic Supercapacitors

김선영, 윤태용, 유경수, 문홍철† 서울시립대학교
In this study, asymmetric electrochromic supercapacitors (ECSs) based on tungsten oxide (WO_3) and nickel oxide (NiO) are proposed. In particular, the thickness of the NiO film was optimized in terms of the areal capacitance and device stability. The device performance could be further enhanced using copper (Cu)-doped NiO film by taking advantage of its higher conductivity. The optimal Cu concentration in NiO was determined to be ~7 mol%, at which the improved electrochromic and capacitive performance were observed compared to those of bare NiO film-based devices. Furthermore, the ECS including Cu-doped NiO exhibited excellent stability. For example, the device indicated stable charge/discharge cyclic operation, reliable operation at high temperature, and low self-discharging behavior, implying high practical feasibility.

2PS-188 김서영

Synthesis and Characterization of Circularly Polarized Light-emitting Liquid Crystalline Fluorene-based Compounds with Chiral Alkyl Groups

김서영, 최이준†, 유창재[1], 김재훈[1] 금오공과대학교; [1]한양대학교
Isotropic light reduces the efficiency of the OLED as it passes through the polarizer. When polarized light is generated in the light-emitting layer of the device, the efficiency can be improved. In particular, the light emitting material which emits circular polarized light can further improved the efficiency of OLED. In this study, chiral flexible chains introduced into the central fluorene unit and terminal of mesogen were suitable to exhibit cholesteric liquid crystal phase and circular polarized light emission. Mesogenic conjugated compounds capable of circular polarized light emission were synthesized by Suzuki coupling reaction. The structure of compounds were identified by 1H-NMR and FT/IR spectrometry. The thermal and liquid crystalline behavior were investigated by DSC and POM. The absorption and emission properties were investigated by UV-Vis and PL spectrometry.

2PS-189 김보미

Highly Stretchable, High-Mobility, Free-Standing All-Organic Transistors Modulated by Solid-state Elastomer Electrolytes

김보미, 김도환[1], 김봉수† 울산과학기술원; [1]한양대학교
Based on a deformable elastomer electrolyte of ionic thermoplastic polyurethane (i-TPU), highly stretchable, high-mobility, and free-standing all-organic transistors exhibited high mechanical reliability with low-voltage operation. The i-TPU electrolyte has outstanding features, i.e., a large specific capacitance, high transparency, flexibility, and even stretchability. Not only bendability and stretchability, these i-TPU based organic transistors also showed a hole mobility as high as 7.9 $cm^2V^{-1}s^{-1}$ and operated in a low-voltage operation. In addition, carrier mobility, on-current, and threshold voltage are maintained even under the concave and convex bending state. Lastly, fully stretchable and semi-transparent coplanar-type all-organic transistors can be fabricated with a PEDOT:PSS layer as source/drain and gate electrodes, performing low-voltage operation and an even higher mobility of up to 17.8 $cm^2V^{-1}s^{-1}$. Moreover, these devices withstand stretching up to 80% tensile strain.

2PS-190 김민수

Carbon-carbon Decoupling Reaction Rate Enhancement by Cation-pi Interaction of Cation-coordinated Graphitic Carbon Nitride

김민수, 이도창† 한국과학기술원
Graphitic carbon nitride (g-C_3N_4) is the promising green material which can alternate molecular catalysts. Because the Ir, Ru-based molecular catalysts are expensive and harmful, replacement of them is meaningful. Moreover, by carbon-carbon decoupling reaction with g-C_3N_4, highly value-added products can be given from nature polymer, such as lignin. In this research, carbon-carbon decoupling reaction rate of lignin β-O-4 model is enhanced by maximizing adsorption. Additional adsorption is driven by strong cation-pi interaction between aromatic reactants and coordinated cations in g-C_3N_4 heptazine(tri-s-triazine) melon structure. Li, Na, K cations were doped and the reaction rate enhancement tendency was exhibited according to cation-pi interaction strength order. The reaction yield was measured by Gas chromatography, and catalysts were characterized with UV-vis spectroscopy, XRD and solid-state NMR.

2PS-191 김민경

용액공정을 이용한 유기발광다이오드(OLED) 개발

김민경, 김민지, 엄태식† 홍익대학교
유기발광다이오드 소자(OLED)는 디스플레이 시장에서 이미 상용화가 된 소자이며, 차세대 및 유연 디스플레이에 모두 적용 가능할 수 있기에 무한한 응용 가능성이 있는 소자이다. 현재 유기발광다이오드 소자는 거의 모든 경우 진공 열증착공정을 통하여 제조되고 있으며, 이는 모바일 기기와 같은 소형 디스플레이에는 적합할 수 있으나 건물 조명 등의 대면적 분야에 적용하기 위해서는 용액공정을 통한 소자 제조 방법이 필수적이다. 고효율의 유기발광다이오드 소자는 일반적으로 다층 적층구조의 소자 구조이며 용액공정으로 이러한 다층 구조를 형성하기는 매우 어려운데, 그 이유는 먼저 만들어진 활성층 위에 용매를 이용하여 다른 물질을 적층시키고자 할 때 용매가 기존의 활성층을 손상시키는 경우가 많기 때문이다. 이에 따라 새로운 용매와 물질을 개발하여 다층구조를 가질 수 있도록 하는 연구가 필요하다. 본 연구에서는 용액공정을 통한 다층구조의 유기발광다이오드 소자 공정을 새로이 개발하여 기존의 진공 열증착공정으로 이루어지던 전하수송층의 적층을 용액을 이용한 코팅 공정으로 대체한 발광다이오드 소자를 개발하고자 한다.

2PS-192 김문규

강유전성 고분자 블렌드를 이용한 유기박막태양전지 개발

김문규, 김지훈, 이 솔, 엄태식† 홍익대학교
현재 지구상의 주된 에너지원은 석유, 석탄, 및 천연가스 등의 화석연료이다. 이들을 사용할 때 발생하는 이산화탄소는 환경문제를 야기하며, 화석연료는 재생이 불가능하므로 지속가능성(sustainability)이 떨어진다는 문제점이 있다. 따라서, 이를 대체할 수 있는 에너지원의 개발이 전 세계적으로 중요한 연구 주제로 부각되어 큰 관심과 투자가 집중되고 있으며, 이 중 태양에너지를 사용가능한 에너지로 전환하는 방법에 대한 연구가 주된 관심사로 자리 잡고 있다. 합리적인 가격의 태양전지를 대량 생산하기 위해서는 기존의 무기 반도체 재료를 이용한 태양전지와 달리 소자를 값싸게 생산할 수 있는 유기박막태양전지의 재료 및 공정기술의 개발이 필요하다. 본 연구에서는 강유전 고분자를 기존 광활성 고분자에 도입하여 효율의 손실없이 고분자 유기박막태양전지 소자의 안정성을 확보하고자 한다.

2PS-193 김대영

PVC Gel-based Skin-attachable Single Layer Triboelectric Nanogenerator and Position Sensor

김대영, 이주혁† 대구경북과학기술원

Advancement of wearable/attachable devices requires the development of corresponding energy supply devices. Triboelectric nanogenerators (TENGs) are being proposed as these energy supply devices. The reported stretchable TENGs are fabricated using a stretchable electrode layer. And, these stretchable TENGs have a disadvantage in that the characteristics of the device are limited by the electrode layer. In this work, we have developed a skin-attachable single layer PVC gel TENG and position sensor. The PVC gel was prepared using biocompatible plasticizer dibutyl adipate (DBA), and not only increased the flexibility, but also increased dielectric constant, transmittance, and reduced electrical resistance. The output performance of the single layer PVC gel TENG and its output stability with high strain were evaluated. Also, we demonstrated a position sensor that uses output difference as a function of the distance between the electrode and the contact point.

2PS-194 김기웅

SnO_2 Electron Transport Bilayer for Highly Efficient Planar Perovskite Solar Cell

김기웅, 신성식[1,†], 이경진[2], 서장원[1] 한국화학연구원/충남대학교 응용화학공학과; [1]한국화학연구원; [2]충남대학교 응용화학공학과

SnO_2 is a very promising material as electron transport layer (ETL) in perovskite solar cells (PSCs). However, efficiency of SnO_2 based PSCs is still lower than that of high temperature processed TiO_2 ETL. In this work, we report a new type of bilayer ETL using SnO_2 sphere and Zn doped SnO_2 nanorod to improve the performance of PSCs. Compared with the PSCs using a typical spherical SnO_2 ETL (PCE = 20%, Voc = 1.14 V, Jsc = 22.4 and FF = 78.9%), the performance of the bi-layer structured ETL based PSC (PCE = 21.1%, Voc = 1.16 V, Jsc = 23.3 and FF = 78.9%) is dramatically improved. This improved performance can be attributed to the higher transmittance, effective blocking effect, and superior charge collection property of bilayer ETL. In addition, bilayer ETL based flexible PSCs show superior device performance beyond 21%, which is the highest efficiency among all flexible PSCs, demonstrating its potential for application into flexible device.

2PS-195 김경주

Red-Green InP/ZnSeS/ZnS QD Incorporated Color Filters for UHD Liquid Crystal Displays

김경주, 최신일, 고윤혁, PREM PRABHAKARAN, 이광섭† 한남대학교

Cd-containing quantum dots (QD) have excellent light-emitting efficiency, narrow full width at half maximum (FWHM) and easy to tune wavelengths, but they do not comply to RoHS regulations because of their inherent toxicity. Indium phosphide (InP) QDs are eco-friendly materials and can be consider an alternative to Cd-containing QDs for use in light emitting devices. By coating thick and multilayer shell using ZnSe/ZnS, we have confirmed that the quantum yield (QY) is significantly higher than the existing ZnS shell coating. Careful tuning of lattice strain by synthesizing a gradient inter shell reduces lattice mismatch and improves performance in $ZnSe_{1-x}S_x$ QDs. Using this strategy, InP/$ZnSe_{1-x}S_x$ QDs are achieved 40-50nm of FWHM and QY values in the range of 50-80% in routinely. From these results, InP/$ZnSe_{1-x}S_x$ QDs show performance comparable to Cd-based QDs in optical properties.

2PS-196 김건우

New Triad-Type, Multi-Functional Compatibilizers for Enhancing Device Efficiency and Thermal/Mechanical Stabilities of Polymer Solar Cells

김건우, 이영웅[1], 우한영[1], 김범준[2,†], 마부수[2], 김진석[2], 박진수[2], 이승진[2], Thanh Luan Nguyen[1], 송 명[2], 김택수[2] KAIST; [1]고려대학교; [2]한국과학기술원

In this work, we report a new acceptor-donor-acceptor (A-D-A) triad-type small molecule, 5TRh-PCBM, for use as a compatibilizer in enhancing the thermal stabilities and mechanical properties of efficient polymer solar cells (PSCs). This multifunctional 5TRh-PCBM molecule, consisting of an oligothiophene segment as the central core and fullerene derivatives as the end groups, is designed to enable strong interactions between the 5TRh-core with various types of efficient polymer donors containing thiophene or fused-thiophene units, while the end fullerene groups preferentially interact with PCBM acceptors. To examine the effectiveness of this molecular compatibilizer, PSCs with different donors (PTB7-Th, PBDB-T, and P3HT) have been fabricated and tested, with the addition of various amounts of 5TRh-PCBM. The addition of 5 and 10 wt% of 5TRh-PCBM significantly enhances the thermal and mechanical stabilities of all these PSCs.

2PS-197 권혁진

Fluorinated Organic-Inorganic Nanohybrid Sol-Gel Derived Gate Dielectrics for Ultra-Flexible and Electrical Stable Organic Electronics

권혁진, 백용화, 엽하경[1], 김나혜[2], 홍지수, 박용환[2], 박찬언, 김주영[2], 김세현[1,†] 포항공과대학교; [1]영남대학교; [2]강원대학교

A new fluorinated organic-inorganic (O-I) hybrid sol-gel-based material was successfully synthesized and applied as a gate dielectric layer in flexible organic thin-film transistors (OTFTs). The three-arm-shaped alkoxysilane-functionalized amphiphilic polymer yielded an uniformly dispersed and stable O-I hybrid material through the formation of an emulsion. Here, a fluorinated precursor was introduced into the system, making it possible to realize highly stable spherical nanoparticles; this enabled long-term colloidal stability (~1.5 years) owing to the presence of fluorine groups with intrinsically strong repulsive forces. Additionally, the FAGPTi film was facilely deposited via thermally annealed sol-gel reactions; the films exhibited enhanced insulating properties with excellent flexibility, and were applied to OTFT with stable operation properties. Moreover, practical logic devices were successfully conducted with these FAGPTi-based OTFTs.

2PS-198 권미정

유기전계효과트랜지스터 특성 향상을 위한 광파에 의한 고분자 반도체의 결정구조 변화와 전하 이동 특성 개선 연구

권미정, 백강준† 부경대학교

유기 전계효과 트랜지스터(OFET)의 성능 향상을 위해 유기물 반도체의 결정구조를 이해하는 것이 중요하다. 또한, 균일한 소자의 특성을 확보하기 위해 고른 결정구조를 가지는 유기물 박막이 필요하며, 이는 전하 캐리어의 이동 효율을 일정하게 유지하도록 하여 인쇄기술을 활용한 대면적 전자소자 구현에 긍정적인 영향을 줄 수 있다. 어닐링은 가열/냉각을 통해 유기물 반도체 물질의 결정성을 향상시키는 공정으로, 효과적인 결정성 개선을 위해 물질에 맞는 적절한 온도와 시간을 설정하는 것이 중요하다. 본 연구는 웨이퍼 기반 소자에서 보편적으로 사용되는 핫 플레이트 어닐링 외에, 광파를 이용하여 물질의 결정성을 향상시키는 새로운 방법을 제안한다. 위쪽에서 광파를 통해 열을 발생시키고, 열이 고르게 전달될 수 있도록 공기를 순환시켜주는 환경에서 소자를 어닐링해 주었으며, 이와 같은 방법이 유기반도체 결정성에 어떤 영향을 미치는지 유기물 반도체 트랜지스터의 특성과 결정/표면 분석 등을 통해 확인하였다.

2PS-199 구지우

Ultrasensitive and Transparent Piezoresistive Force Sensor Based on Spike-Stimulated Dendritic Networks

구지우, 이윤구† 대구경북과학기술원

Piezoresistive force sensors based on interparticle quantum tunneling among electroactive fillers are widely used in various fields of wearable healthcare device, and human-machine interaction, touch panel, and energy harvesting due to its enormous potentials enabling to realize integrated sensing system. So far, however, existing strategies to form percolative networks have shown poor sensitivity in low pressure range despite use as a promising candidate for the stimuli sensing layer. To improve the sensing performance, in this study, we demonstrate synergistically combined spike-stimulated dendritic network leading to the significantly enhanced quantum tunneling effect among fractal conducting microchannels. Fabricated nanocomposite sensor shows standout capability to transduce the dynamic pressure distributions from external stimuli into electrical signal variations enabling to detect soft touch on the human skin and display touch panel.

2PS-200 구예진

Synthesis of Fluorinated Alternating Copolymer and Photolithographic Characterization under High Energy Electron-beam and EUV Radiation

구예진, 이진균† 인하대학교

Chemically amplified resists (CAR) have high sensitivity, but when applied to EUVL, they appear several disadvantages such as stochastics problem and pattern blurring due to acid diffusion. Non-chemically amplified resists (non-CARs) have high resolution and low sensitivity. We synthesized an alternating copolymer sensitive to E-beam, EUV radiation to simultaneously improve sensitivity and resolution. It was composed of perfluoroalkylated maleimide with non-CAR characteristics due to crosslinking reaction under E-beam and EUV irradiation and tert-butoxy styrene with CAR characteristics in the presence of PAG. We prepared a maleimide-styrene alternating copolymer via reversible addition fragmentation chain transfer (RAFT) polymerization. When applied to E-beam or EUV exposure with photoacid generator (PAG), a negative tone pattern was formed and the sensitivity of the resist could be improved.

2PS-201 고현주

Nano-crack Formation on the Micro-structure for Piezo-resistive Pressure Sensor with High Linearity and Flexibility

고현주, 김성원[1], 조길원[1], 이승구† 울산대학교; [1]포항공과대학교

A piezo-resistive type pressure sensor with high stretchability and linear sensitivity was developed via the in-situ formation of nano-cracks and micro-wrinkles on pyramidal elastomers using the tensile/compressive residual stress applied on metal thin film. The nano-cracks generated in the process of thermal evaporation improved the stretchability, and the micro-wrinkles formed during the deformation of pyramidal structure helped to achieve the linear sensitivity. Furthermore, our pressure sensor maintained its sensing performance even after repeated pressure cycle tests due to high interfacial adhesion between the surface thiolated elastomer and the deposited metal thin film.

2PS-202 고지영

Realization of Hysteresis-Free Two-Dimensional Perovskite Transistors at Room-Temperature

고지영, HUIHUI ZHU, AO LIU, 노유진, 노용영† 포항공과대학교

Organic-inorganic perovskite have been emerging semiconducting material for high-performance optoelectronics such as solar cells, photodetectors, and laser due to their outstanding intrinsic properties. Among them, Two-dimensional Ruddlesden-Popper perovskite (2DRP) has advantages for horizontal charge transport and good air stability owing to layered structure. Based on these merits, several studies have been conducted on transistors over the past two decades. However, perovskite transistors still suffer from inherent defects and high ion migration at room temperature that cause great hysteresis in channel. Therefore, a strategy to reduce

hysteresis is required for stable operation. Herein, we fabricated hystereses-free perovkite transistors at room temperature via alkali metal cation additive and self-assembled monolayer. The enhancement of electrical properteis on perovskite transistors was confirmed and improvment on the perovksite film was observed by SEM, PL, GIWAXD.

2PS-203 고성준

Optical Anisotropy in InP/ZnS Core/Shell Nanotetrapods

고성준, 이도창† KAIST

Here, we report the synthesis of environmentally friendly heterostructured core/shell NCs, i.e., ZnSe/ZnS, InP/ZnS and InAs/ZnS multipods (MPs). The MPs show polarized absorption and emission across a wide range of wavelength from ultraviolet to near-infrared. A statistical analysis based on transmission electron microscopy and small-angle X-ray scattering reveals that InP/ZnS MPs have shape anisotropy in terms of the difference in diameters of ZnS arms in a particle. This difference results in the asymmetric wavefunction delocalization of electrons, which eventually leads to the fluorescence polarization. In addition, the anisotropic dipole moment of MPs conferred by shape anisotropy interacts with external electric field. We utilize this interaction to achieve a uniaxial alignment of InP/ZnS MPs in a film.

2PS-204 강민균

Noise-Tolerant Optical Sensors via Junction Engineering of Organic Photodiodes

강민균, Syed Zahid Hassan[1], 정대성[1,†] 대구경북과학기술원; [1]포항공과대학교

A fine and facile engineering method of organic photodiode (OPD) response spectra via chemical doping, while maintaining their thin-film nature to realize color-filter-free noise-tolerant sensors, is demonstrated. It is shown that excitons with the desired wavelength range can be selectively dissociated by doping-induced engineering of the depletion region width (DW). This method is different from previous optical manipulation methods such as charge collection narrowing, in that DW, not the overall thickness, is controlled. Based on carefully designed planar heterojunction structure, thin-film (~ 500 nm) narrowband (FWHM < 60 nm) R/NIR-selective OPDs are realized with high specific detectivity over 10^{12} Jones. Furthermore, two OPD applications were carried out: 1) OPD-based optical communication platform with ambient noise-tolerance and 2) ambient light pulse oximetry with two NIR-selective OPDs.

2PS-205 Yuanyuan Zhang

Phenylethylammonium Iodide Induced Interface Engineering and Surface Passivation for Efficient and Stable Perovskite Solar Cells

Yuanyuan Zhang, 박성흠†, 김주현, 이보람, 정윤경[1], 양현석 Pukyong National University; [1]Inje University

Phenyl ethyl−ammonium iodide (PEAI) induced bilateral interface engineering was developed via incorporation of its activated bottom and top ways. As for bottom way, PEAI solution is spin−coated on the top of hole transfer layer (HTL) then active film is deposited. As a result, high−quality perovskite film with enlarged grain sizes can be obtained. Moreover, PEA+ could realize superior energy level match between HTL and active layer, largely decreasing energy loss during charge transfer. With regard to top way, PEAI solution is deposited on the top of perovskite film to construct 2D/3D stacked structure for active layer. Because the 2D top layer acts as a capping layer to prevent water penetration, the stability of the perovskite active layer is significantly enhanced. A PeSC device fabricated based on this combination exhibits enhanced power conversion efficiency and extended device lifetime compared to a pristine PeSC.

2PS-206 SABRINA AUFAR SALMA

Poly[(9,9-bis(3′-((*N,N*-dimethyl)-*N*-ethylammonium)-propyl)-2,7-fluorene Derivatives as Interfacial Layer in Polymer Solar Cell

SABRINA AUFAR SALMA, 정미진, RAHMATIA FITRI BINTI NASRUN, 아날리아 도라지오 컬만, 손동환, 이준호, 김주현† 부경대학교

A modified fluorene derivative-based material has been applied for inverted organic solar cell (OSC) devices. Series of Poly[(9,9-bis(3′-((N,N-dimethyl)-N-ethylammonium)-propyl)-2,7-fluorene with different backbone have been synthesized and fabricated as an interlayer for OSC. The materials consist of Poly[(9,9-bis(3'-(N,N-dimethylamino) propyl)-2,7-fluorene)-alt-2,7-9,9-dihexylfluorene)(**PFN**), Poly[(9,9-bis(3'-(N,N-dimethylamino)propyl)-2,7-fluorene)-alt 4,7-thiophene) (**PFN -T**), and Poly[(9,9-bis (3'-(N,N-dimethylamino)propyl)-2,7-fluorene)-alt 4,7-dithienyl-2,1,3-benzothiadiazole) (**PFN -TBT**) are used and studied the their power efficiency. These modified materials improved the electron collection efficiency, reduced the leakage current and enhanced device performances. We found that by coating PFN based material onto the ZnO surface gained high power conversion efficiency of 9% (with a fill factor more than 60%) and the highest PCE (9.41%) among PFN series is achieved in PFN-TBT.

2PS-207 RAHMATIA FITRI BINTI NASRUN

Cathode Modification of Polymer Solar Cells by Introducing Conjugated Polyelectrolytes with Diverse Acid Derivatives

RAHMATIA FITRI BINTI NASRUN, 이준호, SABRINA AUFAR SALMA, 정미진, 손동환, 아날리아 도라지오 컬만, 김주현† 부경대학교

An amino-functionalized polymer, poly[(9,9-bis(30-(N,N-dimethylamino)propyl)-2,7-fluorene)-alt-2,7-(9,9-dihexylfluorene)] (PFN), was introduced to different amounts and types of acid derivatives such as acetic acid (AA), 4-trifluoromethyl benzoic acid (CF_3BA), trifluoroacetic acid (CF_3AA), and 4-toluene sulfonic acid (TsOH) to investigate the effect of amounts and types of acid additives on the device performances. It was applied as the cathode buffer layer in inverted polymer solar cells (PSCs) with PTB7-Th:$PC_{71}BM$ blend as the active layer. The power conversion efficiency (PCE) of the device with pristine ZnO was 8.7%, while the PCE of the devices with the 1.0 equivalent of AA, CF_3BA, CF_3AA, and TsOH was 9.9, 10.3, 10.3, and 10.6%, respectively. The device performances and the reduced trap-assisted recombination matched the trend of the acid dissociation constant.

2PS-208 Pesi Mwitumwa Hangoma

Air-processable and Stable Perovskite Planar Solar Cells with Base-Layered 2 Dimensional Perovskite

Pesi Mwitumwa Hangoma, 김단비[1], 정윤경[2], 이보람[1], 김주현[3], 박성흠[1,†] Pukyong National University; [1]Department of Physics, Pukyong National University; [2]Department of Biomedical Engineering, Inje University; [3]Department of Polymer Engineering, Pukyong National University

Despite having record efficiencies, moisture instability still presents a challenge for the commercialization of inverted planar perovskite solar cells. We overcome this by introducing extra ethylenediamine cations at the base of the 3D perovskite layer. A 2D/3D hybrid active layer is formed when the cations induce thin (2D) perovskite growth beneath the 3D perovskite layer. This 2D layer in turn acts as a template for the growth of relatively large grains compared to that of pure 3D perovskite films. This stems from the merging of grain boundaries. The hydrophobicity of the 2D/3D perovskite film consequently improves. Because of fewer defects sourced from grain boundaries, the 2D/3D devices yield a higher efficiency of 15.02%, compared to 13.10% from 3D devices. When stored in humid environment of 55% RH, the 2D/3D devices exhibit longer stabilities, with 75% of their efficiencies maintained after 150 hours, compared to a total loss in efficiency for 3D devices in the same time frame.

2PS-209 HUIHUI ZHU

Lead-free Layered-perovskite Transistors

HUIHUI ZHU, 노용영† Pohang University of Science and Technology

In this study, we report the universal approaches for high-performance and reliable p-channel lead-free phenethylammonium tin iodide TFTs. These include self-passivation for grain boundary by excess phenethylammonium iodide, grain crystallisation control by adduct, and iodide vacancy passivation through oxygen treatment, as schematically shown in Fig. 1. We found that the grain boundary passivation can increase TFT reproducibility and reliability, and the grain size enlargement can hike the TFT performance; thus, enabling the first perovskite-based complementary inverter demonstration with n-channel indium gallium zinc oxide (IGZO) TFTs. The inverter exhibits a high gain over 30 with an excellent noise margin. This work aims to provide widely applicable and repeatable methods to make the gate more open for intensive efforts towards high-performance printed perovskite TFTs.

2PS-210 Eswaran Kamaraj

Intra Molecular Charge Transfer from Phenanthro-Imidazole Based T and Y Shaped Donor-Acceptor Molecules

Eswaran Kamaraj, 박상혁† Kongju National University

The molecular geometry effects of phenanthro-imidazole based donor-acceptor-donor molecules on intramolecular charge transfer (ICT) were studied structure-ICT relationship. The T and Y shaped fluorophores consisting of an imidazole ring end-capped with two electrons donating phenoxazine (PXZ) and phenothiazine (PTZ) groups at C6, C9 and C5, C10 and one electron-withdrawing trifluoromethyl (-CF3) group on the imidazole moiety at position C2 were examined. The photophysical, electrochemical and thermal characters of the compounds were systematically investigated, which consistent well with the theoretical quantum chemical calculations. In addition, solvent polarity effect on the relaxation dynamics has also been studied.

2PS-211 Anky Wibowo

Stretchable Transparent Conductive Biopolymers with Embedded Silver Nanowires

Anky Wibowo, 박성빈, 한주원, 김용현† 부경대학교

We demonstrate AgNWs-embedded chitosan biopolymers as stretchable transparent electrodes. The introduction of organic surface modifier improves the adhesion properties between the chitosan film and AgNWs, thereby improving the electrical and mechanical properties of stretchable films. The prepared films exhibits a high transmittance of about 89%, a low sheet resistance of about 8.4 ohm/sq, and a limited resistance change upon tensile strains. The heating devices based on the conductive films can generate a temperature of 60 ℃ at a low voltage of 3 V, so it can be applied as a promising personal thermal management device. Moreover, the film has expanded its applications as a strain sensor and has been found to react sensitively and quickly to small external forces. We believe that AgNWs-embedded chitosan films with surface treatment will contribute to the development of high-performance wearable devices with applications such as personal thermal management devices and strain sensors

2PS-212 Aamir Iqbal

Anomalous Absorption of Electromagnetic Waves by 2D Transition Metal Carbonitride Ti3CNTx (MXene)

Aamir Iqbal, 구종민† Korea Institute of Science and Technology

Lightweight, ultrathin and flexible electromagnetic interference (EMI) shielding materials are highly needed to protect electronic circuits and portable telecommunication devices and eliminate cross-talk between devices and device components. Here,

we show that a 2D transition metal carbonitride, Ti3CNTx MXene, with a moderate electrical conductivity provides a higher shielding effectiveness compared to more conductive Ti3C2Tx or metal foils of the same thickness. This exceptional shielding performance of Ti3CNTx was achieved by film annealing and is attributed to an anomalously high absorption of electromagnetic waves in the layered metamaterial-like structure. These results provide guidance for designing advanced EMI shielding materials, but also highlight the need for exploring fundamental mechanisms behind interaction of electromagnetic waves with 2D materials

2PS-213 AO LIU

Molecule Charge Transfer Doping for p-Channel Solution-Processed Copper Oxide Transistors

AO LIU, 노용영[†] Pohang University of Science and Technology; [1]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH)

The doping of semiconductors plays a critical role in improving the performance of modern electronic devices by precisely controlling the charge carrier density. However, the absence of a stable doping method for p-type oxide semiconductors has severely restricted the development of metal-oxide based transparent electronics. Here, we report an efficient doping process for p-type oxide semiconductors by using molecule charge transfer doping with F4TCNQ. The selections of a suitable dopant and geometry play a crucial role in the charge-transfer doping effect. The insertion of F4TCNQ dopant film between a Au S/D electrode and solution-processed p-type CuxO film in bottom-gate top-contact thin-film transistors (TFTs) provide a mobility enhancement of over 20-fold with the desired threshold voltage adjustment. By combining doped p-type CuxO and n-type IGZO TFTs, a solution-processed transparent complementary metal-oxide semiconductor inverter is demonstrated with a high gain voltage of 50.

기능성 고분자 (II)

2PS-214 김진호

UV Reactive Self-healing Polymer with Water Repellency Property and Coating Process

김진호, 오명건, 이강택[†], 이선종[†] 한국생산기술연구원; [1]연세대학교

HFA(Hexadecafluorodecane-1,10-diyl bis(3-phenylacrylate)) synthesized using fluorine compounds to give hydrophobic surface properties of UV reactive self-healing polymers has a cinnamate function at terminal group, so [2+2] cycloaddition is designed to self-healing through reaction. WCA(water contact angle) was used to analyze the hydrophobic properties of this monomer, and in the HFA has a hydrophobic surface at about 105°. In addition, UV-spectroscopy is ussed to analyze the reaction rate of [2+2] cycloaddition, and it can be seen that the UV absorption rate of the cinnamate functional group is also increased due to the high electronegativity of fluorine. In order to identify the properties of self-healing, observation using optical microscopy and confocal microscopy showed that self-healing was possible. The monomer designed by this study is a water repellency self-healing polymer with fast curing speed and is expected to be application to various coating material.

2PS-215 김지혜

Facile Fabrication of Polyaniline Films with Hierarchical Porous Networks for Enhanced Electrochemical Activity

김지혜, 구형준[†], 소주희[1], 김성곤[2], 최종훈[3] 서울과학기술대학교; [1]한국생산기술연구원; [2]전북대학교; [3]중앙대학교

A conducting polymer with well-defined porous structures would be preferred as an electrode of a capacitor. Upon crosslinking with phytic acid, polyaniline (PANI) forms a hydrogel with a 3-D porous structure. In this study, we checked the effect on its pore morphology and electrical property of PANI with various compositions. It turns out that the composition in preparation has a significant influence on the morphology of the PANI hydrogel. As ratio of initiator/crosslinker increase or monomer decreases, the PANI hydrogel has denser morphology with decreased pore size and high volumetric surface area, resulting in higher conductivity. So, in the 3-electrode system, the PANI hydrogel electrode prepared at optimized compositions exhibited 105.6 F/cm^3 of capacitance with ~50% retention rate after 5000 cycles. Finally, we fabricated a practical capacitor with two symmetric PANI hydrogel electrodes, which shows 271.4 F/cm^3 of capacitance with improved cycle stability of 80% retention rate.

2PS-216 김지영

Colorimetric Detection for Organic Solvent in Water Using Microfluidic System

김지영, 김세민, 지유진, 고원건[†] 연세대학교

The chemicals currently in use have greatly contributed to the development of human civilization, but indiscriminate use and release of them poses a danger to humans and the environment. Water pollution, one of the various critical environmental pollutions, is a problem because of the mixing of organic solvents with industrial wastewater and discharging them. To prevent this, checking the quality of the waste water regularly to reduce leakage is being conducted. However, in addition to regular inspections, the factory itself can prevent water pollution by proactively inspecting pollutants. The device is made of polydimethylsiloxane for multi-channels using a micro total analysis system. The device can detect and generate various results at once. Devices can lead to simplification and miniaturization of chemical analysis that is expected to be self-tested easily in the real world. Therefore, the expected function of the device is used to diagnose organic solvents in the chemical field.

2PS-217 김준용

Highly Purified MSC-derived Exosome Isolation Methods for Attenuating Inflammatory Cells

김준용, 임원규, 박천권[1], 한동근[†] 차의과학대학교; [1]성균관대학교

Extracellular vesicles (EVs, including exosomes) derived from mesenchymal stem cells (MSCs-EVs) have been studied as vital components for cell-based regenerative medicine and attenuating inflammation. Typically, various isolation methods have been developed for increasing yield. Moreover, the components of cell culture medium have been considered to get clinically active purified EVs. In order to obtain high yield EVs, we compared ultracentrifuge-based method and tangential flow filtration (TFF) system-based method. And the bioactivity according to the impurities from fetal bovine serum (FBS)-derived exosomes has been compared depending on exosome depletion methods from FBS. To demonstrate the biological properties, depending on purity of EVs, we pretreated EVs to inflammation induced cells. The effect of EVs was compared in vitro using various inflammation-related assays. These studies indicate that the purity of MSC exosomes is an important factor for efficient biological effects.

2PS-218 김준석

PP-g-MAH 및 EOR-g-MAH 첨가가 polypropylene/kenaf 펠프 복합체의 상용성 및 충격강도에 미치는 영향

김준석, 김상윤, 김연철[†] 공주대학교

Polypropylene(PP)/kenaf(KF) 펠트 복합체의 상용성 및 충격강도 개선을 위하여 1) PP-g-MAH와 EOR-g-MAH를 단독 사용하는 방법과 2) PP-g-MAH와 EOR-g-MAH를 복합 사용하는 방법으로 구분하여 PP/KF 5:5 펠트를 처리하였다. PP-g-MAH와 EOR-g-MAH는 용액함침법으로 처리하였으며, PP-g-MAH와 EOR-g-MAH를 100 ml 자일렌에 5, 10, 15, 20 wt% 용해시킨 후 펠트를 함침시켰다. 복합체 시편 제조는 180 ℃ 핫프레스에서 3분간 압착하여 제조하였다. PP/KF 복합체의 화학결합 분석은 X-선 관전자분석분석기(XPS)를 통하여 확인하였다. PP/KF 복합체의 기계적 물성은 만능시험기(UTM)과 아이조드 충격강도시험기(Izod impact test)를 통하여 측정하였으며, 형태학적 특성은 시편 파단면의 주사전자 현미경(SEM)을 통하여 확인하였다.

2PS-219 김준서

Conductive Inks Using Modified PVB with Improved Dispersibility and Adhesion

김준서, 안다혜, 손경철, 박상기, 조유장, 최민석, 차석준, 박종진[†] 전남대학교

Conductive carbon black ink was prepared using Modify PVB. PVB has strong adhesion to organic and inorganic materials and has transparent physical properties. In particular, the acetal structure can easily interact with the end group oxygen of the carbon black, thus showing good adhesion. However, PVB has good adhesion but the cohesion of carbon black, a nano material, is very strong and cannot prevent aggregation. This causes PVB materials to agglomerate with each other during dispersion, resulting in a poor conductivity. In this study, PVB was modified with various types of Ring opening materials to prevent such aggregation. Modify PVB has a –COOH group at the end of the side chain. Carboxylic acid groups prevented cohesion between Modify PVBs due to repulsion due to negative charges and showed shifts in finally and zeta potentials.

2PS-220 김주란

Vascularized Cardiac Tissue Network by a Direct Patterning via a 3D Bioprinter

김주란[†] 한국생산기술연구원

3D bioprinting is a widely used technology to dispense cell-laden biomaterials for rapid fabrication of complex 3D tissue constructs or artificial organs. In this study, we developed heterogeneous cell-laden microchannel network using human umbilical vein endothelial cell-cardiomyocytes by a direct patterning with a 3D bioprinter. This system also facilitated cell alignment and migration within each constructs and promoted vascular network with high cell viability. Calcium imaging was used to optically probe intracellular calcium ion signals during excitation-contraction coupling in cardiomyocytes within 3D vascular network. The cell-laden 3D constructs could be extended to serve as in vitro models for clinical cardiovascular disease researches and cardiovascular tissue regenerations.

2PS-221 김정민

Fabrication of Conductive Overcoating Layer Based on Hybrid Composites to Improve the Stability of Flexible Transparent Conductive Films

김정민, 이진근[1], 조원석[1], 조한결[1], 김영노[1], 이홍주[1], 김중현[†] 연세대학교; [2]연세대학교 화공생명공학과

Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) is one of the conductive polymers with excellent conductive and transparent conductive materials. However, since PEDOT has insolubility insoluble in water and solvent, it introduces a primary dopant, Polystyrene sulfonic acid (PSSA) is hydrophilic and has low stability in water or chemical conditions. As a result, the PEDOT:PSS film exhibits a rapid deterioration in physical properties under high temperature and high humidity conditions. A protective layer that can be applied on a flat flexible transparent conductive film was prepared by combining silica sol and organic polymer.

(3-Glycidyloxypropyl) trimethoxysilane (GPTMS) was used as a precursor for the silica sol, which hydrolyzed under moisture to form silanol groups and self-condensed to form a sol under acidic conditions.

2PS-222 김주란

Acaricidal Effects of Eugenol-encapsulated Cellulose Acetate Nanofibers Against Dermatophagoides Farinae via Emulsion Electrospinning

김주란† 한국생산기술연구원

Eugenol, a natural essential oil that has acaricidal effect on Dermatophagoides farinae dust mite, was encapsulated in a gelatin capsule by the coacervation method. The eugenol oil-loaded gelatin capsule (EOGC) was in spherical shape with an average diameter of 1.46 μm, and the loading efficiency of eugenol in EOGC was 45%. EOGC-embedded CA nanofibers demonstrated the acaricidal effect in reducing the number of D. farinae, showing up to 97% mortality in 24 h.

2PS-223 김정동

Functional Polyimide Binder for High-nickel, High-voltage Cathode Materials of Lithium Rechargeable Batteries

김정동, 정현민†, 박준우, Azimov Farkhod, 박수빈, 송승완[1] 금오공과대학교; [1]충남대학교

Ni-rich layered oxides such as $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ (NCM811) are appealing as promising high-capacity cathode materials. The reversible capacity can be charged with a voltage higher than 4.2 V of a conventional battery. But it is difficult to manufacture due to the unstable cathode-electrolyte interface and structural degradation. Herein, we report the combination of NCM811 with non-aqueous functional polyimide binder to imparts enhanced thermal stability and stable interface originating from insitu building-up of surface protective polyimide layer at cathode through monodentate metalcarboxylatechemical bonds during slurry preparation, which permits to charge to 4.4 V despite incommercial electrolyte without additive. It can be charged up to 4.4 V in commercial electrolyte conditions, suppresses metal dissolution and cathodic decomposition, creates a reversible capacity higher than 200 $mAhg^{-1}$, and provides non-combustible properties unlike conventional binders, enabling stable operation.

2PS-224 김정규

Highly Efficient and Sustainable Alginate/Carboxylated Lignin Hybrid Beads as Adsorbent for Cationic Dye Removal

김정규, 박진석, 방준식, 김윤진, 곽효원† 서울대학교

From the viewpoint of the application of these lignin polymers, the application as a biosorbent for water treatment material is increasing its interest due to the abundance of raw materials and reactive functional groups including hydroxyl groups. In this study, carboxylated lignin (C-Lig) was prepared by chemical modification of kraft lignin (KL). Thereafter, through the alginate (Alg) encapsulation strategy, bead-type Alg/C-Lig hybrid adsorbents were successfully fabricated. The optimum Alg/C-Lig blend ratio for effective adsorption performance and a stable batch type dye removal process was found to be 50:50. Alg/C-Lig hybrid beads showed excellent 555 mg/g of maximum MB removal capacity within a 6h fast adsorption process. From the adsorption isotherm, kinetics and thermodynamic behavior analysis, "electrostatic attraction-based surface adsorption and internal diffusion" was identified as the main MB removal mechanism.

2PS-225 김의혁

Sensing and Memorising Liquids Information with Polarity-interactive Ferroelectric Sound

김의혁, 박철민† 연세대학교

For emerging biomedical applications, the direct sensing and storing of information regarding liquids are of significant interest in relation to human senses. Here, we present a novel interactive platform capable of sensing, monitoring, and storing the information of various liquids. Our platform with a ferroelectric polymer layer operated under alternating current utilises liquid-interactive ferroelectric sound (LIFS), which is dependent upon the polarity of the liquid, allowing for facile liquid sensing. More importantly, as LIFS of a liquid is correlated with non-volatile ferroelectric polarisation, the information of a liquid is stored and retrieved even after the liquid is removed, resulting in a liquid sensing memory. By programming different LIFSs on a thin film pad, the 2D position of a liquid droplet is identified on the pad. Moreover, both microfluidic and tube-type LIFS devices allow for in situ analysis of the flows of liquids including a human serum fluid with sound.

2PS-226 김은지

폐가죽 추출 단백질 가수화물/폴리비닐알코올 복합 수지 제조 및 지력증강제 적용 연구

김은지†, 백인규, 윤영호[1] 한국신발피혁연구원; [1](주)기륭산업

최근 환경에 대한 사람들의 인식 및 관심이 증가함에 따라 폐자원의 재활용 및 천연물질 유래의 변형체 개발에 대한 연구가 증가하고 있다. 종이 강도를 증가시키는 지력증강제 역시 환경친화적인 에폭시화 폴리아미드 수지가 사용되는 추세이다. 유기자원인 폐가죽은 산, 알칼리, 효소 처리를 통해 단백질 가수화물로 추출되며 amidation 반응을 통해 변성 가수화물을 제조할 수 있어 이를 적용한 지력증강제의 개발이 필요하다. 또한, 폴리비닐알코올은 우수한 기계적 강도, 유연성, 내흡수성 등의 성질을 가지고 있어 제지산업에서 널리 이용되고 있다. 따라서 본 연구에서는 폐자원으로부터 얻어진 단백질 가수화물과 종이 물성 향상을 위한 폴리비닐알코올을 혼합한 복합 수지를 제조함으로써 습윤지력 향상 및 환경친화적인 지력증강제를 제조하고 그 특성을 평가하였다. *본 연구는 산업통상자원부와 산업기술평가관리원이 지원하는 "생산시스템산업전문기술개발사업"으로 수행된 연구결과입니다(과제번호 : 20000127).

2PS-227 김유경

Carbon Nanotubes-in-polymer Nanofibers with a Long-range Ordered Structure

김유경, 윤현석[1,†] 한국소방산업기술원; [1]전남대학교 대학원 고분자공학과/전남대학교 고분자융합소재공학부

Single-walled carbon nanotubes (SWNTs)-in-polymer nanofibers with a long-range ordered structure were readily produced via the electrospinning of the SWNT/polyvinyl alcohol/polyacrylonitrile solution. The resulting SWNTs-in-polymer nanofibers exhibited enhanced crystallinity due to the role of the introduced SWNTs over the process of the electrospinning followed by solidification. It was notable that the new nanostructured composite was fabricated without any special processing and treatment. Moreover, the SWNT-in-polymer nanofibers with increased crystallinity were converted to carbonized products via heat treatment under inert atmosphere. The textural properties of the carbonized products were determined by the key variables such as the nature of the polymer precursors and the content of the SWNTs introduced. Consequently, the major electrochemical properties of the carbonized products were also highly dependent on the key variables.

2PS-228 김원혁

Hydrogel Encapsulation System for Aquaculture of Marine Organism

김원혁, 나양호† 한남대학교

Recently, the temperature of seawater is increasing due to environmental pollution, followed by an increase in the number of herbivores. The reduces algae in the bedrock areas, leading to sea desertification. This situation leads to a decrease in algae in the rocky areas and sea desertification. One of the solutions for healing sea desertification is undertaking marine forest development. However, this method does not result in sustainable growth, as young algae are eaten by direct exposure to herbivores. In this study, as a solution to the problems mentioned above, the growth behavior of microalgae was studied while immobilizing the microalgae in a hydrogel. Two hydrogels were attached to each other through interfacial bonding, and the degree of interfacial bonding between hydrogels was evaluated by measuring peeling energy. This hydrogel system is expected to be a useful material for preventing sea desertification.

2PS-229 김용수

Influence of Wettability on Glass Transition Temperature on the Interface of Polymer Core-shell Nanoparticle Films

김용수, 이찬민[†], 이준영[†], 황기섭[†,†] 한국생산기술연구원/성균관대학교; [1]한국생산기술연구원

Self-cleaning coating materials have been widely studied in the entire industry such as construction and automobiles. In particular, emulsion polymerization has an easy polymerization method and safe particle dispersibility. In addition, there is an advantage of being able to freely set the coating strength and contact angle characteristics on the surface by controlling the glass transition temperature (T_g) of the polymerized nanoparticles through emulsion polymerization. In this study, nanoparticles were prepared by emulsion-free polymerization, and the Tg of the particles was set differently, coated on slide glass, and the change in anti-wetting properties was observed through changes in surface morphology and roughness and distribution of surface elements. In order to effectively control the Tg of the particles, the ratio of (MMA, T_g 100 ℃) and (BA, T_g -60 ℃) was controlled for the core. When anti-wetting properties were observed through contact angle measurement (CAM).

2PS-230 김완서

광학적 안정성을 증진시킨 옥사디아졸 형광체를 이용한 나노구조제어체의 면역형광표지법을 위한 연구

김완서, 김형준† 공주대학교

면역 형광 표지법은 항원-항체 특이성을 이용하여 형광 염료로 세포 내 특정 생체 분자의 분포를 시각화함으로써 여러 생물학적 연구에서 사용되는 기술이다. 현재 일반적인 형광물질보다 훨씬 강한 형광을 좁은 파장대에서 발생시키는 양자점(quantum dot)과 우수한 형광 효율을 나타내는 유기 형광 염료를 사용하고 있다. 양자점은 일반적 염료보다 흡광계수(extinction coefficient)가 100~1000배 크고 양자효율(quantum yield)이 높아서 매우 센 형광을 발생시키지만 세포 독성이 있어 살아있는 세포에 치명적이다. 또한 유기 형광 염료는 용액 상태에서는 우수한 형광 효율을 나타내지만 고체 상태에서 형광 효율이 감소하고 빛과 pH에 민감하기 때문에 들뜬 상태에서 광화학반응에 의해 분해되어 광탈색(photobleaching)이 일어날 수 있다. 이러한 기존 형광 표지물질의 문제점을 보안하고자 고체상태에서도 형광 효율이 높고, 발광효율과 광화학적 안정성, 생체적합성과 특이성을 가진 형광 표지물질을 나노구조 제어체를 이용하여 분산시켜 특정 세포를 검출할 수 있도록 했다.

2PS-231 김예린

Improvement of Absorption Properties by Formation of Surface Pores Using Chemical Blowing Agent

김예린, 남현구, 곽영제† 숭실대학교

Superabsorbent polymers (SAPs) is synthetic polymeric materials used in disposable hygiene products due to its ability to absorb and retain large volumes of aqueous solutions. Recently, there has been an increasing demand for thin diapers, which requires excellent absorption performance and absorption rate of SAP. The most common approach to increasing absorption rate is to introduce pores inside SAP particles. In this study, we used chemical blowing agent during surface crosslinking process of poly(itaconic acid) based core SAP particles to introduce additional pores on the surface of the SAP particles. The surface pores were expected to improve absorption rate while maintaining or improving absorption performance of the SAP particles.

2PS-232 김영훈

Enhanced Photocatalytic Activity of Ce-doped β-Ga_2O_3 Nadnofiber Films Fabricated by Electrospinning Method

김영훈, 허윤정, 백정주, 장기철, 송광식, 박성만, 배근열, 이효선, 신교직, 최경호† 한국생산기술연구원

In the present study, we fabricated Ce-doped β-Ga_2O_3 catalysts synthesized by a sol-gel derived electrospinning and subsequent calcination. The electrospun nanofiber films were characterized by using a scanning electron microscopy (SEM), UV/Vis spectrophotometer, X-ray diffraction (XRD), and photo-degradation analyses. It is notable that Ce doping affects the morphology, crystallinity, optical band gap energy, and finally photo-degradation ability. For photo-degradation, the highest degradation kinetic constant (k) was obtained from 0.7 mol% doped β-Ga_2O_3 nanofiber films. Therefore, it can be concluded that the degradation of MB under UV radiation was more efficient with the Ce-doped β-Ga_2O_3 nanofiber films than with un-doped β-Ga_2O_3 nanofiber films.

2PS-233 김영석

Icephobic-coating Characteristics of Polymers with Controlled Modulus

김영석†, 천지민, 김진환, 정진영, 조보경 한국전자기술원

Removing ice accreted on exposed surfaces of many critical infrastructures incurs enormous economic and social cost. Recent researches have focused on smearable slippery liquid-infused polymers with the durability. The icephobicity can be effectively controlled by modifying bulk modulus and slippery condition of polymer simultaneously, when icing/deicing process is repeated. Here, we present icephobic performance with fabricating a series of the different elastomeric coatings of siloxane polyurethane rubbers, which have the different modulus values from 1.5 to 42.6 MPa. To enhance the effect of icephobicity, we added the silicone oil and porous silica aerogel. We measured the ice adhesion strength (τ ice) of the prepared films with repeated icing/deicing processes. The results showed low τ ice below 50 kPa during 15 icing/deicing cycles.

2PS-234 김영경

A Highly Self-healable Heterocyclic Elastomer Synthesized Using Cage-shaped Adamantane with Outstanding Mechanical Properties

김영경, 문경민, 전혜련, 홍평화, 홍성우† 한국생산기술연구원

A new heterocyclic elastomer based on cage-shaped adamantane (hEA) is synthesized and its self-healing and mechanical properties are characterized in this study. To synthesize hEA, acrylate-based polyol, adamantane derivative, and 2,5-bishydroxymethyl tetrahydrofuran are blended and the blend is reacted with crosslinker with multiple isocyanate groups. Acrylate-based polyol and crosslinker are reacted to prepare a conventional elastomer (cE) as a reference. Interestingly, the mechanical properties of hEA with adamantane groups are increased in both in-plane and out-plane directions compared with those of cE. In addition, hEA shows more outstanding self-healing performances than cE owing to the supramolecular network resulting from the strong hydrogen bonding interaction between heterocyclic groups and urethane groups. These results demonstrate that cE can achieve both excellent self-healability and mechanical properties by introducing cage-like structure and heterocyclic moiety.

2PS-236 김승균

Multiple Enzyme Immobilization Using Heat-sensitive Polymeric Nanocarrier for Enhanced Cascade Reaction

김승균, 권인찬[1,†] 광주과학기술원; [1]광주과학기술원 신소재공학부

Various enzymes have been studied for the application and one of the applications is immobilization. As enzyme is immobilized on support matrix, it can drive enhanced stability and easy downstream process. Moreover, multiple enzyme immobilization can help construction of cascade reaction to enhance production yield. However, it is difficult to immobilize multiple enzymes while maintaining high immobilization yield, retention of enzymatic activity and low leaching. Furthermore, multiple enzyme immobilization considering with reaction rate is hard because of difference of immobilization yield of each enzyme. In this study, we demonstrated that heat-sensitive polymeric nanocarrier (HSPC) has desirable feature for immobilization in case of single/multiple enzymes. Since HSPC can reduce size when temperature is increased, enzymes can be located inside HSPC after temperature treatment. We have demonstrated that various enzymes were immobilized in HSPC while maintaining desirable features.

2PS-237 김수찬

Durable Sulfur Cathode *via* an Elastic Chitosan Network Designed for Fast-Charging Lithium-Sulfur Batteries

김수찬, 조미숙, 이영관† 성균관대학교

Next-generation energy storage devices such as lithium-sulfur batteries (LSBs) face several challenges including fast charging and high-power delivery. Thus, it is necessary to improve the stability of the electrodes with efficient electrochemical system. In this work, a durable sulfur cathode even at high rates is enabled *via* an elastic chitosan networked binder. The binder consists of a chitosan cross-linked with a carboxylated nitrile-butadiene rubber (XNBR), which exhibits high affinity toward lithium polysulfide along with robust mechanical properties because of the synergistic effect of the polar chitosan and the elastomeric XNBR. Despite using extremely small content of binder (3 wt%), the LSB shows a highly stable long-term cycling performance with a low capacity retention decay after 500 cycles at 5 C and 10 C. Moreover, the cell shows an outstanding specific capacity of 228 mAh g^{-1} at an ultrahigh charge-discharge rate of 20 C.

2PS-238 김성민

Enhancement in Soil Moisture Retention Using Hydrophilic Hydrogel with Homogeneous Network Structure

김성민, 나양호† 한남대학교

Superabsorbent polymer (SAP) hydrogel is a material with a three-dimensional polymer network structure, containing water hundreds of times more than their own weight. It is used in various fields such as baby diapers, cosmetic, and agriculture. Recently, droughts caused by abnormal weather have made water supply difficult for plants, causing problems all over the world as forests and trees disappear. One solution to this problem is to use a soil water retention enhancer made with SAP hydrogel that can provide continuous moisture to plants. However, the general soil water retention enhancers use organic crosslinking agents. It has an inhomogeneous network structure, which limits its ability to water absorption capacity. In this study, we report a high water absorption capacity soil water retention enhancer based on inorganic crosslinker. The SAP hydrogel using the inorganic crosslinker was prepared and the swelling characteristic of the SAP hydrogel was studied.

2PS-239 김선호

Influences of Nanoparticles on Ion Conduction in Poly(lithium acrylate)-based Solid Polymer Electrolytes (SPEs)

김선호, 최우혁† 인하대학교

Many researches are conducted to develop solid polymer electrolytes (SPEs) that show higher electrical and mechanical properties, compare to liquid electrolytes. We prepared poly(lithium acrylate)-based SPEs which were combined with cross-linkable vinyl nanoparticles (either silica or alumina). The addition of the nanoparticles increased ionic conductivity of SPEs due to the interaction between nanoparticles and ionic species, but also increased mechanical properties of SPEs through crosslinking the polymer chains. We investigated the influences of nanoparticles on ionic conduction and thermal and viscoelastic properties of poly(lithium acrylate)-based nanocomposite SPEs, using differential scanning calorimetry (DSC), scanning electron microscopy (FE-SEM), Fourier transform infrared spectroscopy (FTIR), rheometer, and electrochemical impedance spectroscopy (EIS). This investigation will provide useful insights for the design of organic-inorganic hybrid SPEs for energy applications.

2PS-240 김서일

Synthesis and Characterization of New Self-polishing Copolymers

김서일, 황도훈† 부산대학교 화학과

Synthesizing copolymers from Zn acrylate monomers is an effective strategy employed in the self-polishing materials industry. In this study, we designed and synthesized polyurethane-based self-polishing copolymers with improved surface adhesion properties. The synthesized polyurethane copolymers were characterized using Fourier transform infrared spectroscopy and inductively coupled plasma optical emission spectrometry. The properties of Zn-based polyurethane copolymers were compared with those of Zn-free polyurethane as reference. The erosion rates of the Zn-based polyurethane SPC films were determined by measuring changes in the film thickness after dynamic immersion tests. In comparison to Zn-free polyurethane, the Zn-based polyurethane self-polishing copolymers demonstrated effective self-polishing and surface adhesion properties.

2PS-243 김부영

Investigations on Diketopyrrolopyrrole (DPP) and Isomeric Fluorinated-Benzothiadiazole-based Polymers

김부영, 전정담, 송지은, 이정훈† 동서대학교

We report the effects rendered on the relevant intrinsic phsical and optoelectric properties and organic field-effect transistors device function by the degree of regioregularity, diketopyrrolopyrrole (DPP) and Fluorinated-Benzothiadiazole-based isomorphic polymers I.e., regiorandom and regioregular polymers, respectively, are synthesiezed and characterized. In addition, finely modulated banching side chains ((e-branched chain) are addopted to the DPP polymer main backbone. The subtle change in the brancing point far away from the backbone alters the $\pi-\pi$ stacking and the lamellar distances between polymer backbones which has a significant influence on the charge-transport properties and in turn the performances of field-effect transistors (FETs).

2PS-244 김보미

pH-Responsive Polymer-coated Silica-titania Hollow Nanoparticles for Controllable Drug Release

김보미, 정의석, 이승애† 건국대학교

Poly(acrylic acid) (PAA)-coated silica-titania hollow nanoparticles (PAA-HNPs) are synthesized and applied as nanocarriers for the smart drug delivery system. Since the PAA-HNPs have high biocompatibility and low cell-toxicity as well as consist of hollow structure that can accommodate drug molecules, the prepared PAA-HNPs are suitable materials for drug delivery systems. Furthermore, the PAA is adopted as a coating substance because of its pH-responsive characteristics. To examine the pH-responsive characteristics of PAA, dye molecules are loaded into the hollow nanoparticles and induced to be released in various pH conditions. The analysis results demonstrate that the PAA-HNPs show pH-dependent properties.

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2019R1C1C1007578) and the Technology Innovation Program (20004627) funded By the Ministry of Trade, Industry & Energy (MOTIE, Korea).

2PS-245 김보람

A Reversible Near-Infrared Fluorescence Photoswitch Based on Diarylethene-Crosslinked Nanoclusters for Live Imaging

김보람, 정혜연, 김윤경† 한국생명공학연구원

Fluorescence imaging is widely used in biological studies due to its ease of manipulation, safety, and relatively low cost. For the imaging requiring penetration of light into the living tissues, the usage of fluorophores with their excitation and emission wavelengths in the near-infrared (NIR) region is beneficial to minimize the issues of autofluorescence and penetration depth. As our continued effort to develop high-performance fluorescent probes for in vivo applications, here we report a photochromic diarylethene-crosslinked dendritic nanocluster as the biocompatible and water-soluble reversible fluorescence photoswitch, with its emission in the NIR region. By carefully differentiating the fluorescence signals in the ON- and OFF-state images, we envision that our reversible NIR fluorescence photoswitch may enable highly sensitive and precise imaging, particularly in the in vivo environment with background signals such as autofluorescence.

2PS-246 김민규

Heat Radiating Polyurethane Composite Using Modified Boron Nitride to Enhance Flame Retardancy

김민규, 조남주†, 이창록 부산대학교

As household appliances such as mobile phones, laptops, and automobiles are highly integrated and miniaturized, a large amount of heat is generated in the driving time. And it is very important to release the heat to the outside, because this heat degrades the performance of device, causes malfunctions, and has a large impact on durability. Then the social interest and market size of the heat radiating materials are increasing every year. In this study, polyurethane (PU)/modified boron nitride (m-BN) composites were prepared for heat-radiating film. PU is flexible and has excellent tensile strength, also physical property can be easily controlled through the molecular design. However, owing to the PU is unstable in heat and easy to burn, its use is restricted in the field which is a risk of fire due to heat, leakage, spark, etc. Then BN was modified with organo-phosphorus incorporated silane coupling agent to solve the combustion problem.

2PS-247 김문현

Thin Film Nanocomposite Reverse Osmosis Membranes Containing Schiff Base Network-1 Having Improved Separation Performance

김문현, 정경화, 서희란, 이종찬† 서울대학교

Thin film composite (TFC) reverse osmosis (RO) membranes can be fabricated via interfacial polymerization using m-phenylenediamine (MPD) and trimesoyl chloride (TMC) as monomers on the surface of polysulfone ultrafiltration membranes. The TFC RO membranes exhibit excellent separation performance for water desalination process, while trade-off relationship between water permeability and salt rejection should be overcome to further increase energy efficiency of RO process. Thin film nanocomposite (TFN) membranes containing nanofillers in the selective layer have attracted attention due to improved separation performance. Among various nanofillers, Schiff base network-1 (SNW-1) can be a candidate for a nanofiller in TFN RO membranes because of its microporous structure and chemical stability. In this study, SNW-1 was synthesized and incorporated to the selective layer of TFC RO membranes to fabricate TFN RO membranes. As a result, separation performance of the membranes can be improved.

2PS-248 김민규

Preparation and Bio-application of Polyphenolic Tannic Acid-containing Polyelectrolyte Nano-films

김민규, 이수진, 윤지원, 양성윤† 충남대학교

Tannic acid (TA) is a natural polyphenolic compound that is known to exhibit many advantageous biological properties. TA acts as a weak acid due to the presence of multi-phenol groups and can assemble with positively charged polymers such as poly-L-lysine (PLL). To modify various substrates, we applied layer-by-layer assembly using a polyelectrolyte that is ionized according to pH conditions. We studied the surface properties such as thickness, wettability, composition, and morphology. Also, to consider the biological application of this nano-films, we conducted studies on cytotoxicity and biocompatibility.

2PS-249 김동현

pH and Acid Type-responsive Self-assembled Colorimetric Film of Block Copolymer Photonic Crystals

김동현, 이찬민, 이준영, 황기섭† 한국생산기술연구원

Stimuli-responsive photonic crystals have been explored as optical sensors for detection of chemical and biological analytes. The stop band of these photonic films was increased with decrease in pH value or increase in hydration energy of its conjugated bases. Thus, pH value and acid type of unknown acidic solution contacted with the photonic film can be identified by the naked eye. The stop band was also tunable by using different molecular weight of block copolymer and introducing the cross-linker. The mechanism of response to pH and acid type in photonic films was explained by Henderson-Hasselbalch equation and Hydration energy of conjugated bases. To confirm our hypothesis, the swelling behavior was modeled by using the transfer matrix method (TMM) based on the experimental reflectivity spectra. This work provide useful information for the development of various photonic applications with polymers.

2PS-250 김동학

The Biocompatible Neural Interface Coated with Heparin/Substance P-conjugated PLCL Promotes Neuronal Development and Limits Astrogliosis

김동학, 김수현[1,†] 고려대학교; [1]한국과학기술연구원

Most neuroprosthetic devices implanted into the central nervous system (CNS) face limitations in longevity and functional reliability due to undesired inflammatory host tissue response initiated upon device insertion. At the implant site, activated microglia, reactive astrocytes, macrophages form glial sheath that can encapsulate and isolate the electrode from the surrounding tissue. In addition, neuronal loss and neurite degeneration occur surrounding the electrode due to inflammatory response. As a result, signal recording becomes inaccurate and the device becomes unusable. Ideally, an implanted devices would minimize glial reactivity and proliferation in the vicinity and support neuron adhesion and neurite outgrowth. Thus, we developed heparin or SP conjugated PLCL polymer coating to support neuronal adhesion and differentiation and to suppress activation of microglia and astrocytes.

2PS-251 김동은

Non-precious Metal Hybrid Hydrochar from Hydrothermal Carbonization for High Level Electrochemical Performance for the Oxygen Reduction Reaction

김동은, 이승연, 김창근† 중앙대학교

Non-precious metals and carbon materials show synergistic effects and show good performance for oxygen reduction reactions. The N-doped porous hydrochar(N-HTC) were firstly synthesized from a hydrothermal reaction of bio sources followed by a pyrolysis with nitrogen sources. Iron nanoparticles are produced between the pores of the resulting product. (Fe@N-HTC) The morphology of carbon encapsulated iron nanoparticles is confirmed by FE-SEM and HR-TEM. XPS, XRD and Raman spectroscopy is conducted to confirm the carbon graphite character in carbon materials and the formation of capsulated iron nanoparticles. To calculate specific surface area, BET analysis is applied cased on nitrogen adsorption/desorption. The oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) activities of Fe@N-HTC nanospheres are investigated using a rotating disk electrode. The Fe@N-HTC show comparable electrochemical performance to platinum-based catalysts (Pt/C) and IrO2.

2PS-252 김동민

Surface Modified Magnetic Particles Removing Nitrogen Organic Compounds in Ultra Pure Water System

김동민, 이강택[1], 이선종† 한국생산기술연구원; [1]연세대학교

Photolithography (PL) process mainly uses chemically amplified resist (CAR). CAR is sensitive for nitrogen organic compounds (NOC). NOC causes a T-topping phenomenon that adversely affects the process. In this study, we demonstrate surface modified magnetic (Fe_3O_4) particles that can reduce total organic carbon (TOC) in UPW by removing NOC. Functionalize using 3-acryloxypropyltrimethoxysilane (AcPTMS) was applied to magnetic particles. It is expected that the ester group and C=C double bond in AcPTMS will remove NOC. SEM and EDS analysis proved that the synthesis was successful. After the trimethylamine (TMA) and Urea exposing tests, the NOC collection capability of the samples was verified with XPS analysis. Samples mixed with IER was put into a column and passed through UPW to conduct TOC analysis. As a result, we found that the TOC can be reduced by catching NOC. This result shows the actual applicability of metal-organic hybrid structure to the UPW system.

2PS-253 김대호

Single-Ion Conductive Divalent Acrylic Fluorosulfonylimide Based Polymer Electrolyte with High Conductivity for Li-ion Batteries

김대호, 류태욱, 진레이, 윤수진, WEI ZHANG, 이용훈, 장호현, 김환기† 건국대학교

Single ion conducting polymer electrolyte is being researched as an alternative to the safety of conventional liquid electrolyte based Li-ion batteries. However, Single-Ion Conducting Polymer Electrolytes (SICPE) are limited because of their low Li ion conductivity at room temperature. This is research, Solvent-free, poly-electrolyte with high ion conductivity(divalent). This is due to the self-healing behavior of the electrolyte, which is induced to increase the proportion of the amorphous phase. In addition, the interaction between the fluorosulfonyl-imped anion and the Li+ cation with stabilized resonance is weak, reducing the separation energy of the reion, which anticipates a high ion conduction.

2PS-254 김금비

Synthesis of Water- and Humidity-Responsive Liquid Crystal Elastomers and Their 4D Printing

김금비, 궈위엔항, 허성현, 배재희, 안석균† 부산대학교

In this study, we synthesized a water- and humidity-responsive liquid crystal elastomer (LCE) by aza-Michael addition using N,N'-dimethylethylenediamine, followed by photopolymerization. To enable water and humidity responsiveness, the top surface of aligned LCE film was activated by acidic solution which generated cations on the surface, resulting in increased hydrophilicity. Due to anisotropic

mechanical properties and asymmetric hydrophilicity, a macroscopically aligned LCE film underwent bending when exposed to water or humidity. The shape changes can be also controlled by the cutting angle with respect to the nematic director as well as by localizing the activated areas of the LCE film. Lastly, we have successfully fabricated humidity-responsive 3D-printed LCEs via UV-assisted direct-ink-writing. Our water and humidity-responsive shape programmable LCEs can find interesting applications in sensors, smart textiles and biomedical devices.

2PS-255 권현주

Fabrication of Thiophene Derivatives Electrolyte for All Solid Polymer Secondary Battery

권현주, 음 율, 조남주† 부산대학교

The demand for lithium secondary batteries in the middle or large sized battery market such as electric vehicles and ESS has increased, and the market for secondary batteries has been developing, but lithium ion batteries have a risk of liquid electrolyte. Lithium polymer batteries have attracted attention, but existing solid polymer electrolytes have a problem that their ionic conductivity efficiency is lower than that of liquid electrolytes. To solve this problem, an electrolyte capable of minimizing the interface resistance with homogeneous polymer electrodes is produced by introducing oligo(3,4-ethylene dioxy thiophene), a thiophene-based derivative with excellent electrical conductivity. The lithium secondary battery of a new system which reduces the interface resistance between the electrode and electrolyte is developed by introducing poly(EDOT-co-DMTP) as an anode material, p-doped PEDOT as a cathode material and oligo (3,4-ethylene dioxy thiophene) as an electrolyte.

2PS-256 권충렬

High Performance and Eco-friendly Polyurethane Using Isosorbide as Chain Extender of Hard Segment Part

권충렬, 이주홍, 민진규, 원종찬, 배지홍, 허필호† 부산대학교

Isosorbide-polyurethane (ISB-PU) series were successfully synthesized using poly(tetramethylene ether) glycol-methylene diphenyl diisocyanate (PTMG-MDI) as soft segment part, Isosorbide (ISB) as chain extender based on different molecular weight of pre-polymer. The ratio of soft segment and hard segment was used in the range of 9:1. The structures and properties of PUs were evaluated by fourier transform infrared spectroscopy (FT-IR), gel permeation chromatography (GPC), universal testing machine (UTM), differential scanning calorimerty (DSC) and thermogravimetric analysis (TGA). Compared using 1,4-BD as chain extender, ISB-PU exhibited high mechanical properties and heat-resisting property for high functional plastic applications in consumer/industrial and environment-friendly products fields.

2PS-257 권영승

Fabrication and Electrochemical Characterization of MXene/Poly(ether amide)-Derived Hybrid Carbon Nanofibers for Supercapacitor Electrode Materials

권영승, 정영규[1,†] 충남대학교; [1]충남대학교 유기재료공학과

The supercapacitors are widely investigated as electrochemical energy storage devices because of their high power density and life cycle. Recently, MXene is investigated as a promising electrode material for supercapacitors due to its unique structure and excellent electrical conductivity. In this study, a series of MXene/PEA-derived hybrid carbon nanofibers (MCNFs) were fabricated by a facile method of electrospinning, dip-coating, and carbonization. The microstructural features of MCNFs were characterized by aids of SEM, EDS, and XRD. The electrical and electrochemical properties of MCNFs were investigated by using conductivity measurement, cycle voltammetry, and galvanostatic charge-discharge test. As a result, MCNF electrodes were characterized to have a specific capacitance of 689 F/g at a current density of 1 A/g, 93% capacitance retention after 3000 cycles, and energy density of 189.7 Wh/kg.

2PS-258 권소정

General Method for the Production of Hydrogel Droplets from Uniformly Sized Smart Shell Membranes

권소정, 박수영† 경북대학교

A smart solid-state liquid crystal (LC_{solid}) shell membrane template prepared by a microfluidic method with a reactive mesogen mixture of RMM727 (from Merck) doped with a nematic liquid crystal of 4′-pentyl-4-biphenylcarbonitrile (5CB) as a porogen was used for a facile and general method to produce uniformly sized hydrogel droplets. Copolymer hydrogels and IPN hydrogels can be prepared based on the LC_{solid} shell template. Molar ratio of the copolymer hydrogel droplet composition could be easily altered by changing the mixing ratio of monomer mixture without tuning the processing conditions for droplet production, which is usually needed when using microfluidic devices. The proposed method can be used to obtain uniformly sized hydrogel droplets without using any instrument (e.g., microfluidic devices) or stabilizing material (e.g., surfactants) at any convenient time.

2PS-259 권미연

Photochromic Dye Sensor with TiO_2 Impacting Nitrogen Oxide Controlling VOCs in the Air

권미연, 김주혜† 한국생산기술연구원

When photocatalysts get light energy and act as a catalyst, affecting reaction rates in chemical reactions. As light is emitted, it behaves like electrons (e-) and holes (electrons with positive charges) on the surface, and electrons react with oxygen and water around the photocatalyst, resulting in hydroxyl radical (neutral OH). In this study, the creation of hybrid TiO_2-photochromic dye coating material is considered in the substrate by photochromic dyes. In order to identify the most efficient NO reduction properties, model is developed according to ISO 22197 test method and evaluated efficiency of photocatalyst by colorimetric analysis. This evaluation work contributes to the development of TiO_2-photochromic dye coating with color sensor and provides high performance in detecting and controlling NO that causes particulate/ultrafine particle contaminants in air.

2PS-260 구자현

A Simple Demonstration of Reversible Transformation between the Programed 2D Structures and 3D Actuators

구자현, 정광운† 전북대학교

Two types of polymers (acrylic rubber and polyimide) were selected to prepare three-dimensional (3D) actuators transformed from the programmed 2D structures. Taking into account the different volume expansion properties of two polymer and structural symmetry, various 2D structures were programmed and transformed to 3D actuators such as roll, helical, and cubic actuators. Furthermore, 3D actuators with more complex shapes were precisely fabricated by combining bending, twisting and folding transformations. This study provides a simple method to fabricate polymer gel actuators with desired shapes and can be applied to educational activity. This work was supported by BRL Program (2020R1A4A1018259), Mistry of Trade, Industry, and Energy (20011031), and Basic Science Research Program (NRF-2019R1A6A3A1 3092060) funded by the Ministry of Education.

2PS-261 권미연

Study on the Photocatalyst Effect of Digital Image Screen with Hybrid TiO_2-SiO_2

권미연, 김주혜† 한국생산기술연구원

The photocatalyst is a material which absorbs light to bring it to higher energy level and provides such energy to a reacting substance to make a chemical reaction occur. The typical photocatalyst is titanium dioxide (TiO_2), which is used to photolyze water to obtain hydrogen and oxygen gas. In this study, the Photocatalyst effects are applied to screen fabrics for outdoor performances because they have effects such as anti-pollution, air purification, and odor removal. The screen fabric for outdoor performances was made of mesh material to match the background in nature. The Photocatalysts were applied to digital imaging screens to reduce fine particle and prevent pollution. The hybrid TiO_2-SiO_2 was synthesized using the SiO_2 binder to introduce hydrophilic property to the surface of TiO_2 and NO_x reduction test was conducted to check the effects of photocatalys.

2PS-262 구민국

Infiltrating Gel Polymer Electrolytes into the Electrodes for Improving Electrode-Electrolyte Interface

구민국, 김파도, 김현준, 송은석, 김성곤† 전북대학교

Gel polymer electrolytes (GPEs) can provide exceptional performance and avoid safety problem like the leakage of liquid electrolyte commonly occurred in rechargeable battery system. So they are attracting great potential power for battery system. Here we synthesize GPEs which are composed of trimethylolpropane ethoxylate triacrylate (ETPTA), poly(ethylene glycol) methyl ether methacrylate (PEGMA), and lithium salt solution by UV-light irradiation. It is easy to tune the mechanical property as well as ionic conductivity by changing the composition of ETPTA, PEGMA and lithium salt solution in the GPEs. The infilling of GPEs with the property of high ionic conductivity ($\sim10^{-3}$ S/cm) into the electrode is performed and it improves the interface characteristics at which the electrode and electrolyte. GPEs, which have the properties of good mechanical strength and relatively small ionic conductivity ($\sim10^{-4}$ S/cm), are used as a flexible film on the electrodes.

2PS-263 고푸른산

Memorizable Gas Sensor Based on Amine-Functionalized Semiconducting Polymer Gel for Retention of Cumulative Gas History

고푸른산, 권혁민, 김재희, 박한울, 김도환† 한양대학교

NO_2 gas can accumulate in our body, causing gradual inflammation and chronic respiratory disease. Although there is a need for a system that can follow trace of cumulative NO_2 gas, majority of gas sensor studies have only focused on high sensing capability, so that memorizing system for accumulated NO_2 gas is still not realized. Herein, we demonstrate amine-functionalized semiconducting polymer gel (NH_2-SPG) where amine groups are anchored in the entire film by utilizing unreacted silanol groups of the SPG. The functionalized NH_2 groups not only improve sensitive and selective characteristics toward NO_2, but also enhance the cumulative effect of exposure history of NO_2 gas. This is because the NH_2 groups acting as a NO_2 trap site postpone recovery time of penetrated NO_2 gas, leading to amplification of paired pulse facilitation (PPF) memory signal. We believe that our approach for retention of historical information of toxic gas will be a guidance for advanced sensor application.

2PS-264 고재형

Electromagnetic Interference Shielding Effectiveness of Single-walled Carbon Nanotube Films

고재형, 유일환, 김태욱[1], 이동수, 주용호†, 김남동, 배수강, 이승기, 최재원[2], 이상석 한국과학기술연구원; [1]전북대학교; [2]경상대학교

Electromagnetic interference (EMI) shielding effectiveness (SE) of various types of single-walled carbon nanotube (SWCNT) films were investigated. By systematically changing M/S ratios of the films, significant change in EMI SE values were observed.

Different shielding mechanisms were discovered from the films of M/S ratio at their extreme, namely purely semiconducting- (s-) and metallic (m-) SWCNT films. These characteristics were explored by density gradient ultracentrifugation (DGU), UV-Vis-NIR spectroscopy, EMI SE measurement. This work is expected to be applied to various shielding materials for future electronic devices.

2PS-265 고은서

Study of Cell Movement and Proliferation by the Control in Physical and/or Chemical Properties of the Substrate

고은서, 양성윤† 충남대학교

The surface properties of biomaterials are important issues in cell culture. Especially, surface-adherent cells are affected by the physical and chemical properties of the surface material on their activities such as cell adhesion, migration, and proliferation. We fabricated micro-pillar structured substrates and applied various polymer coatings to use them as cell culture plates. Cells including neuronal cells were cultured on these substrates and monitored their activities. Depending on the surface structure and the wettability, cellular morphology and growth were changed. Besides, cells that were grown for 3 days on microstructured surfaces showed special morphology even after transferred to a general flat dish. These results present more understanding of the chemical and physical influence of cell culture condition to cell function.

2PS-266 강하은

Microstructures and Electrochemical Properties of Bicomponent Nanofibers Consisting of PAN/Lignin-derived Carbon Nanofibers and $LaMnO_3$ Nanofibers

강하은, 정영규[1,†] 충남대학교; [1]충남대학교 유기소재섬유시스템공학과

Perovskite oxides have attracted great attention as supercapacitor electrode materials because of their high specific capacitance and electrochemical stability. $LaMnO_3$, as one of the perovskite oxides exhibits high capacitance. However, it is difficult to apply to practical fields because of its low electrical conductivity. To overcome the disadvantages of $LaMnO_3$ electrode materials, in this study, a series of bicomponent nanofibers composed of polyacrylonitrile/lignin-derived carbon nanofibers and $LaMnO_3$ nanofibers were fabricated via dual electrospinning technique and following heat-treatment at different temperatures for simultaneous carbonization and calcination. The microstructural features of the bicomponent nanofibers were characterized by using SEM, EDS, and XRD. The electrochemical performance of the hybrid nanofibers as self-standing and binder-free supercapacitor electrode materials was analyzed by using cyclic voltammetry, galvanostatic charge-discharge measurement.

2PS-267 강진현

Performance Optimization of Polymer Photovoltaic through Immiscible Ternary Blends

강진현, 김준호, 정인환† 국민대학교

The use of a ternary blend as an active layer in a polymer photovoltaic (PPV) is one of several strategies for improving the power conversion efficiency (PCE) of a PPV. In this study, we fabricated a PPV using an immiscible ternary blend which is not commonly used and improved the PCE. The immiscible ternary blend is composed of one donor material, IDIC as a non-fullerene acceptor, and $PC_{70}BM$ as a fullerene acceptor. Binary blends such as POTz:IDIC and POTz:$PC_{70}BM$ showed a typical bicontinuous and uniform morphology. In the other hands, the ternary blends showed immiscible domains on the morphology. When small amount of $PC_{70}BM$ was added into the POTz:IDIC:$PC_{70}BM$ blend, the $PC_{70}BM$ formed small domains into the continuous POTz:IDIC phase like raisin bread. The immiscible $PC_{70}BM$ domains improved the electron mobility, resulting in an increased J_{SC} and FF. In addition, the ternary blends with $PC_{70}BM$ domains showed enhanced long-term stability in light soaking test.

2PS-268 강지선

Reinforcing Cellulosic Hydrogels

강지선, 심재민, 조연주, 윤석일† 상명대학교

Development of bio-based hydrogels with good mechanical properties is essential for bio-applications such as bio-sensing, drug-delivery and tissue engineering. Cellulose is the most abundant bio-polymer which is widely distributed in plant. Cellulose gels are biocompatible and biodegradable but have weak mechanical properties. Cellulose-nanocrystals (CNCs) represent a biodegradable nanofiller and has excellent strength-to-weight ratio. In this study, we prepared cellulosic gels through the chemically-crosslink compounding the derivative of cellulose, carboxymethylcellulose sodium salt (CMCNa) and 2-Hydorxyethylcellulose (HEC). CMCNa and HEC were crosslinked by citric acid (CA), a naturally occuring crosslinking agent. To enhance the mechanical properties of cellulosic hydrogels, we introduced CNCs or ionic crosslinker (Fe^{3+}) and KC network into CMCNa/HEC network. The effect of addition of CNC, Fe^{3+} ion and KC network on mechanical properties of cellulosic hydrogels is investigated.

2PS-270 강은지

Biocompatible Tissue Adhesive Using Double-network Concept

강은지, 나양호† 한남대학교

Hydrogel is a material consisting of a three-dimensional polymer network containing excess water. Double network (DN) hydrogels intrinsically possess extraordinary mechanical strength and toughness due to their unique contrasting network structures, strong interpenetrating network entanglement, and efficient energy dissipation. DN gels consist of two polymer networks with contrasting physical properties: a densely cross-linked strong polyelectrolyte (rigid and brittle skeleton) network in low concentrations and a sparsely cross-linked neutral polymer (soft and ductile substance) network in high concentrations. Recently, many studies related to tissue adhesives using hydrogels have been carried out. Conventional tissue adhesives have limitations in use, such as inflammation, toxicity, the non-biocompatibility in vivo. In this study, the properties and adhesion behaviors of biocompatible tissue adhesives were investigated by preparing the DN hydrogels made of natural polymers.

2PS-271 강유리

Ag-chitosan Nano-composite Layered Paper Sensor by Surface-enhanced Raman Spectroscopy

강유리, 형지우, 노혜란† 서울과학기술대학교

Surface-enhanced Raman spectroscopy (SERS) is emerging technique detecting analytes, though a method to increase signal enhancement for limited and/or small amount analytes is remained unsolved. We developed Ag-chitosan nano-composite layers to increase sensitivity of the paper sensor. In order to amplify a Raman signal, Ag-chitosan nano-composite is manufactured by using layer-by-layer assembly which is a kind of in-situ reducing synthesis. In this presentation, we used rhodamine 6G, methylene blue, and 4-amino-thiophenol as testing analytes. As the layers of nano-composite on paper increasing, signals of analyte increased. It was found that optimum generation of paper sensor inversely dependent on analytes' size exhibiting less layers are required for larger analytes. In conclusion, it was confirmed by the enhancement of signal that the 'hot spot' increased as the number of layers increased. Reliable sensing data was obtained by a simple fabrication using paper.

2PS-272 강승욱

Improvement of Gas Adsorption Efficiency of Fragile Porphyrin Based MOFs

강승욱, 설규민, 강찬우, 최은영† KSA of KAIST

Metal-Organic Frameworks (MOFs) are nanoporous materials that have various functions such as chemical separation, gas storage, ion conduction, and catalysis, etc. Among them, Porphyrin-based paddle-wheel frameworks (PPFs) have rarely reported gas adsorption data, despite the various structures reported and the high potential for further application. Based on previous research, 3D PPFs had a fatal drawback of being unable to be activated because the pillar molecules leak out on the harsh activation condition, unlike 2D PPF-1 without pillars. Our research proposes a new activation method that enables activation without exceeding the collapse condition of 3D complex structures. Also, this activation method is expected to be applicable not only for PPFs but also for other structures that were not available to activate due to their fragile structures.

PS-274 강동규

Uniaxially Oriented Liquid Crystal Polymer for Redox-Responsive Smart Window

강동규, 정광운† 전북대학교

A redox-responsive electrochromic (EC) smart window with linear polarization of light was fabricated using a polymerizable lyotropic chromonic liquid crystal (LCLC). The perylene diimide (PDI) -based dichroic mesogen core has a redox-responsive color tunability with large dichroic ratio. Through the simple shear coating process and subsequent polymerization, it is possible to fabricate the color-switchable smart windows. The LCLC-based multimodal smart windows were applied to curtain-free smart window, selective sign indicator and anticounterfeiting optical filter. This work was supported by Ministry of Trade-Industry-Energy (20011031), BRL Program (2020R1A4A1018259) and NRF Global Ph.D. Fellowship Program of Republic of Korea.

2PS-275 WEI ZHANG

Improved Performance of Single Ion Conducting Polymer Electrolyte Based on Polystyrene with an Additive of Lithium Salt for Lithium-ion Batteries

WEI ZHANG, Ahmed Faiz, 진레이, 류태욱, 윤수진, 김대호, 이용훈, 장호현, 김환기† 건국대학교

Recently, solid polymer electrolytes (SPEs) for lithium-ion batteries have drawn increasing attention due to their integrating advantages, including high safety, non-flammability and good flexibility, as well as interfacial compatibility, compared with liquid or gel-type electrolytes. In this work, we synthesized blending polymer electrolyte containing single li-ion, consisted of lithium poly [(p-styrenesulfonyl) (fluorosulfonyl) imide] (LiPSFSI) and poly (ethylene glycol) dimethacrylate (PEGDMA). Subsequently, the physico-chemical properties and cell performances of as-prepared electrolyte were carried out. Compared to LiPSFSI/PEGDMA blending electrolyte, the electrolyte of LiPSFSI/PEGDMA with a conducting lithium salt displays better thermal stability, excellent cycling stability and considerable transference number (t_{Li+}). Besides, the LiPSFSI/PEGDMA electrolyte with an additive lithium salt, which exhibited higher ionic conductivity (σ) under the temperature range of 30-80 ℃.

2PS-276 Puji Lestari

High Conductive and Stretchable Thermoplastic Polyurethane (TPU)-Silica Nanoparticles for Electrical Double Layer Supercapacitor

Puji Lestari, 최우혁† Inha University

Thermoplastic polyurethane-based gel polymer electrolytes (GPEs) was prepared to address the challenge of safety issues in energy storage devices. Electrically conductive and high stretchable TPU-based GPEs with silica nanoparticles as a fillers was prepared via one-pot synthesize of the sol-gel process. Interaction between 1-butyl-3-methylimidazolium bis(trifluorosulfonyl)imide ionic liquid and soft segments of TPU allows for the enhancement of ionic conductivity and tensile strain. Silica nanoparticles were added via in-situ sol-gel reaction resulting in the enhancement

of mechanical properties. Morphologies, electrochemical properties, and mechanical properties were systematically investigated using scanning electron microscopy (FE-SEM), Fourier transform infrared spectroscopy (FTIR), electrochemical impedance spectroscopy, dynamic mechanical analyzer (DMA), and rheometer. Remarkably, TPU-based GPE with 1 wt% of silica particles shows high ionic conductivity at room temperature ($\sim 10^{-3}$ S/cm). Moreover, TPU-based GPE shows high specific capacitance that considers as prospective candidate for flexible electronics applications.

2PS-277 Hiep Dinh Xuan
Mechanically Reinforced Ionogels of Double Network Structure
Hiep Dinh Xuan, Bernard Timothy, 김도완, 윤진환† 부산대학교
Ionogels are good candidate for smart materials with tunable thermal, mechanical and electrical properties. In our previous paper, we provided poly(N-isopropylacrylamide-co-N,N'-diethylacrylamide) (PNN) as a promising temperature-responsive ionogel, but the weakened mechanical durability has limited its application as stretchable materials. To overcome this drawback, we prepared the ionogel in double network structure by associating PNN with chitosan which plays a role as sacrificial network. By utilizing the sacrificial network that will form additional physical crosslinking of chain entanglement upon network breakage, we are able to enhance mechanical properties as well as preserving its thermal responsiveness. Furthermore, from the double network ionogels system, we attempted to load electroluminescent (EL) nanoparticles to make EL ionogels. Due to the ionic conductivity property of IL, prepared ionogels can show the luminescence when applied the alternating current.

2PS-278 류승완
High Performance Organic Field-effect Transistor through P3HT/EEG Channel Flexible Nanocomposite
류승완, 이경진[1,†] 한국화학연구원/충남대학교; [1]충남대학교
We demonstrate that using nanocomposite thin films consisting of semiconducting polymer, poly(3-hexylthiophene) (P3HT), and electrochemically exfoliated graphene (EEG) for the active channel layer of organic field-effect transistors (OFETs) improves both device performances and mechanical properties. The nanocomposite film was developed by directly blending P3HT solution with a dispersion of EEG at various weight proportions and simply transferring to a Si/SiO_2 substrate by the solution floating method. The OFET based on P3HT/EEG nanocomposite film showed approximately twice higher field-effect mobility of 0.0391 $cm^2 \cdot V^{-1} \cdot s^{-1}$ and one order of magnitude greater on/off ratio of ~104 compared with the OFET based on pristine P3HT. We also measured the mechanical properties of P3HT/EEG nanocomposite film via film-on-elastomer methods, which confirms that the P3HT/EEG nanocomposite film exhibited approximately 2.4 times higher modulus (3.29 GPa) than that of the P3HT film (1.38 GPa), while maintaining the good bending flexibility and durability over 10.0% of bending strain and bending cycles (1,000 cycles). It was proved that the polymer hybridization technique, which involves adding EEG to a conjugated polymer, is a powerful route for enhancing both device performances and mechanical properties while maintaining the flexible characteristics of OFET devices.

2PS-279 김선우
Electrically Conductive and Water-stable Melanin-polymer Composite
김선우, 심봉섭† 인하대학교
생체 일렉트로닉스를 구현하기 위해서는 생체적합성, 우수한 전기화학적 성능 등의 요건이 만족되어야 한다. 그와 더불어, 장기적 응용에 있어 물리적, 화학적 안정성은 반드시 고려되어야할 조건 중 하나이다. 멜라닌은 먹물 등 자연계에서 쉽게 얻어질 수 있는 구형의 색소 물질로, 우수한 생체적합성과 전도성을 가지는 것으로 알려져 있다. 하지만 멜라닌 입자의 구형의 구조와 친수성질 때문에 입자 사이의 연결을 유지하기 어려우며, 이는 거시 규모에서의 전도성을 구현하기 어렵게 만드는 요인으로 작용한다. 본 연구에서는, 가교를 통해 수용액에서 안정한 멜라닌 복합재를 개발하고 이의 기계적 물성 및 전기적 성질을 분석하였다.

2PS-280 김대석
Colloidal Origami Using Liquid Crystal Polymeric Shells
김대석†, Teresa Lopez-Leon[1,†] 부경대학교; [1]UMR Gulliver 7083 CNRS, ESPCI Paris Tech, PSL Research University
Over the past decades there has been a significant effort to produce new typess of colloid crystals with increasingly complexity. However, colloidal particles are typically spherical and thus only functions through highly symmetric potentials, which limits designing shape of colloids and their functions for a simple aggregation. Thus, it has been highly required to develop a system to modify such a tiny spherical colloid into particular complex shape. In this presentation, we will introduce novel approach to fabricate various shape and surfaces of colloids using liquid crystals (LCs) as scaffold for the polymeric network. Since LCs can have various self-assembled structures depending on their phases, size, thickness, surface anchoring and elasticity, a rich of topologies can be formed in spherical confinements such as shell or bulk drop by coding particular LC fields. Here, we have shown various LC polymeric colloids by using the topologies as skeletal for topographical evolution through two steps, polymerization and buckling by volume contraction. The mechanism of buckling and reversible behaviors by swelling and de-swelling were studied and the topographical structures were observed using polarized optical microscopy (POM) and scanning electron microscopy (SEM).

포스터 발표 (III)

유무기 양자소재 및 응용기술

3PS-1 함동효
III-V Semiconductor Colloidal Quantum Dots
함동효, 허성필, 박지수, 정동주, 임재민, 배완기† 성균관대학교
In this presentation, we suggest a design principle for bright and robust heavy metal-free quantum dots (QDs). Specifically, we propose a InP emissive core/$ZnSe_xS_{1-x}$/ZnS heterostructure and conduct a comprehensive study across synthesis, spectroscopy and calculation. The experimental results attest that the presence of Se near the InP core facilitates a uniform shell growth and S-rich outermost shell enables the decoupling of the electron wavefunction from the surface trap states. Bright, robust and color-pure InP/$ZnSe_xS_{1-x}$/ZnS QDs, which meet the requirements of light-emitting applications, have been realized *via* engineering the composition profile of thick $ZnSe_xS_{1-x}$ shell. In addition, we also propose ternary III-V semiconductor nanocrystals, $In_{1-y}(Ga_xAl_{1-x})_yP$. With sophisticated engineering of the size and composition of the alloyed QDs, the key characteristics (*i.e.*, lattice parameter, optical band gap and energy band position) can be controlled.

3PS-2 정병국
Colloidal Semiconductor Nanocrystals for Solar Energy Conversion
정병국, 배완기†, 김선호, 박정우 성균관대학교
The luminescent down-shifting (LDS) layer can transform the high energy photons to visible ones. To meet the requirements of luminophores in LDS, high photoluminescence quantum yield and strong photostability are necessary. We demonstrate full-colored, opaque PV modules with LDS layers of structurally-engineered, eco-friendly InP/ZnSeS QDs. The Se rich and thick shell allows the enhanced absorption in the UV region and improved PL QY of QDs. Furthermore, the surface ligand engineering improves the stability of LDS layer after the damp heat test. With the beneficial effects of QD-LDS layers, commercial CIGS and c-Si PV modules exhibit 40% efficiency enhancement in the UV regions and wide color tunability. We believe this integrated approach will contribute to the realization of opqaue PV modules with aesthetically appeal.

3PS-3 임세영
Stabilizing Cubic-Phase of Perovskite Quantum Dots in Photovoltaics via Low-Temperature-Processed Electron Transporting Layer
임세영, 박태호, 김영훈[1,†], 최종민[1] 포항공과대학교; [1]대구경북과학기술원
Fully-inorganic $CsPbI_3$ quantum dots ($CsPbI_3$-QDs) are used as a promising photovoltaic absorber showing the high device performance in QD solar cells. However, low stability of cubic-phase $CsPbI_3$ QDs has been pointed out as a problem that makes difficult for photovoltaics application. In the previous studies, many researchers used compact TiO_2 (c-TiO_2) as an electron transport layer (ETL) in $CsPbI_3$-QD solar cells, which have several limitations such as high-temperature process and low electron mobility. In addition, we newly found that c-TiO_2 ETL can induce the cubic-phase degradation of $CsPbI_3$-QDs. To address these issues, we introduced a new strategy for ETL of $CsPbI_3$-QD solar cells by using SnO_2 QDs instead of c-TiO_2. We showed that the SnO_2 enables to maintain the stable cubic-phase of $CsPbI_3$-QDs under humid and illumination conditions. Consequently, we believe that our new approach can provide insights that will help development of highly efficient and stable $CsPbI_3$-QD solar cells.

3PS-4 이기범
Upconversion Nanoparticles/Hyaluronate-Rose Bengal Conjugate Complex for Noninvasive Photochemical Tissue Bonding
이기범, 한슬기† 포항공과대학교
Photonic nanomaterials have contributed greatly to the development of photomedicines. However, the finite depth of light penetration is still a serious limitation. Here, we developed a poly(allylamine) (PAAm)-modified upconversion nanoparticle/hyaluronate-rose bengal (UCNP/PAAm/HA-RB) complex for photochemical bonding of deep tissue with NIR light illumination. Compared to the conventional invasive treatment, the UCNP/PAAm/HA-RB complex could be noninvasively delivered into the deep tissue and accelerate the tissue bonding upon NIR light. The NIR light triggered UCNP in the complex to illuminate green light under the skin tissue. The activated RB in the HA-RB conjugate by the green light induced radical formation for the crosslinking of incised collagen matrix. In vitro light propagation test, collagen fibrillogenesis analysis, in vivo animal tissue bonding test, and ex vivo tensile strength test confirmed the successful photochemical tissue bonding effect of UCNP/ PAAm/HA-RB complex.

3PS-5 오진우
Nanopatterning of Perovskites Templated in Self-assembled Block Copolymer Films Enhancing Photoluminescence and Environmental Stability
오진우, 한효원, 박철민† 연세대학교

Ordered nanostructured crystals of thin organic–inorganic metal halide perovskites (OIHPs) are of great interest because of the dimensional–dependence of their photoelectronic properties for developing OIHPs with novel properties. Herein, we developed a simple route, involving the controlled crystallization of the OIHPs templated with a self–assembled block copolymer (BCP), for fabricating nanopatterned OIHP films with various shapes and nanodomain sizes. When the precursor solution of perovskite and poly(styrene)–block–poly(2–vinylpyridine) was spin–coated on the substrate, a nanostructured BCP was developed by microphase separation. Spontaneous crystallization of the precursor ions coordinated with the P2VP domains yielded ordered nanocrystals with various structures with controlled domain size. The nanopatterned OIHPs showed significantly enhanced photoluminescence with resistance to humidity and heat due to geometrically confining OIHPs and passivation with the P2VP chains.

3PS-6 박상준

Light–Emitting Electrochemical Cells with Polymer–blended InP/ZnSeS Quantum Dot Active Layer

박상준, 강문성†, 양지혜 서강대학교

A light–emitting electrochemical cell (LEC) is an innovative device in a simple structure containing a mixture of luminophore and electrolyte sandwiched between electrodes. Here, we report LEC containing an active layer comprising green–emitting InP/ZnSeS quantum dots (QDs) blended with polyvinyl carbozole (PVK) p–type polymer semiconductor along with 1–butyl–3–methylimidazolium bis(trifluoromethylsulfonyl) imide ionic liquid. The blending of polymer semiconductor boosts the density of holes reaching to QD, leading to emission from QD, which is unattainable without PVK. Moreover, employing zinc oxide nanoparticles layer onto the QDs–PVK–ionic liquid active layer enhances the density of electrons reaching to QDs. The composition of these materials is varied systematically for balancing the injection of electrons and holes into QD. High luminescence of ~632 cd/m^2 and high efficiency > 1.3 cd/A are achieved, both of which are higher than the values obtained from any previous QDs based LEC.

3PS-7 김현호

Two–Dimensional Magnetic Semiconductors for Spintronic Devices Applications

김현호† 금오공과대학교

Family of two–dimensional materials has rapidly grown from semimetals (graphene) to systems exhibiting collective electronic properties. In particular, several two–dimensional magnetic compounds have been recently discovered. Experimental observations of the magnetic ground state in single atomic layers of such materials are not only important for fundamental interest, but also technologically relevant for next–generation spintronic devices. In this talk, I will present studies of atomically thin magnetic semiconductors CrX_3 (X = Cl, Br, and I) as well as their device applications. By sandwiching CrX_3 between few–layer graphene electrodes, we are able to fabricate high–quality van der Waals magnetic tunnel junctions and electrically probe the magnetic properties of the three materials. Moreover, we found that CrI_3 exhibits an extremely large tunnel magnetoresistance (~10^6%) as well as a robust memristive switching behavior that is tunable with magnetic field.

3PS-8 김지건

Phenethylammonium–Stabilized $CsPbI_3$ Perovskite Quantum Dots Enable Stable and Efficient Photovoltaics

김지건, 고민재, 김영훈†, 한양대학교; [1]DGIST

Photovoltaic applications require manipulation of $CsPbI_3$ perovskite quantum dots ($CsPbI_3$–QDs) surface to replace long–chain ligands such as oleate and oleylammonium with short–chain ligands, in order to improve charge transport. These ligands are sequentially replaced with acetate anions and formamidinium (FA) cations via solid–state ligand exchange. However, FA replacement removes the hydrophobic protective layer, opening the path for moisture penetration and resulting in poor device stability. Herein, we demonstrate that aromatic ring–based hydrophobic phenethylammonium (PEA) cations are incorporated into the $CsPbI_3$–QDs, leading to improved their charge transport and moisture stability. PEA does not change the size, composition, and dimensionality of $CsPbI_3$–QDs and affords high moisture stability under ambient conditions. In addition, PEA–incorporated $CsPbI_3$–QD solar cells show a high device stability and performance with power conversion efficiency of 14.1%.

3PS-9 김승한

Semi–interpenetrating Diphasic Network of CdSe Tetrapod Nanocrystal and P3HT Polymer Semiconductor with Balanced Ambipolar Transport

김승한, 박한나, 강문성† 서강대학교

One of representative method for implementing an ambipolar transistor capable of transferring both electrons and holes is using blended of n–type and p–type materials as a channel. However, this blended channel generally involves the degradation issue due to phase separation. In this study, a semi–interpenetrating diphasic network composed of n–type CdSe TpNCs with 60 nm long branchs and p–type P3HT was constructed to fabricate an ambipolar transistor with high stability. The TpNCs easily form a percolation pathway due to long branches of each particles leaving plenty of voids that can be filled with P3HT. The results from SEM and EDS conform that the two materials were uniformly blended. The electrical properties of hybrid film according to the mixing ratio were confirmed by the ion gel transistor. In addition, since the network contains polymer semiconductor, it has an opportunity to develop into a flexible electronic device, and the possibility was confirmed through a tensile test.

콜로이드 및 분자조립 부문위원회

3PS-10 황준호

Helical Assembly of Au Nanoparticles in 1D Nanocylinders Confirmed by 3D Transmission Electron Microscopy

황준호, Ke Wang[1], Jiangping Xu[1], Jintao Zhu[1], 이은지† 광주과학기술원; [1]Huazhong University of Science and Technology

The superstructure of chiral plasmonic nanoparticles (NPs) has proper properties for chiroptical sensors, circular polarizers, and optical metamaterials. The helical structure of NP assembly could improve the optical chirality induced by destruction of symmetric structure with NPs closely packed in confined within the cylindrical assemblies. Here, we demonstrate the assembly of polystyrene (PS)–tethered Au NPs composed of zigzag array was reconstructed into a 3D image with various angles to precisely confirm the internal NPs symmetries. The number of NP layers and the packing structures are controlled by molecular weight of PS to influence the surface plasmon resonance properties of the assemblies. These assemblies were analyzed for the location and array of NPs by 3D transmission electron microscopy. This study presents a strategy for controlling the helical assembly and plasmon optical activity of NPs and predicting the correlation between nanostructure and chiroptical properties.

3PS-11 호정원

Fabrication of Flexible and Bendable Surface Enhanced Raman Scattering (SERS) Substrate Exhibiting Constant Performance at Strained Condition via AuNPs Monolayer Assembled on Wrinkled PDMS

호정원, 유성수, 유필진† 성균관대학교

Recently, lots of studies for fabrications of flexible/bendable Surface–enhanced Raman scattering (SERS) substrates have been researched, because of their outstanding applicability. However, there are trade off relation between enhancement factor (E.F.) and strain (i.e. E.F. decreases as the SERS substrate is stretched). To overcome this problem, in this research, we proposed flexible SERS substrate that is fabricated by assembling gold nanoparticles (AuNPs) monolayer on the wrinkled structure of polydimethylsiloxane (PDMS). In addition, we deposited the MXene layer on presented SERS substrate to enhance the SERS effect, and established optimum thickness of MXene layer. To measure the E.F. of SERS substrate, the crystalviolet (C.V.) and rhodamine 6g (R6G) were used as analytes. Since a lot of molecules can be bound with MXene which is located on outside of presented SERS substrate due to its functional groups, it is anticipated to utilized at wide range of detecting field.

3PS-12 한상영

Iron Gall Ink–Inspired Supramolecular Complex of Fe^{3+} and Tannins for Black Hair–Dyeing

한상영, 홍석표, 강은혜, 최인성† KAIST

The need for hair dyeing has recently been intensified because of the ever–increasing occurrence of gray hair at the early age. Herein, we report a natural formulation for black hair–dyeing, which does not require toxic chemicals and harmful oxidizing agents, inspired by the ancient iron gall ink. The Fe^{2+} cations bound to tannins are oxidized rapidly upon their exposure to the air and form the blackish Fe^{3+}–tannin supramolecular complex that coats hair firmly. After dyeing, the dyed black color does not fade under sunlight exposure for at least three months and also after shampooing. Considering the long–term stability and simple process, this natural formation for black hair–dyeing would have merit in the cosmetic industry.

3PS-13 팜티투이동

Preparation of PEGlated Conjugated Polymer Nanoparticles

팜티투이동, 박주현†, 이다빈, 정상원, 전예지, 신용훈, 알렉스[1] Chung–Ang University

On these days, the developing application of conjugated polymers have gradually admitted as a promising material in different aspects. Their versatile properties such as high brightness, high photostability, and low cytotoxicity have transformed them to become alternatively multifunctional biomaterials. However, these organic–based materials were limited by the lack of hydrophilicity and bioavailability. This obstacle can be overcome by the incorporation of conjugated polymer nanoparticles (CPNs) to functionalized polyethylene glycol (PEG) in an aqueous medium. This research provides a view of different techniques in the fabrication of structural PEGlated CPNs formed from the phase–separated thin film [1] in the incorporation of a conductive polymer and a phospholipid. The difference in PEG–linked methods results in the changing of assembled molecular structures, thus giving the significant effect on the near infrared absorption and photothermal properties for theranostic applications.

3PS-14 최효린

Enhanced Stability of $FAPbBr_3$ Nanoparticle–Polymer Composite Films

최효린, 강영종† 한양대학교

Lead halide perovskite nanoparticles are promising materials for light-emitting diodes (LEDs) because of their superior optical properties. However, their practical applications are often hindered by the poor stability of perovskite nanoparticles against polar solvents including water. Additionally, micropatterning of perovskite is highly demanded for their LED device fabrications. In this experiment, perovskite nanoparticle composite films are prepared by photosynthesis of polymers and formamidinium lead bromide ($FAPbBr_3$) nanoparticles. Patterns of $FAPbBr_3$ nanoparticles are formed by controlling the size exclusive flow of nanoparticles in polymer networks and the position of nanoparticles is spatially controlled in both lateral and vertical directions. The composite films show not only high-resolution pattern and excellent resistance to various aqueous and organic solvents, but also high photoluminescence quantum yield (up to 44%) and broad color tunability in visible region.

3PS-15 최진우

Thermal Control of Mechano-Responsive Property at LDPE Organogel

최진우, 강영종† 한양대학교

Responsive polymer gel materials can be adapt to soft mechatronic and robotic devices. Here, we report on simple and fast method for making mechano-responsive polyethylene gel. By manipulating the heating temperature to dissolve polyethylene, the viscosity of the polyethylene gel can be diverse, and even can have mechano responsive property. we have examined recovering time of viscosity by fluorescence rotor, which increases its emission intensity as the viscosity of environment rises. we use scanning electron microsope to research structure of the gel by freeze drying of the polyethylene gel. we use the o-xylene, decalin, toluene, cyclohexane, and benzene as solvent of the gel. The heating temperature range was vary along the solvent. the cyclohexane and toluene have small range to mechano-responsive, while the benzene and o-xylene have relatively wide range. The aggregates of the polyethylene gelator become bigger as the heating temperature increases, and the gels become turbid.

3PS-16 최인혁

Fabrication of Thermoresponsive Hydrogel and Conjugated Polymer Composites

최인혁, 전석진† 금오공과대학교

자극 감응성 하이드로젤은 주변 환경에 의해 제어되는 팽윤 특성으로 소프트 액츄에이터 등 다양한 분야에서 많은 관심을 받았다. 그 중 우리는 온도 민감성 하이드로젤인 polydiethylacrylamide (PDEAM) 에 공액 고분자가 도입된 컴포짓을 제작하고자 한다. 공액 고분자는 트랜지스터, 유기 태양전지, 발광 다이오드와 같은 광전자 소자로 많이 사용되고 있고, PDEAM과 공액 고분자의 복합체는 기존에 보고되지 않은 새로운 응용을 가능하게 할 것으로 기대된다. 본 발표에서는 PDEAM과 공액 고분자의 복합체 제조 및 공액 고분자의 농도에 따른 PDEAM의 팽윤 거동에 대해 설명한다.

3PS-17 최예훈

Thermo-Responsive Microcapsules with Tunable Molecular-Size-Selective Permeation

최예훈, 전석진[†], 김신현† KAIST; [1]금오공과대학교

Thermo-responsive polymers show difference solubility or miscibility in aqueous solutions as temperature. Using these polymer, microcapsule can control as changing the size. These microcapsules are used microreactor, release control drug-delivery or sensor, etc. But hydrogel matrix polymers are not solute in aqueous phase so micro-emulsion design will be oil-in-water-in-oil. In this case, liquid exchange step after polymerization, oil to water, is negative influence to capsule condition and hydrophilic materials encapsulation is impossible. In this study, we use Poly(N,N-diethylacrylamide) with benzophenone (PDEAM-BP) as hydrogel materials. This polymer has good solubility to aqueous so it can be remove washing step and enable encapsulation. Fabricated micro-capsules shows sharp cut-off value control as temperature compared other hydrogel microcapsule. We expect fabricated microcapsule applied as microreactor or catalyst system to control materials transfer as temperature.

3PS-18 최영호

Investigation on Surface Chemistry of InP-based Quantum Dots During Shell Growth Reaction

최영호, 임재훈† 성균관대학교

InP-based quantum dots (QDs) have become as one of promising candidates for electroluminescence materials in the field of displays and lightings owing to band gap tunability and high photoluminescence quantum yield (PL QY). In-depth study on surface chemistry of InP QDs has given a clue to explore synthetic protocol for high quality core/shell QDs with nearly unity QY. However, detailed reaction steps occurring on QDs' surface during the shell growth is still unrevealed and different valency between III-V core and II-VI shell has been addressed as complication in the synthesis of core/shell QDs. Here, we investigate the modification of surface chemistry of InP-based QDs in the course of ZnSe shell growth. Multilateral probes like XPS, 1H-NMR, and ultrafast PL decay were introduced to track the change of surface ligands and chemical composition. We believe that our meticulous study helps broaden our understanding of semiconductor heteroepitaxy in wet chemistry.

3PS-19 정세희

Preparation of Docetaxel Loaded Nanoparticles Using a Coaxial Turbulent Jet Mixer

정세희, 임종민† 순천향대학교

기존의 회분식 나노 입자 생산법은 입자의 물리 화학적 특성의 정교한 조절과 재현성 측면에서의 한계점을 보였고 대량 생산을 위해 반응기의 크기를 증가시킬 경우, 다시 생산 공정을 최적화하여야만 했다. 이를 개선하고자 미세유체소자를 이용한 나노 입자의 연속 생산 공정이 활발하게 연구되고 있지만, 제작 방법이 복잡하고, 대량으로 생산하는 데 한계가 있었다. 본 연구에서는 대량생산 공정에 적합한 coaxial turbulent jet mixer를 이용하여 약물전달에 사용될 수 있는 생분해성 고분자 나노 입자를 제조하였다. Tube fitting을 이용하여 기존에 보고된 coaxial turbulent jet mixer 보다 소자 제작의 간편성을 확보할 수 있었다. 나노 입자 전구체와 Non-solvent를 고속으로 주입하여 docetaxel을 함유하고 있는 생분해성 고분자 나노 입자를 대량으로 제조할 수 있었고 HPLC를 이용하여 나노 입자 내 docetaxel의 함유량과 방출특성을 측정할 수 있었다.

3PS-20 전나영

Optical Chirality Induced by Chiral Peptide Assembly

전나영, 김하연, 이은지† 광주과학기술원

Optical chirality including circular dichroism (CD) and circular birefringence (CB) is an intrinsic optical property of chiral molecules or chiral supramolecules. To amplify this optical property, inorganic nanoparticles like gold nanoparticles (AuNPs) are added due to its unique optical property, known as surface plasmon resonance, that exhibits strong absorption band in the visible spectrum. Because morphology of AuNPs like size and distance is decisive in this context, hybrid of helical structure and AuNPs with regular pitch and width is an attractive template for controlling optical property by manipulating morphology of AuNPs. Here, with assembled nanostructures of short peptide enantiomers, AuNPs chelated along the helical fibers with fabricated the size and shape generate enhanced chiroptics. This work can provide a understanding of self-assembled structure of peptide enantiomers with opposite helictity and a useful strategy for functionalizing chiroptical nanomaterials.

3PS-21 자 오

Effect of Phenolic Acids on the Temperature Sensitivity of Self-assembled Nanospheres Containing Poly(ethylene imine) and (Phenylthio)acetic Acid

자 오, 김진철† 강원대학교 의생명과학대학

Poly(ethylene imine)(PEI) and (phenylthio)acetic acid(PTA) can self-assemble in the water phase. These nanospheres are sensitive to temperature. In the range of 20 ℃~50 ℃, with 4 kinds of phenolic acids(PAs)(Cinnamic acid(CA), hydroxy cinnamic acid(HCA), dihydroxy cinnamic acid(DCA), methoxy hydroxy cinnamic acid(MHCA)), the phase transition temperature changed significantly. The higher the PAs concentration, the lower the phase transition temperature, which meaned that the nanospheres became unstable. It was because PAs also had carboxyl groups, it may had electrostatic interaction between themselves and the amino groups of PEI. The PEI/PTA/PA conjugate showed circular shape from TEM. The release profile at different temperature was measured. Only in PEI/PTA, the release and the temperature effect was small. When CA was added, the release was relatively increased. With HCA and DCA, the release rate increased significantly. MHCA showed some effect on release, but was small.

3PS-22 이현준

Sub-Band Gap Operation Mechanism of InP Quantum Dot-Based Light-Emitting Diodes

이현준, 정병국[†], 배완기[†], 이도창, 임재훈[†,†] 한국과학기술원(KAIST); [1]성균관대학교(SKKU)

Colloidal quantum dot-based light-emitting diodes (QLEDs) are being to the fore as next-generation technology for future information displays. Though the research for QLEDs have made much progress from perspective of efficiency and stability, the origin of sub-band gap (sub-Eg) operation is still undisclosed. Here, we investigate the sub-Eg phenomenon in QLEDs. In the course of assessment using hole transport materials with different energy levels, the diode and light turn-on voltages display a clear dependence on the difference between electron and hole carrier transport levels, not hole injection barrier by QDs' shell material. Fermi level pinning between ZnO electron transport layer and QDs revealed by ultraviolet photoelectron spectroscopy implies that an involvement of surface states of QDs to the alignment of energy level landscape. We attribute the sub-Eg turn on to the vacuum shift originating from surface states of QDs which allows to minimizing the hole injection barrier.

3PS-23 이태민

Suppression of Exciton Quenching in All-inorganic Quantum Dot Light-emitting Diode Through Nickel Oxide Surface Treatment

이태민, 이도창† KAIST

Inorganic hole transport materials in quantum dot light-emitting diodes (QD-LEDs) have attracted attention due to inherently high stability in harsh driving conditions and ambient environments. NiO is a suitable candidate for inorganic hole transport materials (HTM) owing to its stability and moderate mobility. However, some hurdles need to be addressed for the high-performance of NiO-based all-inorganic QD-LED. Exciton quenching caused by free carriers and surface traps on the surface of NiO hole transport layers (HTLs) deteriorates the performance of the devices. We suppress exciton quenching by passivating the trap site of NiO using an appropriate ligand. The ligand exchange method was applied to NiO, XPS conducted for analysis of NiO surface, and the suppression of exciton quenching evaluated through PL decay of QD/NiO.

3PS-24 이채원

In situ Polymerization of Melanin Nanoparticles in Hydrogel Bilayers for Controlled Photothermal Effect Toward Programmable Actuation

이채원, 심태섭† 아주대학교

Soft actuators are actively being researched to develop soft robots responding to

various stimuli. Although photo-responsive material can adjust deformation by remote control, there has been difficulty in manufacturing to have different driving properties within a single material. We developed a melanin-driven light-responsive hydrogel actuator composed of agar/alginate double-network (DN) hydrogel and N-isopropylacrylamide. For melanin nanoparticles, dopamine precursor was introduced to the pristine hydrogel and in situ oxidation polymerization was proceeded in polymer networks. It was possible to form different melanin concentrations depending on the time and number of polymerization. As hydrogel containing melanin were irradiated, heat was generated by photothermal effect and caused actuation, which leads to shrinkage resulting in shape morphing. Finally, we observed different shape morphing behaviors with different melanin concentration under the same light irradiation condition.

3PS-25 이창재

Reconfigurable Periodic Liquid Crystal Defect Array via Application of Electric Field

이창재, 윤동기† 한국과학기술원(KAIST)

Topological defects in liquid crystal (LC) phases have attracted much attention in the areas of self-assembly, and applications including particle manipulation system and template for material micropatterning. Developing reconfigurable periodic topological defect arrays in the nematic LC phase is demonstrated by applying electric field using a crossed-linear and interdigitated transparent indium-tin-oxide (ITO) electrode on glass substrates. Modulation of the defect patterns is achieved via varying configurations of the electric field and electrode. The individual LC defect can be employed to generate an optical vortex inducer and a particle trapping-releasing unit, which could be dynamically controlled. This approach would be beneficial to extend the use of LC patterns in lithographic tools and optoelectronic devices.

3PS-26 이일송

Cadmium-free Colloidal Nanocrystal Quantum Dots (QDs) for Selective Bacterial Cell Killing

이일송, 이도창† 한국과학기술원

Antibiotic-resistant bacterial cell infection is a serious problem in many countries. Reactive oxygen species (ROS), which is toxic to bacterial cells, is one of reactive species responsible for the photoactivity of semiconductor nanoparticles. In this study, we have prepared highly efficient antibiotical colloidal nanocrystal quantum dots (QDs). The bandgap energy of cadmium-free QDs (indium phosphide quantum dots, InP QDs) was tuned their size. The cadmium-free QDs were treated to bacterial cells (drug-resistant Escherichia coli, MG 1655 strain) and the bacterial viability was analyzed to confirm the QD-induced bacterial cell death. The cadmium-free QDs efficiently attacked and growth-inhibited the bacterial cell, but had less effect on the mammalian cells. The cadmium-free QDs could be used for clinical phototherapy to care the bacterial infections.

3PS-28 이승연

Effect of Isopropyl Alcohol (IPA) on Tin Oxide (SnO_2) Nanoparticle (NP) Suspension and Dried Film for Electron Transport Layer (ETL) of Solar Cell

이승연, 명진석[1], 함동석[1], 이재흥[1], 김영진[2], 최우진[1,†] 한국화학연구원/충남대학교; [1]한국화학연구원; [2]충남대학교

The roll-to-roll (R2R) process is widely adopted to produce large and low-priced flexible devices due to its productivity and scalability. To improve the performance of perovskite solar cells (PSCs), the uniform morphology of SnO_2 NP (ETL) on a flexible substrate should be achieved to produce the PSC using a R2R process. Water/IPA solvent is widely used to improve the wettability between SnO_2 NP suspension and substrate by controlling the surface tension and NP dispersion, so the effect of co-solvent (IPA) on the suspension should be investigated. In this study, we investigated the effect of co-solvent content on NP aggregations in a solution and surface properties in a dried film. In addition, we utilized the Brownian dynamics simulations to study the structure formation and deformation of NP during drying. The results reported in this presentation help to understand the dynamic behavior of attractive colloidal suspension and the morphology development of the ETL during drying.

3PS-29 이성민

All-water-based Solution Processes for Metallic Electrodes on Various Substrates and Their Applications

이성민, 오인혁, 장석태† 중앙대학교

Developing fabrication of conducting electrodes on various substrate has attracted substantial attentions as an essential way to achieve wide-ranged application of electronic devices. Here, we report a simple and effective approach for the fabrication of highly conductive electrodes utilizing various substrate. Electrodes were formed by combining colloidal gold nanoparticles deposition with Au or Ag enhancement. Firstly, Ag film is applied to electrocatalyst for CO_2 conversion and it demonstrates a high CO FE of 75.7% at a low overpotential of 0.19 V. Secondly, transparent mesh electrode is fabricated, having 700 nm feature size with high optical transmittance of 97.7% and high conductivity (71.6 Ω/sq). Cotton-based Au electrodes is applied to flexible wearable heater which is able to heat up to 120 ℃ at 1 V within a few second and supercapacitor is fabricated with electrodeposited MnO_2 as active material showing good specific capacitance of 227 F/g at 5 mV/s scan rate.

3PS-30 이명구

Inkjet-printed Low-cost Colorimetric Tickets for TNT Detection in Contaminated Soil

이명구, 유해욱[1], 임성현, 이기라† 성균관대학교; [1]국방과학연구소

A simple colorimetric detection method for 2,4,6-trinitrotoluene (TNT) in contaminated soil has been developed. Procedurally, a TNT responsive chromogenic reagent was inkjet printed on commercially available photo paper, and the resulting colorimetric ticket was laminated with a precut patterned film to make a bilayer microfluidic sensor. For the TNT detection experiments, a drop of TNT solution was placed on the center of the prepared sensor. Color measurement of the sensor with a photo scanner showed a wide detection range of TNT, ranging from 14 parts per million (ppm), which is below its residential screening level (~21 ppm) to 7,200 ppm. To further demonstrate its efficacy, TNT spiked soil samples were extracted with acetone and evaluated with the developed sensor.

3PS-31 이다빈

Increasing Photocatalytic Efficiency by Photothermal Effect

이다빈, 박주현†, 팜티투이동, 정상원, 전예지, 신용훈, 알렉스 중앙대학교

Photocatalytic reactions in which the semiconductor material absorbs light and affects the chemical reaction rate include hydrogen production by water decomposition, fuel production by reduction reaction of carbon dioxide, and decomposition and removal of toxic pollutants in fine dust and wastewater. Thermodynamic major factors which include photocatalytic energy level and band gap and kinetic major factors which include reactant concentration, light intensity, reaction temperature affect the photocatalytic reaction. In this study, we fabricated nanohybrid composite fibers that contained conjugated polymer nanoparticles (CPNs) with photothermal property inside the fibers and porous silver nanoshells. Photocatalytic effects of the silver nanoshells was dramatically increased by synergetic effects of enhanced light harvesting followed by efficient energy transfer and photothermal temperature increase.

3PS-32 윤현수

Free Energy Analysis of Commensurability-driven Block Copolymer Self-assembly

윤현수, 최홍균† 공주대학교

블록공중합체를 이용한 Directed self-assembly에서는 주형 내에서 블록공중합체의 정렬을 예측하고 제어하는 것이 중요하다. 본 연구에서는 블록공중합체가 2차원 제한적 공간에서 어떻게 거동하는지 연구하였다. 특히 사각 주형 내에서 블록공중합체의 정렬을 예측, 설명하기 위해 자유에너지 모델을 도입하였고 이를 통해 사각 주형의 변의 길이와 종횡비, commensurabilty에 따른 블록공중합체의 정렬을 분석하였다. 실험결과와 자유에너지 모델링을 비교, 분석하여 자유에너지 모델이 성공적으로 사각 주형 내부의 블록공중합체의 정렬을 예측할 수 있음을 보였다.

3PS-33 윤다은

Synthesis of Heterostructured Semiconductor Nanocrystals by Cation Exchange

윤다은, 이도창† KAIST

Semiconductor nanocrystals, also known as quantum dots, have unique optical and electronic properties depending on their size and shape. Synthesis of heterostructured semiconductor nanocrystals enables various control of particle properties by introducing new composition and geometries. In this study, we introduced cation exchange method to synthesize heterostructured nanocrystals. Based on the understanding of binding energy between cations and organic ligands, Cd-to-Zn direct cation exchange reaction is successfully induced in CdSe quantum dots. We also expanded our study on two-dimensional colloidal nanoplatelets and synthesized new type of heterostructure.

3PS-34 엄홍식

Fabricating Transparent Electrode Based on Grid-patterned Silver Nanowires

유진선, 엄홍식, 장석태† 중앙대학교

Abstract: Recently, transparent conducting electrode (TCE) formed with silver nanowires (AgNWs) have been attracted attention as substitute of Indium tin oxide (ITO). However, the randomly deposited AgNW film has a poor performance in the transmittance and the sheet resistance to replace ITO. To improve the performance of AgNW film, we fabricated grid patterned AgNW by modifying the surface energy of substrate. The hydrophobized surface was selectively etched by UV light through quartz chrome mask and then the solution which was made of isopropyl alcohol (IPA) and ethylene glycol (EG), and the AgNWs was coated on the substrate by using meniscus dragging deposition (MDD) process. The grid structured AgNW films were estimated to have better property as a TCE than the randomly deposited AgNW films by measuring the transmittance and the sheet resistance then calculating the value of figure of merit and the percolation threshold.

3PS-35 양한솔

Facile Route to Highly Stable $CH_3NH_3PbBr_3$ Quantum Dots with High Production Yields and Their Optoelectronic Applications

양한솔, 장재영†, 노성훈, 서의현, 정재민, 오종규, 이경호 한양대학교

$CH_3NH_3PbBr_3$ ($MAPbBr_3$) perovskite quantum dots (QDs) have attracted great attention as promising and cost-effective elements for optoelectronic devices. However, commonly used polar non-solvents can damage the QD cores during centrifugation for purification, which significantly diminish their production yields and optical properties. Here, we introduce an effective non-solvent to purify as-synthesized $MAPbBr_3$ QDs without severe damage, obtaining stable QDs with high production yields. The washed $MAPbBr_3$ QDs maintained their high photoluminescence (PL) quantum yields and crystalline structures for long times. Time-resolved (PL) analysis revealed that the QDs showed suppressed non-radiative recombination and a prolonged (PL) lifetime, supporting the minimized damage on the QDs. Finally, we

fabricated stretchable and self-healable green color filters for the demonstration of white light-emitting diodes by composing the $MAPbBr_3$ QDs with a thermoplastic elastomer.

3PS-36 알렉스

A PALLADIUM CATALYZED Di-pendant Substituted Conjugated Polymer (CP) with Styrene Back Bone for Enhanced Thermal, and Optical Property

알렉스, 박주현†, 이다빈, 정상원, 전예지, 신용훈, 팜티투이동 중앙대학교

Tailorable nature, light weight, versatility and stability are some advantages of Conjugated Polymers (CPs) to be used in optical and electronic arena. In our work a novel route of disubstituted polymeric material via multistep synthesis for optoelectronics application is proposed. In the polymer synthesis both Sonogashira reaction and metathesis reaction were used, yielding stable crystalline complex. Furthermore, the effect of the pendant alkene chain length to the thermal and optical property of the assembly will be studied.

3PS-37 신민경

A Twisted Stack of Aligned Gold Nanowire Arrays from a Repetitive Tilted Transfer of Block Copolymer Thin Films

신민경, 오진우[1], 손정곤[1], 염봉준† 한양대학교; [1]한국과학기술연구원

Chiral nanomaterials can present chiroptical properties that can preferentially interact with circularly polarized lights. Based on such unique optical properties, there have been enormous efforts to utilize these novel materials in advanced optical and biomedical applications. However, artificial constructions of chiral nanostructures with high enantiomeric purity is still challenge. For pure chiral structure at the nanoscale, we fabricate a twisted stack of unidirectionally aligned gold nanowire arrays from the repetitive tilted transfer of a aligned block copolymer films. Firstly, we execute a shear rolling process for the alignment of BCP microdomains of cylindrical PS-b-P2VP films, and perform a liquid phase infiltration process of gold precursor selectively into the P2VP cylinders for creating an aligned gold nanowire array with diameter of ~20 nm. Then to realize a chiral nanostructure, we repetitively transferred at a specific angle in a clockwise or counter-clockwise direction.

3PS-38 신도중

Uniaxial Orientation of Semiconductor Nanorods for High Outcoupling-factor Light-emitting Devices

신도중, 이도창† 한국과학기술원

The alignment of anisotropic semiconductor nanocrystals in the emissive film poses important challenges for improved overall efficiency of electroluminescent devices. The uniaxial dipole orientation of the emitters immediately induces not only enhancing the optical extraction efficiency of the device but reducing the light loss through the linear polarized filter. Herein, we report enhanced EL polarization with uniaxial alignment of CdSe/CdS core/shell dot-in-rods (DIRs) film blending with conductive polymer with poly(9-vinylcarbazole) (PVK). This study on flow-induced alignment of anisotropic nanocrystals provides quantitative understandings in the solution processible film formation.

3PS-39 성민철

Synthesis of Silica Nanoplatelets with Controllable Wettability Using β-Sheet Structured Polypeptide Templates

성민철, 김진웅† 성균관대학교

Colloidal particles with 2-dimensional geometry exhibit high adhesion energy at the interface so that there have been tries to synthesized new types of particles with a tailored platelet structure. Herein, we introduce an approach to synthesize silica nanoplatelets (SiNPs) with controllable wettability. For this, we synthesized the SiNPs by precipitating silica from β-sheet structured polypeptide templates. The surface modification of SiNPs led to formation of a preferred configuration at the oil-water interface. Taking advantage of high adhesion energy coming from the platelet-geomerty of SiNPs, we could easily obtain stable O/W and W/O type Pickering emulsions. These results highlight that the SiNPs developed in this study could have great potential for applications to complex multiphasic fluid systems.

3PS-40 서복기

Synthesis of Amphiphilic Silica Nanoplatelets via Surface Initiated ATRP for Effective Stabilization of Pickering Emulsion Drops

서복기, 성민철, 김진웅† 성균관대학교

Amphiphilic Janus particles are widely considered as advanced Pickering emulsion stabilizers due to their unique biphasic structure. In general, particles with a plate-geometry exhibit excellent interfacial adhesion energy, which is originated from their high geometric anisotropy. Herein, we introduce a new synthetic approach to obtain amphiphilic silica nanoplatelets (ASNPs) which enables self-assembly at the oil-water interface. For synthesis of ASNPs, we sythesized silica nanoplatelets (SiNPs) from polypeptide-templated silicification. The conformation changes to δ-sheet structure led to formation of plate geometry. Stepwise modification of SiNPs was conducted for the preparation of macroinitiator. The ASNPs were finally obtained by carrying out SI-ARGET ATRP against the neat SiNPs located the O/W interface, thus simultaneously grafting both hydrophilic and hydrophobic polymers on each SiNP surface.

3PS-41 박안성

Dynamical Changes Induced by Perovskites ($BaTiO_3$) in Ionic Liquid Lithium Ion Battery

박안성, 김용주[1], 이원보† 서울대학교; [1]국민대학교

Recent study showed hybrid solid electrolyte (HSE), nanosize perovskite particles mixed with ionic liquid (IL), exhibits excellent flame retardancy, thermal stability and better ionic conductivity compared to pure IL electrolyte. However, the mechanism of high performance of HSE in ionic conductivity is yet be explained. In this work, HSE system (perovskite $BaTiO_3$ (BTO), anion bis(trifluoromethane)sulfonamide (TFSI-) and cation 1-Butyl-1-methylpyrrolidinium (PYR14+)) is studied by molecular dynamics simulation. We found Li+ had unexpected large mobility near the BTO surface which lead to increase in its average mobility. By calculating transport properties and distribution, we found strong attraction between ions and crystal and decreased correlation between Li+ and counter ions. This study suggests high dielectric constant ionic crystals (such as $SrTiO_3$, $CaTiO_3$, $MgSiO_3$, $PbTiO_3$) can increase total Li+ mobility, one important factor to consider when developing solid electrolyte.

3PS-42 박소희

Effects of Vegetable Oils as Carrier Liquids on Mg-doped Silica/Titania Hollow Nanoparticles-based Electrorheological Fluids

박소희, 김세문, 이승애† 건국대학교

Ecofriendly electrorheological (ER) fluids are developed by adopting vegetable oils as insulating liquid media and silica/titania hollow nanoparticles as the dispersed electroresponsive particles. Four different biodegradable vegetable oils are used as carrier liquids due to their high biodegradability compared to the conventional carriers, such as silicone oils. Furthermore, the magnesium, which is a biodegradable and non-toxic metal, is used as a dopant to increase the electroresponsive activities of the fluids. Ascribed to the hollow structured nanoparticles, the synthesized eco-friendly ER fluids exhibit excellent dispersion stability as well as high shear stress. Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2019R1C1C1007578) and the Technology Innovation Program (20004627) funded By the Ministry of Trade, Industry & Energy (MOTIE, Korea).

3PS-43 박건형

Bilayer Dichroic Films Using Liquid Crystalline Polymer for Various Optical Applications

박건형, 윤동기† 한국과학기술원 나노과학기술대학원

We have fabricated a bilayer dichroic-doped liquid crystal film by uniaxial alignment method and photopolymerization process, which is useful for dichroic color filter, dual mode circular polarizer, and chirality detector. Two kinds of dichroic polymer films that have different absorbing wavelengths are cross-stacked to show various colors and contrasts depending on the polarization direction of incident linear polarized light, which is comparable with the conventional single-layer dichroic dye-doped liquid crystal film that only shows the contrast difference. We believe that our platform can be used in many other multiplex applications including what we have suggested in this study such as multi-color holograms, optical signal encryption, and electrically tunable devices.

3PS-44 박강호

Orientation Control of Supramolecular Columns by Photo-thermal Laser Heating on Graphene Light Absorbing Layer

박강호, 진형민[1], 권기옥[2], 김장환, 윤해주[3], 한규호, 윤태영, 김상욱, 정희태† KAIST; [1]한국원자력연구원; [2]한국생산기술연구원; [3]삼성디스플레이

Self-assembling properties of soft materials has been investigated for the formation of highly periodic nanostructures. One of soft materials, supramolecular structures are attractive due to their advantageous properties such as small feature size (2-10 nm), various chemical functionalities, and fast stabilization time (~few mins) to self-assembly. In this research, we demonstrate directed self-assembly of supramolecular columns by photo-thermal annealing. Thermal gradient was generated from irradiated laser beam onto photo-thermal conversion layer. Thermal gradient oriented the supramolecular columns, then four different orientations of supramolecular columns were observed by controlling laser power and laser scanning velocity. It was revealed that quench boundary velocity mainly affected to the orientation direction. This method can be applied for supramolecular structures with different phases and dimensions, then various periodic nanostructures can be generated.

3PS-45 남성경

Photonic Janus Balls with Optical, Magnetic, and Density Anisotropy for Dynamic Structural-Color Tuning

남성경, 김종빈, 한상훈, 김신현† 한국과학기술원

When all spreading parameters are negative, Janus configuration that exposes two drop phases to the continuous phase at comparable level can be obtained. In this work, a microfluidic system was used to produce uniform Janus particles. By incorporating aligned magnetic particles in one compartment, the Janus microparticles respond to the external magnetic field. By creating regular array of silica particles in the other compartment, structural colors were developed. If the magnetic alignment is different before curing, the magnetic orientation of the produced particles will be different. Particles with different structural colors have different orientations and different colors depending on the direction of the external magnetic field. The Janus microparticles with optical and magnetic anisotropy were able to dynamically switch structural colors on and off by controlling the external magnetic field, serving as active color pixels for reflection-mode displays.

3PS-46 김하정

In-situ Interfacial Coacervation of Silica Nanoplatelets with Polymers for Production

of Structrually Stable Macroemulsion Drops

김하정, 박대환, 성민철, 김진웅† 성균관대학교

We introduce a novel interfacial structure which is engineered by in-situ coacervation of silica nanoplatelets (SiNPs) and polyacrylic acid (PAA). For this, we synthesized SiNPs by silicification in β-sheet stuructured polypeptide template. To give controlled wettability to SiNPs, we grafted 3-aminopropyltriethoxysilane (APTES) and hexyltrimethoxysilane (HTMS) through silane coupling reactions. Modification of SiNPs led to controlled wettability depending on the concentration of organosilanes. Thanks to high adhesion energy of SiNPs, monodisperse macroemulsion drops could be produced in a capillary-based microfluidic device. The interfacial structure could be engineered by controlling the electrostatic coacervation of amine-functionalized SiNPs and carboxylic acid groups of PAA. The morphology of coacervate membrane was directly observed via CLSM analysis. The macroemulsion with this coacervate membrane exhibited excellent storage stability without any coalescence and coagulation.

3PS-47 김철호

Self-assembly of Icosahedral Cluster and Its Photonic Properties

김철호, 박상혁[1], 김신현[1], 이원보[2], 문준혁† 서강대학교; [1]KAIST; [2]서울대학교

Icosahedral colloidal clusters are a new class of spherical colloidal crystals. However, the optical characterization of the icosahedral cluster has not been achieved. Here, we produce icosahedral clusters by slowly shrinking particle-laden water droplets in water-saturated oil and characterize their optical properties. We controlled the drying time of aqueous droplets using a water-saturated hexadecane medium for preparation of the icosahedral cluster. In particular, we present real-time clustering using dual dye labeling under fluorescent confocal microscopy. The icosahedral clusters exhibit relatively strong structural colors compared to conventional onion-like supraballs. Simulations prove that the crystalline array inside the icosahedral cluster strengthens the collective specular diffraction. Moreover, the carbon-coated clusters further improve the saturation of structural colors.

3PS-48 김진영

Novel Synthesis Method of Perovskite Quantum Dots with Improved Colloidal Stability via Split-Ligand Re-Precipitation Technique

김진영, 김병기, 장웅식, 왕동환† 중앙대학교

$CH_3NH_3PbX_3$ (X = Br, I) perovskite Quantum Dots (PQDs) have excellent physical and chemical properties, but have been limited due to poor efficiency than conventional QDs. PQDs are undergoing experiments with many efforts to improve efficiency and stability. We succeeded in synthesizing colloidal QDs that can simultaneously improve efficiency and stability. Octylamine, which controls the size of QDs, and the oleic acid, which acts as a stabilizer, are separately dissolved to conduct the experiment. We call this the S-LMRP (Split-Ligand Re-Precipitation) technique, and it is done in an easy way. Strong luminescence and narrow FWHM can be obtained. The experiment was performed under ambient conditions, and PLQY of $CH_3NH_3PbX_3$was obtained up to 91.5%. $CH_3NH_3PbX_3$ synthesized through S-LMRP is maintained a strong PL intensity even after 500 hour. These results suggest that PQDs through the proposed synthesis method have potential for high-performance displays and technology using QDs.

3PS-49 김종현

Macroporous Photonic Hydrogels for Encryption of Structural-Color Patterns

김종현, 김종빈, 김신현† KAIST

Colloidal crystals exhibit structural colors that are tunable by an external stimulus. Thus, the colloidal crystals have been used for stimuli-responsive colorimetric sensors. In this study, we design macroporous hydrogels that are highly reversible switching between transparent dried state and structurally-colored wet state. The macroporous hydrogels are prepared by film-casting of photocurable dispersions of silica particles and selectively removing silica particles. The cavities of hydrogels are randomly collapsed due to the capillary force, being transparent in a dried state. The regular array of cavities is restored by absorbing water-ethanol mixture, exhibiting structural colors in a wet state. The structural colors depend on the concentration of the water-ethanol mixture. The hydrogels can be micropatterned that have encrypted graphics in a dried state, which disclose hidden patterns in a wet state. Therefore, the hydrogels can be used for alcohol sensors and security materials.

3PS-50 김종식

All-Hydrogel Supercapacitor from Integration of Agar/Activated Carbon Composite Gels with Agar Hydrogel

김종식, 심태섭† 아주대학교

Supercapacitor is a prominent energy strorage with fast charging capabilities. Recently, a high-capacity supercapacitor with 3 dimensional elctrodoes has drawn much attention. In this study, we assembled all-hydrogel supercapacitor with 3 main components: current collectors, electrodes and electrolyte. As the hydrogel forms the interface between the parts make conformal contacts. They are in contact seamlessly with each other. As a result the resistance of interface between the electrodes and electrolyte is significantly reduced. Subsequently, the agar/AC electrodes were integrated with agar-based solid electrolyte containing NaCl. With these integrations, the specific capacitance of the supercapacitor was 155 mF/cm^2 at 0.5 mA/cm^2. The flexible, all-polymer supercapacitor sustains electric stability from mechanical deforamtions and charging-discharging cycles. The study has shown the potential of hydogle as a 3D electrode for supercapacitors.

3PS-51 김정연

유해물질 제거가 가능한 습도 변색성 스마트 윈도우

편승범, 김정연, 조은철† 한양대학교 화학공학과

중세 stained glass는 아름다운 색상을 나타낼 뿐만 아니라, 공기 중의 유해물질을 제거하는 기능을 한다고 알려져 있다. 본 연구에서는 중세의 stained glass를 모방하여, 플라즈모닉 나노입자 기반 다기능성 스마트 윈도우를 제조하였다. Stained glass 윈도우는 자극응답성 수화젤 콜로이드 나노시트가 코팅된 유리에 금 나노입자를 부착하여 제조하였다. 온도감응형 고분자인 수화젤을 이용하여, stained glass 윈도우가 제조되는 온도에 따라 나노시트에 부착되는 금 나노입자의 밀도조절이 가능했고, 파랑, 보라 및 크랜베리 색상의 윈도우가 제조되었다. 또한 콜로이드 기반 광결정층을 도입함으로써 윈도우의 색상이 무지개빛으로 반짝거리도록 제조할 수 있었다. 제조된 stained glass 윈도우는 주변의 습도에 따라 색상 (파란색 ↔ 크랜베리 색) 및 투과도가 가역적으로 변화하는 특성을 나타내었다. 또한 저전력의 실내등 아래에서도 광촉매 작용을 통한 포름알데히드의 분해가 가능함을 확인하였다.

3PS-52 김용재

Fabrication of Highly Crystallized Multi-Pathways Poly(3-hexylthiophene) (P3HT) Thin Films

김용재, 전환진[1], 정희태† 한국과학기술원; [1]한국산업기술대학교

Conjugated polymers (CPs) have been considered promising candidates for next-generation organic electronics and optoelectronics. In these applications, the controlling of crystallinity and molecular chain packing in CP films is a key factor for the optimization of device performances. Here, we suggest a new one-pot strategy to create a high quality and large area organic semiconducting thin film using Poly(3-hexylthiophene) (P3HT). We successfully obtained highly crystallized multi-pathways P3HT thin films by dropping a P3HT solution onto a surface of the water. Dropped P3HT solution is spread on a water substrate. Then, the organic solvent can be evaporated with the simultaneous inducement of self-assembly of P3HT and the formation of thin films without any additional processing and additive. The fabricated thin film can be easily transferred to other target substrates for fabrication organic field-effect transistors (OFET) devices with outstanding charge carrier mobility.

3PS-53 김영민

PDMS Based Liquid Contactable Colorimetric Sensor Array for Bacteria Discrimination

김영민, 이명구, 신동인, 임성현, 이기라† 성균관대학교

Using PDMS material to solve problems such as spreading phenomenon, non-uniformness of inks, liquid contact inability, and these problems of existing paper base CSAs. Furthermore, by utilizing the advantage of being able to contact the color liquid phase Therefore, target recognition was conducted with of amine, thiol and CO_2 compounds, which are by-products produced by bacteria, and through a method that prevents dye from leaking out of the liquid in PDMS, we have developed liquid contactable PDMS based CSAs which have 500 μM of NH_3, 100 μM H_2S and 200 μM CO_2 detection limit each. We expect to be able to detect sepsis, a disease caused by infection of bacteria in the blood and bacteria that proliferate in the liquid.

3PS-54 김영건

Eutectic Crystallization of Binary Colloidal Fluids in Double-Emulsion Drops for Dual Photonic Stopbands

김영건, 박상혁, 김신현† 한국과학기술원

Colloidal crystals show structural colors through selective reflection of light at stopband. We can fabricate photonic capsules with colloidal crystals by microfluidic devices. When polymer chains and particles are present in the medium, the polymer chains induce depletion-attraction between particles. Even charged colloidal particles are crystallized in the medium by depletion-attraction force. Here, photonic capsules which display mixed structural color is achieved by independent crystallization of polystyrene (PS) nanoparticles with different sizes via depletion-induced phase separation. Crystallization of colloids occurs during the concentration process of capsules that contain PS nanoparticles and depletant. We crystallize two types of particles in groups by controlling the attraction force. In addition, the degree of color mixing is controlled by the sizes of each crystallite, which are controllable with the rate of concentration.

3PS-55 김언지

PLGA Hollow Nanoparticles for Selective Targeting Liver Macrophage

김언지, 이승우, 남기범, 이재빈, 이욱상, 이지영, 박진규, 이동윤† 경북대학교

This study is about preparing PLGA nanoparticles containing L-ascorbic acid to be applied for the detoxification of liver. PLGA (poly lactic-co-glycolic acid)) is a copolymer of lactic acid and glycolic acid, approved by Food and Drug Administration (FDA) as therapeutic material owing to its biodegradability and biocompatibility. We introduced vitamin C in the core of the PLGA particles to determine the properties of PLGA as a drug delivery material. We prepared drug containing nanoparticles by double-emulsion solvent evaporation/diffusion method. First emulsion was prepared by dispersing the water phase with L-ascorbic acid into the domain of oil phase containing PLGA. The mixture was dropped into the aqueous phase again to prepare second emulsion. As mentioned above, prepared PLGA nanoparticles can be applied biotechnology such as drug delivery systems by introducing the desired substance, which is hydrophilic like L-ascorbic acid, in the hollow of the obtained nanoparticles.

3PS-56 김선호

Ultrathin Hydrogel Skin Encapsulated 3D Nanoporous Plasmonic Chips for Toxic Small Molecular Analysis in Complex Fluids

김선호, 박성규[1], 김신현† KAIST; [1]재료연구소

3D plasmonic nanostructures provide enhanced molecular Raman fingerprints in a nondestructive and label-free manner. However, the molecular detection of small target molecules in complex fluids is challenging due to nonspecific protein adsorption, which prevents access of the target molecules. Herein, we report the encapsulation of 3D plasmonic nanostructures with an ultrathin hydrogel skin for the rapid and direct detection of small molecules in complex mixtures. We directly detect pesticide dissolved in milk without pretreatment. This detection is enabled by the selective permeation of target molecules into the mesh of the hydrogel skin and the adsorption onto plasmonic hotspots, accompanied by the rejection of large adhesive proteins. The high sensitivity of plasmonic nanostructures in a conjunction with the molecular selection of the hydrogel skin enables the fast and reliable detection of tricyclazole in whole milk with a limit of detection as low as 10 ppb within 1 h.

3PS-57 김병재

Near-unity Photoluminescence Quantum Yield of Quantum Dots with Thick and Continuously Graded Shell

김병재, 이현준[1], 임재훈† 성균관대학교; [1]KAIST

Core/shell structures, chemical and electronic envelopment of emissive cores with wider band gap semiconductors, have been widely adopted for colloidal quantum dots (QDs) to improve photoluminescence quantum yield (PL QY) and chemical stability. Ceaseless efforts made over two decades have reached nearly unity PL QYs of QDs. And recently, continuously graded (cg-) structure has been proposed to detrimental multicarrier Auger decay that lowers performance of QD-based light-emitting diodes. However, PL QY of cg-QDs is necessarily limited up to ~70% due to interfacial defect originating from accumulated lattice strain. Here, we address that minute shell design allows us to attain near unity PL QY without loss of suppressed Auger decay. Multilateral analysis on strain and morphology development in the course of shell growth reveals that the lattice parameter management in shell phase is crucial to realize defect-free QDs despite gigantic shell thickness over 10 nm.

3PS-58 김민정

Designing Multicolor Patterns of Plasmonic Metasurfaces via Colloidal- and Photo-Lithography

김민정, 김종빈, 김신현† KAIST

Plasmonic colors are structural colors that emerge from resonant interactions between light and metallic nanostructures with high durability, spatial resolution and sustainability. Most nanopatterning for plasmonic colors are done by electron beam lithography, which is costly and time consuming. In this work, colloidal lithography is used for nanowell fabrication. Instead of precise electron beam patterning, colloidal lithography uses spin-coating and incubation, simple methods with high area coverage and low cost. By using acrylate containing polymers and silica particles for non-close packed structure generation, this technology further excludes the use of reactive ion etching and embedding process. Multiple colors are generated by varying incubation time, utilizing the hydrophilic property of silica. This nanopatterning strategy would open a new generation of low-cost, high-coverage 2D plasmonic color generation with applications such as security windows and information storage.

3PS-59 김동환

Hierarchical Self-assembly of Block Coplymers Templated by Colloidal Crystals

김동환, 최홍균† 공주대학교

블록공중합체를 이용하여 넓은 영역의 균일한 나노패턴을 제조하기 위해서는 자기조립 패턴의 배향을 유도하기 위한 template가 필수적이다. 기존의 연구에서는 포토리소그라피, 전자빔 리소그라피 등 top-down 방식의 template 가 주로 사용되었다. 본 연구에서는 다른 자기조립 구조체인 콜로이드 결정을 template로 사용하여 블록공중합체의 패턴을 조절하는 실험을 진행하였다. 블록공중합체의 주기보다 수십배 (수백nm ~ 수 um)의 크기를 가지는 고분자 콜로이드 입자로 3D 자기조립 결정을 제조한 후 표면 층을 전사하여 2D 단일층의 콜로이드 결정을 구현하였다. 이를 template로 사용하여 입자의 크기 및 간격, 어닐링 조건 등에 따라 template 내부의 블록공중합체 패턴이 어떻게 변화하는지 관찰하였다.

3PS-60 김도은

Thermal Tunning of Colloidal Array in Microcapsules from Crystalline to Glassy Packing

김도은, 박상혁, 김신현† 한국과학기술원

Colloidal assembly photonic capsules with different optical responses depending on thermal history can be designed. Thermally responsive colloidal particles are formed by using hydrogel polymer with lower critical solution temperature (LCST), and these particles are encapsulated in capsules. Colloidal particles are gradually swollen as the temperature drops below LCST and effective volume fraction of the colloids in capsules increases, causing colloidal assembly. Herein, we control the crystallinity of colloids by modulating the rate of cooling. If the temperature decrease is slow enough, the colloid particles form a crystalline phase. If the cooling rate is too fast to prevent rearrangement, the colloids form glassy packing. Colloidal crystals have a high and narrow reflection peak while colloidal glasses have low and broad peak. Therefore, these capsules with unique optical responses can be a recorder of thermal history.

3PS-61 김나연

Reentrant Graphene/Carbon Nanotube-Melamine Micro-cellular Foam Electrode for Stretchable Lithium Metal Batteries

김나연, 손정곤[1], 염봉준† 한양대학교; [1]한국과학기술연구원

Recent advances in wearable electronic devices demand stretchable energy storage systems with high-energy-density. Lithium metal has been considered as one of the most promising anode materials because of its high theoretical capacity. However, stable deformation of such metal electrodes is constrained within a very confined value due to innate limit of mechanical deformation for solid materials. Here we present stretchable and conductive melamine foam based microstructured electrodes for stretchable lithium metal batteries. The highly porous and elastic open-cell melamine foams were filled with micro-celluar structures with reduced graphene oxide (rGO) and carbon nanotube (CNT) by directional freezing method. After a reentranting process, such hierarchical structures have advantages in elastic deformations with maintenances of high electrical conductivity. Lithium can be plated on the rGO/CNT surfaces via electroplating method for the anode applications.

3PS-62 김귀민

Core-Position Controlled CdSe/CdS Heterostructure Nanorod for Efficient Photocatalytic Hydrogen Generation

김귀민, 이도창† 한국과학기술원

Colloidal quantum-confined semiconductor nanoparticles has attracted great attention for solar-to-fuel conversion photocatalytic system reaction because of their many advantages, such as size-dependent absorption properties, longer exciton lifetimes, possibility of generating multiple excitons by single photon, and enhanced photo-stability. Among them, CdSe/CdS nanorod heterostructure, which consists of CdSe spherical core in CdS rod, shows slow exciton recombination and highest hydrogen generation activity than core-shell CdSe/CdS hetero-structures. Different reactivity and surface ligand density of each CdS facet enables co-catalyst amount control and therefore affects hydrogen evolution activity. In this work, we systematically investigate CdSe/CdS dot-in-rod core position dependent photocatalytic activity and design efficient structure of CdSe/CdS dot-in-rod structure for photocatalytic hydrogen evolution.

3PS-63 김건웅

Changes in Colloidal Properties of Graphene Oxide by Mild Thermal Annealing

김건웅, 김소연† 울산과학기술원

Graphene oxide (GO) is covered with dense oxygen functional groups on the basal plane and edges, thus exhibits good dispersibility and colloidal stability in aqueous solution. Based on these properties, GO fibers can be produced from the wet-spinning of GO liquid crystal (LC) suspensions, where the qualities of the produced fibers are often affected by colloidal stability. Here, we report that mild heating for GO suspensions increases electrostatic repulsion, thereby improving colloidal stability and local orientation of GO colloids. On the contrary, longer heating decreases the colloidal stability of the GO colloids. The delicate change of colloidal stability is discussed with its rheological properties of GO LC.

3PS-64 권혁준

Effect of Various Metal Doping on the Electroresponse of Ecoresorbable Smart Fluids

권혁준, 김성진, 이승애† 건국대학교

Ecoresorbable electrorheological (ER) fluids are fabricated by applying biodegradable metal (Mg, Zn, and Fe)-doped SiO_2/TiO_2 hollow nanoparticles (HNPs) as the electro-responsive material and soybean oil as the carrier oil. Doping the bioresorbable metals on the HNPs improves the dielectric properties and helps to achieve the optimum electrical conductivities, leading to the enhanced electro-response of the smart fluids. The ER behavior of the metal-doped smart fluids is elucidated based on the Wagner model. In addition, the ecoresorbable smart fluids exhibits high anti-settling properties, showing that the metal doping has a minimal impact on the colloidal stability of the fluids. Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2019R1C1C1007578) and the Technology Innovation Program (20004627) funded By the Ministry of Trade, Industry & Energy (MOTIE, Korea).

3PS-65 권예진

Solubility and Crystallization of PMMA with Chain Stretching Agent at Room Temperature

권예진, 강영종[1,†] 한양대학교; [1]한양대학교 자연과학대학 화학과

In the recent research of our group, stereo-irregular PMMA is crystallized by rapid thermal quenching with chain-stretching agent. Also, extraordinarily extended conformation of PMMA chains in PMMA/benzoic acid binary melts were found in the search for crystallization mechanism. Here, we suggest quick and simple solution processing of 1D hc-PMMA from quaternary solutions with air spray-coating at room temperature. Although 1D hc-PMMAs via spray-coating provided relatively lower crystallinity compared to those from the rapid thermal quenching, its successful preparation supports the crystallization mechanism previously proposed. In solution process, we use quaternary solutions of PMMA/BA/EtOH/H_2O by using 80 vol% EtOH cosolvent. Solubility of PMMA in quaternary solutions with BA is higher than in only 80 vol% EtOH cosolvent. 2D correlation analysis was presented to explain why solubility of PMMA is very high in quaternary solutions of PMMA/BA/EtOH/H_2O.

3PS-66 권기옥

Ultra-dense (~20 Tdot/in2) Nanoparticle Array from an Ordered Supramolecular Dendrimer Building Block Containing a Metal Precursor

권기옥† 한국생산기술연구원

The creation of an ultra-dense, highly periodic nanoparticle array from a soft building block is one of the most important issues in the fields of material science and nanotechnology. Herein, we demonstrate for the first time the use of a supramolecular dendrimer assembly for the formation of a highly ordered nanoparticle array with a high areal density of ~20 Tdot/in2. By the simple thermal annealing of a supramolecular dendrimers containing a metal precursor between two flat, solid substrates, a hexagonal array of small gold nanoparticles (diameter of ~1.6 nm, center-to-center distance of ~5.3 nm), oriented normal to the bottom, was achieved. The findings provide a new paradigm for creating highly periodic, ultra-dense nanoparticle arrays by using a supramolecular assembly. We anticipate that this study will lead to the creation of a large family of supramolecular dendrimers that can be utilized as soft templates for creating periodic, ultra-dense nanoparticle arrays.

3PS-67 kubra akyildiz

Dielectrophoretic Behavior of Janus Particles and Biomolecule-Conjugated Janus Particles

kubra akyildiz, 구형준†, 이민지[1], 최종훈[2], 김교범[3] Seoul National University of Science and Technology; [1]한국생산기술연구원; [2]중앙대학교; [3]동국대학교

Dielectrophoresis (DEP) can be defined as the transport phenomenon of polarizable particles under a non- uniform electric field. DEP offers a relatively convenient, versatile, and efficient manipulation of particles in terms of sensitivity, selectivity, and label-free characteristics. In our study, DEP behaviors of Janus Particles (JPs) with and without biomolecule conjugation were investigated under various AC voltages and frequencies. The polystyrene-based JPs consisting of two physicochemically different sides were prepared by the formation of particle monolayer and anisotropic metal deposition. DEP behavior of the JPs was monitored and compared depending on the biomolecule conjugation. Such experimental results of the current study could be applied for detection and separation of biomolecules.

3PS-68 Wenting Long

Upper Critical Solution Temperature Behavior of (Phenylthio)acetic Acid and Poly(ethyleneimine) Mixture and Their Temperature-dependent Release from Monoolein Cubic Phase

Wenting Long, 김진철† 강원대학교 의생명과학대학

A new phenomenon has been found that the (phenylthio)acetic acid (PTA) could be conjugated with poly(ethyleneimine) (PEI) to form nanoparticles in aqueous solution. It is possibly dominated by the electrostatic attraction between the carboxyl group of PTA and the amino group of PEI. Meawhile, the hydrophobic interaction inside the PTA also plays an important role. Besides, during the experiment we found that the self-assembly of PEI/PTA exhibited reversible UCST behavior in the temperature range from 20--50 degrees when the molar weight of the amino group of PEI to the molar weight of carboxyl group of PTA was 4:6 or 5:5 in PBS buffer (10 mM, pH 7.4). What's more, the monoolein cubic phase which was temperature-responsive was prepared. By containing the PEI/PTA conjugate and FITC-dextran (MW: 10,000) within its structure. The release of dye from the cubic phase containing PEI/PTA at 45 degrees is obviously higher than the release at 25 degrees.

3PS-69 Pyae Myat Phyo Thu

Formation of Fluorescent One-dimensional Structures from Trigonal Molecules

Pyae Myat Phyo Thu, 박용해, 한민아† Kongju National University

Light-responsive fluorescent compounds are imperative in applications such as optical information storage and fluorescence sensing in contactless function. Herein, we synthesized a trigonal azobenzene framework connected with three methoxy group at the meta position. Photoisomerization process of the trigonal compound was affirmed by NMR spectroscopic measurements. Upon irradiation with UV light, the proton signals related to the aromatic rings were shifted to upfield because of its molecular structure change. Reversely, thermal recovery to the original state was completed in three days in the dark. Optical microscopy (OM), Scanning electron microscopy (SEM) and fluorescence optical microscopy (FOM) observations showed fibrous structures formed from the mixture of chloroform and methanol. The introduction of green light to the self-assembled structures exhibited red fluorescent emission.

3PS-70 Nian fang Wang

Solar-driven H_2 Evolution from Photo-reforming of Biomass with Colloidal Quantum Dots

Nian fang Wang, 이도창[1,†] KAIST; [1]Department of Chemical and Biomolecular Engineering (BK21+ Program), KAIST Institute for the NanoCentury, Korea Advanced Institute of Science and Technology(KAIST)

H_2 can be produced through artificial photosynthesis process using solar energy as a driving force to promote reduction of water into hydrogen, coupled with oxidation of a substrate. Waste biomass is ideal oxidation substrates to promote H_2 generation through photocatalytic reforming, promoting both solar-to-H_2 conversion and environmental remediation. For H_2 evolution from photo-reforming (PR), the main hinderance we need to overcome is the great kinetical barrier in PR process caused by the recalcitrant polymeric structure of substrates. Colloidal semiconductor quantum dots (QDs) with their tunable band gap (Eg) and band edge level controlled by the size and surface compositions, have the potential of generating oxidizing VB holes with high energy to drive PR conversion. In this work, we focus on designing a novel QD-based photocatalysts to achieve the H_2 evolution from photo-reforming of biomass.

3PS-71 Ngoc Bao Tran

An Approach of a Recently Developed Material: 2D Mn2C (MXene)

Ngoc Bao Tran, 강영종† Hanyang University

MXene is a group of 2D materials, the first paper about MXene was published in 2011, opened a new era for this new material. By combination of transition metal and carbon, nitride, many types of MXene have been predicted and synthesized. The most common MXene is Ti3C2Tx (making from Ti3AlC2) with three methods of synthesis. 10 years later, MXene becomes interesting material for the researchers due to their properties such as high electrical conductivity, functional terminal surface, its potential application are expected to investigate in different fields: water purification, energy storage, electromagnetic interference shielding. By etching to the MAX phases, MXene has been synthesized from immense compositions to developer new MXene. Our project focus on the synthesis of new MXene, Mn2CTx from MAX powder Mn2AlC using some different methods and also study their applications afterwards.

3PS-72 Khin Moe Lwin

Solvent-dependent Modification in Morphologies of Molecular Assemblies

Khin Moe Lwin, 박상혁, 한민아† Kongju National University

Fabrication of organic fluorescent nanostructures with different morphologies can give the new insights into the intermolecular interactions with the environment, therefore grant excellent practical applications. To study the morphology of molecular assemblies depending on the solvent environments, 3*t*-BuAz was prepared from the precursor 3BrAz **(1)**. The terminal t-butyl group seems to allow good solubility in organic solvents of differing polarity. Formation of self-assembled nano/microstructures were initiated by gradual addition of poor solvents to the solutions of 3*t*-BuAz in good solvents. Grain-like aggregates were readily formed from the tetrahydrofuran and water mixture, whereas long fibrous structures were observed from dichloromethane and methanol mixture. The morphology in nano/microstructures induced by different solvent environments were characterized by SEM, OM, FOM and XRD observations. Light-responsive properties of the molecular assemblies have been also investigated.

고분자합성 (I)

3PS-73 황환민

Hydrogels Synthesized Using Copolymer-Tethered Lignin

황환민, 손동완, 김명웅† 인하대학교

Recently, a polymeric material made from natural biomass have attracted interests as a sustainable material. In particular, lignin, a representative biomass generated as a biomass in pulp industry, receives a lot of attentions because of its abundance, rich chemical functionalities, CO_2 neutrality, reinforcing properties, antioxidant and UV blocking abilities, as well as its environmental friendliness. However, due to its intrinsic structural heterogeneity, poor processability and chemical reactivity, the use of lignin for certain applications has been limited. Herein, we demonstrate chemical routes to tether copolymers of methyl methacrylate and methacrylic acid via grafting-from approach with atom transfer radical polymerization (ATRP). The resulting copolymers were further utilized to form functional hydrogels. The effect of the incorporation of lignin into the hydrogel to various properties of the hydrogel, such as stretchability and adhesiveness, is closely examined.

3PS-74 홍동기

Synthesis and Preparation of Solid Polymer Electrolytes Based on Anion-Trapping Boron Moieties and Polysiloxane for Lithium Ion Batteries

홍동기, 백지훈[1], 김상완, 이종찬† 서울대학교; [1]한국화학연구원

In this study, solid polymer electrolytes were prepared via in situ crosslinking using thiol-ene click reaction between polysiloxane and anion-trapping boron moieties. Polysiloxane containing thiol group was synthesized by reaction between 3-mercaptopropyl(dimethoxy)methylsilane and 3-mercaptopropyltrimethylsilane using HCl catalyst. Anion-trapping boron moieties containing crosslinker was synthesized by the reaction between trimethyl borate and poly(ethylene glycol) methacrylate. Allyl PEG was synthesized by reaction between poly(ethylene glycol) methyl ether and allyl bromide using KOH catalyst. Solid polymer electrolytes were prepared by UV-initiated thiol-ene click reaction between thiol group of polysiloxane and carbon-carbon double bond of allyl PEG and the boron crosslinker. The thermal properties and ionic conductivity of the prepared solid polymer electrolytes were investigated.

3PS-75 하태화

Determination of Amine Derivatives by Color Difference from Stilbene-modified Silica Beads

하태화, 이승우†, 강인수 영남대학교 화학공학부

As the result of increasing attention paid to human health, and diagnosis and treatment

of disease, many efforts have been directed to the development of new methods toward amine derivatives such as amino acids, peptides, biogenic amines, and organic amines. A variety of techniques for the determination of amine have been investigated intensively in the literature including spectroscopy, chromatography, electrophoresis, and fluorescence detection. In here, the most used analytical procedures to detect and characterize amine derivatives are based on spectroscopic, chromatographic or electrochemical approaches. However, each approach has some drawbacks such as the need of apparatus and operational convenience, trained personnel, analysis cost and so on. In order to overcome the drawbacks, novel and simple fluorescent and colorimetric chemosensors for visual discrimination due to their ease of use in solution as well as the high sensitivity and selectivity methods have been developed.

3PS-76 하채연

Thiourea-based Nanoporous Membranes Using Spinodal Decomposition and Their Applications

하채연, 하성균, 송창식† 성균관대학교

In the field of environmental protection, the efficient separation of oil and water is required with appropriate surface chanmical characteristics and selective separation. Thiourea-based continuous network is formed using the thiourea bonding and synthesized through the organic sol-gel transition. The thiourea has the property of binding anions via the acidity of hydrogen bonding according to the alkyl group. The nanoporous thiourea-based membrane can be made by spinodal decomposition which is extractioned porogen materials that do not participate in the reaction. In this study, we prepared thiourea-based nanoporous membrane using spinodal decomposition mechanism for the flexible and porous polymer membrane which can be controlled the pore size depending on a ratio of the porogen materials. The pore size of the synthesized polymer was measured by a dynamic light scattering (DLS), Brunauer-Emmett-Teller (BET). The extractioned porogen was identified by the IR and SEM measurements.

3PS-77 카루빠사미 가네쉬

Effect of Chain Substitution of Mussel-inspired Dopa Acrylamides on Oxidation Mechanism and Their Surface Functionalization

카루빠사미 가네쉬, 서성백[1,†] 부산대학교; [1]부산대학교 바이오소재과학과

DOPA (3,4-dihydroxyphenyl-L-alanine), a catecholic amino acid containing proteins to be responsible for the versatile adhesion of Mussels to various substrates under harsh and wet conditions. The catechol redox chemistry of DOPA in Mussel adhesive plaques precisely control its interfacial adhesive and internal cohesive functionality. Therefore, a better understanding of interfacial DOPA redox chemistry is essential for developing underwater biomedical adhesives and coating materials. The present work deals with the comparative study of surface binding ability and possible oxidative crosslinking property of the synthesised chain substituted DOPA acrylamides with varioussubstrates. The plausible mechanism of surface functionalisation and their order of correlation has been proposed on the evaluation of its atomic force microscopy, contact angle measurements, X-ray photoelectron spectroscopy, UV-Visible spectroscopy and cyclic voltammetric studies.

3PS-78 최호중

Removal of Copper (II) Ions by Hyperbranched Poly(amidoamine) Microparticles

최호중, 강인아, 김상율† 한국과학기술원

Heavy metal sorption ability of poly(amidoamine) (PAMAM) dendrimers have attracted a lot of attention mainly because their abundant amine groups effectively facilitate heavy metal ions absorption/adsorption into the polymers. However, PAMAM dendrimer requires long and costly synthetic steps to obtain a desired molecular weight. Moreover, small dendrimers need to be treated with ultrafiltration for recovery. In this study, we carried out a simple synthesis of hyperbranched PAMAM (hPAMAM), which is an analogue of dendrimers, in the shape of particle by inverse suspension polymerization. With Oil-in-Water-in-Oil (O/W/O) suspension polymerization, porous PAMAM particles were obtained with controllable macropores. Copper (II) ion absorption test revealed that the synthesized hPAMAM particles are highly capable of metal ion absorption.

3PS-79 최민혁

Solvent-less Surface Coating Using Organic/Inorganic Hybrid Ladder-like Poly (silsesquioxane)

최민혁, 우한영[1], 이성수[2], 백경열[2,†] KIST/고려대학교 화학과; [1]고려대학교 화학과; [2]한국과학기술연구원

The surface coating technologies without using toxic organic solvent were highly desired to reduce environmental impact and operation cost. In this study, the ladder-like poly (silsesquioxanes) (LPSQs) with alkyl and methacrylate functional group were strategically designed, and synthesized as a potential solvent-less coating material. The LPSQs with longer alkyl side chain exhibit higher fluidity and flexibility with maintaining its optical property and mechanical strength. The experimental results in this paper reveal that the introducing long alkyl side chain to LPSQs can provide high flexibility, and processability with preserving advantages of LPSQs. The LPSQs with having long alkyl chain (LOPMSQ, LDPMSQ) were considered as the most suitable polymer for solvent-less surface coating materials.

3PS-80 진승원

A Comparison of Different Methods to Synthesize Polyimide Powders for Application to Compression Moulding

진승원, 최주영, 박형주, 이승현, 최윤제, 김담비, 정찬문† 연세대학교

Polyimide powders can be used in manufacturing lightweight moulding parts where precision, thermal, and dimensional stability are critical such as bearings, sealing because of their excellent thermal, mechanical properties, and high glass transition temperature. However, polyimide powders are generally obtained in toxic solvents such as dimethylformamide (DMF), *N,N*-dimethylacetamide (DMAc), and *N*-methyl-2-pyrrolidone (NMP), which are hazardous to the environment. Moreover, these organic solvents lead to high production cost. To solve the problems, we developed a green method to synthesize polyimide powders using distilled water as solvent. In this study, we compared different methods to prepare polyimide powders using organic solvents and distilled water. Dog-bone shaped specimens were manufactured by compression moulding method and their tensile strength was measured. The results were explained based on the shape and size of the polyimide particles.

3PS-81 조혜진

Solid-State Emissive Metallo-Supramolecular Assemblies Based on N-Acylhydrazone

조혜진, 송창식†, 김현우 성균관대학교

Development of sensory materials for metal elements is currently in the mainstream of research because they are a typical pollutant, and at the same time, essential trace elements in biology. Based on the simplicity and usability of fluorescence as a method of detection, various fluorophores were developed as chemosensors for metal sensing. Herein, we report a novel “bis”-quinoline-based N-acylhydrazone named bQH, with Zn sensing property. This N-acylhydrazone showed emissive properties through the coordination to Zn, especially in its solid-state. Along with the emission of bQH, the binding mode toward Zn2+ was proved to consist of two modes, 1:1 and 1:2 (bQH:Zn2+). Under the 1:1 binding mode, bQH-Zn2+ complexes formed a polymeric array through the metallo-supramolecular assembly. Various experiments such as UV-Vis, photoluminescence (PL), nuclear magnetic resonance (NMR) spectroscopy were used to discover the Zn2+ sensing property of bQH.

3PS-82 조웅현

Living Anionic Polymerization of Styrene Derivatives Containing Adamantylimino Group

조웅현, 강범구† 숭실대학교

The anionic polymerization of N-(1-adamantyl)-N-4-vinylbenzylideneamine (1) and N-(2-adamantyl)-N-4-vinylbenzylideneamine (2) was performed using various initiators in THF at −78 ℃ for 1 h to investigate the effects of adamantyl groups on the polymerization behaviors and thermal properties of the resulting polymers. The well-defined poly(1) and poly(2) with predictable molecular weights and narrow molecular weight distributions were successfully obtained, indicating that the bulky adamantyl groups effectively protected the carbon−nitrogen double bond from the nucleophilic attack of the initiators and the propagating chain ends. The resulting poly(1) and poly(2) showed significantly high glass transition temperatures (T_g) at 257 and 209 ℃ due to the bulky and stiff adamantyl substituents.

3PS-83 조연주

Optimization of 3,4-Epoxycyclohexylmethyl-3',4'-Epoxycyclohexane Carboxylate (ECC) Synthesis Process

조연주, 강지선, 심재민, 윤석일† 상명대학교

Cycloaliphatic epoxy (CE) resins are widely used thermosetting materials in various industrial applications. Due to the absence of strong UV-absorbent chromophoric groups, they offer improved resistance to ultraviolet light and more durable for outdoor applications in comparison with aromatic epoxy resins. In this study, the synthesis of 3,4-Epoxycyclohexylmethyl-3',4'-epoxycyclohexane carboxylate (ECC), the most commonly used cycloaliphatic epoxy resins, has been optimized; high purity, high yield, less yellowing. The ECC was synthesized by epoxidation reaction with 3-cyclohexenylmethyl-3'-cyclohexenecarboxylate using peroxide oxidants. We have established efficient and stable conditions for the synthesis of high purity ECC by changing the type and amount of oxidants, reaction temperature, and amount of catalyst. The chemical structure of ECC was characterized by FT-IR, ^{1}H-NMR and ^{13}C-NMR methods. Its purity was analyzed by GC-MS method.

3PS-84 조민철

Synthesis of Cyclohexanedimethanol Pitch Based Plasticizer and Its Application to Poly(vinyl chloride) Fabrication

조민철, 강종구, 강민경, 리종위, 김광언, 배진영† 성균관대학교

Poly(vinyl choloride)는 전 세계에서 널리 사용되는 범용 플라스틱 수지의 하나로 일반적으로 제품을 제작할 때는 DEHP 등과 같은 프탈레이트계 가소제가 반드시 필요하다. 하지만 최근 프탈레이트계 가소제가 인체 및 환경에 유해하다는 연구 결과가 나오면서 이러한 문제를 개선하는 (독)BASF사의 DINCH 또는 (한)한화케미칼의 Eco-DEHCH와 같은 시클로헥산 기반의 친환경 가소제가 등장하였다. 본 연구에서는 시클로헥산 구조를 함유한 Cyclohexanedimethanol 핏치를 기반으로 하여 2-ethylhexanoic acid와 반응시켜 혼합물 형태의 가소제를 합성하였다. 합성된 가소제 혼합물을 PVC에 적용하여 다양한 PVC 시편을 제작하였으며 각 시편의 기계적 특성, 이행 특성, 및 열적 특성을 분석하여 PVC용 가소제로서의 효과를 확인하였다.

3PS-85 조민기

Catalysis for ATRP Using Organic Photo-catalysts and Visible-light Irradiation

박경수, 조민기, 백지수[1], 이은성[1], 손경선† 충남대학교; [1]포항공과대학교

The metal-free atom transfer radical polymerization (ATRP) under visible light irradiation and activated by new organic photo-catalysts (PCs) was investigated.

A series of PCs based on N–trifluoromethylphenyl phenoxazine were evaluated for organocatalyzed ATRP (O–ATRP). Especially, 3,7–di(4–biphenyl) 4–trifluoromethylphenyl–10–phenoxazine enabled successful O–ATRP with good catalytic performance, producing well–defined polymers with low dispersity under irradiation with a CFL bulb, white LEDs, or sunlight. With the advantages of visible light catalysis and a metal–free strategy, these organic PCs would further broaden the scope of application of this process.

3PS-86 제갈영순

Bromine–Induced Polymerization of Ethynylpyridines

김태형, 진성호[1], 심상연[2], 박종욱[3], 임권택[4], 김상율, 제갈영순[5,†] 한국과학기술원; [1]부산대학교; [2]강릉원주대학교; [3]경희대학교; [4]부경대학교; [5]경일대학교

A new family of substituted ionic polyacetylenes that retain extensive conjugation have been prepared through the activated polymerization of ethynylpyridines. These ionic conjugated polymers have potentials as material candidates for mixed ionic and electronic conductivity, energy storage devices such as batteries, permselective membrane, solar cells, and light–emitting devices. Here, we report on the preparation of poly(N–bromoethynylpyridinium bromide)s via the simple bromine–induced polymerization of ethynylpyridines. The chemical structure of resulting polymers was characterized by using various instrumental methods such as IR, NMR, and UV–visible spectroscopies. The electro–optical and electrochemical properties of ionic conjugated polymers were measured and discussed.

3PS-87 정재언

Fully Polyester–Based Thermoplastic Polyurethanes

정재언, 김 일† 부산대학교 고분자공학과 고분자합성연구실

Thermoplastic polyurethanes (TPUs) with unique properties such as elasticity, flexibility, mechanical strength have been applied for a wide variety of application. In general, TPUs comprise two segments in which diisocyanate and diol generate the hard segment (HS) whereas polyol generates the soft segment (SS). In this study, a series of TPUs have been synthesized employing hexamethylene diisocyanate as a HS, 1,4–butanediol as a chain extender, and polycaprolactone (PCL, MW ≈ 500–2000) diol as SSs. The producing TPUs were characterized by infrared and nuclear magnetic resonant spectroscopy, and gel permeation chromatography. The mechanical properties of the resultant TPUs were investigated by universal testing machine, thermogravimetric analysis, and differential scanning calorimetry. The influence of the HS/SS ratio and the MW of the PCL on the properties of the TPUs was also investigated. The resultant TPUs exhibit high tensile stress up to 65 MPa and breaking strain up to 990%.

3PS-88 제갈영순

Modification of a Polyacetylene Polyelectrolyte via the Ion–exchange Reaction of Precursor Polymer Using Sodium Tetraphenylborate

제갈영순†, 진성호[1], 박종욱[2], 심상연[3], 임권택[4] 경일대학교; [1]부산재학교; [2]경희대학교; [3]강릉원주대학교; [4]부경대학교

We have reported the synthesis and characterization of various polyacetylene–based ionic polymers. Polyacetylene–based polyelectrolytes were synthesized in high yields by the polymerization of ethynylpyridines using functional alkyl halides or carbonyl chlorides without any additional catalysts. Due to the noteworthy properties of conjugated organic polymers, these materials have been used as candidate materials for various optoelectronic devices. Here, we reported an effective synthesis of polyacetylene–based polyelectrolyte, poly(2–ethynyl–N–iodopyridinium tetraphenylborate) via the simple ion–exchange reaction of poly(2–ethynyl–N–iodopyridinium iodide) using sodium tetraphenylborate. The absorption spectrum of polymer shows strong absorption peak at 335 nm and the shoulder peaks at 415nm and 516 nm.

3PS-89 정성욱

Synthesis and Chiral Self–assembly of Core–extended Triarylamine Derivatives

정성욱, 박창준[1], 김동휘, 김상율† KAIST; [1]삼성전자

Triarylamine (TAA) derivatives show self–assembly behavior in several organic solvents. Especially, in chlorinated solvents, TAA compounds are oxidized into the radical cation under light irradiation and transformed to nano–rod type self–assembled structures. Interestingly, when TAA derivatives in chlorinated solvent are exposed to circularly polarized light (CPL), chiral self–assembled supramolecules with helicity were obtained. Here, we synthesize the TAA compound with an increased number of aromatic rings at core and induce the chiral self–assembly by irradiation of circularly polarized light (CPL). Chiral self–assembled structure obtained from the core–extended TAA compound is expected to show improved stability much more than the stability of chiral supramoleculs from triphenylamine derivatives.

3PS-91 전수현

Self–Assembly of Two–Tailed Tadpole–Shaped Amphiphilic Copolypeptides

전수현, 김 일†, Rimesh Augustine, Nagendra Kalva 부산대학교 고분자공학과 고분자합성연구실

Smart amphiphilic polypeptide self–assembly derived nanoparticles offer unique control over molecular behavior for biomedical engineering applications. In this work we have synthesized a two–tailed tadpole–shaped poly(N–isopropylacrylamide)20–block–(cyclic–poly(L–lysine)25)–block–poly(N–isopropylacrylamide)20 amphiphilic copolymer utilizing reversible addition–fragmentation chain transfer polymerization (RAFT), click cyclo addition reaction and ring–opening polymerization of α–amino acid N–carboxyanhydrides. The polymer was characterized using 1H nuclear magnetic resonance and Fourier–transform infrared spectroscopy. Final amphiphilic copolymers were self–assembled into spherical micelles, two–dimensional square, cubic, rods and thread–like fiber morphologies under various self–assembly conditions and confirmed using transmission electron microscopy. The selfassemblies were controlled by the factors such as type of solvent ratio of of the solvents and polymer concentration.

3PS-92 장성욱

Synthesis of Acrylated Vegetable Oil and UV–Curing Properties

장성욱, 류상욱[1,†] 충북대학교; [1]충북대학교 공업화학과

Recently, there has been an increasing tendency to use biomass as a recyclable resource, and some derivatives of vegetable oils are suitable for use in converting to monomers. In this study, the epoxidation of vegetable oil synthesized using hydrogen peroxide and formic acid. Then, the acrylated vegetable oil resins were synthesized using epoxidized vegetable oil, acrylic acid, and hydroxyethyl methacrylated maleate. As a result, the yield of epoxidized vegetable oil is about 92%, and the yield of acrylated vegetable oil is about 82%. UV curing was performed at 370 nm using a DMPA, and it was confirmed that the hydroxyethyl methacrylate maleate functionalized oil was cured by 90% at 20 min. The stability and behavior of the UV cured film will be discussed in more detail.

3PS-93 임종진

Bulky Alkyl Chain Optimization for High Performance Polymer Solar Cell

임종진, 이근대, 박성수, 이원기, 진영읍† 부경대학교

Recently, many studies have been conducted to increase the efficiency of PSCs. And there are many ways to increase power conversion efficiency. One of them is to use bulky alkyl chains as substituents. We wanted to create a new material for the active layer of the device. So, Diflourinated Phenazine (DFPz) and benzodithiophene (BDT) were used for alternating copolymers. Phenazine was predicted that it has good charge mobility attributed to extended π conjugated structure and it was also expected that it has strong electronegativity attributed to C=N double bonds. To investigate the effect of bulky alkyl chain, various bulkyl alkyl chain were introduced. In result, the polymer with BO (butyl octyl) alkyl chain has better performance than polymer with other bulky chain. This suggests that the BO alkyl chain is the most suitable substituent. So, the polymer with BO alkyl chain (PBDT–DT–BOFPz) achieved 4.24% of PCE.

3PS-94 임유정

Synthesis of Nonionic Surfactants Based on Hyper–Branched Polyglycidol

임유정, 김 일† 부산대학교 고분자공학과 고분자합성연구실

Hyper–branched polyglycidol with various degree of branching has been employed for a wide variety of application such as drug delivery systems, hydrogel substrates and coating biomaterials. In this study, we have synthesized various nonionic surfactants based on hyper–branched polyglycidol via ring–opening multibranching polymerization of glycidol in the presence of various initiators such as hydroxy–terminated lipophilic polymers using heterogeneous double metal cyanide catalyst. The chemical structures of the hyper–branched surfactants were determined by infrared and nuclear magnetic resonance spectroscopy. The degree of branching and the hydrophile–lipophile balance values of the surfactants are varied depending on the type of initiators.

3PS-95 임종진

Variation of Characteristics of D–A Structure OPV Using Phenazin and BDTT with Alkyl Chain Variation

임종진, 이근대, 박성수, 이원기, 진영읍† 부경대학교

A novel donor–acceptor alternating copolymers were designed. These polymers were consisted of difluoro–phenazine that electron–acceptor unit and Benzodithionylthiophene that electron–donor unit. These copolymers were synthesized by stille coupling reaction. Phenazine derivatives were choosed. One is liner alkyl chain (Dodecyl) and the other is two bulky alkyl chain (2–Butyl octyl, 2–decyl hexyl). Comparing with linear alkyl chain and bulky alkyl chain, the former is worse than the later. Because of it's bad solubility. So it cause low PCE of 2.73%. And then comparing with two bulky alkyl chain, 2–decyl hexyl and 2–butyl octyl, the later chain has better performance than the former because of its crystallization properties. The former is too bulky so its crystallization properties low degree and it cause low PCE of 2.76%. But 2–butyl–octyl phenazine has proper size. So it can draw out high performance of PCE of 5.28%.

3PS-96 임원택

생분해성 고분자의 마이크로파티클 제조와 약물전달시스템 응용

임원택, 이선준, 고영수† 공주대학교

약물전달시스템에 사용할 전달체는 무해한 물질로 분해되어야하기 때문에 생분해성 고분자를 이용한다. 이 실험에서는 poly(L–lactide–co–glycolide)(PLGA)의 합성에 있어 다양한 OH기 수를 갖는 아민을 개시제로 사용하고 lactide/glycolide의 몰 비를 변화시켰다. 합성된 고분자와 약물을 혼합해 마이크로파티클을 제조하여 성능을 분석하였다.

3PS-97 임종진

A Novel D–A Alternating Copolymers Based on Fluorinated Phenazine

임종진, 이근대, 박성수, 이원기, 진영읍† 부경대학교

Solar cells are in the spotlight as one of the eco–friendly energy sources. However, efficiency is still a problem for solar cells to be commercialized, so we used a D–A

shift structure where new high efficiency can control energy levels to develop structures. Difluorinated phenazine(DFPz) composed of butyl octyl alkyl chain as an accepter was used, and efficiency was compared using BDT and BDTT as a donor. As a result, BDTT-DFPz was found to obtain increased Voc due to lower HOMO than BDT-DFPz, and FF was also improved, showing that BDTT-DFPz was better at PCE. This was assumed to have expanded π conjugated structure due to the added thiophene, which may have improved the charge mobility. As a result, it was found that BDTT-DFPz showed 5.28% PCE to show better efficiency, whereas BDT-DFPz showed 4.24% PCE.

3PS-98 임원택

가지형 Poly(ε-caprolactone-co-glycolide) 합성과 구조분석연구

임원택, 지영현, 고영수† 공주대학교

ε-caprolactone(CL)을 이용한 중합체는 결정성과 소수성이 높아 약물전달체와 같은 응용이 어렵다. 이러한 특성을 보완하기 위해 ε-caprolactone과 glycolide를 공중합하여 Poly(ε-caprolactone-co-glycolide)를 합성하였다. 이 과정에서 OH기의 수가 다른 아민 화합물을 개시제로 이용했다. 합성된 고분자를 GPC, ^{1}H-NMR, DSC등을 통해 구조 및 특성을 확인했다.

3PS-99 임승호

Effects of Various Types of Polar Dispersants on the Properties of Silica/SBR Compounds

임승호, 권용록, 김정수, 홍석주, 김하은, 장영욱[1], 김동현† 한국생산기술연구원; [1]한양대학교

The silica dispersibility is related to the processability, mechanical properties, and abrasion resistance of tires tread rubber. To improve the silica dispersibility in the silica-SBR compound, we used wet masterbatch (WMB) process which is a method of mixing rubber in water phase. However, WMB process has difficulties in improving the mechanical properties of the rubber compound due to low silica dispersibility caused by the silica aggregation when the silica content is higher than 100 phr. Five types of silica dispersants applicable to the WMB process were applied to silica/SBR compound. The vulcanization properties, mechanical properties, and abrasion resistance of silica/SBR compounds were compared using a Moving Die Rheometer, Universal Testing Machine, and DIN wear tester, respectively.

3PS-100 임동혁

Compatibility and Hydrolytic Behaviors of Polylactide Isomer/Poly(butylene succinate) Mixtures by the Langmuir Technique

임동혁, 비샬가반데, 김가연, 이 봉, 진영읍, 이원기† 부경대학교

The compatibility and hydrolytic behaviors of the monolayer mixtures of biodegradable stereochemical polylactide (l-PLA or dl-PLA) and poly(butylene succinate) (PBS) were studied by the Langmuir technique at the air/water interface. The π-A behaviors of two binary systems, well mixed and unmixed, were compared with each other to demonstrate their compatibility. The hydrolytic behaviors of the homopolymer and mixed monolayers on an alkaline subphase were monitored at a constant surface pressure as a function of exposure time. The compatible monolayer mixtures showed much slower hydrolytic kinetics than their arithmetic averages.

3PS-102 임동혁

Synthesis and Properties of Block Copolymers of Enantiomeric Polylactide and Biopolyester

임동혁, 이승재, 비샬가반데, 진영읍, 이원기† 부경대학교

To develop carbon dioxide-reducible polymeric materials, triblock copolymers (PLA-polyester-PLA) of enantiomeric lactides and biopolyester diol, were synthesized by the ring-opening polymerization of lactide in the presence of diol using stannous octoate. The results showed that the incorporation of the biopolyester decreases the crystallinity and melting temperature of PLA. However, the blend of enantiomeric PLA copolymers revealed more thermal stability than homo- and copolymers. It was due to the formation of stereocomplexes between enantiomeric PLAs. The topographic images of degradation showed that the degradation rate of a copolymer was faster than of PLA while that of stereocomplex became much slower.

3PS-103 이효철

Synthesis of Poly(acrylic acid)-co-Poly(glycidyl methacrylate) Binders for Silicon Anodes in Lithium Ion Batteries

이효철, ANJALI NAGAPADI PREMAN[1], 안석균† 부산대학교; [1]Pusan National University

Silicon (Si) has evolved as one of the most promising anode materials for high capacity lithium-ion batteries due to high theoretical capacity. However, a significant volume change of the Si during charge/discharge cycle causes pulverization and delamination, and thus becomes a major obstacle for commercialization. Among the several strategies to overcome the challenges of the Si anode, the development of properly designed polymeric binders is imperative for enabling stable cycling performance. In this study, we synthesized a series of poly(acrylic acid)-co-poly(glycidyl methacrylate) with various composition. Thermal, mechanical and adhesion properties of these binders were effectively manipulated by adjusting the composition of random copolymers. Most importantly, the optimum composition of copolymers that can maximize the cycling stability of Si anode was found, which exceeded that of Si anode prepared with conventional PAA binder.

3PS-104 이홍찬

Effect of Norbornenyl Comonomer Design on Dynamic Covalent Polymerization with Chalcogenide Hybrid Inorganic/Organic Polymer Resins

이홍찬, 권민호, 이서희[1], 전흥배[1], 오민철, Jeffrey Pyun[2], 백현종† 부산대학교; [1]광운대학교; [2]University of Arizona

Herein, we report on the preparation of chalcogenide hybrid inorganic/organic polymers (CHIPs) derived from elemental sulfur which was obtained by using bifunctional norbornene comonomers (NC) from dynamic covalent polymerization (DCP). For this study, p(S-r-Sty) resin was prepared by inverse vulcanization. A series of new NCs which contain thioether, disulfide, benzylic ether units were designed for demonstrating the effect of molecular architectures. Sulfur radicals generated by fragmentation of p(S-r-Sty) were then able to undergo thiol-ene addition to norbornenyl comonomers resulting in the formation of new CHIP terpolymers as characterized by ^{1}H NMR, FT-IR, SEC, elemental analysis, and DSC. From the change of molecular weight and T_g after DCP, we demonstrate the effect of comonomer design on copolymerizations with sulfur resins. These results point to the need for enhanced screening methods to optimize structure-reactivity design parameters for future studies.

3PS-105 이진은

Synthesis and Properties of Imide-linkage Photocyclodimerizable Mesogen Componds

이진은, 곽기섭† 경북대학교

There are some drawbacks that dust and scratches are generated in the polyimide rubbing process, and to solve the problems, researches on photoalignment have been intensively conducted. photoalignment can be induced by photocyclodimerization, photoisomerization, and photolysis reaction by irradiation with linearly polarized ultraviolet light. Especially, polymers having photocyclodimerizable groups are known as ones of the best materials for high photosensitivity and orientation stability. Recently, a research group in Korea Institute of Industrial Technology (KITECH) has successfully synthesized polymaleimides having cinnamate or chalcone groups capable of photocyclodimerization. To improve the photosensitivity and orientation stability, the mesogen compounds having the same photoreactive groups were synthesized in this study and used as an additive. In addition, the miscibility of these additives with the base polymers, liquid crystallinity, and photoreactivity were investigated.

3PS-106 이지훈

Open-to-air RAFT Polymerization on Surface Under Ambient Conditions

김청수, 조수정, 이지훈, 조우경, 손경선† 충남대학교 화학과

Oxygen (O_2)-mediated controlled radical polymerization was performed on surface under ambient conditions, enabling on-surface polymer brush growth under open-to-air conditions at room temperature and free of metal contamination. Polymerization of zwitterionic monomers using this (O_2)-mediated surface-initiated RAFT (O_2-SI-RAFT) polymerization method provided a hydrophilic surface, which exhibited antibiofouling effects. This O_2-SI-RAFT polymerization strategy can avoid prior deoxygenation steps or the use of inert conditions for polymerization, thus it could be applied for the substrates with large surfaces under ambient benchtop conditions, enabling surface functionalization in a practical and user-friendly manner.

3PS-107 이지은

Synthesis and Characterization of Mechanophore for Mechanical Stimuli-responsive Polymer

이지은, 가재원†, 최재학[1] 한국화학연구원; [1]충남대학교

Mechanophores are compound whose color changes due to chemical bond dissociation, molecular arrangement change and photonic crystal structure change due to mechanical force. It can be applied as a sensor and self-reporting material by using a characteristic that changes color in response to mechanical stimulation. Among various mechanopores, systems whose color changes due to dissociated bonds include spiropyrans, naphthopyrans and anthracene-based materials. In this study, we designed a molecular structure capable of self-reporting by designing a molecular structure whose optical properties change due to the dissociation of covalent bonds. The introduction of mechanopores into adhesives will act as a damage sensor. The molecular structure and properties of the mechanopores were characterized by NMR, UV-vis, ESR and PL, and the color change through impact test were also studied.

3PS-108 이주현

Synthesis of Furan-based Polyurethanes with Photo-degradability via Curtius Rearrangement

이주현, 송창식† 성균관대학교

Polyurethanes (PUs) are one of the most interesting polymers which are generally synthesized from petroleum-based materials. Furandicarboxylic acid (FDCA) from biomass sugars, which have good thermal stability, has been considered as a good biomass precursor. Curtius rearrangement is the thermal decomposition of an acyl azide to an isocyanate with a loss of nitrogen gas. Bioplastics are commonly defined as the biobased or biodegradable polymer. To solve environmental pollution, it is important to develop eco-friendly polyurethane with photodegradation ability. In this study, FDCA is substituted with acyl azide and reacts to a variety of alcohols via Curtius rearrangement. Through various catalyst screenings such as DBTDL, DABCO, organic catalyst, optimize the reaction condition. Also, the nitro group was introduced at the ortho position to photo-degradable polyurethane. We measured photo-degradability of synthesized polyurethane and can be applied as eco-friendly plastic.

3PS-109 이제현

Tunable Silica/Graphene Composite Based Hierarchical Closed-cellular Structure

이제현, 유필진† 성균관대학교

Cellular structure is breakthrough to design lightweight, strong materials for various scientific and engineering industries. In particular, hierarchical closed-cellular structure (CCS) consisted of uniform building units can be utilized as advanced materials. Here, we report the tunable CCS with wide range of density and modulus characterizing elastic or thermal insulation property. We show that the tunable CCS can be generated with elaborately controlled hollow bubbles as building units made by microfluidic system. The carbon/silica composite bubble can have wide variation of shell thickness of 90 nm–3.2 μm depending on the constituent. The tunable CCS can be achieved after thermal treatment of simply assembled bubbles, resulting in different morphology (rhombic dodecahedral honeycomb structure or fused-face-centered cubic structure). The tunable CCS exhibits the wide window of density above two orders while maintaining high young's modulus with elastic or thermal insulation property

3PS-110 이정현

Harnessing Semifluorinated Backbone in the Heterograft Copolymer by Sequential Grafting-through/Grafting-from Polymerizations

이정현, Gérald Lopez[1], Bruno Améduri[1], 서명은† 한국과학기술원; [1]Institut Charles Gerhardt Montpellier, CNRS, ENSCM, Universite' de Montpellier

A heterograft copolymer consists of different polymer side chains grafted along the backbone. Here we propose a new synthetic route to a heterograft copolymer with a semifluorinated backbone by sequential "grafting-through" and "grafting-from" polymerizations, and its further use for mesoporous polymer synthesis. Alternating copolymerization of chlorotrifluoroethylene (CTFE) with vinyl ethers including polylactide (PLA)-tethered one affords PLA-grafted P(CTFE-*alt*-VEs). Then, chlorine atoms in the backbone are used as initiating sites for atom transfer radical polymerization (ATRP) for polystyrene grafting. Copolymerization of styrene and divinylbenzene followed by PLA etching produces a mesoporous polymer with fluorinated pore surface, which may enhance chemical stability.

3PS-111 이은호

Reversible Addition-Fragmentation Chain-Transfer (RAFT) Dispersion Polymerization of Block Copolymer Nano-objects in Presence of Solvophilic Macro-RAFT Agent in Ethanol/Epoxy Resin Mixture

이은호, 김경호, 이원주[1], 서봉국[1], 백현종† 부산대학교; [1]한국화학연구원

One of the common methods for improving the toughness of the epoxy resin is dispersing core-shell rubber particles prepared by emulsion polymerization. Usually, these particles are coagulated from latex and then re-dispersed in the epoxy resin under strong shear force, but it is difficult to achieve uniform dispersion without agglomeration. Therefore, we report on the simplified method without the re-dispersion processes. The polymer particles are obtained through reversible addition-fragmentation chain-transfer (RAFT) dispersion polymerization in ethanol/epoxy resin mixture using a macro RAFT agent containing hydroxyl groups. After polymerization, the epoxy resin in which polymer particles were dispersed could be obtained simply by removing ethanol. The block copolymers obtained under different conditions were characterized by size exclusion chromatography and ^{1}H NMR. The morphology of the block copolymers was confirmed by transmission electron microscopy (TEM).

3PS-112 이유정

Synthesis and Analysis of Polyimides Having with Different Position in Aniline Moieties

이유정, 이승우[1,†], 신요섭[1] 영남대학교; [1]영남대학교 화학공학부

Due to its high electrical conductivity, stability, and electroactive characteristics, polyaniline has attracted considerable attention for potential applications in electrochromic devices, sensors and photodiodes. And polyimides are very interesting group of incredibly strong and astoundingly heat and chemical resistant polymers. Their strength and heat and chemical resistance are so great that these materials often replace glass and metal. In this study, a series of electrochromic aromatic polyimides with aniline units in the backbone were prepared by the chemical imidazation from 9 kinds of diamine monomers and 4,4'-(hexafluoroisopropylidene) diphthalic anhydride (6FDA). The molecular structures of the polyimides were analyzed by means of fourier transform infrared spectroscopy (FT-IR), thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC), UV spectroscopy and cyclic voltammograms (C-V).

3PS-113 이원준

Alkoxy side group을 포함하는 열방성 액정 공중합체의 합성, 용융 방사 및 섬유의 열처리 효과

이원준, 우현준, 민병길, 장진해† 금오공과대학교

열방성 액정 고분자(Thermotropic liquid crystalline polymer, TLCP)는 열적 특성, 기계적 성질 및 내 화학성등이 매우 우수하지만, 한편으로는 내열성이 너무 높아 가공이 어려운 단점이 있다. 이런 단점을 극복하기 위해서 그동안 주 사슬에 주로 사용되었던 곧고 강직한 모노머 구조 대신에 alkoxy side group을 가진 2,5-dihexyloxyterephthalic acid의 모노머를 사용하였고 acetoxy-1,4-hydroquinone, 그리고 4-hydroxybenzoic acid (HBA)를 다양한 몰 비 (mole ratio)에 따라 여러 가지 TLCP 공중합체를 합성하였다. 용융 방사(melt spinning)를 통해 얻은 TLCP 공중합체의 섬유는 다양한 열처리 온도 및 시간에 따라 열적-기계적 성질 및 물성 변화들과 모폴로지를 조사하였다. 공중합체의 섬유의 기계적 성질은 열처리 온도가 230 ℃에서 9 시간일 때 최대 값을 보였지만 그 이상의 열처리 시간에서는 오히려 감소하였다. 열적 성질과 결정화도는 열처리 및 시간에 큰 차이를 보이지 않았고, 합성된 TLCP에서는 모두 네마틱 액정상이 관찰되었다.

3PS-114 이원기

Synthesis and Properties of UV-curable Polyurethane Acrylates with Reactive Silicones

이원기†, 이승재, 임동혁, 이 봉, 진영읍 부경대학교

Over the past few years, silicone-based polymers have been widely studied because silicone shows unique surface properties, such as hydrophobicity, film formability, etc and then silicone-based compounds are being mainly applied to the coating field. To have these characteristics in coatings, it is crucial that silicone component participates in covalent bonding. In this research, UV-curable polyurethane acrylates (PUAs) with different molecular weights and contents of reactive silicones were synthesized to improve the surface and mechanical properties of coating films. The synthesized PUAs were identified with FT-IR spectra and the mechanical properties of the cured PUAs films were investigated by UTM. The water contact angle of the cured PUAs were measured by the drop shape analyzer and the gloss values of PUAs were measured by a gloss meter. Finally, the optimum content of reactive silicones in the PUAs was obtained.

3PS-115 이용표

Fabrication of PAN-based Carbon Fibers Containing PAA-grafted CNTs

이용표, 임정혁, 김경민† 한국교통대학교

Polyacrylonitrile (PAN) is the most general precursor of carbon fibers. PAN-based fibers have excellent strength and modulus to replace metals using on aerospace and sports. Recently, Carbon nanotube (CNT) with high conductivity and good mechanical properties was introduced into PAN precursor. Oxidation and carbonization of PAN precursor are conducted to fabricate carbon fibers. In these processes, acidic- and aliphatic- components in CNT have good effect on manufacturing PAN-based carbon fibers because of reduction of oxidation temperature. In this work, we functionalized the surface of SWCNT or MWCNT with the poly(acrylic acid) (PAA) via radical polymerization of acrylic acid. PAA-grafted CNTs were homogeneously dispersed in PAN precursor solution. PAN-based carbon fibers containing different feed ratio of PAA-grafted CNTs were fabricated and characterized.

3PS-116 이아름

Synthesis and Properties of Aromatic Copolyesters with a Ionic Liquid

이아름, 신종찬, 김정민, 이민재† 군산대학교 화학과

A series of aromatic copolyesters containing pyrrolidinium/piperidinium cations with PF_6^- or Tf_2N^- counter-anions are successfully synthesized from terephthaloyl chloride, *N,N'*-dihydroxylalkyl pyrrolidinium/piperidinium ionic liquids (ILs) and an aromatic comonomer, BPA di(2-hydroxyethyl)ether (BDHE). The various copolyesters are prepared from changing the mole ratio of the two dihydroxy monomers, pyrrolidinium/piperidinium IL and BDHE, and the existence of the comonomers are confirmed by ^{1}H NMR. Thermal stabilities of the synthesized copolyesters are investigated by TGA and they are stable up to 300 ^oC. During the 2nd heating scan of DSC, only a T_g is shown, from which all the copolyesters are amorphous and no crystalline morphology is found. As the ratio of BDHE is higher, T_g is increased, because of the more rigid aromatic units in the polymer backbone. Ionic conductivities with different temperatures are measured. Pyrrolidinium-C_{11} Tf_2N^- polyester shows highest ionic conductivity.

3PS-117 이시영

Synthesis of Novolac-coated Superabsorbent Polymer (SAP) for Antibacterial Property

이시영, 백지훈[1], 서희란, 궁찬영, 조경화, 김진석, 김상완, 육진솔, 이종찬† 서울대학교; [1]한국화학연구원

Superabsorbent polymer (SAP) is widely used in sanitary area, due to high water-absorbent property of the polymer. Despite of the application area of SAP, SAP hardly show antibacterial property, which is essential for hygiene. In this research, antibacterial novolacs were synthesized from cardanol, cashew nut shell liquid (CNSL), nonylphenol (NP), and 3-pentadecylphenol (PDP) and characterized via NMR and water contact angle. Subsequently, the novolacs were coated on SAP, which was confirmed by IR. The water uptake and antibacterial test showed that the coated SAP exhibited high antibacterial property without notable decrease in water absorbance.

3PS-118 이수정

Synthesis of Comb-Branched Polyethers Using Double Metal Cyanide Catalyst

이수정, 김 일[1,†] 부산대학교; [1]부산대학교 고분자공학과 고분자합성연구실

A series of comb-type polyethers consisting of polyethylene glycol monomethyl ether side chains with various repeating units (n = 3, 8, 28, 48, 94) have been synthesized by employing ring-opening polymerization (ROP) of ethylene glycol monomethyl ether (EGME) end-functionalized oxirane monomers. The functionalized monomers were prepared by reacting epichlorohydrin with different EGME derivatives in the presence of sodium hydroxide and tetrabutylammonium bromide. The comb-shape polymers were then synthesized by ROP of the functionalized monomers using double metal cyanide catalyst. The resultant polymers were characterized by nuclear magnetic resonance and gel permeation chromatography. The effect of the ethylene oxide repeating units in the side chains on the properties of the corresponding polymers was also investigated by thermogravimetric analysis and differential scanning

calorimetry.

3PS-119 이세진

Synthesis and Properties of PVDF Grafted Copolymer from Polyfluorene-based Polymer

이세진, 이진균† 인하대학교

Poly (vinylidene fluoride) (PVDF) exhibits piezoelectric characteristics, and It can be used as an synchronized piezoelectric-luminescence material through the formation of a complex with light emitting materials. However, there are only few research of composites or copolymers with polyfluorene-based polymers. Therefore, this study aims to synthesize a copolymer between polyfluorene-based polymers and PVDF. We synthesized Poly(dihydroxyl fluorene-co-dioctyl fluorene-co-benzothiadiazole) [P(F6OH-F8-BT)] via Suzuki coupling polycondensation. Macro chain transfer agent (Macro CTA) for polymerization of PVDF was synthesized by esterification of P(F6OH-F8-BT) and S-ethyoxythiocarbonyl mercaptoacetic acid (XAA). Finally, PVDF grafted copolymer [P(F6OH-F8-BT)-g-PVDF] was synthesized by radical addition fragmentation transfer (RAFT) polymerization. Synthesized polymers were characterized by several analytical methods and fabricated as a device to evaluate their properties.

3PS-120 이민웅

Synthesis of Hyperbranched Poly(glycidol carbonate) Polyols Using Double Metal Cyanide Catalysts

이민웅, 김 일[1,†] 부산대학교 고분자공학과 고분자합성연구실; [1]부산대학교고분자공학과

A series of hyperbranched poly(glycidol carbonate) polyols were synthesized by direct copolymerization of carbon dioxide and glycidol using heterogeneous double metal cyanide catalyst. The copolymerization was performed in the presence of different solvents and different solvent/monomer ratio. The catalyst was characterized by common technique including infrared, X-ray photoelectron spectroscopy, inductively coupled plasma optical emission spectrometry and thermogravimetric analysis. The degree of branching and carbonate content of the resultant polyols were determined by nuclear magnetic resonance and infrared spectroscopies. The thermal properties of the produced polyols were also investigated by differential scanning calorimetry and thermogravimetric analyses. This work offers a promising and simple strategy for producing polycarbonate polyols as precursor for polyurethane.

3PS-121 윤준혁

Synthesis and Self-assembly of pH-Responsive Poly(4-hydroxystyrene)-*b*-Poly(*N*-vinylamine) Diblock Copolymer by RAFT Polymerization

윤준혁, 김상율†, 김태형 KAIST

Poly(N-vinylamine) (PVAm) is a promising polymer, having a large amount of primary amine groups, but there are only few reports regarding the controlled radical polymerization of N-vinylamine monomer. We synthesized poly(4-hydroxystyrene)-*b*-poly(N-vinylamine) (PHS-*b*-PVAm) by Reversible Addition Fragmentation Chain-Transfer (RAFT) polymerization of 4-acetoxystyrene and N-vinylformamide with 'Switchable' RAFT agent to make a precursor polymer, poly(4-acetoxystyrene)-*b*-poly(N-vinylformamide) (PAcOS-*b*-PNVF), and by the subsequent hydrolysis. The reactivity of C-S double bond on the switchable RAFT agent gives a good control for the polymerization of both AcOS and NVF. Detailed synthesis and self-assembly behavior of PHS-*b*-PVAm diblock copolymer will be presented.

3PS-122 윤영록

Synthesis of Melamine-formaldehyde Resin with Hierarchical Porous Structure by High Internal Phase Emulsion Polymerization and Solvent-assisted Curing

윤영록, 강인아, 김상율† 한국과학기술원

A hierarchical porous structures of melamine-formaldehyde resin that contains meso and macro pores with high surface area has been synthesized via high internal phase emulsion (HIPE) polymerization and solvent-assisted curing. High internal phase emulsion polymerization, a convenient synthetic pathway with 3 components, aqueous phase, oil phase and stabilizer, was used to make macroporous melamine-formaldehyde resin (polyHIPE). Solvent-assisted curing of the polymer created a mesoporous structure in the skeletal framework of maroporous melamine-formaldehyde resin. The meso and macro porous melamine-formaldehyde resin was characterized by Fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM), Hg porosimetry, N_2 sorption isotherm and Brunauer-Emmett-Teller (BET) analysis.

3PS-123 유호균

Alternating Ring-opening Copolymerization of Epoxide and Anhydride Using a Chromium Complex with a Sterically Demanding Amino Triphenolate Ligand

유호균, 배대영[†], 임현기, 이은성[†], 손경선† 충남대학교; [1]포항공과대학교

We have investigated alternating ring-opening copolymerization (ROCOP) of epoxides (limonene oxide, cyclohexene oxide) with anhydrides (phthalic anhydride, naphthalic anhydride and maleic anhydride) using a chromium complex containing sterically-demanding amino triphenolate ligand. The polymerization reactions were strongly affected by the type and the amount of co-catalyst, reaction time, and feed ratio of monomers. Under the optimized conditions, the chromium complex produced perfectly alternating polyesters with high molecular weights, high glass-transition temperatures, and low polydispersity. It also showed a very high activity (TOF up to 380 h^{-1}).

고분자가공/복합재료

3PS-124 황종하

Three-dimensional Graphene/transition Metal Alloys from Gelatin-based Hydrogel for Zinc Air Battery

황종하, 장지현† 울산과학기술원

A study on stable and efficient bifunctional oxygen reduction/evolution electrocatalysts is mightily important in rechargeable Zn-air battery. In this work, we develop in-situ grown few-layers graphene-decorated transition metal alloys on nitrogen-doped carbon sheets (3DGM-NC) from anionic gelatin-based hydrogels with cationic transition metal particles for high performance Zn-air battery. This bifunctional catalyst achieves a positive half-wave potential of 0.947 V (vs reversible hydrogen electrode, RHE) for oxygen reduction reaction, and a operating potentials of 1.67 V at a 10 mA/cm^2 of oxygen evolution reaction with high stability for 10 hours due to stable graphene structure and synergetic effects of transition metal alloys and nitrogen-containing functional groups. This study suggests new opportunities to develop new design and synthesis for energy conversion or storage industries.

3PS-125 황보현우

Development of Resin Formulation with High Mechanical Strength for Projection 3D Printing

황보현우, 전석진† 금오공과대학교

레진의 광경화를 이용해 3D 구조물을 형성하는 투영 방식 3D 프린팅은 높은 성형정밀도로 인해 폭넓은 산업적 응용을 기대할 수 있다. 그러나 현재의 광경화성 레진은 높은 성형정밀도에 비해 취약한 기계적 물성으로 인해 최종 제품의 응용이 모델링 용도에 머물러 있다. 본 연구에서는 아크릴레이트기를 가지는 우레탄 올리고머에 다른 종류 및 함량의 모노머를 첨가하여 레진 조성물을 제조하였고, 레진으로부터 프린팅된 시편의 탄성계수, 인장강도, 신율 등 기계적 물성을 측정하여 레진 조성물과 기계적 물성 사이의 연관성을 확인하고자 하였다. 이 연구 결과는 향후 높은 기계적 물성을 요하는 정교한 3D 구조물의 제작에 적용 가능할 것으로 기대한다.

3PS-126 홍준표

FeSiAl@metal Core Shell Composite with Electromagnetic Interference Shielding

홍준표, Pradeep Sambyal, 황승상, 구종민† 한국과학기술연구원

FeSiAl@metal hybrid materials were synthesized with a magnetic core and a electrically conductive metal shell for shielding electromagnetic interference (EMI) pollution. Soft magnetic sendust (FeSiAl) flakes were electroless-plated with electrically conductive Ag or Ni metal to form Ag-plated and Ni-plated sendust core-shell hybrids. The magnetic and metal hybrid-incorporated paraffin wax composites exhibited a better absorption-dominant EMI shielding performance of 65.6 dB and 58.5 dB, respectively, than that of the sendust wax composite and the composite with a mixture of sendust and electrically conductive Ag@Cu dendrite. The superior shielding performance was attributed to the synergistic combination of the effective magnetic loss, dielectric loss, and conduction loss. These exceptional properties of the new hybrid composite showed that it could be used in absorption-dominant EMI shielding applications.

3PS-127 현하늘

Analysis of Thermal Degradation Energy for Liquid Crystalline Epoxy Using Linear Polymerization

현하늘, 조승현† 숭실대학교

액정을 이루는 열경화성 에폭시 수지는 고결정성으로 열전도도가 높은것으로 알려져 있다. Diglycidyl ether of terephthalylidene-bis-(4-amino-3-methylphenol) (DGETAM)은 주쇄내에 방향족 고리를 포함해 높은 열적 특성을 갖는다. M. Harada 등이 합성한 방법을 이용하여 DGETAM를 제조하고, 에폭시기를 Linear polymerization을 이용하여 경화하기 위해 N-benzylpyrazunium Hexafluoroantimonate(BPH)를 합성하여 시편을 준비하였다. 기존의 아민계 경화제인 4,4'-diaminodiphenylethane(DDE)를 사용한 시편과의 열안정성을 비교하기 위해 TGA를 사용하여 활성화 에너지를 계산했고, Kissinger method와 Flynn-wall method를 이용하여 초기 분해에 필요한 에너지를 계산하였다.

3PS-128 허윤정

Mechanically Controlled Rheological Properties of Epoxy Composite via Introduction of Ultrasonic Disperser Techniques

허윤정, 김영훈, 백정주, 장기철, 송광식, 박성만, 배근열, 이효선, 최경호, 신교직† 한국생산기술연구원

Epoxy is commonly used thermosetting polymers with a wide range of applications such as coatings, adhesives and electronic components. For extensive applications of epoxy composite, rheological properties, for example, viscosity and thixotropy, have been considered as crucial factors. Especially, thixotropy is a shear-stress dependent viscosity properties resulting in the reversible changes from gels and fluidic state. Therefore, there are several attempts to investigate the rheological properties of epoxy composite. Herein, we controlled the rheological properties of epoxy composite by introducing ultrasonic disperser techniques. As a simple and universally available method, the ultrasonic disperse techniques is used to provide

the external energy into epoxy composite. As a results, 1.5 times higher thixotropy values could be achieved by ultrasonic disperser techniques. These results will be attributed well-dispersed silica particles supported by infrared (IR) spectroscopy analysis.

3PS-129 허 윤

Adhesion Behavior of Catechol-Incorporated Silicone Elastomer on Metal Surface

허 윤, 문준수, 방준하† 고려대학교

Inspired by the ability of shellfish to attach to rocks in water, the use of catecholic moieties is a widely used strategy for adhesives. In this study, we designed a catechol-based compound, 4-allyl pyrocatechol (APC), which contains catechol and alkene groups capable of interacting with various metal oxide substrates and being chemically incorporated into a polydimethylsiloxane (PDMS) matrix, respectively. The adhesion property was evaluated by measuring the lap shear strength on various metal substrates, such as aluminum (Al), stainless steel (SUS), and copper (Cu), and compared with that of the commercial additive, 3-glycidoxypropyltrimethoxysilane (GPTMS). Remarkably, APC-incorporated PDMS adhered to metal oxide substrates exhibited the maximum shear strength at a lower loading than GPTMS, suggesting that APC enhances the adhesion of PDMS onto metal oxide surfaces more significantly than GPTMS.

3PS-130 한석환

천연섬유의 종류별 폴리프로필렌/천연섬유 복합체의 물성 및 냄새에 대한 금속산화물 영향

한석환, 정혜원, 김연철† 공주대학교

폴리프로필렌(PP)을 매트릭스로 하는 '천연 섬유 강화 플라스틱(natural fiber reinforced plastics, NFRP)'의 압출 가공 시 높은 가공 온도로 인하여 상대적으로 낮은 분해온도를 가지는 리그닌, 헤미셀룰로오스 등의 열분해, 탄화가 발생하고 이로 인해 냄새 문제가 발생하고 이에 대한 해결이 필요하다. 따라서 본 논문에서는 휘발성 유기 화합물(VOCs)의 저감과 냄새 개선을 위하여 금속 산화물 촉매의 일종인 구리 산화물과 망간 산화물을 적용하였다. NFRP 복합체 제조에 사용된 섬유는 대나무 섬유(bamboo fiber, BF), 양마 섬유(kenaf fiber, KF), 셀룰로오스 나노 섬유(cellulose nano fiber, CNF) 등을 사용하였다. 관능적 평가를 통해 복합체에 금속산화물이 적용되었을 때 사람이 느끼는 냄새 수준을 측정하였고, 객관적인 분석을 위하여 전자 코를 통해 VOCs 물질에 대한 분석을 시행하였다. 특히 NFRP의 주요 냄새 성분으로 알려진 furfural과 주요 유기화합물에 대해 주성분분석(PCA)을 시행하였다. 또한, 금속산화물의 적용이 NFRP의 인장, 굴곡, 충격 특성 등의 기계적 물성에 미치는 영향을 UTM, IZOD 충격강도 시험기를 이용하여 고찰하였다.

3PS-131 한동헌

친환경 바이오매스 기반 탄소저감형 합성목재 개발

한동헌, 오승주, 염주선, 정다은, 배진우† 한국기술교육대학교

합성목재는 목분과 PP, PE와 같은 범용 플라스틱을 혼련하여 제작된다. 하지만 범용 플라스틱은 다양한 환경문제를 야기할 수 있기 때문에 친환경적인 합성목재의 개발필요성이 대두되고 있다. 따라서 친환경적인 식물계 바이오매스 기반 고분자인 Cellulose acetate butyrate(CAB)와 Polylactic acid(PLA)를 이용하여 합성목재를 제작하였다. CAB는 열분해온도와 용융온도가 가까워서 가소화를 통해서 가공성을 향상시켰는데, 단일 가소화보다 복합 가소화를 통한 효과가 더 크게 나타났다. PLA는 목분에 비해서 상대적으로 소수성이므로 Maleic acid(MA)에 PLA를 그라프팅시킨 MA-g-PLA 상용화제를 통해서 결합력을 개선하였다. 이렇게 제작된 합성목재의 물성평가를 진행하였으며, 기존 석유계 기반 합성목재에 비해서 물성이 우수하게 나타난 것을 확인할 수 있었다.

3PS-132 한석환

실란 커플링제 처리에 의한 소수화가 PP/CNF 복합체의 물성에 미치는 영향 연구

한석환, 송재헌, 김연철† 공주대학교

셀룰로오스 나노 섬유(Cellulose Nano Fiber, CNF)를 고분자와 복합화할 때 CNF의 분산화가 매우 중요하다. 이를 위해 CNF를 현탁액 상태에서 소수화하는 것이 중요하며, 본 논문에서는 실란 커플링제인 (3-aminopropyl) triethoxysilane(APS)를 CNF 현탁액에 함량별로 처리하여 FT-IR, XPS를 통해 화학구조 변화를 확인하고 수분흡수지수(water absorption index, WAI)를 측정하여 소수화 정도를 고찰하였다. 또한, 이러한 소수화가 폴리프로필렌(polypropylene, PP)과의 복합체 물성에 미치는 영향을 고찰하기 위하여 PP/CNF 복합체를 이축 압출기에 의해 제조하여 복합체의 기계적 물성 측정은 UTM, IZOD 충격강도 시험기를 이용하였고, DSC를 이용하여 열적 특성을 분석하였다. CNF 첨가에 따른 흐름성 및 점탄성 특성은 동적 유변학 측정기를 이용하여 측정하였다.

3PS-133 하 손

High-Performance Sodium Metal Hybrid Capacitors Based on Metal Anode and Capacitive Cathode

하 손, 강동혁, 윤영수† 고려대학교

Current energy storage devices can be classified into two categories such as rechargeable batteries and supercapacitors. Rechargeable batteries have relatively low power and high energy characters, while supercapacitors can deliver relatively low energy and high power capabilities. In order to achieve high energy and high power performances, a hybrid type device composed of a faradic (battery-type) electrode and non-faradic (capacitor-like) electrode was designed. In this study, a new hybrid type energy storage device was developed by using an asymmetric electrode configuration of sodium metal anode and capacitive cathode. The new device showed significantly high energy and power performances as well as stable cycling behaviors over several hundreds of cycles.

3PS-134 티와리 아준 프리차스

Three-dimensional Carbonaceous Network with In-situ Formed Metallic Cobalt for Energy Storage Application

티와리 아준 프리차스, 김학용† 전북대학교

Designing 3D nanostructures for the energy storage application evokes much interest due to their several advantages over their corresponding 2D materials counterparts.1 3D nanostructures with high surface area and short electron path not only offer the additional ion-accessible surface for charge storage but also support the ion diffusion within the structure. In these consequences, we showed the synthesis of 3D porous composites together with transition metal attachment for energy storage.

3PS-135 최준석

Electrospray Preparation of Hierarchically Structured Fe_3O_4 for Long-term Stability of High Performance and Long-term Stability of Magnetorheological Fluids

최준석, 서용석† 서울대학교

One of the major problems of magnetorheological fluids (MR fluids) is long-term stability aganinst sedimentation of mangetic particles. Because the density of magnetic particle is much larger than the density of the carrier liquid, sedimentation of magnetic particle occurs, and this phenomena can degrade the performance of MR fluids. In this research, we fabricated hierarichically structured Fe_3O_4 particles through simple electrospray process of citric acid-capped Fe_3O_4 solution. with pores inside, those structured particles have lower density compared to citric acid-capped Fe_3O_4, leading to better long-term stability of MR suspensions. Besides, the exclusion of non-magnetic polymer materials from the stuctures make the MR suspensions to have much better MR performance than previous polymer-mangetic composites-based MR fluids.

3PS-136 최은지

Direct Growth of Ultrathin ZIF-8 Membrane on Graphene Nanoribbon Treated Polymeric Support for Hydrogen/Hydrocarbon Separation

최은지, 김대우† 연세대학교 화공생명공학과

Zeolitic imidazolate framework-8 (ZIF-8) membranes are promising to separate hydrogen/hydrocarbon mixture due to its precise molecular sieving property. To maximize the separation efficiency with high permeance and selectivity, it is required to form ultrathin ZIF-8 layer on porous support without defects. However, previous ZIF-8 based membranes were usually thick (~1 μm) and mainly fabricated on inorganic supports because the precursors for ZIF-8 films were passed through into the porous supports and the overgrowth of ZIF-8 film were occurred. Herein, graphene oxide nanoribbons (GONR) were deposited on porous polymeric support and ZIF-8 layer was directly grown on its top surface. The thickness of the ZIF-8 layer is ultrathin around 400 nm because the GONR layer blocks the overgrowth of ZIF-8 film into the porous support. The ZIF-8 membrane showed high permeance and selectivity for hydrogen because of its ultrathin thickness and negligible gas flow resistance through the GONR layer.

3PS-137 최윤제

Preparation of LaF_3/Polyimide-Based PolyHIPEs Nanocomposite Foam with Low Dielectric Constant *via* Pickering High Internal Phase Emulsions

최윤제, 최주영, 진승원, 박형주, 이승현, 김담비, 정찬문† 연세대학교

Polyimides have been widely utilized as packaging material and dielectric layers for the electronic and micro electronic industry because of their outstanding characteristics such as low dielectric constant. In this study poly(amic acid) salt (PAAS) was synthesized using 4,4′-(Hexafluoroisopropylidene)-diphthalic anhydride and 3,3′-Dimethylbenzidine (m-toluidine). LaF_3 nanoparticles with an average diameter of 20nm were added PAAS aqueous solution. HIPEs were prepared by adding cyclohexane as an internal phase in an aqueous dispersion and subsequent homogenization. LaF_3/polyimide-based polyHIPEs nanocomposite foam was prepared through freeze-drying and subsequent thermal imidization of LaF_3/PAAS-based HIPEs. The characteristics of the LaF_3/polyimide-based polyHIPEs nanocomposite foam, including their morphology, thermal decomposition temperature, and dielectric constant were investigated.

3PS-138 최유라

Development of Ceramic 3D Printing Materials Based on Zirconia and Acrylic Photo-curable Resin

최유라, Nguyen The Manh, Lường Nguyen Dai Triet, Huynh tan Thai, 이민찬, 조남철† 순천향대학교

3D printing technology is highly optimized for medical applications because metal and polymer based printing materials can easily produce patient-customized implants. Recently, photo-curable ceramic 3D printing materials have been actively studied to compensate for the high processing cost of metallic materials and the low mechanical properties of polymer materials. In the case of ceramic printing materials, ceramic powder is added to a photo-curable resin to form a slurry, and then photo-cured with a laser. In this study, the surface of zirconia powder was modified using a silane coupling agent and then used as a 3D printing material. In addition, we studied the mechanical properties and curing properties of ceramic 3D printing materials according to the ratio of ceramic material and polymer resin.

3PS-139 최승은

Graphene Oxide Liquid Crystal by Controlling the Amount of Diamine Vapor for Fabricating Gas Resistant Coating

최승은, 김성수[1], 김대우† 연세대학교 화공생명공학과; [1]한국과학기술연구원

Graphene oxide/ethylenediamine (GO/EDA) composite film with gas barrier properties was fabricated by EDA vapor treatment to GO liquid crystal (GOLC). The exposure

time of EDA was critical element for controlling the amount of EDA intercalation between GO scaffolds. A GO/EDA coated film with the substrate of polyethylene terephthalate (PET) film was impermeable to gas molecules (He, H_2, CO_2, N_2, and CH_4) and the gas permeance was reduced up to 99.6% (He) and 98.5% (H_2) in comparison to the neat PET film. This enhanced gas barrier properties can be ascribed to the high tortuosity of aligned GO nanosheets. The stability and the mechanical properties of the GO/EDA film were increased due to the crosslinking between EDA and oxygen-containing groups of GO. Therefore, the presented coating method can be applied to various substrates including three-dimensional structure because of the viscoelastic properties of GOLC and the volatility of EDA.

3PS-140 최슬기

Transparent Conductive Reduced Graphene Oxide/Nickel Sulfide Flexible Thin Film

최슬기, 박희경, 정진주, 김재훈, 이정수† 조선대학교

In recent years, the transparent conductive flexible thin film has a lot of attention due to considerable demands for wearable devices. Reduced Graphene Oxide/Nickel Sulfide (rGO/NiS) film was produced by heat treatment process after layer-by-layered Graphene Oxide/Nickel Sulfide on a silicon wafer. The morphology and crystallinity of the samples as-obtained were characterized by XRD, UV-vis, SEM and Raman spectroscopy, respectively. This film expected to be easy for mass production because Nickel Sulfide simple production process, and it is look forward to being used in various fields such as displays, next generation energy materials, battery and electrochemistry.

3PS-141 최솔아

Analysis of Microplastic Fibers Released from the Various Fabrics Through Washing

최솔아, 권미연, 박명자[1], 김주혜† 한국생산기술연구원; [1]한양대학교

Microplastic is insoluble plastic less than 5mm, and that having a fiber shape is microplastic fiber. In the apparel industry, where the use of synthetic fiber accounts for 65%, various studies related to microplastic fibers release are being conducted. Research on the release of microplastic fibers in the washing process predicts the amount of microplastic fibers released from fabric, and research on various variables is needed to reduce microplastic fibers. Therefore, in this study, polymer type, yarn type, and weaving method of fabrics are closely analyzed to compare the amount of microplastic fibers discharge and the type of fibers (length, diameter, etc.), and suggest that reduction technology of microplastic fibers from the manufacturing process through analyzing the trend of occurrence.

3PS-142 진희경

Carboxymethyl Cellulose/MMT Bionanocomposites Modified with Imidazolium-POSS

진희경, 박성수, 하창식† 부산대학교

Cellulose has been studied a lot for its eco-friendly, biocompatible and biodegradable properties. Cellulose does not melt well in common solvents because of hydrogen bonds. Carboxymethyl cellulose is, however, water soluble and is easy to process. Montmorillonite (MMT) is a clay reinforcing material widely used in polymer-clay composites. Polyhedral oligomeric silsesquioxane (POSS) has good thermal, mechanical properties and can widen the distance between layers of sodium MMT. Previously, we investigated on the bionanocomposite films using three materials : microcrystalline cellulose, MMT, and POSS with ammonium moieties (ammonium-POSS). POSS with imidazolium moieties (imidazolium-POSS) as filler may improve the thermal stability of the composite films because of imidazolium moieties with high thermal stability. Therefore, in this work, we prepared carboxymethyl cellulose/MMT bionanocomposites and studied on their properties.

3PS-143 지성민

Capacitance of MnO_2 Micro-Flowers Decorated CNFs in Alkaline Electrolyte and Its Bi-Functional Electrocatalytic Activity toward Hydrazine Oxidation

지성민, 김학용[1,†] 전북대학교 나노소재연구실; [1]전북대학교

The specific capacitances of nanostructure at different scan rates are shown. The specific capacitance decreases with the increase of scan rates from 5 to 75 mVs^{-1}. At low scan rates (5 mVs^{-1}), both active areas (internal and external) of the surfaces of electrodes could take part in reaction while at high scan rate (75 mVs^{-1}) the diffusion of the electrolyte ions was limited thus only the external surface area of electrodes could participate in ion transfer reaction. As shown in fig.1 (b) the maximum specific capacitance obtained at a scan rate of 5 mVs^{-1} of was 120 Fg^{-1}. The CV curve indicates an excellent electrocatalytic activity of nanostructure by showing effective hydrazine oxidation with high current density in presence of hydrazine (Red). At the potential of 1 V, the current density of the nanostructure reached 38 mA cm^{-2}, which was about double than that in 1 M KOH.

3PS-144 조하니

자동차 내장재의 VOCs 방출 특성 및 저감방안 연구

조하니, 박장석† 대한솔루션

자동차 보급 확대와 자율주행차의 발전으로 자동차 실내 공간에 대한 인식이 운송수단에서 거주공간으로 변화되고 있다. 이에 따라, 자동차 내부 환경이 탑승자의 건강에 미치는 영향이 증가하면서 실내 공기질에 대한 관심도 확대되고 있다. 자동차 내부에서 발생하는 주요 오염물질은 내장재에서 방출되는 휘발성유기화합물(VOCs, volatile organic compounds)을 주성분으로 포함하고 있다. 자동차 실내공기질 관리 기준에 따라 VOCs (벤젠, 톨루엔, 에틸벤젠, 자일렌, 스티렌)와 알데히드류를 기준치 이하로 관리하며 규제가 점차 강화되고 있다. 특히 VOC 물질 중 알데히드류는 방출량 감소를 위해서 저감 소재 개발 및 제조 공정 개선이 필요한 현황이다. 본 연구에서는 자동차 실내소음을 저감하는 내장재인 DASH ISO PAD에서 우레탄 흡음재 발포성형 전에 아민계 저감제를 적용하여 VOC 물질이 감소된 제품을 제작했다. 제조공정으로는 폴리올에 아민계 저감제를 0.5~1 wt% 교반, 분산 후 폴리우레탄폼을 발포하였다. 제작된 제품의 VOC 물질을 GC-MS와 HPLC를 이용해 분석하였으며 VOC 저감제 적용 후의 효과를 검증하였다.

3PS-145 조윤호

PNIPAM-PDMS Composite Coating Layers Having Rapid Temperature-responsive Surface Transition

조윤호, 이종휘[1,†] 중앙대학교; [1]중앙대

Poly(N-isopropylacrylamide) (PNIPAM) is a kind of hydrogel having their unique lower critical solution temperature (LCST) properties. Because of their unique LCST properties, PNIPAM has been widely studied as an actuator in temperature changing conditions. However, the weak mechanical properties of PNIPAM are obstacles to utilize. In this study, we prepared PNIPAM film having directional pores by using a Directional Melt Crystallization method. After that, we coat different thickness of poly(vinyl alcohol) on PNIPAM film to control the thickness of exposed PNIPAM phases. PDMS was infiltrated into the pores of PNIPAM, and the composite layers were fixed on the surface of a model substrate PU. Exposed PNIPAM phase was well controlled depending on the PVA coating thickness. By combining with PNIPAM and PDMS, the modulus of coating layers was enhanced. PNIPAM/PDMS composite coating layers show fast surface structural transition and changes in hydrophilicity depending on temperature.

3PS-146 조영훈

$CoMn_3O_4$ and Fe_2O_3 Metal Oxides Coated Polyimide-based Carbon Fibers as Cathode and Anode Materials for Wire-type Supercapacitor Applications

조영훈, 고태훈, 정용식, 김학용, 김병석† 전북대학교

In recent years, many researches of the energy storage devices are proceeded to overcome the energy shortage from the fossil fuel. Among the energy storage devices, supercapacitors (SCs) have gained great attention owing to their higher power densities, and longer cycle life compared with other devices. Among them, pseudocapacitors based on transition-metal oxides and wire-type SCs are promising strategies for a high energy and power density with flexible properties to make an excellent energy storage devices. In this work, $CoMn_3O_4$ and Fe_2O_3 were coated on polyimide-based carbon fibers by a facile chemical oxidation with ammonium persulfate and hydrothermal method, respectively. The prepared $CoMn_3O_4$ and Fe_2O_3 polyimide-based carbon fiber electrodes delivered high performance in terms of high specific capacitance, good conductivity and long cyclic stability with flexible properties.

3PS-147 조승빈

Engineering Methods of Drug Crystals by Porous Nucleation Plates

조승빈, 이종휘† 중앙대학교

Downstream processing in the pharmaceutical industries is very important because it can save the cost and time of the manufacturing process by improvement of processability. If the crystal particles have high aspect ratios, they can be easily damaged during processing and have poor fluidity, causing problems in the downstream processes such as packaging and filtration in the pharmaceutical industry. To solve these problems, various studies have been conducted to change the physicochemical properties of drugs such as the size, shape and aspect ratio of drug crystals. In this study, naproxen, which is used as a nonsteroidal anti-inflammatory drug, was produced by using drowning-out crystallization with uniform porous devices, and the change in the properties of the drug was verified through the examination of various parameters. These changes improve the flowability of drugs and provides the possibility of solving problems in the downstream processes.

3PS-148 조성훈

Effects of Plasma Treated CVD Graphene on Crystallinity, Thermal, and Mechanical Properties of Polyketone

조성훈†, 이준섭[1], 장혜지[2] 영남대학교; [1]가천대학교 신소재공학과; [2]영남대학교 화학공학부

In this work, we report a facile way to control crystalline structures of polyketone (PK) films by combining plasma surface treatment with chemical vapor deposition (CVD) technique. The crystalline structure of PKs grown on plasma-treated graphene, and the resulting thermal and mechanical properties were systematically discussed. The production of PKs having different crystallinity were performed on the O_2- and N_2-doped graphene sheets. It was evident that the CVD-grown graphene sheets acted as the nucleating agents for promoting the crystallization of β-form PK, while suppressing the growth of α-form PK crystals. N_2 plasma treatment of the CVD-grown graphene promoted growth of the β-form PK, whereas the O_2 plasma treatment of CVD graphene led to transformation of the unoriented β-form PK into the oriented α-form PK. Thus, the resulting thermal and mechanical properties of the PKs were highly dependent on the surface functionality of the CVD graphene.

3PS-149 조남정

Properties Prediction of Plastic Compounds by Machine Learning and Data Mining

조남정, 박재성, 이재흥, 최우진† 한국화학연구원

Plastic compounds have been developed by many experts having experience in various industries. However, it takes a lot of effort and time to acquire the properties of plastic compounds due to compounding mixing, injection condition and measurement method. We studied the properties prediction technology of plastic compounds by data mining and machine learning algorithms. To collect data on the

compositions, processing and properties of plastic compounds, we built templates and database systems. Machine learning algorithms were applied to predict tensile strength, flexural modulus, Izod impact strength, and heat deflection temperature of plastic compounds. To improve the prediction performance, we adopted the classification and properties of materials used in plastic compounds. In addition, the clustering of similar fillers was visualized by applying principal component analysis method using the characteristics of the various fillers used in plastic compounds.

3PS-150 제롬 피터

Palladium Alginate Polymer Beads for Transfer Hydrogenation of Ketones

제롬 피터, 아난두 모한, 안주 마리아 토마스, 하창식† 부산대학교

Transfer hydrogenation reaction is an alternative and greener approach to reduce the unsaturated bond. Herein, a novel functionalized alginate with palladium bead was developed cooperatively covered with polyethylenimine (PEI) and modified with $CaCO_3$ composites as a catalyst. The advantage of heterogenized Pd alginate beads are very effective and reusability. The prepared polymer composites were characterized by various sophisticated techniques. Significantly, the TEM-EDS analysis showed that the weight % of Pd was found to be 0.6% in the composite. The FTIR analysis confirmed the presence of functional groups in the alginate composites. The synthesized Pd alginate beads were used for the transfer hydrogenation of ketones to their corresponding alcohols and achieved good conversion (85–97%) with high selectivity. The catalyst was easily separated and reused for 5 times without loss of catalytic activity. The isolated catalytic products were characterized using 1H and 13C NMR studies.

3PS-151 정혜림

The Effect of Nickelocene on in-situ Growth of MWCNTs in SiCN Ceramics

정혜림, 곽영제†, 허태환 숭실대학교

Since carbon nanotubes (CNTs) have excellent mechanical, electrical, and thermal properties, as well as chemical inertness, large aspect ratio, and high surface area, research has been actively conducted to apply those characteristics in the composite material field. In this study, we used phenyl silsesquiazane (SSQZ) as a precursor to silicon carbonitride (SiCN) ceramics. SSQZ was mixed with nickelocene and pyrolyzed to form SiCN ceramics. During the process, it was observed the growth of CNTs in the ceramic matrix. The formation of CNTs was studied by changing pyrolysis time, temperature, and amount of nickel precursor using XRD, FE-SEM, EDS, and FE-TEM.

3PS-152 정현오

Fabrication and Characterization of High-filler-load Graphite/Polystyrene Composites

정현오, 임홍진, 정광운[1], 장세규† 한국과학기술연구원; [1]전북대학교 고분자나노공학과

In general, high-load of fillers in polymer composites significantly improves material properties such as thermal/electrical conductivities. However, difficulties in compounding and fabrication processes as well as poor mechanical properties of high-filler-load composites have been considered as major issues. In this study, we introduce an efficient method to prepare fillers with designated filler to matrix composition and polymeric composites with high-filler-load (>95%) were prepared by hot-pressing. Despite of the high-load, the composites showed an excellent mechanical property clearly contrasted to the one prepared by simple mechanical compounding of matrix and filler. The fabricated composites with high thermal conductivity, high electrical conductivity, and high mechanical strength can be potentially useful as electrodes for batteries as well as thermal management materials.

3PS-153 정한빛

Ultra-low Pt Loading on Small-Sized Carbon Support Fabricated Using Emulsion Polymerization for Proton Exchange Membrane Fuel Cell

정한빛, 최주혁, 이준호, 이영준, 이현주, 김범준† KAIST

Developing a high-performance proton exchange membrane fuel cell (PEMFC) with minimal use of Pt is essential in cost reduction of the PEMFC, and its commercialization. Herein, we developed the facile synthesis method of supporting particles by emulsion polymerization, allowing high yield and simple method with low cost. The fabricated single cell exhibit a high mass activity in oxygen reduction reaction (ORR) and a high durability after 30,000 cycles. The same power density could be obtained with 1/20 of Pt usage, when the developed catalyst and commercial Pt/C were compared. Also, size-controlled carbon particles were designed to elucidate the effect of particle size on the PEMFC performance. As the particle size decreased, the PEMFC performance increased with enhancing mass transport behavior.

3PS-154 정진주

Highly Porous Carbon Structure Using Nanocellulose Derived from Marine Biomass as an Alternative Supercapacitive Material

정진주, 김재훈, 박희경, 최슬기, 이정수† 조선대학교

Emerged as an attractive new material, nanocellulose was successfully isolated from *Undaria pinnatifida* green algae of marine biomass. Cellulose extracted from marine biomass was not only eco-friendly because it contains little lignin so that can shorten the chemical process, but mass production was also possible at low cost due to it grows in water does not require cultivation areas and nutrients. The carbonized nanocellulose/metal salt showed favorable features required for excellent electrochemical properties such as high surface area and electrical conductivity. Especially porous carbons have outstanding properties with respect to their use in energy applications that require constrained space such as the electrode materials for supercapacitors. Our study demonstrates that nanocellulose derived from marine biomass can serve as a low-cost, simple process, environmental protection electrode materials for supercapacitors, it can be compared with the current supercapacitor.

3PS-155 정지훈

Enhancing the Mechanical Properties of Alginate/Polyacrylamide Double Network Hydrogels by Incorporating Cellulose Nanocrystals

정지훈, 엄영호† 부경대학교

Hydrogels, which are water-rich cross-linked polymeric networks, have been widely used in various applications such as scaffolds for tissue engineering, vehicles for drug delivery, and model extracellular matrices for biological studies. Nonetheless, the scope of hydrogel applications is severely limited because of their insufficient mechanical performances. To develop strong and tough hydrogels, a preparation of double network hydrogels has been recently proposed, and attracted considerable attention. Particularly, a combination of alginate/polyacrylamide hydrogel has been extensively studied due to its high toughness and excellent biocompatibility. To further improve the mechanical performances of the double network hydrogel, in the current study, cellulose nanocrystal (CNC) was incorporated and then the mechanical and rheological properties of the nanocomposite hydrogels were evaluated in terms of the filler loading.

3PS-156 정지인

High-performance Stretchable Conductive Adhesives Based on Silver Flakes and Multi-walled Carbon Nanotubes in Elastomer

정지인, 김희숙†, 윤호규[1], 고영표 한국과학기술연구원; [1]고려대학교

Stretchable conductive adhesives have received considerable attention for applications in wearables, healthcare, and robotics. Here, we report a stretchable conductive adhesives consisting of silver flakes with multi-walled carbon nanotubes as an auxiliary filler in Silicone rubber. The conductive adhesives with 70 wt% silver flakes show the resistivity as low as ~ 10-5 Ω · cm. The introduction of carbon nanotubes into the silver/silicone adhesives help to decrease the electrical resistivity. Furthermore, the carbon nanotubes decrease the amount of silver flakes required for the desired electrical conductivity, which should help improve other physical properties such as viscosity and mechanical properties.

3PS-157 정재환

Facile Synthesis of Metal Nanocrystals Embedded Hydrogel Beads and Their Application

정재환, 김문호† 부경대학교

Silver (Ag) nanoparticles have been applied in many fields. However, since Ag nanoparticles are easily aggregate to minimize their surface areas in the solution phase, various methods using polymers as support materials were developed for the immobilization of Ag nanoparticles. Alginate which is one of the biocompatible hydrogel polymers was used in this work because it can be easily crosslinked with cations, and it can cap and stabilize metal nanoparticles. There are a lot of ways to synthesize and immobilize Ag nanoparticles, however, most of them still use a two-step method in which hydrogel polymer is crosslinked first before the Ag precursor is reduced. In this study, an easy one-step method, where crosslinking of a hydrogel polymer and Ag nanoparticles formation occurred at the same time, is introduced. It is easy to see that silver nanoparticles are reduced by changing the color. The as-prepared Ag/Alginate beads showed high catalytic activity and excellent reusability.

3PS-158 정용일

나노셀룰로스 FRP(Fiber Reinforced Plastic)가 적용 된 친환경 농업용 전기차 대면적 외장재 제조 기술 개발

정용일†, 전경수, 이민지, 민경배 한국섬유기계융합연구원

지구온난화의 주된 원인인 온실가스 배출에 대한 국제적 규제가 강화됨에 따라 세계 6대 자동차 제조 기업은 “Sustainable Plastic 사용전략”을 발표하여 2020년까지 내장재 플라스틱의 100%를 대체하겠다고 밝히며 친환경 바이오 복합소재를 적용한 플라스틱 개발에 박차를 가하고 있음. 나노셀룰로스(Nano Cellulose)는 고강도 천연 나노섬유질 소재로 전 산업분야에 적용 가능한 친환경 섬유소재이고 일본, 미국, 유럽을 중심으로 다양한 연구개발 및 제품화 시도가 진행되고 있음. 본 연구에서는 폐기 불가능한 유리섬유 및 일반 플라스틱의 차량 부품 사용량을 가능한 줄이고 바이오매스 기반의 자연순환형 셀룰로스계 섬유소재를 이용한 차량 부품 시스템을 구축하고자 함. 초지법(wet-laid)으로 제조한 나노셀룰로스 non-woven 시트를 이용하여 프리프레그 제작 및 적층하여 최종 FRP를 제작하고자 하며, 프리프레그 적층, 계면, 분리, 굴곡진 부분에서의 성형성 및 경화 적층 관련 레진의 최적화를 진행하고자 함.

3PS-159 정예빈

Highly Efficient, 1D Structure Bi-functional Electrocatalyst Based on Co Atoms with Ultralow Ru Nanoclusters for Overall Water Splitting in Acidic Electrolyte

정예빈, 안성훈† 조선대학교

We fabricated free-standing bi-functional catalytic electrode of cobalt-nitrogen-carbon matrix with ultra-low loading of ruthenium nanoclusters for efficient water splitting in acidic media. One dimensional tellurium nanowires with porous structure were firstly prepared, followed by the subsequent coating process by metal-organic framework (MOF) with bimetallic zinc and cobalt. After this process, the complex was annealed under argon flow at 950 ℃ to evaporate tellurium and zinc and produce porous carbon matrix with atomic Co sites. After the annealing process, it was immersed in the ruthenium solution and ruthenium nanoclusters fill where the tellurium and

zinc were evaporated. The electrodes were applied to the acid water electrolyzer toward both hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) simultaneously. The results suggest that the complex is performing similar or superior to noble metal catalysts, implying a promising prospect in the catalytic field.

3PS-160 정민웅

Enhanching the Mechanical Performances and Durability of Composite Polymer Electrolytes with Cellulose Nanocrystals

정민웅, 엄영호† 부경대학교

Owing to safety issues of liquid-containing polymer electrolytes, lots of efforts have been devoted to developing the liquid-free all-solid polymer electrolytes (SPEs) for lithium or sodium-ion batteries. However, the SPEs suffer from a lack of the ionic conductivity and mechanical performances for the applications, and therefore, numerous strategies have been reported to overcome the disadvantages. Among them, the preparation of composite polymer electrolyte (CPE) has been regarded as one of the most efficient and facile approaches due to the convenient fabrication procedure and easily tailorable properties for both ionic conductivity and mechanical durability. In the current study, the all-organic CPE was prepared using cellulose nanocrystals (CNCs) as a reinforcing agent and poly(vinylidene fluoride) (PVDF) as a polymeric matrix. The reinforcing effects of CNCs on the ionic conductivity and rheological behaviors were evaluated in terms of the filler loading of 0-30 wt%.

3PS-161 정도연

내충격성 및 내마찰성이 우수한 UHMWPP를 이용한 복합소재 개발

정도연, 이종수† (주)KOPLA

본 연구는 우수한 내충격성 및 저비중으로서 자동차 내/외장 부품용으로 알루미늄 소재 등의 대체가 가능한 복합재를 개발함으로써, 경량, 내열성, 내약품성, 성형성 등 성능개선을 위해 UHMWPP를 이용한 컴파운딩 소재를 개발을 하고자 하였다. 현재 UHMWPP는 유럽 및 일본에서 연구개발중에 있고 상용화는 이루어지지 않은 실정으로 상용화로서의 공정 및 복합소재의 작업성 등 최적의 Formulation을 연구개발 중에 있다. 본 실험에서는 파우더형상의 UHMWPP의 압출평가의 수지의 유동과 물성을 평가를 하였다.

3PS-162 정대영

Thermal and Mechanical Properties of Silica-filled Epoxy Molding Compound for Fan Out Wafer Level Packaging

정대영, 서흔영, 윤호규† 고려대학교

Looking into the inside of the package, different materials such as silicon chips, metal electrodes and epoxy resin are used. When it exposed to high temperatures, which can cause problems caused by CTE-mismatch between components. When the temperature changes rapidly, thermal stress occurs on the interface between the dissimilar materials, resulting in interfacial cracking or bending. Therefore, epoxy composite materials with low coefficient of thermal expansion are needed. By adding silicas of different size and content to the epoxy, the warpage can be improved by lowering the CTE. The properties of the mixture between the epoxy material and the filler are very important and are analyzed to construct the optimal mix composition. UTM, DMA, TMA and LFA were also measured to identify the thermal and mechanical properties of these epoxy composite materials. Based on this data, epoxy composites with low CTE and low modulus properties can be created.

3PS-163 정도연

진동감쇄 플라스틱 복합소재 개발

정도연, 이종수† [1](주)KOPLA

전기자동차의 구동시스템을 지지하는 모터 마운트 구성부품은 강도 유지와 경량화를 위해 알루미늄 소재를 이용한 제품을 양산하고 있으며, 지속적인 향상을 위한 기술로 알루미늄 최적화 설계가 이루어져 왔지만, 주행거리 향상에 대한 지속적인 기술개발이 요구되면서 일정 기준 이상의 강도를 유지하면서 단위 무게를 경량화 할 수 있는 소재로 대체가 필요한 상황이다. 또한, 전기자동차의 주행거리 향상, 진동 및 소음 억제 기능에 대한 소지바 욕구 수준은 해가 거듭될수록 높아지고 있으며 NVH(Noise, Vibration, Hashness)에 대한 개선 방법으로 복합소재 부품을 개선하여 진동 소음 고감쇄 성능을 필요로 하고 있는 실정이다. 본 연구에서는 주요 문제인 와인노이즈(whine noise)가 발생되는 주파수 대역(500~700 Hz)을 회피할 수 있는 엔진마운트 브라켓 복합소재 개발을 하고자 한다. *본 연구는 산업통산자원부 자동차활력제고사업(2007176)으로 수행된 연구결과입니다.

3PS-164 정다운

Fabrication and Characterization of Multifunctional Carbon Dots Embedded Keratin/Poly(Vinyl Alcohol) Nanofiber Membranes

정다운, 오자 구넨드라프러사드, 윤홍진[1], 국윤수[2], 김홍관[1], 서민강[2], 박미라† 우석대학교; [1]FITI 시험연구원; [2]한국탄소융합기술원

Carbon quantum dots (C-dots) were loaded dispersed into the keratin/PVA solution and electrospun into the nanofiber to obtain C-dots embedded keratin/PVA NFs membrane. The morphology, optical transparency, and biocompatibility were evaluated. It was observed that the nanofibers preserved their morphology and optical property even after the incorporation of C-dots. More importantly, the as-obtained C-dots/keratin/PVA nanofiber membrane demonstrated biocompatibility in the living cell environment. The as-prepared composite nanofibers can be applied for various applications such as optoelectronic devices and biomedical applications.

3PS-165 전상우

Fabrication of Closed-Packed and Highly Aligned Boron Nitride Nanotube/Polymer Complexes

전상우, 김태환†, 강신현†, 최정철 전북대학교; [1](주) 퀀텀캣

Boron Nitride Nanotube (BNNT) have attracted for their excellent physical properties and wide range of potential applications such as thermally conducting, piezoelectric materials. For practical application of boron nitride nanotubes (BNNTs) with excellent thermal, electrical and mechanical properties, however, it is very important to control their morphology. Therefore, we made a complex of hydrophilic modified BNNTs and a Pluronic triblock copolymer having both hydrophilic and hydrophobic group. To identify the morphological behavior of BNNTs, the well mixed BNNTs/Pluronic copolymer complexes were measured by small angle x-ray scattering (SAXS) technique upon heating. In this presentation, we report the highly aligned and closed-packed hexagonal structures of BNNT/Pluronic copolymer complexes.

3PS-166 정다운

Preparation and Photoluminescent Assessment of Carbon Quantum Dots Incorporated Keratin/Polyvinyl Alcohol Hydrogels

정다운, 오자 구넨드라프러사드, 박미라† 우석대학교

Photoluminescent carbon dots (C-dots) incorporated keratin/poly (vinyl alcohol) (keratin/PVA) hydrogels were prepared via an electron beam irradiation (EBI) technique in order to exploit the photoluminescent property of C-dots and biocompatibility of the keratin/PVA hydrogels. The porous structure along with the homogeneous networks of hydrogels showed excitation dependant photoluminescent (PL) emission similar to that of the C-dots. The well preserved quantum confinement effect of the C-dots in the hydrogel can extend its application to various fields such as optoelectronic devices, metal ion detection, and biomedical applications.

3PS-167 전경수

A Study on the Cellulose Nanofiber (CNF) Sheet Fabrication for Application to Secondary Cell Separator

전경수, 이민지, 민경배, 정용일† 한국섬유기계융합연구원

본 연구에서는 셀룰로오스 나노섬유(CNF)의 전처리 및 후처리로서 TEMPO 촉매 산화 반응으로 셀룰로오스에 음이온성을 부여하였으며, 이후 기계적 처리방식인 그라인딩을 통해 셀룰로오스 나노섬유를 제조하였다. 제조된 셀룰로오스 섬유의 표면관찰을 위해 주사전자현미경(SEM)으로 관찰한 결과, 균일도는 다소 떨어지지만 300~800 nm의 나노급 두께를 가진 CNF가 제조되었음을 확인하였다. 시트 제작을 위해 수초지기를 사용하여 Wet-laid 방식으로 CNF와 하드우드 펄프의 함량비를 조절하여 제조하였으며, 셀룰로오스 나노섬유의 함량은 100, 90, 80%로, 평량은 10~30 g/m^{2}로 유지하였다. 시트의 건조는 90 ℃에서 Drum drier를 사용하여 수축의 발생을 없게 하였다. 분석을 위해 시트의 두께와 표면구조, 기계적 강도, 투기도 등을 분석하였다. 결과적으로, 20 ㎛급의 CNF 시트제조가 가능함을 알 수 있었고, 향후 배터리 충방전 시험을 위해 분리막으로 적용하여 가능성을 평가해 보고자 한다.

3PS-168 장희수

Metal 3D 프린팅용 필라멘트 개발

장희수, 장타오, 조민기, 강호종† 단국대학교

본 연구에서는 금속 3D 프린팅 중에 하나인 Atomic Diffusion Additive Manufacturing (ADAM) 공정은 금속 분말에 고분자 소재를 바인더로 사용하여 필라멘트를 제조하고 이를 FDM 방식에 의하여 3D 프린팅하는 공정이다. 이러한 메탈 필라멘트는 기존의 Metal Injection Molding 수지에 비하여 메탈 함량이 높아 메탈함유 고분자 복합소재의 개발에 대한 연구가 필요하다. 본 연구에서는 메탈 함량이 80%이상인 메탈/고분자 복합소재를 제조하고 메탈의 융착과정에 필수적인 바인더로 사용한 고분자 소재의 debinding 공정에 관하여 연구를 수행하였다. 본 연구는 copper와 stainless 분말을 사용하였으며 이러한 금속 파우더를 결합시키기 위한 backbone binder로 Polypropylene 분말을 사용하였다. 메탈 융착과정에 필수적인 Calcination(하소)을 위하여 수용성 고분자인 PVA를 첨가 사용하여 이들이 메탈 융착에 미치는 영향을 살펴보았다. 연구 결과 메탈이 함량이 90% 이상의 메탈/폴리프로필렌 복합소재를 제조할 수 있었으며 PVA의 첨가가 하소 공정을 가능하게 하여 메탈 융착이 원활하게 일어남을 확인하였다.

3PS-169 장혜지

Comparative Studies on Polyurethane Composites Filled with Polyaniline and Graphene for DLP-Type 3D Printing

장혜지, 조성훈[1,†] 영남대학교; [1]영남대학교 화학공학부

Digital light processing (DLP)-type 3D printing ensures several advantages, such as an easy solution process, a short printing time, high-quality printing, and selective light curing. Furthermore, polyurethane (PU) is among the promising candidates for 3D printing because of its wide range of applications. This work reports comparative studies on the fabrication and optimization of PU composites using a polyaniline (PANI) nanomaterial and a graphene sheet (GS) for DLP-type 3D printing. The morphologies and dispersion of the printed PU composites were studied by field FE-SEM images. Bonding structures in the PU composites were investigated by FT-IR spectroscopy. As-prepared PU/PANI and PU/GS composites with different filler contents were successfully printed into sculptures with different sizes and shapes. The PU/PANI and PU/GS composites exhibit the improved sheet resistance and mechanical properties than the pristine PU.

3PS-170 장웅식

Correlation between Morphological and Electrical Characteristics for High Current Generation: Methylammonium Lead Halide Solubility Control in Perovskite Photovoltaics

김병기, 장웅식, 조재상, 왕동환† 중앙대학교

Although many efforts have been made to achieve a uniform and dense perovskite film, the use of stoichiometry (CH_3NH_3I:PbI_2:DMSO=1:1:1) has been limited. This is

because the CH_3NH_3I–PbI_2–DMSO intermediate phase and the $CH_3NH_3PbI_3$ crystal phase can coexist in the precursor solution with stoichiometric ratios. To solve this, a complex process was inevitably needed to ensure the uniformity of the perovskite layer. Here, the quality of the $CH_3NH_3PbI_3$ crystal thin film is simply improved via controlling non stoichiometric molar ratio (CH_3NH_3I:PbI_2:DMSO) a uniform and dense $CH_3NH_3PbI_3$ thin film was successfully fabricated by controlling the solution solubility and the perovskite adduct formation. This demonstrated a critical point to improve current density and power conversion efficiency in inverted perovskite solar cells. The synergistic effect of morphology and electrical properties has demonstrated a critical point for generating high current densities in inverted perovskite solar cells.

3PS-171 장시훈

Synthesis and Properties of PI–silica Composites Containing Silane Coupling Agent

장시훈, 박준철, 임다정, 박진경, 박수일[†], 박노형[†] 한국생산기술연구원; [1]연세대학교

Polyimides (PI) are generally classified as thermally stable polymers due to the excellent mechanical strength and the thermal. Silica has been most investigated as an inorganic filler for the composites because of improvement in the thermal and mechanical properties. The PI–silica composites were prepared from poly(amic acid) (PAA) solution as precursor. Pristine PI and PI–silica composites could be obtained via thermal imidization of PAA produced with BPDA and ODA in DMAc. The content of silica in the composites was 1, 3 and 5 wt% with the use of silane coupling agent (SCA) to improve dispersion of silica in the matrix. And the thermal imidization of PAA in composites was heated for 1h at 100 ℃, 30 min at 200 ℃ and 1h at 350 ℃ to adapt PI form. The PI–silica composites were characterized with thermal, mechanical and morphological properties. The results demonstrated that the addition of small amount of silica and SCA led to the improvement in thermal and mechanical properties.

3PS-172 임회연

Multimodal Sensing with a Three-Dimensional Piezoresistive Structure

임회연, 김봉훈[†] 숭실대학교

피부 감각 수용체는 주위의 물리적 환경으로부터 기계적, 열적 자극을 검출하는데 결정적인 역할을 한다. 이와 같은 특성을 재현하는 센서를 위해서는 높은 감도와 넓고 다이나믹한 레인지 (압력과 전달력, 비틀림 변형 및 온도를 감지 가능한) 기능들이 요구되며 제작된 센서들은 인공 장치로써 건강 모니터링, 전자 피부, 인간–기계 인터페이스 등 다양한 웨어러블 분야에서 널리 사용될 수 있다. 그러나 지금까지 대부분의 센서들은 압력 또는 온도와 같은 단일 매개의 변수에 대해서만 측정이 가능했다. 따라서 우리는 다중 외부 자극의 측정을 분리 가능하고, 소프트 플랫폼에 통합된 단결정 실리콘 나노멤브레인을 사용한 '3차원 (3D) 촉각 센서' 설계를 시도했다. 3D 구조는 4개의 실리콘 나노멤브레인 요소를 통합한 2차원 (2D) 평면 전구체의 지오메트리 변환으로 생성된 테이블 같은 형태로써 다양한 형태의 스트레인을 측정할 수 있다는 특징을 가진다. 결과적으로 우리는 온도와 함께 압력, 전단력 및 굽힘 변형률을 동시에 기록 할 수 있는 고감도, 고성능의 센서를 제작했다.

3PS-173 임홍진

Wet-spinning of Boron Nitride Nanotube Liquid Crystal for Multifunctional Polymeric Composite Fibers

임홍진, 김영경, 김홍식, 장세규[†] 한국과학기술연구원

Wet-spinning of CNT liquid crystal (LC) has been reported as a promising way to produce a high-performance fiber with multifunction owing to highly ordered nanotubes inside the fiber which greatly improves its material properties. Up to now, the LC wet-spinning method with boron nitride nanotubes (BNNTs), an emerging nanomaterial with excellent specific strength and oxidation resistance, has not been reported due to difficulty in preparation of highly stable dispersions of BNNT to prepare lyotropic BNNT LCs at high concentration. Here, we introduce a facile method to prepare lyotropic BNNT LCs with polymeric dispersing agent. The BNNT LCs were processed into a fiber possessing internal microstructure of unidirectionally aligned BNNTs by wet-spinning. The aligned BNNTs inside the fiber were characterized by polarized optical microscopy (POM) and Raman spectroscopy. In addition, mechanical property of the fiber was studied to the structure–property relationship of BNNT fibers.

3PS-174 임주희

Improved Thermal and Mechanical Properties of Epoxy Networks with Polyurethane Using Polyhedral Oligomeric Silsesquioxane (POSS) as Crosslinking Agent

임주희, 임정혁, 김경민[†] 한국교통대학교

Epoxy resins, one of the thermosetting plastics, have excellent thermal and mechanical properties. However, high degree of cross-linking after curing causes high internal stress and poor impact resistance, of epoxy resins. To improve these problems, and to increase thermal stability and impact resistance, polyhedral oligomeric silsesquioxane (POSS) and polyurethane were introduced in epoxy system. In this study, octa-aminophenyl POSS, with eight end groups of NH_2, was used as curing agent in the polyurethane/epoxy network. Polyurethane, having excellent elasticity, flexibility, and high strength, was synthesized by urethane reaction of aliphatic and aromatic diisocyanate with polyether glycol. Finally, structure, thermal stability, mechanical properties of epoxy networks with polyurethane and POSS were analyzed using FT-IR, H-NMR, TGA, tensile test, flexure test, and impact test.

3PS-175 임도현

Properties of EBA Composites Filled with Multi Walled Carbon Nanotubes and Carbon Blacks

임도현, 정대영, 남채윤, 윤호규[†] 고려대학교

The polymer composites reinforced with multi walled carbon nanotubes (MWCNT) and carbon black (CB) were fabricated for semiconducting layers of high-voltage electrical power cables. The polymer composites were successfully fabricated by melt mixing method by kneader and twin extruder. Materials of composites were used muti-walled carbon nanotube (MWCNT), carbon black, poly(ethylene-co-butyl acrylate). The morphology and electrical properties of polymer composites were investigated via scanning electron microscope (SEM), dielectric analysis (DEA).

3PS-176 인준서

Effect of the Type of Hardener and Curing Condition on Mechanical Properties of DGEBA/Amine Epoxy

인준서, 강영정[†], 이영철[†,†] 고려대학교; [1]한국생산기술연구원

The effect of the type of amine hardener on the mechanical properties of epoxy was investigated with diglycidylether of bisphenol A (DGEBA) epoxy resin, cured with aliphatic amine hardener, triethylenetetramine (TETA), and aromatic amine hardener, 4,4'-diaminophenylmethane (DDM). Also, to obtain epoxy with high conversion ratio and better mechanical properties, epoxy resin and hardeners were cured and tested under several different conditions. The resin and each hardener were blended with 1:0.9, 1:1, and 1:1.1 equivalent ratio, and in case of DGEBA/DDM, the specimens were prepared under various post-curing conditions. The mechanical properties of epoxy were analyzed with compression and hardness tests.

3PS-177 이희은

Enhanced Impact Strength and Toughness of Polyamide 6,6 – micro-crystalline Cellulose Composites via Hydrogen-bonding

이희은, 김용주, 이재경, 위정재[†] 인하대학교

Polyamide66 (PA66) is engineering plastic used as a battery pack material by compounding with glass fiber (GF) through extrusion process. The PA66-GF composites account for 30% of the total weight of battery. Toward lightweight and low-cost battery pack, we employed micro-crystalline cellulose (MCC) to replace GF in the extrusion process for the PA66 composites. In addition to the benefits, hydroxyl groups of MCC participate in hydrogen bonding with amide group of PA66, improving chemical compatibility as well as interfacial adhesion at polymer-filler interfaces. The favorable interactions resulted in enhanced mechanical properties of the composites. At 0.5 wt% of MCC loading, impact strength increased by 7 kgf cm/cm in comparison with the neat PA66, comparable to the impact strength of GF 20 wt%. Remarkably, toughness increased by 40% from that of neat PA66 mainly by enhanced elongational properties. We will also discuss structure-property relationships of the PA66-MCC composites.

3PS-178 이한비

Eco-friendly Air Filter with High Filtration Efficiency and Low Pressure Drop

이한비, 최원산[†,†] 한밭대학교; [1]한밭대학교 화학생명공학과

Particulate matters (PMs) in air have recently become one of the most serious environmental issue that poses huge threat to public health. PMs are a complex entity composed of sulfates, nitrates, ammonium, soot, sea salt, silicates, trace metals, carbonaceous material, and water. Prolonged exposure to PMs can lead to respiratory disease, cardiovascular disease, and even cancer. Therefore, there is an increasing demand for developing high performance air filters with low pressure drop. The development of abovementioned air filter is one of important challenging tasks because there is trade-off between filtration efficiency and pressure drop. We report eco-friendly novel air filtration system with high filtration efficiency and low pressure drop.

3PS-179 이지수

Microstructure, Thermal and Mechanical Characterization of Poly(lactic acid) Composites Reinforced with Aramid Scrap Powder

이지수, 정영규[†] 충남대학교

Poly(lactic acid) (PLA) is one of the most promising biopolymers derived from renewable resources. To enhance the physical properties of PLA, PLA-based composites reinforced with various organic or inorganic fillers have been investigated extensively. Aramid fibers, which are excellent organic fibers with low density, low thermal conductivity and high mechanical strength, have been adopted as reinforcements. In this study, aramid scrap powder (ASP) was prepared by milling to recycle the high strength aramid fibers and utilized as a reinforcing filler for PLA. A series of PLA/ASP composites was fabricated by master-batching and melt-compounding. The morphology, rheological, thermal and mechanical properties of the composites were investigated with aids of FT-IR, SEM, Rheometer, DSC and DMA. The effects of ASP on the morphology, thermal and mechanical properties of PLA composites were analyzed by taking account of the ASP content and the molecular interaction between ASP and PLA.

3PS-180 이주호

Synthesis of Self-Healing Shape Memory Vitrimers for the Application of Direct Ink Writing 3D Printing Process

이주호, 권용구[†] 인하대학교

Novel epoxy-based vitrimer resin inks containing covalent adaptable networks triggering the rearrangement of bonds within a polymer structure have been synthesized for 3D printing applications. Epoxy vitrimer networks are synthesized from DGEBA and fatty acid in the presence of catalyst, and crosslinked upon heating. To avoid the collapse of the as-printed parts during the entire 3D processing, photo-curable diacrylate comonomers are introduced in the reaction mixture to be

crosslinked through UV irradiation. The self-healing capability of the epoxy network is achieved by adding disulfide bonds in the comonomeric unit. Various 3D structures using as-prepared photo- and thermally-curable epoxy vitrimers are prepared using direct ink writing (DIW) process. Shape memory and self-healing capability of the 3D printed shapes are investigated at various conditions.

3PS-181 이주형

Fabrication of Silane-grafted Graphene Oxide and Its Effect on the Structural, Thermal, Mechanical, and Hysteretic Behavior of Polyurethane

이주형, 현지은, 김성훈† 한양대학교

Incorporation of nanofillers into polyurethane (PU) is a promising technique for enhancing its thermal and mechanical properties. Silane grafting has been used as a surface treatment for the functionalization of graphene oxide (GO) with numerous reactive sites dispersed on its basal plane and edge. In this study, amine-grafted GO was prepared using silanization of GO with (3-aminopropyl)triethoxysilane. The functionalized graphene oxide (fGO) was characterized by Fourier transform infrared spectroscopy (FT-IR) and X-ray photoelectron spectroscopy. Next, it was introduced in PU fabricated using polycaprolactone diol, castor oil, and hexamethylene diisocyanate. The fGO-PU nanocomposites were in turn characterized by FT-IR, X-ray diffraction, scanning electron microscopy, differential scanning calorimetry, thermogravimetric analysis, and a universal testing machine.

3PS-182 이종인

Study on Impact Resistance, Wear Resistance and Crystallization Kinetics of Polypropylene Modified by Complex Crosslinkers

이종인, 배진우, 남병욱† 한국기술교육대학교

As environmental regulations become strict, automobile industry has focused on the light material to reduce carbon dioxide emission. Among these light materials, polypropylene (PP) has received considerable attention in automobile industry because of low cost and good processability. However, the PP has low impact resistance and wear resistance to be used in various automotive parts. To improve the impact resistance and wear resistance, in this study, linear PP was branched and/or crosslinked by the initiator with the crosslinkers of trimethylolpropane trimethacrylate (TMPTMA) and divinylbenzene (DVB) through the twin screw extruder. The modified PP improved the impact resistance and wear resistance than those of linear PP while keeping process flowability. It is considered that the crystallization kinetics of branched and/or crosslinked PP have an influence on the improved properties.

3PS-183 이재혁

Preparation and Properties of Carbon Nanotube (CNT)/Nylon 12 Film

이재혁, 서영석, 박노형† 한국생산기술연구원

탄소 나노튜브(Carbon nanotube, CNT)는 열 및 전기 전도도가 좋은 탄소 동소체 필러로 다양한 분야에 널리 적용되고 있다. CNT는 분산성의 문제로 인하여 고분자와의 복합화에 있어서 첨가량, 균일성 등의 문제로 적용에 한계를 보이는 것으로 알려져 있다. 본 연구에서는 CNT와 Nylon12를 Melt blending을 통하여 복합소재를 개발하고 Press를 이용한 복합 필름을 제조하였다. 분산성 및 물성 향상을 위하여 modified CNT를 개발하여 적용한 복합소재와 비교 분석 연구를 수행하였다. 균일 혼합 여부 확인을 위하여 필름 단면을 Scanning Electron Microscope(SEM)으로 확인하였고, 기계적 물성 및 열 물성 확인을 위해 Universal Test Machine(UTM)와 Thermogravimetric Analysis(TGA)를 측정하였다. 그리고 전기전도 특성을 확인하기 위해 Multimeter(Fluke 289)를 사용하여 전기저항을 측정하였다.

3PS-184 이재빈

Effect of Poly(butyl acrylate) on Poly(lactic acid)/Poly(butylene adipate-co-terephthalate) as Compatibilizer

이재빈, 남기범, 김언지, 이욱상, 이지영, 김도영, 서관호, 이동윤† 경북대학교

Poly(lactic acid) (PLA) is one of the most popular biodegradable polymers and has high tensile modulus and stiffness. However, PLA has a limit of the usage due to its low inherent toughness and impact resistance. On the other hand, poly(butylene adipate-co-terephthalate) (PBAT) is the another biodegradable polymer which has high ductility, but low compatiblity with PLA. Here, poly(butyl acrylate) (PBA) was added in PLA/PBAT to improve the compatibility and impact resistance. We analyzed the thermal, dynamic viscoelastic, morphological, mechanical and impact strength by DSC, DMA, SEM, UTM and Izod impact test. As the result, PLA/PBAT blends with PBA could be used as applications of eco-friendly plastics through enhancing the impact strength.

3PS-185 이의원

The Influence of KOH Activation Temperature on the Microporosity of N-doped Activated Carbon Material and Their Supercapacitve Behaviors

이의원, 박수진† 인하대학교

In this work, microporous activated carbons were synthesized by sequential process of carbonization and KOH activation. Activated carbons (ACs) were treated with various activation temperatures. The coffee grounds and polypyrrole (PPy) were used as carbon precursors and a selective nitrogen source. ACs have various micropore distributions with notable changes of other textural properties. The structural properties were analyzed by X-ray diffraction (XRD). The morphological properties were investigated by scanning electron microscopy (SEM). The textural properties were measured by N2/77 K adsorption isotherms using Brunauer-Emmett-Teller (BET) equation.

3PS-186 이원준

알콕시 곁사슬을 포함하는 열방성 액정고분자/organoclay의 합성 및 특성

이원준, 우현준, 민병길, 장진해† 금오공과대학교

2,5-Dihexyloxyterephthalic acid, 4,4'-diacetoxybiphenyl를 모노머로 사용하여, 유기화점토(Closite 93A)를 함량별로 첨가하여 in-situ 중합법을 이용하여 단계별 반응 온도와 진공 상태의 용융 조건에서 알콕시 곁사슬을 가지는 열방성 액정 고분자(Thermotropic liquid crystalline polymer, TLCP)를 합성하였다. 각각의 모노머는 몰 비(mole ratio)를 동일하게 하여 합성하였고, 유기화 점토의 무게비에 따라 각각의 TLCP를 합성하였다. 유기화 점토의 양에 따른 TLCP의 열적 성질은 DSC, TGA를 통해 조사하였고, 액정상은 편광현미경을 통해 관찰하였다. 분산성과 결정화도는 XRD를 통해 조사하였고, 점토층간의 분산을 정확하게 확인하기 위해 TEM을 측정하였다.

3PS-187 이의원

Optimization of the Pore Structure of Petroleum-based Activated Carbons/Tubular Polypyrrole Composites with Enhanced Electrochemical Performance as Supercapacitor Electrode

이의원, 박수진† 인하대학교

In this work, Pitch-based activated carbon/tubular polypyrrole (ACPPy) composites with various tubular polypyrrole (T-PPy) contents are prepared as active electrode materials for supercapacitors. Examination of the morphology of the ACPPy composites by scanning electron microscopy (SEM) and transmission electron microscopy (TEM) shows that T-PPy is deposited onto the surface of pitch-based activated carbons (ACs). The electrochemical performance of the prepared materials was characterized by cyclic voltammetry (CV) and galvanostatic charge/discharge (GCD) measurements using an IviumStat electrochemical workstation.

3PS-188 이영재

Improved Dispersion of Cellulose Nanofibers (CNFs) in Polypropylene Based Composites by Using a Various Dispersant

이영재, 황준성, 권미경, 김현철, 정상원, 이세근, 이성준† DGIST

Spray-dried cellulose nanofibers (CNFs) powder prepared via TEMPO mediated oxidation and treated in a high pressure homogenizer are used as filler in a polypropylene (PP) matrix. In order to improve the dispersion and ease of handing of CNF powder, we have investigated the surface modification of PP pellet by mechanical treatment and the combined use of dispersants. The nanocomposites consisted various dispersant, with PP/CNF/dispersant ratio of 90/10/3 (wt/wt/wt), respectively. CNF dispersion in the nanocomposites was analyzed by examining the distribution of oxygen element using SEM-EDS. The use of a dispersant was helpful in uniform dispersion of CNF in the PP matrix. Acknowledgements : This work was supported by the DGIST R&D Program of the Ministry of Science, ICT and Future Planning of Korea (20-BT-04). It was also supported by the Strategy Technology Development Programs of the Ministry of Trade, Industry & Energy of Korea (20011310).

3PS-189 이영동

Synthesis and Characterization of Porous and Functional Polyimide with Inorganic Nanosphere Separator for Lithium-Sulfur Cell

이영동, 권용구[1,†] 인하대학교; [1]인하대학교 고분자공학과 교수

Porous polyimide(PI) xerogel membranes with uniform pores were prepared by sol-gel process and chemical imidization followed by freeze drying. Gel precursors are prepared using various aromatic dianhydrides, aromatic diamines, and graphene oxides. After that, Inorganic filler are added to prevent volume shrinkage that may occur during freeze drying process, and freeze drying process is performed to prepare a separator through a final casting process. The membrane showed high ion conductivity and better cycling performance and also showed excellent thermal properties. Electrical, physical, thermal properties and structural forms were measured by various measuring instruments.

3PS-190 이송희

Morphology and Electrical Conductivity of Carbon Foams via High Internal Phase Emulsion Templating by Polypyrrole-Coated CNTs

이송희, 신홍희, 김선겸, 이성재† 수원대학교

Carbon foams can be prepared from polystyrene (PS) foams via high internal phase emulsion template. However, styrenic polymers do not have strong crosslinking and decompose into volatile products when heated above 400 ℃. In this study, potential crosslinking sites were introduced by sulfonating the PS foam to prevent structural collapse at high temperature. In addition, CNTs modified with polypyrrole (PPy), a conductive polymer, were added. PPy-CNT has good affinity with the oil phase, resulting in a well-developed microcellular foam with improved electrical conductivity. Carbon foams having various cell sizes were obtained by carbonizing the prepared PS foams at 800 ℃. PPy-CNT showed a significant effect on the morphology and cell size of the PS and carbon foams. As the content of the nanofiller increased, the cell size of the carbon foam reduced, and the electrical conductivity increased.

3PS-191 이상운

Mechanical Properties and Bioactivity of Polyetheretherketone Composites with Modified Hydroxyapatite and Modified Carbon Fiber

이상운, 전인성, 조재영† 서울대학교

Polyetheretherketone (PEEK) has received a lot of attention for use in orthopedic implants due to its chemical stability and biocompatibility. However, there is still room for improvement in terms of bioactivity and mechanical strength. Regarding bioactivity, the inertness of PEEK should be overcome so that the material can be

directly attached to the bone. For this, hydroxyapatite (HA), a bioactive material that binds to human bones, has been added as a filler. In terms of mechanical strength, it is ideal for the implant material to have the elastic modulus as similar to that of the cortical bone as possible. Thus, carbon fiber (CF) has been added as a filler. Finally, HA and CF have been modified to enhance the interfacial adhesion between the matrix and fillers. This is to prevent the aggregation of HA in the polymer matrix. The effects of modified fillers on composite strength and bioactivity were measured.

3PS-192 이 봄

Binodal, Wireless Epidermal Electronic Systems with In-Sensor Analytics for Neonatal Intensive Care

이 봄, 김봉훈† 숭실대학교

신생아 집중 치료실에서 사용되는 기존의 메디컬 기기는 딱딱한 전선들과 센서/피부 사이에 복잡한 계면으로 구성 되어있어, 신생아를 눕히거나 엎드리게 하는 등의 기초적인 활동조차 힘들게 한다. 특히 기존의 유선 메디컬 기기와 함께 사용하는 의료용 접착제들은 얇고 연약한 신생아의 피부에 상처를 주기 때문에 2차 감염과 같은 심각한 의료사고/부작용을 초래한다. 우리는 이러한 문제를 해결하기 위해 매우 얇고 부드러워 신생아 피부에 자극을 가하지 않는 '생체 신호 측정용 사물 인터넷 소자'를 개발하였다. 우리가 연구 개발한 차세대 메디컬 센서는 ⅰ) 부드러운 실리콘 패치를 사용하여 제작하였기 때문에 피부에 부착하였을 때 자극이 나타나지 않으며, ⅱ) 신생아의 피부에 무리를 주는 생체신호 측정 장비를 얇고 작은 센서에 집약함으로써 전력과 데이터를 모두 무선으로 송수신할 수 있다. 또한, ⅲ) 주요 생체 신호인 심장 박동수, 호흡, 체온, 혈중 산소, 혈압 등을 한번에 측정할 수 있다.

3PS-193 이민지

40vol% 이상 고함량 수산화인회석 혼합 레진의 3D 프린팅을 위한 광경화 시스템 연구

이민지, 전경수, 민경배, 정용일† 한국섬유기계융합연구원

세라믹 소재는 내열성, 내마모성, 내식성 등 뛰어난 장점을 가지고 있으나, 취성으로 인한 긴 공정 시간 및 높은 가공비용을 필요로 함. 이러한 단점은 세라믹 제품의 산업적 제조에 방해되며, 세라믹 소재의 적용분야를 한정시키는 결정적 요인으로 작용함. 산업화 수준의 기술개발 및 보급이 가속화 되고 있는 3D 프린팅 기술은 고분자와 금속재료용으로는 많은 발전이 되어 왔으나, 세라믹 3D 프린팅은 상대적으로 발전이 더딤. 높은 녹는점, 탈지 및 소결 과정이 필요한 세라믹 3D 프린팅 기술을 극복하려는 시도가 최근에 많이 시작되고 있음. 따라서 본 연구에서는 의료용 세라믹 소재로 많이 사용되는 HA(Hydroxyapatite)를 이용하여 40vol% 이상 고농도 광경화 레진을 제형화하고 필름이 송형 DLP 3D 프린팅 장비를 이용하여 조형 평가를 진행하여 출력 조건을 최적화하고자 함. 또한 디바인딩(Debinding) 및 신터링(Sintering) 조건을 최적화하는 것이 목적임.

3PS-194 이민규

Epoxy Toughing for Semiconductor Encapsulation Material : Acrylic Block Copolymers Based on Poly(methyl methacrylate) and Poly(butyl acrylate)

이민규, 신범수[1], 김수현[1], 나창운[1,†] KCC/[1]전북대학교;

Improving toughness for delamination resistance, without sacrificing thermal resistance and maintaining its flowability of an epoxy resin for application in semiconductor encapsulation process has been challenging. we studied three block copolymers (BCP) of roughly the same weight average Molecular Weight and the same composition of Poly(Methyl methacrylate) and Poly(Butylacrylate) to enhance impact resistance of semiconductor packaging materials. The flowability, thermal stability and mechanical properties of the BCP modified epoxy composites were studied. The results show that the BCP modified epoxy composite maintained the flowability and thermal stability of the epoxy resin, while its delamination property, flexural strength and toughness index were significantly improved in comparison with the neat epoxy. It is believed that this study provides a new pathway for the toughening of epoxy matrix materials for advanced semiconductor packaging.

3PS-195 이동한

Effect of Carboxymethylated Cellulose Nanofiber on the Tensile Strength of Polyacrylamide Hydrogel

이동한, 현진호† 서울대학교

Carboxymethylated cellulose nanofiber (CM-CNF) was incorporated into the polyacrylamide (PAAm) to make composite hydrogel with high tensile strength. Cellulose is the most abundant renewable natural polymer. Especially, CNFs are promising filler for effective reinforcement of composites due to their large surface area, high aspect ratio, and high Young's modulus. PAAm has been used in various fields due to its promising optical transparency but its mechanical properties need to be improved. The composite hydrogel of CM-CNF/PAAm showed the enhanced mechanical strength maintaining its adequate transparency. The CM-CNF/PAAm composite hydrogel can be used in biomedical engineering and soft electronics in the future.

3PS-196 이동은

Fabrication of Cellulose Nano Fibers as Compatible Reinforcements for Polypropylene Composites

이동은†, 이승준, 박규환 HDC현대EP

In this study, a simple method was investigated to fabricate cellulose nano fibers (CNFs) by chemical and mechanical process from cellulose powders (CPs). Hydroxyl groups of two kinds of CPs (fiber/spherical type) having 10 ~ 40 μm diameter size, were chemically modified as sulfur contents. The CPs were micro-fibrillated through passing once micron slot of microfluidizer, then the CNFs which have a size of about 30 nm were easily obtained because of its electrostatic repulsion of positive charged sulfur molecules. It was confirmed that the modulus and stiffness of CNFs significantly improved comparing to existing CPs, and the CNFs used as reinforcing additives to increase mechanical properties of polypropylene (PP) composites using the twin extruder.

3PS-197 이대환

A New Droplet Based Stretchable Substrate with High Modulus Resolution and Stretchable Stability via Simultaneous Curing

이대환, 임세영, 최예림, 민지현, 박태호† 포항공과대학교

Soft electronics is a promising field as a next-generation electronic device that can interact with humans. Therefore, efforts are being made to develop flexible electronic devices. Strain isolation is known as the most common strategy in that it maintains the performance of a inorganic based device and can easily control mechanical deformation. However, the method of controlling the stiffness of a single materialhas limitations in process complexity, stiffness control. Here, we improved the modulus control and resolution by using two pre-polymers. Furthermore, by using a simultaneous curing technique we can obtain a highly durable substrate that does not break even after repeated stretching of 75%. As a result, the potential of the technology has been demonstrated by applying it to the stretchable mircroheater system, which shows that it is a next-generation stretchable substrate manufacturing technology that can replace human-friendly devices.

3PS-198 이건석

Fabrication of Porous PDMS/Au Composites for Solar-based Thermoelectric Power Generation

이건석, Iseki Tissasera, 김유빈, 유성일† 부경대학교

Metal nanoparticles absorb photons at certain wavelengths by localized surface plasmon resonance (LSPR) phenomenon and have photothermal properties that generate heat around nanoparticles. The heat generated by photothermal properties can be applied to many chemical systems including thermoelectric generator. Recently, significant efforts have been devoted to fabricating broadband light absorbers to improve their photothermal efficiency. In this study, we demonstrate a simple in-situ synthesis method for gold nanoparticles on porous polydimethylsiloxane (PDMS) as a light absorber. Porous PDMS elastomers were prepared by the well-known sugar template method and subsequently immersed in the solution of gold chloride ($HAuCl_4$) for the in-situ synthesis of Au nanoparticles. Finally, the prepared PDMS composite was irradiated with a stimulated sun light to induce photothermal conversion, and the generated heat was applied to a thermoelectric device for power generation.

3PS-199 윤영진

Liquid Crystalline Phase Behavior of Hydrophilic Gold Nanoparticles Induced By Pluronic Triblock Copolymer

윤영진, 장종대[1], 김태환† 전북대학교; [1]한국원자력연구원

The gold nanoparticles (AuNPs) having unique optical and electrical properties, are being explored widely for use in a nanotechnology application such as bio-imaging, electronic conductor, and radiotherapy. Herein, the influence of adding CTVB (cetyl trimethylammonium bromide) tethered AuNPs on the phase behavior of highly concentrated amphiphilic triblock copolymer pluronic P85, P104, F127, PE6200 and PE6400 in H_2O was investigated. For the size monodispersity and aqueous stability of the particles, we further functionalized the AuNPs (p-AuNP), and as using these hydrophilic fabricated spherical particles, highly ordered self-assembled complexes were successfully made. The liquid crystalline phase transition as increasing temperature below 85 ℃, with various p-AuNP weight fraction, have been studied by using in-situ small-angle X-ray scattering(SAXS) experiments.

3PS-200 윤기로

고분자전해질연료전지(PEMFC)용 수직정렬된 PTFE 나노섬유 기반 고내구성 강화복합전해질막

윤기로† 한국생산기술연구원

고분자전해질 연료전지(PEMFC)는 차세대 친환경 에너지원으로 각광받는 연료전지의 한 종류로써 수소 이온 교환 특성을 갖는 고분자막을 전해질로 사용한다. 전해질막 소재로 높은 열적 안정성과 이온전도도를 가지고 있는 Perfluorosulfonic acid(PFSA)를 주로 사용하나, 높은 원가, 낮은 이온전도도, 낮은 기계적 내구성 등 문제점을 가지고 있다. 이를 해결하고자 최근에 PTFE와 같은 다공성 지지체에 PFSA 이오노머를 함침시킨 형태의 강화복합막이 연구개발 되고있다. 본 연구에서는 전기방사 공정을 통하여 손쉽게 다공성 PTFE 나노섬유 지지체를 제조하였다. 특히, 방사시 전기장을 제어하여 나노섬유를 패턴화 하였으며, 수직정렬된 섬유 구조를 통하여 PFSA 함침에 최적화된 강화복합막을 제조하였다. 제조된 강화복합막은 순수 PFSA 막에 비해 높은 수소이온전도도, 뛰어난 치수 안정성을 보여 주었으며, 단위전지 내에서도 안정적인 연료전지 성능을 보였다.

3PS-201 유용환

Manufacture of Polymeric Foam and Evaluation of Properties Under Various Conditions Using Supercritical Fluids

유용환, 이승준, 박규환† 현대EP

This poster aims to develop an Expanded Polymer that satisfies both the advantages of thermoplastic and the light weight through the application of a foam system using supercritical fluid. TPU is a thermoplastic elastomer with the most excellent tensile strength and wear resistance among thermoplastic elastomers, and is widely applied to applications requiring high durability. However, since there are limitations in the application of wide-ranging industrial groups due to their high weight, we tried to overcome this problem through the application of a supercritical fluid foaming system.

In particular, carbon dioxide is a colorless, odorless, tasteless, inactive gas and other volatile gases, and it has the advantage of being relatively eco-friendly and capable of meeting lower supercritical fluid conditions. Therefore, the $scCO_2$ application to TPU according to isocyanate type resulted in the development of the Expended TPU with excellent Resilience, C-Set and high expansion ratio.

3PS-202 유민지

Spray-able Polyurethane 차음재 수지 조성물에 따른 고주파 소음에 대한 차음 성능 향상 연구

유민지†, 김상민, 박장석 (주)대한솔루션

지금까지 엔진기술을 주도해왔던 구동 방식인 내연기관 차에서 전기모터 차로 변경되면서 자동차에서 발생하는 주요 소음원도 변화하게 되었다. 기존 내연기관의 경우 엔진 연소음이 주요 소음원이었는데, 전기차의 경우 엔진이 전기 모터로 변경되면서 엔진에서 발생되는 소음과 진동은 상대적으로 줄었다. 그러나, 기존 엔진 연소음으로 인해 잘 들리지 않았던 고주파대역 소음들이 상대적으로 크게 부각 되었다. 전기차는 주행 중에 발생하는 가장 큰 소음으로는 모터소음과 로드노이즈 있으며 이러한 소음 특성을 파악하여 전기차에 발생되는 소음 특성에 최적화된 흡/차음재 개발이 필요하다. 본 연구에서는 흡음형 재료인 다공성 PU(Polyurethane) foam에 차음 성능을 향상 시키기 위해 PUE(Polyurethane elastomer)계 차음재 수지 조성물을 스프레이로 도포하여 흡/차음재를 제작하였다. 차음재 조성물의 두께에 따른 성형성 평가 및 최적화를 위하여 도포되는 PUE 차음재 단면을 SEM으로 확인하였다. 또한, PUE차음재 조성 차이에 따른 차음성능을 비교하기 위하여 APAMAT- II로 비교 시험하였다.

3PS-203 우현준

점토 광물을 이용한 열방성 액정고분자 나노복합재료의 합성과 특성연구

우현준, 이원준, 민병길, 장진해† 금오공과대학교

Montmorillonite 점토를 유기화 시켜 얻은 Cloisite 계열의 유기화 점토를 열방성 액정고분자(thermotropic liquid crystalline polymer, TLCP) 사슬에 나노 스케일 단위로 분산시켜 나노 복합재료를 합성하였다. 합성은 단계적인 열처리와 압력을 통해 용융 intercalation 방법을 사용하였으며 나노미터 수준으로 분산성을 유지하여 열적-기계적 성질이 우수한 파우더 형태의 나노 복합체를 얻었다. 매트릭스로 사용한 TLCP를 고분자 매트릭스로 하여 다양한 함량의 유기화 점토를 각각 다른 wt%로 분산시켜 열적, 기계적 성질 변화를 확인하는 동시에, 점토 광물이 액정성에 미치는 영향을 확인하고자 하였다. TLCP 합성용 모노머로써 2,5-dihexyloxy-terephthalic acid와 acetoxy-1,4-hydroquinone를 사용하였고, in-situ 중합법을 사용하여 나노 복합체를 제조하였다. TGA, DSC 측정을 통하여 각각 다른 wt%별로 열적 성질의 변화를 확인하였고, XRD 및 TEM을 이용하여 점토의 분산을 조사하였으며, POM 측정을 통해 액정상을 확인하였다.

3PS-204 우루즈

Acid Functionalized Carbon Nanofibers Decorated with Mn Doped TNTs Nanocomposites for Lithium Adsorption and Recovery from Aqueous Media

우루즈, 박수진† 인하대학교

The industrial need for lithium metal is foreseen to be stepping up in the near future. Herein, we have successfully fabricated microwave-assisted, acid-functionalized carbon nanofibers (ACNFs) decorated with manganese-doped titanium nanotubes (TNT-Mnx), a novel nanocomposite for Li^+ adsorption. Nanocomposites (ACNF-TNT-Mn0.5, ACNF-TNT-Mn1, and ACNF-TNT-Mn1.5) were prepared by oxidizing acidic treatment, hydrothermal technique, and conventional Murray approach. The different Li^+ adsorption parameters were identified by batch adsorption tests. The adsorbed Li^+ ions from nanocomposites were easily recovered. Besides, the nanocomposites show selective Li^+ adsorption and stability over several adsorption tests. By considering these efficient properties, the fabricated nanocomposites can be applicable on a large scale as a potential adsorbent for Li^+ recovery.

3PS-205 오자구넨드라프러사드

Carbon Supported TiO_2 Nanofiber as an Electrode Material for Supercapacitors

오자구넨드라프러사드, 권오훈[1], 박용완[1], 박미라† 우석대학교; [1]ECO융합섬유연구원

Carbon supported TiO_2 nanofibers (C-TiO_2 NFs) electrodes were synthesized by the electrospinning technique using polyvinylpyrrolidone (PVP) and titanium tetraisopropoxide (TTIP) as precursors. After the direct thermal treatment of the as-spun nanofibers into the inert atmosphere, the PVP was converted into the carbon whereas the TTIP decomposed into the TiO_2. The electrochemical studies revealed that the loading of TiO_2 into the amorphous carbon showed an extraordinary enhancement in terms of electrochemical properties which is due to the combined effect of TiO_2 and carbon. The prepared material can be considered as a potential candidate for supercapacitor electrode

3PS-206 우루즈

Acetic Acid-mediated Melamine-modified Carbons: Influence of Activation Conditions on Textural Features and CO_2 Adsorption Performance

우루즈, 박수진† 인하대학교

We investigated an approach to fabricating acetic acid-mediated cellulose-based melamine-modified carbons through hydrothermal treatment and chemical activation, where the ratios of melamine and activation conditions were tailored. The CO_2 uptake properties were modified by tuning the experimental conditions. By tuning the activation condition, we obtained carbons with high specific surface area (SSA) in the range 1458-3019 $m^2\ g^{-1}$ and an ultra-high micropore volume (0.21-1.13 $cm^3\ g^{-1}$). The adsorbents CM1-900-2 showed an excellent CO_2 adsorption capacities of 297 and 174 mg g^{-1} at 273 K and 298 K/1 bar. Moreover, CO_2 adsorption capacities remained stable after several continuous adsorption cycles. It possessed high isosteric heats of adsorption. Furthermore, the fabricated carbons exhibited efficient CO_2 selectivity over N_2. Collectively, these properties indicate that the fabricated adsorbents are promising candidates for use in CO_2 adsorption applications.

3PS-207 오자구넨드라프러사드

Ion-exchange Mediated Assembly of Ag_3VO_4 Nanoparticles in Polyacrylonitrile Nanofibers

오자구넨드라프러사드, 박미라† 우석대학교

Ag_3VO_4 nanoparticles loaded polyacrylonitrile (PAN) nanofibers were synthesized by an easily controlled, template-free method as a photocatalyst for the degradation of methylene blue and antibacterial activities. The structural, optical, and photocatalytic properties were studied by the state-of-art techniques. The photocatalytic degradation of methylene blue (MB) was investigated under UV irradiation and it showed about 99% degradation of the dye within 75 min. Furthermore, the antibacterial performance of the as-synthesized Ag_3VO_4/PAN composite nanofibers was experimentally verified by the destruction of Escherichia coli (E. coli). These results suggest that the developed inexpensive and functional nanomaterials can serve as a non-precious catalyst for environmental applications.

3PS-208 우루즈

Cellulose-derived Nitrogen-doped Carbons for Improved Textural Features and Enhanced CO_2 Uptakes

우루즈, 박수진† 인하대학교

Herein, cellulose-derived nitrogen-doped carbons were designed by hydrothermal treatment and chemical activation, where the ratios of melamine and activation conditions were tailored. The CO_2 uptake properties were modified by tuning the experimental conditions. By tuning the activation condition, we obtained carbons with high specific surface area and an ultra-high micropore volume. The adsorbents CM1-900-2 showed an excellent CO_2 adsorption capacities of 297 mg g^{-1} at 273 K/1 bar. Moreover, CO_2 adsorption capacities remained stable after several continuous adsorption cycles. It possessed high isosteric heats of adsorption; 45 kJ mol^{-1}. Furthermore, the fabricated carbons exhibited efficient CO_2 selectivity over N_2. Therefore, these properties indicate that the fabricated adsorbents are efficient contenders CO_2 adsorption applications.

3PS-209 오승주

Development of Impact Resistant and High-forming PLA/PBAT Blends for 3D Printers and Filaments for 3D Printers

오승주, 배진우, 남병욱† 한국기술교육대학교

As interest and demand in the environment have been increased, study on the development of biomass-induced materials has been actively conducted to replace petroleum-based polymer. Polylactic acid (PLA) is well known for one of the most environment-friendly polymers. Recently, the PLA has been received attention to be used as a filament for 3D printer with many advantage such as and strong for crack and shrinkage. However, the PLA has low impact strength and slow crystallization rate. To improve the impact strength and crystallization rate, poly(butylene-adipate-co-terephthalate) and talc, used as impact modifier and nucleating agent respectively, were blended into the PLA according to various content in the twin screw extruder. Crystallization, phase morphology, and mechanical properties of the blend were investigated. Consequently, we could obtain that the introduction of impact modifier and nucleating agent results in the improvement of impact strength and crystallization of PLA.

3PS-210 오상아

New Approach for Fabricating Flexible Polymer Substrate with Hihgly Uniform High-curvature Structures

오상아, 전환진† 한국산업기술대학교

Fabricating curvature structures is researched worldwide for application in optical materials, superhydrophobic materials, and smart adhesives. Conventional lithography faces 2D-limitation because it is transferring target materials structure to substrate using a polymer. Recently, interference lithography and colloidal lithography have been developed for overcoming this matter. But they use repetition occurring in contact with light and polymer and it is only possible to produce repetitive structure so there is a limitation in position precision. Our group have developed a new patterning process for high-curvature structure using expansion of a gas trapped in a pattern. To control size of structure is possible by regulating polymer properties and process conditions. This technology can produce a polymer substrate with continuous and uniform high-curvature structure, expanding the research scope in various fields. Also, it is expected to have great academic/industrial effects.

3PS-211 오미혜

열가소성기반 UD Tape를 이용한 도어 임팩트빔 제조 및 강도에 관한 연구

오미혜†, 윤여성, 문동준, 김경철[1], 정우철[1], 김화남[2] 한국자동차연구원; [1](주)캠스; [2]지금강(주)

연속공정으로 제작된 열가소성 UD(Uni-Directional) Tape 은 기존 열경화성 복합재료에 비해 제조공정, 저비용 제조 및 높은 재활용성를 달성 할 수 있기 때문에 복합재료의 경량구조 응용분야에 빠르게 확장 되고 있다. 본 연구에서는 열가소성 UD(Uni-Directional) Tape를 이용한 차량용 도어 임팩트 빔를 제조 하였다. UD Tape 적층방향 및 Base 소재를 달리하여 Sheet를 제작 후 강성 보강을 위한 리브 구조를 설계, 오버몰딩 공법을 이용하여 리브의 구조를 성형 하였다. 실험 결과 임팩트 빔 의 중량은 11.32%의 경량화 효과를 나타 내었다.

3PS-212 안성현

Fluidity Improvement of Polyamides by Adding Hyperbranched Additives

안성현, 박승규, 유영재† 한국화학연구원

Polyamide(PA) based composite materials have been widely explored in various industries such as automobiles, electronics and construction due to their high chemical resistance, mechanical properties, thermal stability, economic properties and light weight. However, the high viscosity of polyamides has limited their processing efficiency in molding. Here, we synthesize hyperbranched additives with amide bonds between aromatic rings and alkyl chains. The amides in the additives allow outstanding miscibility with polyamides, resulting in high fluidity of the PA. To demonstrate the fluidity enhancement of the PA by adding the additives, the length increase in injection molded spiral specimens and the viscosity decrease measured by a rotational rheometer, were shown.

3PS-213 신은애

Ceramic Coating Reinforced by Amine-abundant Natural Polymeric Nanofibers and Its Properties

신은애, 김계현, 정제영, 이상봉, 이창기† 한국생산기술연구원

Ceramic coating is difficult to coat ceramic solution on plastic substrate. Plastic does not have functional groups for bonding or reaction and therefore ceramic coating solution is easily peeled from the plastic substrate. In this study, ceramic coating solution was incorporated amine-abundant nanofibers to enhance attachment between ceramic coating and plastic surface. Chitosan nanofibers was fabricated from chitin which has amine groups in its structure. In our previous research, addition of cellulose nanofibers into ceramic solution improves the flexibility and prevents cracks of coating so two kinds of natural polymeric nanofibers were selected. After incorporating nanofibers, respectively, the ceramic coating solutions were prepared under rolling process. Final ceramic solutions were thicker and stickier and they were coated PP substrate respectively. They were measured their adhesion, contact angle, and thickness.

3PS-215 송신애

프로브카드 미세니들 고정을 위한 펀칭필름 레이저홀가공기술 개발

송신애†, 김기영, 임성남 한국생산기술연구원

반도체 칩 소형화, 다기능화에 따라 Chip 내부선폭 및 Pad pitch가 줄어들고 검사속도를 높이기 위해 ful contact 방식으로 검사요건이 강화되면서 프로브카드에 요구되는 스펙이 매우 높아지고 있다. 특히 반도체 칩과 접촉하는 니들탐침의 갯수 수천개로 늘고, 각각의 두께는 매우 미세화되고 있는 실정이다. 이런 니들 탐침을 스파이더내에 배열 고정하기 위해 폴리머필름에 홀을 가공하고 홀에 니들을 꽂아 고정하는 방식이었다. 하지만 니들의 굵기가 매우 얇아지면서 기존의 기계적 펀칭으로는 한계가 있어 레이저를 이용하여 홀을 가공하여 니들을 고정하고자 한다. 레이저의 높은 열에 의해 수축이나 팽창이 없어야 하며, 원형을 잘 유지하는 일정한 크기, 일정한 간격의 홀을 가공하는 레이저 홀 드릴링 기술이 매우 중요하다. 펀칭필름으로 고온에서 변형이 없으며, 기계적 물성을 갖는 두께를 갖는 적정 폴리머필름을 선정하였으며, 레이저 조건을 변화시켜 홀의 가공의 최적화를 진행하였다.

3PS-216 손희상

Polymer/Inorganic Nanohybrid Membrane on Lithium Metal Electrode: Effective Control of Surficial Growth of Lithium Layer and Its Improved Electrochemical Performance

손희상† 광운대학교

Despite the large theoretical capacity of Lithium metal battery (LMB), some critical problem including lithium dendrite undermined its practical application to the real battery. Here, we report polymer/graphene oxide (GO) composite based novel hybrid type lithium protective layer to enhance the electrochemical performance of LMB. Our hybrid type protective layer could effectively suppress the formation of dendrite, resulting in improved coulombic efficiency of LMB. Specifically, polymer/GO hybrid protective layer treated LMB exhibited maintained columbic efficiency of 87.4% on average until the 100th cycles. In addition, voltage profiles indicated reduced overpotential in comparison to the electrodes without protective layer.

3PS-217 손희상

Core-shell Structured $BaTiO_3$@SnO_2 Microsphere Composite as Li-ion Battery Anode with Enhanced Electrochemical Performance

손희상† 광운대학교

Due to the low specific capacity (372 mAh/g) of graphite as a Li-ion battery (LIB) anode, we developed $BaTiO_3$-coated SnO_2 microsphere composite (SnO_2@$BaTiO_3$) as a novel anode exhibiting superior electrochemical performance. The composites were synthesized by barium titanate coating on the surface of tin oxide followed by carbonization at the N_2 atmosphere. As-formed composites show reduced irreversible loss of active masses because of the mechanical pressures occurred from high volumetric change of tin oxide during charge/discharge process. The mechanical pressure generates electric fields and piezoelectric potential allows its enhanced Li^+ mobility owing to the polarization of barium titanate particles in charge/discharge process. Our SnO_2@$BaTiO_3$ composite exhibited the improved electrochemical performance as LIB anode of good rate performance and moderate cycle stability.

3PS-218 손희상

Hybrid of Ag Nanowires and Doped Graphene for the Transparent Conductor with Enhanced Conductivity

손희상† 광운대학교

A hybrid transparent conducting films based on silver nanowires (Ag NWs) and doped graphene (GP) were prepared through dual co-doping method by applying p-/n-type dopants on top and bottom sides of GP. The dual-doping effect on the surface and electrical-optical properties of GP and Ag NW/GP hybrid films were systematically investigated through the combination study with various dopants (p/p, p/n, n/p, and n/n). We found that p/p-type dual-doped GP and its hybrid with Ag NWs appeared to be the most effective to enhance electrical-optical properties of GP and Ag NW/GP hybrid. In addition, the enhanced conductivity of p-type dual-doped GP allows a hybrid system to form co-percolating network in which Ag NWs can form a secondary conductive path at grain boundaries of polycrystalline GP.

3PS-219 손희상

Bimetallic Porous Material with Enhanced Catalytic Performance

손희상† 광운대학교

The porous material of bimetallic (NixPt1-x) alloy mesocrystals within carbon framework was prepared by an aerosol process to be used as high-performance catalysts. As-prepared porous NiPt alloy has a robust mesostructure of nanoparticles with tunable composition and carbon framework and exhibits a high thermal stability at various sintering conditions (time, temperature, and atmosphere). As a catalyst for propylene hydrogenation, NiPt alloy shows excellent catalytic activity and low activation energy through the control of elemental compositions and pore structures. As an electro-catalyst for oxygen reduction reaction, NiPt alloy shows superior catalytic activity to that of conventional Pt/C due to highly activated metal alloy nanoparticles and increased reactants accessibility to catalyst.

3PS-220 손희상

The Porous Carbon-Polymer-Sulfur Composite: Novel Li-S Battery Cathode with Enhanced Performance

손희상† 광운대학교

We prepared the pyrolyzed porous spherical composites of polyacrylonitrile-Ketjenblack carbon and sulfur (*p*PAN-KB/S) with a high sulfur content (*ca.* 72%) and enhanced conductivity and porosity (pore volume: 1.42 cm^3/g; BET surface area: 727 m^2/g) by an aerosol process to be used as cathode for high performance lithium-sulfur batteries. Electrochemical tests showed that the *p*PAN-KB/S composite exhibited a high capacity of 866 mAh/g (based on sulfur) after 100 cycles at 0.5C (1C=1.68 A/g) and a good rate performance at high current density (431 mAh/g at 5C). In addition, a *p*PAN-KB/S composite electrode with high sulfur loading (*ca.* 4.4 $mg-S/cm^2$) exhibited impressive electrochemical performance with a reversible capacity of 513 mAh/g and 576 mAh/cm^3 (based on sulfur) and a coulombic efficiency >99% after 100 cycles at 0.5C.

3PS-221 손홍진

Monolithic 1D Nickel-based Catalytic Electrode with 2D Graphene Oxide for Efficient Hydrogen Production by Reconstruction of Interfacial Mass and Charge Transfer

손홍진, 안성훈† 조선대학교

The study aims to develop monolithic, self-supporting catalyst electrode for efficient hydrogen production by water splitting. Monolithic nano-structure of catalyst electrode fulfills the facile mass and charge transfer which are pivotal for efficient hydrogen production by water splitting. Nickel-nanowires are prepared in the presence of the magnetic-field. Nickel-metals have ferromagnetic property, so these are arranged in a line by the magnetic-field. The mechanical and electrochemical properties are controlled by adjusting the strength of magnetic field and/or the amount of reductant. Graphene Oxide (GO) is homogeneously mixed with nickel nanowire to fabricate the freestanding Ni-GO monolithic electrode. It is observed that GO nanosheets are enveloped by 1D nickel matrix to promote the interfacial mass/charge transfer, leading to improvement in hydrogen evolution reaction (HER) activity. The role of GO can be further identified by the reduction of GO to reduced graphene oxide (rGO)

3PS-222 손나래

Fabrication of PA6/MXene/rGO Nanocomposite for Enhancement of Mechanical and Thermal Properties

손나래, 류현민, 박지은, 이관희, 윤근병† 경북대학교

Two-dimensional MXene nanosheet was investigated widely for its potential for fillers in polymer nanocomposites with excellent mechanical and electrical properties. However, polymer-MXene nanocomposite exhibited relatively low thermal stability as decomposition temperature. Graphene oxide has outstanding thermal and mechanical properties compared to MXene. As a bi-filler system, if MXene and graphene oxide are incorporated into polymer matrix, graphene oxide will be able to reinforce the polymer/MXene nanocomposite with better mechanical and thermal. Here, we report PA6/MXene nanocomposite for enhanced mechanical and thermal properties. MAX (Ti3AlC2) was first etched with hydrochloric acid and lithium fluoride. As modifier, Jeffamine D-400 was intercalated into the layer of MXene for better dispersion in polymer matrix. Mechanical properties and thermal stability on several filler loadings were investigated.

3PS-223 성재경

Engineering the Hierarchical Heterostructures of Zn-Ni-Co Nanoneedles Arrays@Co-Li-LDH Nanosheets Core-Sheath Electrodes for Hybrid Asymmetric Supercapacitor with High Energy Density and Excellent Cycle Stability

성재경, Jiwan Acharya[1], 고태훈, 서민강[2], 길명섭[3], 김학용, 김병석[3,†] 전북대학교; [1]전북대학교

BIN 융합공학과; [2]한국탄소융합기술원; [3]전북대학교 유기소재파이버공학과
A 3D hierarchical zinc–nickel–cobalt (ZNCO)@Co–Ni–LDH (LDH–1 and LDH–2) core–shell nanostructured arrays on Ni foam as pseudocapacitive electrodes are prepared by using facile hydrothermal and metal organic framework (MOF) assisted co–precipitation method. FE–SEM images shows that the core 1D ZNCO and shell 2D Co–Ni–LDH are well interconnected to form a 3D porous and hierarchical ZNCO@Co–Ni–LDH core–shell nanostructures, leading to the fast and efficient transmission/transfer of both electrolyte ions and electrons, due to the higher electroactive surface areas and enhanced electrical conductivity. In a conventional three–electrode system, the ZNCO@Co–Ni–LDH–2 electrode material displays excellent electrochemical performance with higher specific capacitance of 2866 F g^{-1} at 1 A g^{-1} with ultra–high capacitance retention of 68.35% at higher current density of 10 A g^{-1} and excellent life span of 89% capacitance retention after 8000 cycles.

3PS-224 서지한

Effect of Resin Impregnation in Carbon Fiber/ABS LFT Pellets on Residual Fiber Length and Mechanical Properties of Carbon Fiber–reinforced Composites

서지한, 조동환† 금오공과대학교
경량성과 높은 비강도를 지닌 탄소섬유강화 플라스틱(CFRP)은 자동차 부품소재는 물론 항공우주, 스포츠/레저 등으로 응용분야가 확대되고 있다. CFRP에는 전통적으로 열경화성 수지가 널리 사용되었으나, 생산성 측면에서 열가소성 수지를 사용한 CFRP에 대한 관심이 높다. 아울러 long fiber thermoplastic(LFT) 기술을 통해 잔류섬유의 종횡비 증가와 CFRP의 물성향상을 꾀한다. 사출성형공정에서 LFT펠렛을 사용하여 CFRP를 제조하는 경우, LFT펠렛에서의 수지함침이 CFRP의 잔류섬유 길이와 기계적 특성에 영향을 미친다. 따라서 본 연구에서는 수지함침에 영향을 줄 수 있는 서로 다른 디자인의 T–type과 I–type 다이를 사용하여 탄소섬유/ABS LFT펠렛을 제조하고, 이들을 사용하여 사출성형공정을 통해 CFRP를 제조한 후, 그들의 인장, 굴곡, 충격특성과 잔류섬유 길이분포를 조사하여 이들의 상관관계를 해석하였다.

3PS-225 서영석

Preparation and Properties of Carbon Nanotube (CNT)/Polyimide (PI) and Modified CNT/PI Composite Film

서영석, 장시훈, 이재혁, 박노형† 한국생산기술연구원 휴먼융합연구부문
탄소 나노튜브(carbon nanotube, CNT)는 원통형 나노 구조를 갖는 나노 탄소 소재로, 그래핀(graphene)이라 불리는 탄소 원자 층으로 만들어지고 긴 중공 튜브 형상을 갖는다. CNT는 열전도율이 우수하고 기계 및 전기 특성이 우수하여 나노기술, 전기 공학, 광학 및 재료 공학과 같은 다양한 분야에서 주목 받고 있다. 본 연구에선 CNT의 전기 전도성을 가진 고분자 복합소재를 개발하기 위하여 CNT/polyimide(PI) 필름을 제조하였다. CNT/PI 복합필름은 pyromellitic dianhydride(PMDA), 4,4′–oxydianiline(ODA)와 N,N–dimethylacetamide(DMAc)를 사용한 poly(amic acid)(PAA) 제조, 초음파 분산을 이용한 CNT 또는 modified CNT 분산, 필름화 및 imidization의 단계를 통하여 제조하였다. Multimeter(Fluke 289)를 사용해 전기 저항을 측정하였고, scanning electron microscope (SEM)을 사용하여 단면 형상을 확인, 그리고 Universal Test Machine(UTM)을 이용하여 인장강도를 측정하였다.

3PS-226 비샬가반데

Multifunctional UV–curable Two Dimensional hBN/Polyurethane Acrylate Nanocomposite Coatings

비샬가반데, 임동혁, 김병욱, 진영읍, 이원기† Pukyong National University
Multifunctional nanocomposite coatings with excellent mechanical and thermal properties have been increasingly demanded by many pioneering fields. This study deals with the organic–inorganic hybrid nanocomposite coatings based on the UV–curable polyurethane acrylate as a matrix and hexagonal boron nitride (hBN) as reinforcement were successfully fabricated. In this study, modified hBN added into the oligomeric formulation with different amounts, such as 0.1, 0.2, 0.5, and 1 wt% to increase mechanical properties, thermal properties, hardness, and water resistance. The structural, morphological, and thermal features of nanocomposite films were characterized by using FTIR, XRD, SEM, DSC, TGA, and water contact angle.

3PS-227 배환철

Ultra High Voltage Cable Semi–conductivity PP Compound Processing Techniques with Sufficient Dispersion for Actual Production Line

배환철, 김동훈† 기술연구소
This study is about PP material which is eco–friendly and has heat resistance of xlpe level by replacing existing non–recyclable power cable semi–conductor xlpe. The existing xlpe is easy to disperse because it contains PE and a large amount of rubber components. PP, a crystalline resin, has a high melting point and low rubber content less than XLPE. It is difficult to have sufficient dispersibility. We have overcome this with study on processing technology and suitable materials. Higher dispersibility was ensured through proper input volume ratio (85%) and suitable carbon particle size (60 um). As a result, it was possible to secure processing technology for mass production.

3PS-228 비샬가반데

Highly Transparent UV–curable Nylon 6 Nanofiber Reinforced Polyurethane Acrylate Nanocomposite

비샬가반데, 임동혁, 김병욱, 김가연, 진영읍, 이원기† Pukyong National University
This study deals with the development of a UV–curable polyurethane acrylate–based transparent nanocomposite by using electrospun nylon 6 nanofibers as reinforcement. The remarkable properties of nylon 6 nanofibers offer the use of nanofibers as reinforcement in making nanocomposites, in which both the mechanical and optical properties of the fabricated nanocomposites are focused. This method allowed the significant enhancement of the mechanical properties by using a very tiny amount of Nylon 6 nanofibers for different time of deposition. This method admitted significant enhancement of the mechanical properties without sacrificing transparency and flexibility.

3PS-230 배성호

The Study on Mechanical and Electrical Properties of Vitrimer Filled with Non–covalently Functionalized MWCNT/PristineGNP Hybrid Filler

배성호, 윤호규† 고려대학교
To improve the dispersion of MWCNT in Epoxt/Vitrimer matrix composites, PMMA–b–PDMAEMA (pyrene) were attached on the surface of MWCNT by noncovalent functionalization. This multiamphiphilic compatibilizer was synthesized by RAFT Polymerization. Then pyrene was introduced by simple reaction. The weight fraction of PMMA and PDMAEMA is 7:3. In the case, pyrene groups can also generate pi–pi stacking with the MWCNT. The noncovalent functionalization of MWCNT was effective in improving the composite's mechanical, electrical properties due to their enhanced dispersion and strong affinity with the epoxy matrix. The incorporation of noncovalently functionalized MWCNT into the Graphene nano platelets yielded enhanced 3–D structure then, mechanical and electrical properties is inhanced

3PS-231 배석영

The Effect of Interparticle Distance on the Fracture Behavior of Rubber Toughened Polyamide 12

배석영, 이민규, 조재영† 서울대학교
Due to structural characteristics, polyamide 12 (PA12) exhibits properties between polyolefins and short chain aliphatic polyamides, such as polyamide 6 and polyamide 66. Features like excellent water resistance and dimensional stability are attributed to the paraffin–like structure of PA12. However little is known about the fracture behavior of the material. In this study, the fracture behavior of rubber toughened PA12 was investigated. Blends were prepared by melt blending polyamide 12 with maleic anhydride (MA) functionalized rubbers. Mechanical properties of the blends were measured by Izod impact tests and tensile tests. In addition, characterization by scanning electron microscopy (SEM) of the blends showed the morphology of dispersed rubber particles in the PA12 matrix. We were able to observe a sharp increase in impact strength of PA12 blends at a critical rubber interparticle distance, therefore assuming brittle–tough transition has occurred.

3PS-232 박초연

Porous Polymers for Effective Passive Radiative Cooling

박초연, 정은진, 유영재† 한국화학연구원
The annual cooling or air conditioning energy demand is rapidly increasing, and there is a significant adverse effect on global warming. To resolve the indiscriminate use of energy, greenhouse gas emission problems, we believe that a passive radiative cooling (PRC) strategy that cools without any electricity input can significantly reduce global energy consumption. PRC involves cooling a surface by reflecting sunlight and radiating heat to the cold outer space simultaneously. Previously proposed nanophotonic devices can achieve PRC, but the use of expensive metallic films and the complicated process limit large–scale applications. In this study, we propose porous polymers of lightweight, flexible and low–cost materials. The porous media provide the high solar reflectivity and high mid–IR emissivity. Our porous polymers can be used as coating materials as well as freestanding films, so expected to be the state–of–the–art polymer coating solution for saving the energy.

3PS-233 박창규

Toughening of Polylactide (PLA) by in–situ Reactive Compatibilization with Isosorbide Containing Copolyester

박창규, 장동진, 김성훈† 한양대학교
Blends with different ratio of polylactide (PLA) and poly (1,4–cyclohexane dimethylene isosorbide terephthalate) (PEICT) were prepared by melt processing. The two immisicible polymers were compatibilized by reactive blending using a multifunctional epoxy oligomer. Infrared spectroscopy and rheological analysis confirmed the formation of a copolymer of PLA and PEICT that reduces the interfacial tension in the PLA/PEICT blends. The improved interfacial adhesion formed a co–continuous phase morphology from a previously sea–island morphology, which is observed by SEM at the fractured surfaces. The added PEICT showed reinforcing effect on PLA by improving the impact strength. The reduced interfacial tension by the compatibilizers improved the energy transfer between the two polymers giving the blends even higher impact strength than the prisitne blends.

3PS-234 박준철

Preparation and Characterization of Acryl–polyurethane Foam Composites Improved Flame Retarding Properties with Various Flame Retardants

박준철, 박노형†, 장시훈 한국생산기술연구원
Flexible polyurethane (PU) foam which has open cell structure, has excellent buffer capacity, mechanical strength and also has good air permeability. But PU foams are highly combustible, and they generally emit unwanted smoke and toxic gases during the burning process because of high rate of heat release. In this study, the impregnation of flame retardant was prepared by dispersing a flame retardant in

an acrylic solution using ultrasonication. FPU foam was immersed into the solution using machine designed by our laboratory and then dried using near-infrared (NIR) oven. Some kinds of flame retardants and titanate coupling agents (TCA) were added into PU foam to obtain flexible FPU foam. Flame retarding characteristic was analyzed using the horizontal flame test. Fire safety performance of the FPU composites with various flame retardants in terms of thermal, morphological properties and flammability performance were investigated.

3PS-235 박준우

Removal of Microplastics via Tannic Acid-mediated Conglobulation

박준우, 서성백† 부산대학교 생명자원과학대학 바이오소재과학과

Microplastics have caused great concern worldwide recently due to their ubiquitous presence. With microplastics being increasingly detected in ocean's, it is urgently necessary to evaluate their presence during coagulation and ultrafiltration processes. Previous studies showed low PE removal efficiency was observed using the traditional process that Al-based salts and Fe-based salts. In the case of the fine particle is made larger size, removed better fine particle removal efficiency can be obtained. We tried to increase the removal efficiency by using harmless chitosan and tannic acid to increase the size of the fine particles and to form a coordination complex with Fe^{3+} of the catechol group of tannic acid. Insight from Dopa-metal coordination in mussel foot protein. In this study, coordination complex was used and the removal efficiency of fine particles of 0.5 μm size was 97%. In the cytotoxicity, a result of causing inflammation by concentration of microplastic was obtained.

3PS-236 박종명

Fabrication of Metal-nanofiber Web-structured Films for Robust Transparent Electrodes by Polymer Coating

박종명, 전환진† 한국산업기술대학교

In electronic materials, transparent electrodes are paid attention for using as a necessary material in various applications. In transparent electrode materials, ITO has excellent conductivity and transparency but is weak in mechanical strength. Recently, metal-nanofiber web-structured films manufactured by electrospinning and deposition process have researched for replacing ITO that metal-nanofiber web-structured films have excellent conductivity, transparency, cost-effectiveness and scalability. But in this process, limitations are existed to be overcome and one of the limitations is the mechanical strength of the nanofiber film. In this study, we have manufactured transparent electrode enhancing mechanical strength of the nanofiber films. It is polymer coating for enhancing mechanical strength and substrate adhesion at polymer films to metal-nanofiber web-structured films. Since these characteristic, transparent electrode manufactured by our process is robust transparent electrode.

3PS-237 박예진

Evaporative Crystallization of Poly(lactic acid) in Presence of Polyphenols

박예진, 이종휘† 중앙대학교

Recently, poly(lactic acid) (PLA) is known as a biodegradable polymer that is being studied as a material of high industrial value. Biodegradable PLA could improve many environmental problems caused by using conventional plastics. Therefore, many studies are being conducted on PLA to control its crystallinity which is one of the main controlling parameters of properties. By controlling the crystallinity of PLA, it will be possible to use it in a wide range of industries. The previous studies on polyphenols have shown various advantages in antioxidant effects and biocompatibility. There are many types of polyphenols in fruits and vegetables of nature. In this study, we tried to make uniform PLA films and control the crystallinity of it. Polyphenols were used as a nucleant to control the crystallinity of PLA films. It is expected that a polyphenol could serve as a crystallization seed in making PLA films. This strategy could find a novel way to control the crystallinity of PLA.

3PS-238 박예림

Cellulose Nanofibril (CNF)-polymer Composite : Effects of Surface Modification on Thermal and Mechanical Properties

박예림, 서영수† 세종대학교

Cellulose nanofibril (CNF), a bio-degradable fibrous nanomaterial extracted from the wood, has attracted attentions for application as a reinforcement filler for polymer composites because of its physical properties comparable to glass or carbon fiber. However, its hydrophilic and thermally unstable natures become a hurdle in dispersion in hydrophobic polymer for a high temperature melt-mixing process. In this study, CNF was modified with inorganic materials that decorate the CNF surface as a form of bead, overcoming those issues. In addition, its surface was chemically modified for enhancing compatibility to polymer matrix. The surface-modified CNF was imaged using scanning electron microscope (SEM) or transmission electron microscope (TEM). Mechanical and rheological properties of the polymer composites was analyzed in terms of inorganic material content, filler content, and so on using UTM and rheometer according to ASTM standards.

3PS-239 박승규

폴리아미드계 복합소재의 유동성 개선을 위한 첨가제의 합성 및 분석

박승규, 안성현, 유영재† 한국화학연구원

폴리아미드계(Polyamide, PA) 복합소재는 우수한 강성, 내충격성, 내화학성 및 열 안정성 등 우수한 특성으로 인해 자동차 내부 재료뿐만 아니라 엔진 부품 및 차체와 같이 높은 수준의 강도와 내열성을 요구하는 자동차 부품에 널리 사용되고 있다. 따라서, 폴리아미드 복합소재의 다양한 이점을 적용하기 위해서는 PA와 강화 충전제 사이의 젖음성 및 계면접착 특성을 개선하여 PA의 유동성을 향상 시킬 필요가 있다. 본 연구에서는 폴리아미드계 복합소재의 유동성 향상을 위해 3, 2 작용기의 클로라이드 및 디아민 단량체의 아미드 결합에 기초하여 첨가제를 합성하였다. 제조한 첨가제를 사용하여 PA의 유동성 개선 효과를 확인하기 위해 회전형 레오미터를 통해 저전단 영역에서 샘플의 점도를 측정하였다. 본 연구에서 합성한 첨가제는 PA 매트릭스의 기계적 특성을 저하시키지 않으면서 유동성 개선이 가능할 것이며, 다양한 고함량 복합재에 사용될 수 있을 것으로 예상된다.

3PS-240 박솔

Photothermal Conversion-based Solar Oil Evaporation for Fast Cleanup of BTX

박솔, 최원산† 한밭대학교

Various water resources have been continuously polluted due to increasingly frequent oil spill accidents and industrial oily wastewater. Thus, oil/water separation has recently become an important issue in scientific research and practical applications. In particular, spill accidents of Benzene, Toluene and Xylene known as expensive and useful solvents have frequently occurred. However, BTX can damage the liver, kidney and central nervous system due to their toxicity and carcinogenicity. Thus, the development of unmanned system for cleanup and collection of BTX is highly necessary. We report here photothermal conversion-based solar oil evaporation system for cleanup of BTX.

3PS-241 박성진

Hydrogel-Templated Transfer-Printing of Conductive Nanonetworks for Wearable Sensors on Topographic Flexible Substrates

박성진, 이현정†, 강태형, 장호찬, 최동원, 김순우, 문지희, 임정아, 이기영 한국과학기술연구원

Transfer-printing is an effective method to provide functional nanomaterials on non-traditional substrates with designed patterns. However, it still remains challenging to assemble nanomaterials on diverse topographic surfaces. Here, we show that hydrogels effectively serve as template material platforms for both the assembly and transfer-printing of conductive nanostructured patterns on diverse substrates. The hydrogel-templated assembly and transfer-printing were developed by systematically controlling nanoporous structure, the non-adherence, molding capability of the hydrogel. Not only pressure sensors, but also flexible strain sensors as monitoring devices of arterial pulses and finger movements were successfully shown. This work could lay groundwork for additive technology for hydrogels, as well as electronic materials for wearable devices and upcoming next-generation functional materials.

3PS-242 박상현

난연특성이 향상된 EG/PU 복합 foam의 제조 및 평가

박상현, 박준철, 장시훈, 박노형† 한국생산기술연구원

Flexible polyurethane(PU) foam은 Open Cell 구조와 우수한 buffer capacity, 그리고 기계적 강도 및 공기 투과성을 가지고 있으며, 다른 고분자와 Compounding을 통해 셀 크기, 비중, 탄성 등과 같은 물리적인 특성을 조절할 수 있어 다양한 분야에 적용되고 있다. 그러나 PU foam은 높은 가연성과 열 방출률로 인하여 연소 과정에서 다량의 유독 기체를 방출하는 문제점을 가지고 있다. 이에 최근 난연성을 가진 PU foam에 대한 다양한 연구가 활발히 진행되고 있다. 본 연구에서는, PU 폼에 Expandable graphite (EG)를 첨가하여 난연성이 향상된 PU foam에 난연제가 분산된 아크릴 용액 함침하여 난연성이 향상된 PU 복합 foam을 개발하였다. 함침은 자체 개발한 함침 장비를, 건조는 near-infrared(NIR) oven을 이용하였다. 제조된 복합 난연 foam의 난연 특성은 수평 불꽃 테스트를 통해 분석하였고, 모폴로지는 3D digital microscope(3Ddm)을 이용하여 분석하였다.

3PS-243 박상진

Ozonization of Single-walled Carbon Nanotubes on Mechanical Properties of Carbon Fiber-reinforced Epoxy Composites

박상진, 박수진† 인하대학교

In this work, single-walled carbon nanotubes (SWCNTs) surface was successfully modified using the ozone treatment for use as the reinforcement for multi-scale composites. We focused on the fracture toughness, crack resistance, dispersion and interfacial adhesion synergistic effects of ozone-treated SWCNTs (O-SWCNTs) in epoxy matrix and carbon fibers, mechanical properties of the prepared composites were investigated according to weight ratio of O-SWCNTs. The mechanical properties were calculated by the critical stress intensity factor (KIC), critical strain energy release rate (GIC) and interlaminar shear strength (ILSS). The morphology was observed by scanning electron microscope (SEM) and field emission transmission electron microscopy (FE-TEM). Ozone treatment, an environmentally friendly and simple method, suggests a way to improve the mechanical properties of multi-scale composites and modify the surface properties of O-SWCNTs.

3PS-244 박병학

Beyond Nanoscale Crack Based Sensors: Sensitivity, Durability and Visualization for Physiology Detection

박병학, 김태일† 성균관대학교

With increasing demands for detection of minute bio-signals in biomedical application, there have been attempts to develop the crack-based mechanosensors, yet still lots of issues of applying crack based sensor for biomedical application including sensitivity, durability, strain visualization, are still remained. Here, we describe the functionalized nanocrack sensor by bio-inspired structures and materials for biomedical application. At first, the key factors for the crack based sensors are described by the geometries of the cracks. Secondly, we describe the durability

issues by solving self-healable polymer as a passivation layer. Finally, the strain visualization issues are dealt with hierarchical thermochromism, which enables fast recovery of the visualization within 0.6s.

3PS-245 박상진

Effect of Blend Ratio on Thermal Properties and Fracture Toughness of Epoxy/Polyetherimide Composites

박상진, 박수진† 인하대학교

Epoxy/polyetherimide (PEI) blends were prepared by melt mixing. The contents of PEI were varied from 0, 1, 2, 3 and 4 wt.% and the influences on mechanical and thermal behaviors of the blends were studied. The mechanical behaviors of the blends were measured using universal testing machine (UTM) for fracture toughness and the morphologies of fracture surface of the blends were observed by scanning electron microscopy (SEM). The thermal behaviors of the blends were investigated by differential scanning calorimeter (DSC) and thermogravimetric analyzer (TGA). These results indicated that PEI showed an important role in improving the therma stabiltyl and mechanical behaviors of epoxy blends.

3PS-246 박병수

Effect of Polished Cross-section on the Mechanical and Thermal Properties of Large-tow Carbon Fiber/Vinyl Ester Composites Filled with Aluminum Hydroxide and Halloysite Nanoclay Produced by Pultrusion Process

박병수, 조동환† 금오공과대학교

인발성형은 재료가 금형을 통해 당겨질 때 실시간으로 경화가 일어나기 때문에 다양한 형태의 성형물을 빠르게 생산할 수 있다. 탄소섬유복합재료는 높은 강도와 탄성률로 다양한 분야에서 사용되며, 인발성형된 탄소섬유복합재료는 섬유길이방향으로 우수한 기계적 물성을 갖는다. 반면, 부족한 수지 함침과 매트릭스 내부 보이드는 복합재료의 기계적 특성을 저하시키는 요인이다. 따라서 본 연구에서는 3개의 굵은 탄소섬유 토우(large-tow carbon fiber, 60k)에 비닐에스터수지를 함침시켜 인발성형을 통해 복합재료를 제조하였다. 복합재료의 함침효율성과 표면윤곽을 개선시키고 보이드 크기와 함량을 감소시키기 위한 필러로 수산화알루미늄과 할로사이트 나노클레이를 각각 사용하였다. 제조한 복합재료의 연마된 횡단면 관찰을 통해 보이드 함량의 크기, 수지 함침효율을 확인하고, 굴곡, 압축 특성과 열안정성을 조사하였다. 비닐에스터수지 무게 대비 필러들의 함량은 각각 1, 5, 10, 15 wt%로 다양하게 하였으며, 필러를 첨가하지 않은 탄소섬유/비닐에스터 복합재료의 기계적, 열적 특성에 미치는 필러의 영향을 조사하였다.

3PS-247 박상진

Effect of Amine-grafted Surface Treatment on Mechanical Properties of Graphite Nanofibers/Epoxy Nanocomposites

박상진, 박수진† 인하대학교

In this work, graphite nanofibers (GNFs) surface was successfully modified using the amine treatment for use as the reinforcement for epoxy nanocomposites. We focused on the fracture toughness, crack resistance, dispersion and interfacial adhesion synergistic effects of amine-treated GNFs(A-GNFs) in epoxy matrix, mechanical properties of the prepared composites were investigated according to weight ratio of A-GNFs. The mechanical properties were calculated by the fracture toughness (KIC), critical strain energy release rate (GIC). The morphology was observed by scanning electron microscope (SEM) and field emission transmission electron microscopy (FE-TEM). Amine grafting establishes the link between GNF and epoxy matrix and converts the smooth non-reactive GNF surface into a hybrid material with both GNF and amine properties, promoting uniform dispersion of GNF and improving nanofiber-epoxy interfacial interactions.

3PS-248 민수홍

Directed Patterning of Quantum Dots Using Chemically Modified Surface for Light Emitting Diodes

민수홍, 마서영, 이동현† 단국대학교

Here, we demonstrate directed patterning of quantum dots (QDs) using a unique imprinting method for the LEDs from chemically modified surface. The chemical patterns are initially fabricated by using selective chemical reaction of surface-modifying molecules on designed photoresist (PR) patterns. The QDs are then spin-coated on the patterned surface after removing the PR patterns. To transfer the QDs layer to the HTL, thin layer of PMMA is coated on the QDs layer as sacrificial layer and the layers of QDs/PMMA are imprinted to the target substrate using commercial adhesive tapes. As the tape is lifted, the only designed QDs patterns are selectively transferred from the chemically modified surface of the donor substrate due to surface energy difference. The QDs/PMMA/tape is subsequently placed on the ITO (Anode)/PEDOT:PSS (HIL)/TFB (HTL) for transferring the designed QDs patterns. As ZnO (ETL), Al (Cathode) are coated successively on the QDs layer, the QD-LEDs are fabricated and characterized.

3PS-249 민경배

칡을 활용한 셀룰로오스 나노 피브릴 제조 및 특성 관찰

민경배, 전경수, 이민지, 정용일† 한국섬유기계융합연구원

칡(Pueraria montana var. lobata)은 다양한 건강식품에서 사용이 되는 동시에 빠른 생장력과 번식력으로 산림 생태계를 위협하는 낙엽활엽의 덩굴성 식물이다. 우리는 식품생산과 제거 작업 후 폐기되는 칡을 활용한 지속 가능한 친환경 소재를 만들어 화석원료 유래의 플라스틱을 대체하고자한다. 우리는 칡에 존재하는 셀룰로오스를 증해(digestion), 표백화(bleach), 전처리(pretreatment), 나노화(nanoization) 과정을 거쳐 셀룰로오스 나노 피브릴화(Cellulose nano-Fibrillization) 시킨 후 FE-SEM, TEM을 비롯한 Raman scattering, X-ray, SAOS, 열중량 분석법 등 다양한 분석을 통한 칡의 나노 피브릴의 특성을 이해하고자 하였다. 이를 통해 칡을 활용한 지속 생산 가능한 친환경 소재 개발과 기계적 · 열적 성질이 개선된 복합소재에 활용할 수 있을 것으로 기대한다.

3PS-250 문하람

MXene (Ti3AlC2) Incorporated Polyimide Hybrid Composite Films

문하람, 옌 융주, 하창식† 부산대학교

In this work, we synthesized polyimide (PI)/MXene hybrid composite films via thermal imidization process using MXene (Ti3C2) as a filler. Polyimides (PIs) are well known for having excellent thermal stability, good chemical resistance and good flexibility. First, polyamic acid (PAA) was synthesized via solution polymerization in DMAc using ODA and PMDA as precursors. MXenes were prepared by etching the Al layers from Ti3AlC2 using HF aqueous solution or LiCl-HCl solution. PI/MXene hybrid composite films with different content (0.5 wt%~10 wt%) were prepared and characterized by Fourier transform infrared (FTIR) spectroscopy, X-ray diffractometer (XRD) and scanning electron microscopy (SEM), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and inductance (L)-capacitance (C)-resistance (R) (LCR) meter. The PI/MXene hybrid composite films are expected to have a controlled dielectric constant, improved thermal stability and a low coefficient of thermal expansion (CTE).

3PS-251 류현민

Modified MXene (Ti3C2) Filled PA6 Nanocomposites for Enhancement of Mechanical and Thermal Properties

류현민, 손나래, 박지은, 이관희, 윤근병† 경북대학교

MXene-based polymer nanocomposites have recently been investigated for enhancement of mechanical properties (e.g. elastic modulus, tensile strength) and thermal properties (e.g. thermal conductivity, stability). In order to fabricate polymer nanocomposite with MXene, good dispersion should be considered through modification. Here, we report PA6 nanocomposites filled with modified MXene for enhancement of mechanical and thermal properties. MAX (Ti3AlC2) was first etched with hydrochloric acid and lithium fluoride to exfoliate MXene nanosheets. As modifier, Jeffamine D-400 was adsorbed on the surface of MXene by ion exchange reaction with Li+ ion. Modified MXene was then melt mixed with PA6 and compression molded. Mechanical, and thermal properties were investigated on different loadings of modified MXene. The modified MXene was well dispersed as exfoliated state, which made the nanocomposites have high mechanical properties and thermal stability.

3PS-252 노지영

Synthesis of Catechol-Functionalized Silsesquioxane for Enhancing Cohesive and Adhesive Forces of Epoxy Adhesive

노지영, 임정혁, 김경민† 한국교통대학교

Epoxy resins have been used in the field of adhesive and have outstanding chemical, thermal, mechanical properties. However, these performances are greatly affected by the absorbed moisture which results in volume expansion, cracks, decrease of T_g and adhesion. In this study, dopamine methacrylamide (DMA) was selected to enhance both cohesive and adhesive force of epoxy adhesive. DMA has a catechol moiety, which includes in marine mussel foot proteins and could adhere to various kinds of surfaces. We synthesized catechol-functionalized polyhedral oligomeric silsesquioxane (POSS) and ladder-like polysilsesquioxane (LPS) via simple sol-gel process, and applied them to prepare epoxy nanocomposites of DGEBA and DDS system using hydrogen bonding and π-π stacking interaction. Finally, we analyzed thermal properties and mechanical properties including tensile, flexure, impact and lap shear test. This research was supported by Korea National University of Transportation in 2020.

3PS-253 노재현

Electrochromic Properties of WO_3-decorated Nanofiber-based Highly Flexible, Transparent and Twistable Electrode Materials

노재현, 곽채송[1], 고태훈, 이기태, 김병석† 전북대학교; [1]한국전자기술연구원

Electrochromism has attracted extensively attention due to its potential applications, such as rearview mirrors for cars, smart windows for building integration and other electro-optical devices. Electrochromic devices are based on chromogenic materials that change their color by a reversible variation of the optical properties and electronic structure (coloration and bleaching processes) in response to external electrical biasing. transition metal oxides have been used as an electrochromic material because of the higher mechanical and thermal stability, and the improvement in the life-time of the device. Among the transition metal oxides, tungsten oxide (WO_3) is one of the most intensively investigated electrochromic material. In this work, we attempt to study the electrochromic properties of WO_3-decorated nanofiber-based flexible transparent electrodes.

3PS-254 남현구

Preparation of Si/C/N/Fe Magnetic Ceramics Derived from Iron Oxide and Polysilazane with Different Carbon Group

남현구, 허태환, 곽영제† 숭실대학교

Preceramic polymers have attracted remarkable interest in the last 2 decades due to their high processability into various shapes. Metal containing SiCN ceramics prepared from polysilazane (PSZ), have drawn special interests in engineering fields because of their electrical, magnetic, and catalytic properties. In this work, we report a novel strategy for the synthesis of nanocrystal containing magnetic ceramics by pyrolyzing Fe_2O_3 and two different polysilazanes, phenyl silsesquiazane (SSQZ) and

vinyl polysilazane. Introduction of different carbon group into the precursors dramatically changes the microstructure and magnetic property of ceramics. It reveals that the ceramics pyrolyzed from different precursors have different crystallinity, which affect to magnetic properties. The ceramics from phenyl SSQZ exhibit high saturation magnetization (27.7 emu/g), whereas ceramics from vinyl polysilazane show low saturation magnetization (10.5 emu/g).

3PS-255 남채윤

The Study on the Effect of Crystallinity at the Dielectric Breakdown Strength According to the Cooling Rate for Insulating Layer of Cable

남채윤, 임도현, 윤호규† 고려대학교

Polypropylene is used for replacing crosslinked polyethylene (XLPE) which was previously used as insulating materials for cable. For high heat-resisting property and flexibility, PP blends that were blended with Styrene-ethylene-butylene- styrene (SEBS) were used and fabricated by melting mixing. The mechanical properties, morphology, and dielectric breakdown strength were measured by Universal Test Machine (UTM) and Scanning Electron Microscope (SEM) respectively. In mechanical properties, the tensile strength was decreased but elongation was increased according to the samples had higher rubber contents. Morphology and dielectric breakdown strength showed difference according to the cooling rate. This study researched the relationship between dielectric breakdown strength and cooling rate.

3PS-256 남정민

Functionalized Graphene Oxides/Cellulose Nanocrystals Hybrid Fillers Incorporated PVA Films

남정민, 정지인, 진형준† 인하대학교

The barrier properties of polymers can be improved by reducing diffusivity and solubility of gases using filler materials such as graphene oxides (GOs) or cellulose nanocrystals (CNCs). These well-dispersed filler materials in polymeric matrix enhance gas barrier properties of polymers, while not affecting its moisture barrier property. In this study, an hydrophobically functionalized graphene oxides (FGOs)/CNCs hybrid fillers were incorporated into PVA films with an enhanced moisture barrier property. The FGO was prepared by alkylation reactions of large lateral sized GO. The functional groups improved hydrophobicity of GO and the large lateral size of GO maximized the tortuous effect by increasing the diffusion path. In addition, CNCs helped improve the dispersibility of FGO in hydrophilic PVA matrix. As a result, the FGOs/CNCs hybrid fillers enhanced the moisture barrier property of PVA as well as its mechanical properties due to the synergistic effect of the hybrid fillers.

3PS-257 남기범

Effect of Solution Shearing Method for Organic Semiconductors

남기범, 김세현[1], 이동윤† 경북대학교; [1]영남대학교

In this study, we introduced the patterning method for the organic thin film transistor (OTFT). We demonstrated a high-performance semiconducting film with 6,13-Bis (triisopropylsilylethynyl)pentacene (TIPS-PEN) and Poly(3-hexylthiophene-2,5-diyl) (p3ht) both had fine holes transfer properties. Here, we exploited the flow coating method to modulate the physical and electronic properties of conducting layers. The flow coating system, a solution shearing method combined with coffee ring effect, was adopted as a patterning method that rendered mechanical shear stress on a solution. The organic semiconductors with a directional alignment by shearing showed excellent electric properties. The identification of the crystallization mechanism was conducted including dependency of the coating speed, concentration of solution, and evaporation of solution. Such method could be a powerful method to control the crystallinity of the organic semiconductor material and to improve the device efficiency.

3PS-258 김효주

Carbon Quantum Dots Incorporated Keratin/Polyvinyl Alcohol Hydrogels: Preparation and Photoluminescent Assessment

김효주, 김학용† 전북대학교

In this work, we report a fabrication of photoluminescent carbon dots (C-dots) incorporated keratin/poly(vinyl alcohol) (keratin/PVA) hydrogel via an electron beam irradiation technique. Hydrogels with porous structure along with homogeneous networks were obtained by this ecofriendly approach. The prepared hydrogels showed excitation dependant photoluminescent (PL) emission similar to the C-dots. The well preserved quantum confinement effect of the C-dots in the hydrogel can extend its application to biological analysis and medical diagnosis in the future.

3PS-259 김효정

Effects of Cellulose Nanocrystals on the Mechanical and Rheological Properties of Biodegradable Poly(butylene succinate)

김효정, 엄영호† 부경대학교

Petroleum-based plastics were once regarded as an integral materials owing to its extensive applications and the convenience in its usage. However, the environmental damages caused by the petroleum products were easily overlooked. As a result, the cumulative plastic pollution in the soil, atmosphere, and marine ecosystems have become severe. To solve this problem, biodegradable polymer is now receiving attention in our everyday life. Despite the eco-friendliness, the commercial applications of the biodegradable polymers have been limited to a few industries due to the inferior mechanical properties. In this study, we fabricated the high performance biodegradable nanocomposites using poly(butylene succinate) (PBS) as a polymer matrix and cellulose nanocrystal (CNC) as a reinforcing filler. The PBS/CNC nanocomposites with the CNC contents of 1-5wt% were prepared by dissolving or dispersing them in DMSO.

3PS-260 김효선

Performance Study of Polymeric Dense Membrane with a Hydrophilic Additive for Energy Efficient Air Conditioning

김효선, 서영수† 세종대학교

As the demand for high-efficiency air conditioning systems from climate change around the world increases, there is a need for alternative technologies that can replace conventional steam compression cycles. Membrane heat pump has recently attracted attention as highly compatible alternative technologies due to the development of various water-permeable membranes that can dehumidify without releasing latent heat, since water molecules selectively permeate, leading to reduced energy consumption. We have developed polymer-based dense membrane with hydrophilic additives which provide a water vapor selective diffusion pathway. The membrane showed a high-water vapor permeable property (~190 $g/m^2 \cdot hr$) based on a standard method described in ASTM-E96. In this study, the water permeation property of the membrane was systematically investigated under various temperature and humidity conditions using vapor permeation performance test system consisting of water vapor supply and membrane chamber.

3PS-261 김홍식

Effect of Boron Nitride Nanotubes on Mitigating Shuttle Effect of Lithium-Sulfur Battery

김홍식, 임홍진, 전영시[†], 장세규† 한국과학기술연구원; [1]전남대학교 화학공학부

The increasing demand for high-capacity mobile energy has been pushing the development of next-generation batteries that can replace lithium-ion batteries. Lithium-sulfur batteries (LSBs) have attracted increasing attention for their high theoretical capacity and low cost. However, the shuttle effect, diffusion of lithium polysulfides (LiPSs) through the separator, is remained as a challenging issue. To inhibit this issue, separators with interlayer have been introduced, such as size exclusion or interaction using nanomaterials. In this study, we investigated the effect of boron nitride nanotubes (BNNTs) on transmission of LiPSs through the commercialized polypropylene (PP) membrane. The systematic study reveals that the favorable interaction between BNNTs and LiPSs via Lewis acid-base reduced the shuttle effect and eventually improved cell performance and life span. Furthermore, the thin film of BNNTs on the PP membrane improved the mechanical strength, thermal and chemical stability.

3PS-262 김호연

Diurnal Solar Evaporator Based on Thermosensitive Hydrogels

김호연, 이종휘† 중앙대학교

Although solar desalination has a great potential for solution of global water scarcity, it has not become practical because of its low efficiency. Generally, the reason of the low evaporation efficiency is blockage of the absorption part caused by the salt accumulation. In the previous study, we developed an asymmetric composite of poly(N-isopropylacrylamide) (PNIPAm) and polydimethylsiloxane (PDMS) showing unique water flow behavior responsive to temperature variation. In this study, by separating the water pumping part from the evaporation part, the salt accumulation will not be present in the absorption surface. By using directional melt crystallization, aligned pores were introduced in PNIPAm, which can give PNIPAm improved its ability of water transport. The evaporation part consist of nickel/cellulose, which can increase heat absorption. This method has a potential to solve the evaporation efficiency limit, one of the tough problems of solar evaporator implementation.

3PS-263 김혜원

Enhancement of Proliferative Effects of Basic Fibroblast Growth Factor with Hyaluronic Acid Hydrogel by Light-induced Thiol-ene Reaction

김혜원, 이현종[1], 고원건†, 최주환, 김현지 연세대학교; [1]가천대학교

The cornea of the eye is at high risk of infection from the outside. As a general treatment method, eye drops are used, however in this case, the residence time of drug in eyes is very short. Therefore, new ways to extend the residence time are needed. Hyaluronic acid (HA) is a substance that has a healing effect on the cornea. HA hydrogel is produced using thiol-ene reaction. Thiol-ene reaction is biocompatible and is proceeded with HA substituted with thiol and alkene through blue light as a light source and riboflavin phosphate as a photo initiator. The hydrogel is expected to increase the residence time of HA in eyes and act as a drug carrier. Therefore, it is possible to develop an efficient treatment method compared to the existing treatment methods. By developing a hydrogel equipped with a drug delivery system, we will develop an efficient alternative treatment for corneal tissue regeneration.

3PS-264 김태은

Synthesis and Characterization of Poly(imide siloxane) Composites Containing Ladder-like Poly(methacryloxypropyl) Silsesquioxane (LPMS)

김태은, 임정혁, 김경민† 한국교통대학교

Recently, the development of pressure-sensitive adhesives with excellent heat resistance is being studied for the application to the process of microelectronics. Also, acryl and silicon-based polymeric materials are widely used as the main material for PSA. In this study, we designed a series of hybrid poly(imide siloxane) composites

by using ladder-like poly(methacryloxypropyl) silsesquioxane for enhancing adhesive and thermal properties. LPMS was synthesized by a simple sol-gel method using 3-(methacryloxy)propyl trimethoxysilane. Organic-inorganic ladder-like polysilsesquioxane (LPS) has excellent chemical and thermal property. Also, LPS with general formula (RSiO3/2)n consisting of Si-O-Si backbone and functional group (R), where R group can be acryl, phenyl, epoxy or high molecular weight organic groups. The structure of LPMS were confirmed by ^{1}H-NMR and FT-IR. And, the characteristics of hybrid poly(imide siloxane) composites with LPMS were analyzed by various analytical tools.

3PS-265 김태곤

Dynamic Properties under Cyclic Strain Test in Conductive Polymer Nanocomposites for Stretchable Electrodes

김태곤, 최지영, 박지원, 이성재† 수원대학교

Stretchable materials are in demand in biomedical engineering and electronics industries. Among them, the conductive polymer nanocomposite for stretchable electrodes improves electrical conductivity by adding conductive nanofillers to the elastic polymer matrix. Carbon nanotubes (CNTs) and silver nanowires (AgNWs) as conductive nanofillers form aggregates in the polymer matrix due to strong van der Waals force and cause deterioration of material properties. To improve the dispersion of nanofillers in polydimethylsiloxane matrix, ultrasonic treatment was performed after adding isopropyl alcohol and methyl silicone oil. Dynamic mechanical properties and electrical conductivity under cyclic strain test were investigated depending on CNT and AgNW contents. The highest electrical conductivity was obtained when the CNT and AgNW contents were 2 wt%, respectively, and the average electrical conductivity was about 10 S/m in a 5,000 cycle test with a 40% strain.

3PS-266 김준혁

Novel Wide Viewing Optical Films Based on Double-Shell Layered Nanoparticles with Gradient Refractive Index Surface

김준혁, 박윤국, 윤준식, 손인태[1], 이준협[2,†] 명지대학교; [1]서울대학교 [코팅기반 화학공정 센터]; [2]숭실대학교

The essential improvements in the performance of light-diffusing materials for wide viewing angles in potential optoelectronic applications have attracted considerable attention. In this study, a simple and unprecedented strategy is proposed to provide exceptional light scattering performance and high optical transparency for optical thin films using hierarchical double-shell nanoparticles possessing a refractive index gradient on the nanoparticle surface. An ultraviolet-light-cured optical film with an extremely low content of double-shell nanoparticles exhibits efficient light scattering characteristics while maintaining high optical transparency. The hierarchical SiO_2/TiO_2/poly(methyl methacrylate) double-shell layered nanoparticles induce enhanced light scattering properties by their nanolayered gradient refractive index structure. This proposed technique provides a scalable yet effective, facile approach to improve the viewing angle performances of optoelectronic devices.

3PS-267 김준석

Cellulose nanofiber slurry를 이용한 polypropylene/CNF 복합체 제조와 다중압출이 CNF 분산 및 응집에 미치는 영향

김준석, 박소연, 김연철† 공주대학교

Cellulose nanofiber(CNF) slurry를 추가 건조과정 없이 사용하여 이축압출기를 이용해 Polypropylene(PP)/CNF 복합체 제조하였다. CNF slurry는 1 wt% 수분산된 제품을 증류수를 사용해 0.67 wt%로 희석하여 사용하였으며, PP powder와 교반하여 전처리시료를 준비하였다. 전처리시료의 수분함량과 다중압출이 CNF 형태에 미치는 영향을 고찰하였다. 전처리시료의 수분함량을 PP+CNF 대비 50, 100, 150%로 조정하였으며, 다중압출의 경우 최대 3번 반복하여 압출하였다. PP/CNF 복합체의 CNF 함량은 10 wt%로 고정하였으며, 이축압출기를 이용하여 다이온도 기준 180 ℃에서 제조하였다. PP/CNF 복합체의 기계적 물성은 만능시험기를 이용하여 측정하였으며, 복합체의 유변특성은 동적유변측정기를 이용하여 측정하였다. CNF의 형태분석과 복합체 내의 분산 미 응집특성은 SEM-EDS를 통하여 관측하였다.

3PS-268 김정은

Influence of Polymer and Metal Ion During Drowning Out Crystallization Process of Polyphenols

김정은, 이종휘† 중앙대학교

Crystallization is widely used in various industries such as pharmaceutical, food and material industries. If there is another soluble material mixed with target material during crystallization, the crystallization process could be affected by it. In the previous researches, it is widely known that polyphenols with hydroxyl group like tannic acid have hydrogen bonding with polymer like polyvinylpyrrolidone (PVP) or polyethylene glycol (PEG), resulting in gelation. In this study, we investigated the effect of polymer-TA-metal ion (P-TA-M) composite's effect during the drowning out crystallization of quercetin. When P-TA-M composite is involved in crystallization process, we observed that crystal structure become amorphous and average crystal size reduces to nano scale. If we identify the effect of polymer, tannic acid and metal ion composite on the surface of polyphenol crystal, it may increase the possibility to improve bioavailability of poorly soluble quercetin via hydrogen bonding.

3PS-269 김재훈

Fabrication of Nanocellulose Derived from Marine Biomass and Its Application for Biodegradable Polymer Composite with Enhanced Physical Property

김재훈, 정진주, 박희경, 최슬기, 이정수† 조선대학교

Nanocellulose derived from marine biomass has considered potentially attractive materials in the battery, flexible film, paper and biomaterials due to superior in strength, high crystallinity, flexible, biodegradable and large surface area. In addition, marine biomass has plenty of cellulose contents which compared to wood biomass, and it can be environmentally extracted without alkali treatment which is essential in wood biomass. This research demonstrated a nanocellulose derived from marine biomass and its application for biodegradable polymer composite film with enhanced physical property that can be used as a next-generation core material for a wide research field.

3PS-270 김재환

Improved Tensile Strength of Bacterial Cellulose/Poly(vinyl alcohol) Double Network Structures

김재환, 최준식, 현진호† 서울대학교

The practical application of bacterial cellulose (BC) produced by Gluconacetobactor xylinus is limited due to its poor mechanical properties especially in tensile strength. In order to increase the applicability of BC, poly(vinly alcohol) (PVA) is introduced for the formation of double networked structure through the diffusion of PVA molecules into the BC networks. The BC/PVA double networked cryogel shows the increase in tensile strength over 6 folds of pure BC hydrogel due to the efficient dissipation of energy. The preparation method and the characterizations for verification of the network structure and the improvement of mechanical properties will be demonstrated in the presentation.

3PS-271 김재우

Study on Thermal and Electrical Properties of the Liquid Crystalline Epoxy (LCE) with CNP, CNT and Hybrid Nanofillers

김재우, 임도현, 남채윤, 윤호규† 고려대학교

Epoxy resins are used in many applications due to good mechanical properties, thermal stability and chemical resistance. The mesogenic groups of epoxy make the high ordered structure by π-π stacking. The high ordered structure makes high crystallinity in the epoxy matrix. The high crystallinity of the liquid crystalline epoxy (LCE) can reduce the phonon scattering. By reducing the scattering of phonon, they improve properties of epoxy such as thermal conductivity and electrical conductivity. Graphene nanopate (GNP), which forms π-π stacking with LCE, can improve thermal properties of LCE. Also, Carbon nanotube (CNT) with lower electrical percolation threshold compared to GNP can improve electical properites. this study shows the thermal and electrical properties of LCE by comparing the structure of LCEs and the type of fillers.

3PS-272 김윤섭

A Study on Electromagnetic Interference Shielding Effectiveness Performance of Nickel-plated Polyester Nonwoven Fabrics

김윤섭, 박수진† 인하대학교

In this present study, Ni layer were plated on polyester nonwoven fabrics (PNFs) surfaces to obtain good electromagnetic interference shielding (EMI-SE). Through scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), and X-ray diffraction (XRD), it was found that the PNFs surfaces were successfully modified by the Ni plating. The electrical characteristics of the Ni-PNFs was measured using a 4-point probe electric resistivity tester. The EMI-SE of the Ni-PNFs was tested by a EMI shielding analyzer in the frequency range of 0.5 to 1.5 GHz. As a result, the electroless Ni-PNFs shows good electrical conductivity and shows the effect of good electromagnetic shielding. This means that the Ni particles played a key role in providing the additional conductivity.

3PS-273 김예진

Superhydrophobic and Superhydrophilic Solar Oil Evaporators for Cleanup and Collection of BTX

최원산†, 김상헌, 김예진 한발대학교 화학생명공학과

Oily wastewater produced from our daily life and industry poses a threat to ecosystems and human health. Superhydrophobic or superhydrophilic materials have been developed for efficient oil/water separation. The purpose of most oil/water separation is cleanup of spilled oils. A little attention has been focused on collection of spilled oil using oil/water separation techniques. Furthermore, collection techniques of Benzene, Toluene, and Xylene (BTX) that are expensive and highly toxic are very important for environmental and economic reasons. To the best of our knowledge, however, it has not yet been reported. We have developed a novel unmanned evaporation and collection system using solar oil evaporation.

3PS-274 김윤섭

A Study of the Electromagnetic Interference Shielding Effectiveness of Nickel-cobalt Plated Carbon Fibers/Epoxy Composites

김윤섭, 박수진† 인하대학교

In this study, an electroless method was used to obtain good electromagnetic interference shielding efficiency (EMI-SE) of Nickel-cobalt (Ni-Co) plated carbon fibers (CFs)/epoxy composites. The surface properties of the Ni-Co plated CFs were characterized by scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), and X-ray diffraction (XRD). The room temperature volume resistivity of the composites was measured using a four-point probe electric resistivity tester. The EMI-SE of the Ni-Co plated CFs/epoxy was tested by a EMI shielding analyzer. As a result, the electroless Ni-Co plated CFs/epoxy composite shows good electrical conductivity and shows the effect of good electromagnetic shielding. The

Ni-CFs can lead to EMI-SE improvement due to the EMI absorption behavior of the Ni particles.

3PS-275 김영주

Enhancement of Electrical and Dispersion Properties of MWCNT in PEDOT:PSS by Non-covalent Functionalization

김영주, 한미정†, 강영종[1] 한국화학연구원; [1]한양대학교

In this study, pyrene derivatives having 3,4-ethylenedioxythiophene (EDOT) with different linkages (amide (PA1E), ether (PE1E), and urethane (PU1E)) between pyrene and EDOT were synthesized and used to functionalize the surface of MWCNTs via non-covalent method. PEDOT:PSS/functionalized MWCNT nanocomposite solutions were prepared by in-situ polymerization. The electrical and dispersion properties of nanocomposite films prepared from PEDOT:PSS/MWCNT solutions were investigated depending on the type of linkages of pyrene derivatives by 4-point probe method and transmission electron microscopy (TEM), respectively. The sheet resistance of PEDOT:PSS/MWCNT nanocomposites were 22.6 Ω/□ (PA1E), 23.2 Ω/□ (PE1E), 25.2 Ω/□ (PU1E), and 28.2 Ω/□ (pyrene derivative without EDOT, PyPI), respectively. The electrical properties of PEDOT:PSS/MWCNT nanocomposites could be improved with all the pyrene derivatives containing EDOT.

3PS-276 김영경

Investigation on Rheological Properties of Boron Nitride Nanotube Liquid Crystals

김영경, 임홍진, 박성준[1], 장세규† 한국과학기술연구원; [1]전북대학교 고분자 나노공학과

Fiber fabrication by wet-spinning of carbon nanotubes-liquid crystal (CNT-LC) has been drawing attention due to superior properties. Meanwhile, the wet-spinning of boron nitride nanotubes (BNNTs) with high oxidation resistance, high specific mechanical strength, high thermal conductivity, piezoelectric, and high neutron shielding, a structural analogue of CNTs, has been remained as a challenging goal due to difficulty in achieving stable dispersion of BNNTs at high concentration enough to form lyotropic LC. In this study, we report a dispersing stabilizer for BNNTs providing an excellent stability in aqueous solution even at high concentration over 20 wt% of BNNTs. BNNT-LC observed by polarized optical microscopy were analyzed systematically. Furthermore, the rheological properties and the microfluidic properties of the BNNT-dopes were investigated to obtain the information on phase transition concentration into nematic phase for better understanding on wet-spinning of BNNT fibers.

3PS-277 김시형

Moisture-powered Tensile Carbon Nanotube Composite Actuator

김시형† 한국생산기술연구원

최근에 빛, 열, 전열, 온도변화 등 다양한 에너지원으로 구동하는 섬유형 엑추에이터가 개발되었다. 특히, 꼬임 기반의 섬유형 엑추에이터는 기존 엑추에이터보다 큰 파워, 일률을 가지며 실용적인 엑추에이터가 개발되었다. 이 흐름속에서 우리는 탄소나노튜브에 습도에 감응하여 부피변화가 큰 폴리머를 컴파짓하고 이를 꼬아 섬유형태로 엑추에이터를 제조하였다. 그리고 이 엑추에이터를 기반으로 외부 습도에 감응하여 기공이 조절되는 스마트 텍스타일을 개발하였다.

3PS-278 김시몬

Mechanically Guided Post-Assembly of 3D Electronic Systems

김시몬, 김봉훈† 숭실대학교

우리는 FPCB(Flexible Printed Circuit Board) 플랫폼을 기반으로 하는 기존의 평면 디바이스를 3D 구조를 갖춘 디바이스로 변환하기 위한 조립 과정(assembly process)을 연구하였다. 이러한 조립 과정에는 FPCB 기판의 정확한 위치에 가해지는 힘으로부터 파생된 평면 버클링 운동으로 인해 유도된 기하학적 변환이 포함된다. 3D 구조의 형태를 가역적으로 변환시키는 것은 구조적 뿐만 아니라 기능적 튜닝도 가능하게 하였으며 3D 구조의 변화를 통해 광학 감지 및 무선 주파수 조정에서의 전자기 작동 조정이 가능한 것을 확인할 수 있었다. 또한 기존의 다양한 전자, 광전자 및 에너지 장치의 구성요소와 자연스럽게 호환되는 것을 확인할 수 있었으며 종합적으로 이러한 기능을 통해 3D 동적 플랫폼, 생물학적 시스템 등 최첨단 구성요소를 활용하는 다기능 시스템에서의 새로운 기회를 제시하고 있다.

3PS-279 김수연

Poly(N-isopropylacrylamide)/Gallium Composite Films Prepared by Melt-Crystallization Based Methods

김수연, 이종휘† 중앙대학교

The hydrogel's flexible and sensitive properties to external stimuli can be applied to biocompatible actuators or soft robotics. Accordingly, a lot of basic research has been actively conducted. However, the hydrogel itself cannot exhibit bending behavior and is difficult to control motion. In this study, a novel actuator is made using a temperature sensitive hydrogel, poly(N-isopropyl acrylamide) (PNIPAm) and a liqiud metal, gallium (Ga). Both of these substances are characterized by temperature sensitivity. PNIPAm has a lower critical solution temperature (LCST) (32 ℃) and Ga has a low melting point (29.76 ℃). Gallium has high thermal conductivity, and volume change occurs through phase change. It is therefore designed to be more sensitive to temperature changes. This film is suitable for temperature sensitive actuators as well as for quick reactions and fine movements such as artificial muscles, powerless pumps, and drug delivery.

3PS-280 김성희

The Moisture Barrier Film Using Thermal Epoxy Resin and Atomic Layer Deposition

김성희, 이준영†, 최명수 성균관대학교

The organic luminescent material easily loses its luminescence once it is exposed to moisture, and the highly reactive cathode with low work function will be easily corroded by moisture and oxygen. To solve this problem, We demonstrate flexible moisture barrier film encapsulation for organic electronics using low temperatures process method. To realize the flexible barrier, the best practice is to make the barrier as multilayer structure. Low temperatures process applied the atomic layer deposition (ALD) method and epoxy coating method to deposit barrier films. Organic-inorganic layers work as moisture barrier and very thin thickness provide the flexibility and planarization. The moisture permeation characteristics of the optimized Al_2O_3/4-component adhesive multilayer films were finally measured using Ca-test's WVTR measuring instrument and WVTR values lower than the detection limit of the measuring device were obtained.

3PS-281 김수연

Electromagnetic Interference Shielding Performance of MXene-Decorated Cellulose Papers and Cotton Fabrics

김수연, 정영규† 충남대학교

Owing to the increase of electromagnetic pollution issues arising from the fast-growing development and need for electronic devices, the demand for lightweight materials with high electromagnetic interference shielding performance has become more urgent. Recently, MXenes, Ti3C2Tx, as conductive 2D nanomaterials have been considered for potential EMI shielding materials. We herein demonstrate a simple dip-coating approach for fabricating MXene dip-coated cellulose papers and cotton fabrics with high EMI shielding performance. For the purpose, substrates were repeatedly immersed into dispersion of MXene. The morphological and microstructural features of all samples were characterized by using SEM, EDS, and XRD. The electrical conductivity and EMI shielding performance were evaluated by using a resistance meter and network analyzer, respectively. The EMI shielding mechanism and effectiveness of all samples were analyzed by considering the microstructure and dip-coating cycle number.

3PS-282 김성황

Interfacial Properties of Graphitic Carbon Nitride/Nanodiamond Composites Toward Synergistic Improvement of Photocatalytic Degradation of Organic Contaminants

김성황, 박수진† 인하대학교

Photocatalytic degradation of volatile organic compounds such as Rhodamine B (Rh B) is considered as one of a promising strategy for resolving environmental pollution problems. Graphitic carbon nitride (g-C3N4) has been widely used in various photocatalyst applications. However, compared to conventional metal-based photocatalysts, its photocatalytic activity is still low because of the low mobility of carriers. In this study, g-C3N4/nanodiamond (ND) hybrid composites were fabricated via a facile one-step heating strategy. The optimal g-C3N4/ND hybrid composites with 1.0 wt% ND loading content show the high performance in Rh B degradation under visible-light irradiation, which is more than about 2 times higher than that of the g-C3N4. In addition, reutilization experiments proved that the g-C3N4/ND composites have good stability and reusability.

3PS-283 김성황

Effect of Dry-ozonized Graphitic Nanofibers on Interfacial Properties of Carbon Fibers-reinforced Composites

김성황, 박수진† 인하대학교

A graphitic nanofiber (GNF) surface was successfully modified using the dry-ozone treatment for use as the reinforcement for carbon fiber-reinforced composites (CFRPs). To evaluate the efficacy of the proposed method, CFRPs are fabricated at different weight contents along with two other types of composites (pristine GNFs and dry-ozonized GNFs). We denoted the specimens of GNF/CF/epoxy composites and OGNF/CF/epoxy composites as GCE and OGCE composites, respectively. The mechanical properties including ILSS and KIC were studied for composites to evaluate their efficiency. The measured highest ILSS and KIC value reached 34.2 MPa and 55.4 MPa.m1/2 in the 0.8 wt% OGCE composites, equating to enhancements of 22.6 and 14.2% compared to the 0.8 wt% GCE composites.

3PS-284 김성황

Thermal and Mechanical Properties of Nickel Plated Basalt Fiber-reinforced Composites

김성황, 박수진† 인하대학교

This study, nickel plated basalt fiber-reinforced composites were fabricated. Basalt fibers were treated by acid and electroless nickel plating was applied on the treated basalt fibers. mechanical properties and thermal properties of the prepared composites were investigated according to plating time. The plating time controlled thickness of nickel on treating basalt fibers. FT-IR and XPS were used to invest effects of acid treatment and electroless nickel plating. The fracture toughness was calculated by the critical stress intensity factor (KIC). The morphology was observed by scanning electron microscope (SEM). A thermal weight analyzer (TGA) was used to invest thermal stability. The results show that nickel plating on basalt fibers affects thermal and mechanical properties of basalt fiber-reinforced composites.

3PS-285 김성황

Effect of Microcrystalline Cellulose on the Fracture Toughness of Epoxy Nanocomposites

김성황, 박수진† 인하대학교

In this study, microcrystalline cellulose (MCCs) were treated with HNO_3/H_2SO_4. MCCs

were observed for surface properties using FT-IR and X-ray photoelectron spectroscopy and were used in epoxy composites. In addition, the mechanical properties of the epoxy nanocomposites were investigated by measuring the fracture toughness (K_{IC}). The related reinforcing mechanisms were also analyzed, and the enhancements on mechanical properties was mainly be attributed to interfacial interlocking effect.

3PS-286 김상준

Synthesis of Nanomaterials via Low-demensional Polymer Templates

김상준† 한국화학연구원

Nanomaterials are chemical substances that are synthesized at a very tiny scale. Because nanomaterials developed to exhibit novel characteristics compared to the same materials, they have abundant applications in chemical sensors, energy storage, electrochemical reactions, etc. In this study, we investigate the synthesis of nanomaterials functionalized with various catalysts using low-dimensional polymer templates. We discuss the various shapes of polymer templates and synthetic techniques to demonstrate a noble synthetic method to prepare highly porous nanostructures with well-dispersed nanoscale catalysts, which are highly promising materials for applications relying on surface reations such as chemical sensors.

3PS-287 김민희

Edge-Propylene Graphitic Nanoplatelets as a Reinforcement for Polypropylene

김민희, 전인엽† 원광대학교 창의공과대학 화학융합공학과

Edge-propylene graphitic nanoplatelets (EPGnPs) are prepared via a mechanical chemistry with solid graphite and propylene gas as an efficient and economical additive for polypropylene (PP). Due to the remarkable dispersibility of EPGnPs in organic solvents (e.g., xylene), PP/EPGnP nanocomposites are made easily through the solution mixing method. PP/EPGnPs nanocomposites show far superior mechanical properties (e.g., tensile strength, yield strength, Young's modulus and tensile toughness) and thermal stability to the raw PP. It is due to the remarkable properties of EPGnPs in itself as well as the enhanced affinity between PP and propylene-functional groups at the edge of EPGnPs. In results, EPGnPs will be a new candidate for a reinforcement to improve the polymer properties because of excellent properties, especially compatibility, economical and mass-production of graphitic nanoplatelets (GnPs).

3PS-288 김민준

Morphology Control and Corresponding Performance of Nitrogen Doped Hollow Carbon Nanocage Assisted Co_9S_8@MoS_2 for Overall Water Splitting

김민준, 유필진† 성균관대학교

There have been tremendous efforts to combine multiple active species into hybrid system that one has high activity for HER and the other for OER. The electrochemical performance of most hybid systems can be improved by synthesizing active species on nanostructured template which enables to maximize their active sites. To further increase the performance of hybrid system, calcination process is frequently conducted which enhances electrical conductivity and crystallinity of the obtained hetero nanostructure. During this process, active species experience changes in their morphology and the morphological changes generally lead to considerable change in electrocatalytic performance. In this work, we prepared nitrogen doped hollow carbon nanocage with Co_9S_8 and MoS_2. The structure and performance change of the as-synthesized samples were investigated thoroughly and thus the morphology and interface of the sample were excellently modified.

3PS-289 김민석

Improvement of Compatibility and Impregnation for PA6/Carbon Fiber Thermoplastic Composites

김민석, 이승준, 박규환† HDC현대EP

Generally, Carbon fiber reinforced polymers are high strength, high elasticity and lightweight materials. So many researches have been conducted on carbon fiber reinforced composites in the aircrafts and automobiles industries. In particular, This composites had a lot of advantages of high speed forming and easy postprocessing. However, there is a poor compatibility between carbon fiber and thermoplastic polymers. To solve this problems, there are so many methods such as surface treatment of carbon fiber and using proper additives. This study inform the mechanical properties between Polyamide6 and surface sizing treatment type of carbon fiber. And physical properties were compared using dendritic polymer which gives free volume within the polymer matrix. Experimentals were performed by twin screw extruder and screw configuration were designed best combination for mixing efficiency between matrix and additives.

3PS-290 김문수

Preparation of Thermoplastic Starch/Poly(butylene adipate-co-terephthalate) Blend with Maleic Anhydride as Compatibilizer

김문수, 김태희, 서관호† 경북대학교

Poly(butylene adipate-co-terephthalate) (PBAT) is a promising biodegradable polymer based on fossil resources, with high flexibility and softness. However, the price of PBAT is too high, thus blending with low-price resins is required. Starch is one of the most abundant natural food sources, has been considered an attractive biopolymer filler because of its low cost, high biodegradability. In this study, thermoplastic starch (TPS) is prepared by plasticizing tapioca starch with glycerol and maleic anhydride in order to enable melt processing, then blended with PBAT to achieve PBAT/TPS composites. And effect of maleic anhydride on TPS and performance of PBAT/TPS composite are evaluated by Fourier transform infrared spectroscopy (FT-IR), melt flow index(MFI), scanning electreon microscopy (SEM), water contact angle, thermal and mechanical analysis. The experimental results show that maleic anhydride improve processability of TPS and promote interfacial adhesion between TPS and PBAT phase.

3PS-291 김동현

Biomass-derived Bulk Catalyst Electrodes Embedding Nitrogen-coordinated Cobalt Species on Miscanthus x Giganteus for Hydrogen Production by Water Splitting

김동현, 안성훈†, 박예은 조선대학교

With the rapid development of highly efficient and eco-friendly non-noble electrocatalysts for hydrogen production by water splitting, new opportunities are opening up for biomass-derived nanomaterials. Herein, We develop a "delignification-impregnation-carbonization" strategy to fabricate uniformly dispersed cobalt-embedding carbon nanotubes (CNTs) anchored on miscanthus x giganteus stalks. Because of raw miscanthus's abundant micropore structure, the bulk catalyst electrode possess the hierarchical porous structure composed of micro/mesopores. This porous structure has large surface area which are beneficial to the exposure of active sites and rapid transportation. Consequently, the resultant electrocatalyst displays high bi-functional activity with an overpotential of ~350 mV toward OER and ~62 mV toward HER to reach the current density of 10 mA cm^{-2}. This work provides a new way for pushing forward the direct conversion of non-useful biomass to efficient catalyst bulk electrode.

3PS-292 김규남

친환경 열가소성 PP 절연소재의 기계적/전기적 특성

김규남† 현대EP

일반적으로 중압 이상 전력 케이블의 절연소재는 가교 Polyethylene(XLPE)이 사용된다. XLPE는 우수한 절연특성에도 불구하고 가교 공정에서 메탄가스, Acetophenone 등의 유해물질이 발생하며 열경화성 고분자로 재활용이 불가능한 문제가 있다. 이로 인해 비가교 Type의 친환경 절연소재 요구가 증대되고 있으며 관련 연구도 활발히 진행되고 있다. 본 연구에서는 재활용이 가능한 열가소성 Polypropylene(PP)를 Base Resin으로 하여 이에 따른 전기적 절연특성 및 기계적 물성을 확인하였다. 또한 원자재의 절연파괴강도를 측정하여 각 소재의 절연특성을 확인하였고 이를 Compound에 적용할 때 미치는 영향을 확인하였다.

3PS-293 김광섭

자동차 판넬 부품의 경량화를 위한 복합소재 연구

김광섭, 이재용, 김승호† 덕양산업

자동차 업계에서는 무게를 줄여야 경쟁에서 살아 남을 수 있을 정도로 경량화에 관심이 높다. 해외 주요 국가에서 환경법규를 강화하면서 배출가스를 줄이고 연비나 주행거리를 높여야 한다. 이를 달성하기 위한 가장 효과적인 방법으로 차량 경량화이다. 2000년대 초반까지 주로 사용하던 금속 재료는 우수한 물성으로 현재까지도 사용되고 있지만 무게가 무거워 경량화에 불리하다. 복합소재는 소재 배합에 따라 다양한 특성을 갖게 되어 적용되는 부품에 적합한 소재 최적화를 통해 금속 대체뿐만 아니라 중량 절감도 가능하다. 본 연구에서는 스틸 적용 판넬을 삭제 및 인서트 공법을 사용하지 않고 자동차 판넬에 적용할 수 있는 복합소재 연구를 진행하였다. 타겟 부품인 테일게이트의 강성과 강도를 양산 부품과 동일한 수준으로 확보하기 위해 소재 최적화뿐만 아니라 인너 판넬과 아우터 판넬 각각 SMC 공법, 사출 공법을 이용하여 경량화율을 극대화하였다. 사의 : 본 연구는 산업통상자원부에서 공고한 경제협력권육성사업(과제번호: P0002292)의 연구 수행으로 인한 결과물임을 밝힙니다.

3PS-294 김건우

Extremely Fast Electrochromic Supercapacitors Based on Mesoporous Wo_3 Prepared by Evaporation-Induced Self-Assembly

김건우, 최예정, 김진곤† 포항공과대학교

Mesoporous metal oxides consisting of fully interconnected network structure with small pores (20-50 nm) have high surface area and reduced ion intercalation distance for high-performance electrochromic supercapacitors (ECSs). Herein, we introduce sub-1 s ultra-fast ECSs based on the amorphous mesoporous WO_3 prepared by EISA. The performance of ECSs with mesoporous WO_3 exhibits larger optical modulation, ultra-fast switching speeds, and high areal capacitance even at a high current density. In addition, excellent device stability during cyclic coloration/bleaching and charging/discharging is observed under fast response condition. Moreover, we fabricated a patterned mesoporous WO_3 for ECS displays (ECSDs) via printing assisted EISA (PEISA). The resulting ECSDs can serve as electrochromic reflective displays that can change color according to the stored energy level and also can be used as portable energy-storage devices, simultaneously.

3PS-295 김광섭

전기자동차용 복합소재 배터리팩 커버 개발

김광섭, 박찬호, 김성지† 덕양산업

친환경 자동차는 배출가스, 온실가스, 연비 규제 등과 같은 정책으로 인한 완성차 업체의 개발 차종수 및 국내외 전기자동차의 판매량이 증가 된가 있다. 친환경 자동차는 크게 HEV, PHEV, BEV, FCEV로 분류되는데 HEV와 PHEV는 화석 연료가 사용되어 배터리의 용량이 적다. FCEV의 경우 화석 연료는 사용되지 않지만 수소연료를 사용함으로써 고용량의 배터리 대신 수소탱크가 적용되어 상대적으로 구조가 복잡하다. 순수 전기차인 BEV는 배터리만을 구동원으로 사용하는데 주행거리 증가를 위해서는 높은 용량의 배터리가 필요하지만 동시에 중량의 증가로 이어져 전력 효율이 나빠지게 된다. 본 연구에서는 고용량의 배터리를 적용하기 위해 배터리팩 커버에 적용하기 위한 복합소재를 연구하고

자 한다. 기존 스틸이나 알루미늄 압출을 통해 제작되지만 배터리팩 커버용 복합소재를 개발하여 중량 절감과 동시에 단열 성능을 높여 열 관리 성능을 끌어 올릴 수 있는 복합소재 연구를 진행하고한다. 사의 : 본 연구는 산업부에서 지원하는 산업기술혁신사업(과제번호: 20011622)의 연구수행으로 인한 결과물임을 밝힙니다.

3PS-296 김강한

Anti-scratch and Anti-fingerprint Hard Coating for Foldable Cover Window

김강한, 정용철† 한국생산기술연구원

In this study, we present anti-scratch as well as anti-fingerprint flexible hard coating fabricated by single-component sol-type polysilsesquioxane resin. In general, imparting the functionality on hard coating pays extra process time and cost that cause increase in production unit price, such as surface acid treatment followed by fluorine-silane coating was performed to increase the hydrophobicity of polysilsesquioxane hard coating. In this work, we provide a hard coating material that can be applied to a foldable cover window through a single coating process. By synthesizing a core nano-sol material having one-component super water-repellent properties, high hardness, and high flexibility at the same time, production cost and time can be saved.

3PS-297 김광섭

에너지 흡수율 향상을 위한 카울크로스바 최적화 연구

김광섭, 이재용, 곽성복, 이동기† 덕양산업

카본 파이버와 같은 복합소재의 개발로 스틸보다 우수한 강도를 갖는 엔지니어링 플라스틱의 개발이 활발해지고 다양한 연구를 통해 각 부품에 적합한 소재를 개발함으로써 스틸 대체 부품 및 경량화 부품이 개발되고 있다. 요구되는 물성에 적합한 베이스 레진과 첨가제를 사용하여 새롭게 소재를 구성하여 부품의 성능을 개선하고 있지만 고강도의 복합소재 부품은 일반적으로 취성이 약해 이를 개선하기 위해 Rubber와 같은 첨가제를 사용하여 개선하는 시도가 있었다. 하지만 유리 섬유와 같은 첨가제의 특성으로 신율의 증가폭이 미미하여 변형이 크게 발생되는 부품에는 단독 적용이 어려웠다. 본 연구에서는 자동차 칵핏 모듈을 지지하고 있는 카울크로스바에 적용하기 위한 복합소재와 구조에 대해서 연구하고자 한다. 단순 소재 변경만으로는 다양한 충돌 성능을 개선하기 어려워 에너지 흡수율을 최적화하기 위한 복합소재 적용 카울크로스바의 구조 연구를 진행하고자 한다. 사의 : 본 연구는 산업부에서 지원하는 소재부품기술개발사업(과제번호: 20011130)의 연구수행으로 인한 결과물임을 밝힙니다.

3PS-298 김가영

Effect of Fiber-Matrix Interface on the Properties of Epoxy Composites Consisting of Carbon Fibers Coated with PEI-modified MWCNT by Ultrasonic Process

김가영, 조동환† 금오공과대학교

최근 자동차 연비와 이산화탄소 배출에 관한 이슈가 떠오르면서 자동차 경량화가 요구됨에 따라 탄소섬유강화 플라스틱(CFRP)에 대한 연구가 증가하고 있다. 탄소섬유강화 플라스틱은 가벼우면서도 우수한 기계적, 열적, 물리적 성질을 가지고, 그 물성은 보강재와 매트릭스의 종류에 따라 크게 좌우되며, 탄소섬유와 매트릭스 사이의 계면결합력에 의해 크게 영향을 받는다. 계면결합력을 향상시키기 위해 보강섬유와 매트릭스 사이에 화학결합을 유도하고 계면의 표면적을 증가시킬 수 있다. 본 연구에서는 다중벽 탄소나노튜브(MWCNT)를 PAN계 탄소섬유 표면에 코팅시켜 개질하였다. 이때 아민그룹을 가지고 있는 양이온성 고분자인 polyethyleneimine을 사용하여 MWCNT를 개질시키고, 초음파 분산기술을 사용하여 MWCNT를 탄소섬유에 코팅하였다. 또한 초음파공정에 의한 코팅 시간에 따른 탄소섬유와 에폭시 매트릭스 사이의 계면결합력 변화를 분석하기 위해 압축성형공정으로 제조한 복합재료의 계면특성을 short-beam shear 시험을 통해 층간 전단강도(ILSS)를 측정하고, single fiber microbonding 시험을 통해 계면전단강도(IFSS)를 측정하여 그 결과를 비교하였다.

3PS-299 권혁준

Glycolysis of Polyethylene Terephthalate under Microwave Irradiation with Ethylene Glycol and Zinc Acetate

권혁준, 박재중[1], 이찬민[1], 이준영[1], 황기섭[1,†] 한국생산기술연구원/연세대학교; [1]한국생산기술연구원

The increasing use of disposable plastics were causative of many kind of environmental problems in the world. Hence, researchers were tried to work for depolymerization of plastics, but the depolymerization methods could not easyly applicate to process system, because of too high process temperature and too long times of reaction. Therefore, we were attempt to depolymerization of PET through microwave system for more low-temperature and rapid times of reaction. The PET was glycolysised wiht ethylene glycol, and zinc acetate as reaction catalyst. Also, microwave was irradiated at 1000W by microwave reactor. Finally, glycolysis ratio of PET was verified by FT-IR, NMR and TGA, then yield of producted monomer were calculated by equation.

3PS-300 권민호

Graphene Functionalization for Crosslinking with SBR Matrix Using Polymer Dispersant

권민호, 양지연, 김한영, 한종훈[1], 백현종† 부산대학교; [1]전남대학교

We report the synthesis of poly((styrene-random-(2-azidoethyl acrylate)) through free radical polymerization and azidation for the stable dispersion of graphene. The polystyrene parts anchor on to the reduced graphene oxide (rGO) as a non-covalent functionalization. On the other hand, poly(2-azidoethyl acrylate) parts help in stabilizing as the functionalized rGO (f-rGO) in organic solvents. The SBR/f-rGO composite is finally prepared by the thermal crosslinking of azide groups of the poly(2-azidoethyl acrylate) parts with the unsaturated bonds of rGO and SBR (allyl group and vinyl groups) through nitrene reactions. Thus, a new method of producing of stretchable composites with good dispersion due to the covalent interaction between graphene and SBR has been successfully developed.

3PS-301 고한승

Synthesis of Polymer-grafted Hydroxyapatite Nanofiber for Improving Mechanical Properties and Dispersion in Polylactic Acid Composite

고한승, 이상운, 조재영† 서울대학교

Hydroxyapatite (HA) is the main mineral constituent in human bones and has attracted much attention for biomedical applications. Because of its biocompatibility and osteoconductivity, many researches about the composite of biodegradable polymer and HA composite have been made for implant materials. However, typical HA rod has lowered the mechanical properties in the polymer composite. In this study, HA nanofiber (HA NF) with an aspect ratio of 70 to 100 was synthesized to enhance the mechanical properties, and polylactic acid (PLA)/HA NF composite was fabricated. PLA was additionally grafted to HA NF to improve the dispersion in the polymer matrix and interfacial adhesion. XRD, FT-IR and XPS were carried out for HA NF synthesis and polymer grafting. Mechanical properties such as flexural modulus and strength of the composite were measured. Morphology of the composite was measured to confirm the dispersion of HA NF in polymer matrix.

3PS-302 고태훈

Three Dimensional Porous Binary Metal Oxide Networks for High Performance Supercapacitor Electrodes

고태훈, 김병석† 전북대학교

The development of hierarchical, porous film based current collector has created huge interest in the area of energy storage, sensor, and electrocatalysis due to its higher surface area, good electrical conductivity and increased electrode-electrolyte interface. Here, we report a novel method to prepare a hierarchically ramified nanostructured porous thin film as a current collector by dynamic hydrogen bubble template electro-deposition method. At a first time, we report a porous 3D-Ni decorated with $ZnCo_2O_4$ and Fe_2O_3 by simple, low-cost electrochemical deposition method. The fabricated porous 3D-Ni based electrodes showed an excellent electrochemical property such as high specific capacitance, excellent rate capability, and good cycle stability. The asymmetric solid-state supercapacitor device was fabricated using porous, 3D Ni decorated with $ZnCo_2O_4$ and Fe_2O_3 as the positive and negative electrodes.

3PS-303 고명철

Ring-shaped Titanium Nitride Broadband Absorber of Visible Light with Multiple Patterning of Colloidal Lithography

고명철, 김 준, 김진곤† 포항공과대학교

Light absorber based on plasmonic materials can be used as thermophotovoltaics, energy harvesting, and sensing devices. Noble metal based light absorbers are vulnerable to heat. For these reason, refractory plasmonics using refractory metals and nitride s such as chromium, tungsten, and titanium nitride have been introduced. Among them, TiN has been utilized to replace gold as solar heat generators and photodetectors because its comparable plasmonic properties in the visible and NIR regimes, better heating efficiency. For the practical applications, we fabricated TiN based nanoring structures over a large area using multiple patterning of colloidal lithography. The absorber shows broadband (300-900 nm) and efficient (95.3%) absorption. This broadband TiN absorber will have application in high temperature photonic devices such as solar thermophotovoltaics and optical circuits.

3PS-304 강영정

Preparation and Mechanical Properties of Epoxy/Hollow Microsphere Composites for Cryogenic Conditions

강영정, 이영철† 한국생산기술연구원

Perlite and polyurethane insulation materials widely using in the LNG and cryogenic industry have poor insulation properties due to low strength and dimensional deformation. It is necessary to develop a new insulation material that can withstand the load of cryogenic thermal stress and minimize the change in insulating properties. This study is development of epoxy based composite insulation for application to pipelines transporting liquefied natural gas (LNG) of about -163 ℃. In order to sustain very low temperature and improve the insulation properties, we were used hollow micro sphere which low specific gravity and excellent insulation properties. In particular, The cryogenic insulation properties of commercial polyurethane foam insulation and developed insulation were compared by applied to LNG pipeline.

3PS-305 강영아

Edge-Styrene Grafted Graphitic Nanoplatelets as Reinforcing Additive to Polystyrene

강영아, 전인엽† 원광대학교 창의공과대학 화학융합공학과

As an efficient reinforcing additive to polystyrene (PS), edge-styrene grafted graphitic nanoplatelets (StGnPs) were prepared by the in-situ mechanochemical reaction between graphite and styrene. The resultant StGnPs exhibited excellent properties with good dispersibility in organic solvents. StGnP/PS nanocomposites were prepared via a facile solution process. Compared to pure PS, the StGnP/PS nanocomposites exhibited significantly enhanced mechanical properties (e.g., tensile strength, yield strength, Young's modulus, and tensile toughness) along with improved thermal stability. The nanocomposites showed efficient load transfer from the PS matrix to the StGnPs because of the good dispersibility and compatibility of the StGnPs in the PS matrix.

3PS-307 강동혁

Graphitic Pyropolymer-Based Nanosubstrate for Rechargeable Mg Metal Batteries

강동형, 하 손, 윤영수† 고려대학교
The high volumetric energy density of rechargeable Mg batteries (RMBs) gives them a competitive advantage over current Li ion batteries, which originates from the high volumetric capacity (~3833 mA h cm^{-3}) of bivalent Mg metal anodes (MMAs). On the other hand, despite their importance, there are few reports on research strategies to improve the electrochemical performance of MMAs. In this study, we demonstrated that a well-designed graphitic pyropolymer-based nanosubstrate (GP-NS) plays an important role in the electrochemical Mg metal deposition/stripping performance of MMAs for RMBs. The performance of the fabricated GP-NS greatly surpassed those of conventional metal substrate-based anodes. In a galvanostatic Mg metal deposition process, the initial nucleation overpotential and plateau overpotential were reduced significantly with GP-NSs compared to those of the Mo-Anode.

3PS-308 Vu Minh Canh

Ultrathin Thermoconductive and Electrically Insulating Exfoliated Graphene Fluoride Paper for High-performance Thermal Management Materials

Vu Minh Canh, Nhat Anh Thi Thieu, Mani Dineshkumar, 김준범, 정태형, 김성룡† Korea National University of Transportation
An ultrathin exfoliated graphene fluoride (GFS) film as the thermal management materials for wearable electronic devices, which possesses superior thermal conductivity, high electrical resistivity, and satisfactory flexibility were prepared. Graphite fluoride powder was exfoliated into GFS by ball milling method, resulting in the fabrication of GFS film via the use of vacuum-assisted filtration. The GFS films exhibit a tunable thermal conductivity by changing the thickness of GFS films. The GFS film at the thickness of 10 μm exhibits an excellent in-plane thermal conductivity of 242 $W \cdot m^{-1} \cdot K^{-1}$. The outstanding in-plane thermal conductivity stems from the high intrinsic thermal conductivity of GFS and highly anisotropic aligned structure of GFS. The GFS film has a potential opportunity for the fabrication of multifunctional flexible thermal management materials in commercial portable electronics. This study is supported by Korea National University of Transportation 2020.

3PS-309 Shahina Riaz

A Comparative Study on the Nanoinclusion Effect of MoS_2 Nanosheets and MoS_2 Quantum Dots on the Fracture Toughness and Interfacial Properties of Epoxy Composites

Shahina Riaz, 박수진† Inha University
The reinforcement effect of molybdenum sulfide (MoS_2) nanosheets on the mechanical properties of epoxy (EP) composites has been extensively studied. However, the effect of MoS_2 quantum dots (MQDs) on the mechanical properties of EP composites has not been reported yet. In this study, we exfoliated bulk MoS_2 into nanosheets (MNS) and MQDs, and use them as reinforcing materials to fabricate a series of high performance EP composites. The MNS and MQDs were dispersed in the EP matrix up to 1 wt.%. The reinforcement effect of MNS and MQDs on the mechanical properties of EP composites was studied in terms of interfacial properties, fracture toughness, and impact strength. Results demonstrated that MQDs remarkably enhance the fracture toughness, flexural strength, modulus, impact strength and interfacial interactions compared to neat epoxy and the one reinforced with MNS.

3PS-310 QUYEN VU THI

Reduced Graphene Oxide Grafted with Amine-functionalized NiO/ZnO for Advanced Attenuation of Electromagnetic Wave

QUYEN VU THI, 손대원† Hanyang University
The explosive wireless technology by utilizing electronic systems in civil and military application unavoidably generate the pollution known as the electromagnetic interference, so effective absorbers are highly in demands. In this work, a hybrids constructed from reduced graphene oxide (rGO) and amine-functionalized NiO/ZnO was prepared via *in situ* amidation reaction. The rGO sheets were found to successfully anchor on NiO/ZnO particles. The hybrid displayed an excellent microwave absorbing performance in polystyrene matrix at 30 weight percentage. The minimum reflection loss reached up to −42.5 dB at 13.2 GHz at the coating thickness of only 2.15 mm with a effective bandwidth of 4.5 GHz. The grafting of rGO on NiO/ZnO particles not only induced a high specific surface area, but also benefited synergistic effects for better electromagnetic wave dissipation due to the well-matching of dielectric loss and magnetic loss components caused by their intrinsic properties.

3PS-311 Shahina Riaz

Enhanced Thermal and Mechanical Properties of Epoxy Composites at Ultra-low Loading of Functionalized MoS_2 Nanosheets

Shahina Riaz, 박수진† Inha University
In this study, single-step branched polyethyleneimine (PEI)-assisted exfoliation of molybdenum sulfide nanosheets (MoS_2-PEI) was carried out. These functionalized MoS_2-PEI nanosheets were employed as toughening agents for epoxy composites. The loadings of nanosheets were kept lower than 1 wt.%. The mechanical and thermal properties, and interfacial interactions of epoxy composites were investigated. The epoxy composites shown ~67% and ~101% enhancements in fracture toughness (KIC) and in fracture energy (GIC) at nanosheets loadings as small as 0.09 wt.% (EP/MoS_2-PEI-0.09), KIC shows direct linear relationship with the surface free energy and is highest at 52 $mJ.m^{-2}$ for the EP/MoS_2-PEI-0.09 composite. However, the surface free energy values of EP/MoS_2-PEI-0.16 and EP/MoS_2-PEI-1 composites decreased to 48 $mJ.m^{-2}$ and 45 $mJ.m^{-2}$. The overall flexural modulus (E) and strength (σ) were not highly responsive to the addition of the MoS_2-PEI nanosheets.

3PS-312 Pradeep Sambyal

Lightweight MXene/CNT Aerogel for Electromagnetic Interference Shielding

Pradeep Sambyal, 구종민† Korea Institute of Science & Technology
EM pollution has become subject of great concern for the unperturbed working of all electronic systems, medical, scientific and defense equipment. Lightweight composites with the excellent conductivity and sufficient mechanical properties has attracted more attention for electromagnetic interference shielding. In this study, 3D porous Ti3C2/CNT aerogel has been fabricated via bidirectional freeze drying method for the exceptional EMI shielding. The synthesized MXene/CNT aerogels with CNTs content reveals excellent EMI SE of 104 dB with the thickness of 3 mm at 12.4 GHz frequency. The synergistic effect of lamellar and porous structure comprehensively contributes to the outstanding electrical conductivity and superior EMI shielding effectiveness of the aerogels. As designed hybrid aerogels with outstanding electrical conductivity, good mechanical strength and superior EMI shielding performance is a capable contender against the electromagnetic interference.

3PS-313 Shahina Riaz

Epoxy Composites with Functionalized Tungsten Disulfide Nanoplatelet Additives

Shahina Riaz, 박수진† Inha University
We present a two-dimensional WS_2-based material as a reinforcement additive to produce thermally stable, mechanically strong, and light-weight epoxy (EP) composites. An aqueous melamine solution was used to exfoliate the bulk WS_2 into nanoplatelets while simultaneously functionalizing them to obtain N-WS_2 nanoplatelets. The results demonstrated that the surface free energy of EP composites had been significantly increased after the incorporation of N-WS_2 nanoplatelets into EP matrix and increases with increased loading of N-WS_2 nanoplatelets up to a maximum value of 54.38 $mJ.m^{-2}$ for the composite containing 0.18 wt.% of N-WS_2 nanoplatelets, suggesting stronger interfacial interaction between EP and N-WS_2. The mechanical properties of the EP composites were analyzed and demonstrated 55%, 101%, 44%, and 15% improvements in fracture toughness, fracture energy, flexural strength, and flexural modulus, respectively, for the composite comprising 0.18 wt.% N-WS_2 nanoplatelets.

3PS-314 Nhat Anh Thi Thieu

Vertical Alignment of Copper Nanowires Network and the Effect of Copper Nanowires Aspect Ratio on the Thermal Conductivity of Epoxy Composites

Nhat Anh Thi Thieu, 김성룡†, Vu Minh Canh, Mani Dineshkumar, 정태형, 김준범 한국교통대학교
In this work, the vertical alignment of copper nanowires (CuNWs) network was prepared by the support of cellulose nanofiber via the ice-templating method. Also, the thermal conductivity of epoxy composites was investigated basing on the effect of aspect ratio (A/R) of CuNWs. The thermal conductivity of epoxy composites reached the highest value of 0.79 W•m−1•K−1 at 1.12 vol% of CuNWs loading in the case of high A/R, which corresponded to an enhancement of 365% as compared to that of the pure epoxy. To demonstrate the application of epoxy composites in heat dissipation, the change of surface temperature on a hot plate as a function of heating time was recorded by using an infrared camera. This study provides an insight into the fabrication of thermally conductive composites with the potential to be applied in thermal dissipating materials of electronic devices.

3PS-315 Maulida Zakia

Mussel-Inspired Synthesis of Heterogeneous Metal Nanoparticles as Efficient Photocatalyst

Maulida Zakia, Merreta Noorenza Biutty, Farris Hilmyafif Elli, 유성일† Pukyong National University
The precise control of the size, morphology and composition of nanoscale objects represent a powerful approach for producing materials with outstanding properties. For instance, heterogeneous nanomaterials with well-defined structures consisting of different metal nanoparticle, i.e. gold and silver nanoparticles have been extensively explored because of their distinctive properties, leading to their enormous applications in many fields such as catalysis, photothermal therapy, and tissue imaging. Herein, we prepare heterogeneous metal nanoparticle assemblies by exploiting the mussel-inspired polydopamine (PDA) approach. We modified the surface of Au NPs with a nanolayer of PDA under alkaline condition. Thus, PDA layer can serve as reduction agent for in situ generation of Ag NPs on the surface of PDA-modified Au NP. In addition, we further investigated the photocatalytic activity of the final assemblies for the reduction of 4-nitrophenol in the presence of excess sodium borohydride.

3PS-316 Bishweshwar Pant

Ag-modified Graphene Oxide Reinforced Electrospun Polyurethane Nanofibers with Antibacterial Performance

Bishweshwar Pant, 정선준[1], 박미라† 우석대학교; [1]전북대학교
Silver doped functionalized reduced graphene oxide (Ag-RGO) nano-sheets were synthesized and then assembled into the polyurethane nanofibers (PU NFs) via electrospinning technique. Various characterization techniques were employed to confirm the distribution of GO sheets along with the Ag nanoparticles in the PU nanofibers. The antibacterial performance of the as-prepared nanofibers (Ag-RGO@PU NFs) membrane was tested against Escherichia coli (E. coli) bacteria and it exhibited a very strong bactericidal activity. It can be anticipated that the Ag-RGO@PU NF composite can be used in various applications such as wound

dressing, biofilm, and the coating of the biomaterials.

3PS-317 Bishweshwar Pant

Silver Nanoparticles Embedded Polyurethane Nano-Fiber/Net Structured Membrane via One-step Electrospinning

Bishweshwar Pant, 박용균[1], 박미라[†] 우석대학교; [1]전주비전대학교

Herein, we proposed a new and straightforward route to prepare Ag NPs assembled spider-net like polyurethane nanofibers mats as a potential antibacterial medium. The addition of $AgNO_3$ and tannic acid in a PU solution prior to the electrospinning resulted into the formation of Ag NPs embedded spider-net like morphology of PU nanofibers. The antibacterial performance of the as obtained composite nanofiber membrane was tested against Staphylococcus aureus (S. aureus) and Escherichia coli (E. coli) bacteria. The composite fibers showed good antibacterial behavior against both S. aureus and E. coli bacteria. In addition, the cytocompatibility and cell behavior were studied by using fibroblast cells and the nanofiber membrane showed good cytocompatibility.

3PS-318 Bishweshwar Pant

Sound Absorption and Insulation Properties of Electrospun Nylon-6 and Polyurethane Nanofibre Mats

이은정, 신혜경[1], Bishweshwar Pant[2], 박미라[2,†] 지리산한지; [1]전주대학교; [2]우석대학교

Nylon-6 and polyurethane nanofibres membrane were prepared by electrospinning technique and glued to a polyurethane foam to study the sound absorption and insulation behavior. An impedance tube was used to measure the sound absorption and airborne sound insulation. The results obtained from the sound absorption and airborne sound insulation tests indicated that the pristine electrospun nanofibres of nylon-6 and PU have very low acoustical performance. However, when applied alongside the porous sound material, the resulting hybrid structure showed highly enhanced performance. We believe that this study can broaden the application of electrospun nanofibres for sound pollution control.

3PS-319 Bishweshwar Pant

Mechanical and Optical Properties of Cyclic Butylene Terephthalate/Nylon-6,6 Composites

김승근, 권오훈[1], 박용완[1], 문승찬[2], Bishweshwar Pant[3], 박미라[3,†] 지리산한지; [1]ECO융합섬유연구원; [2]나눔; [3]우석대학교

Herein, we prepared cyclic butylene terephthalate (CBT)/Nylon-6,6 composite with improved mechanical and optical properties. The formation of hydrogen bonds between CBT and nylon-6,6 molecules results enhancement of the mechanical property of the composite. In addition, the high optical transmittance of the composite was also achieved. The enhancement in the mechanical and optical properties of the composite indicated that the strategy presented in this work may helpful for the preparation of a new type of composite for making transparent substrate that can find applications in various fields such as electronic devices, flexible display, solar cells, etc.

3PS-320 류승완

Improved Tribological Properties of TPEE/EEG Nanocomposite through Extrusion Molding

류승완, 이경진[1,†] 한국화학연구원/충남대학교; [1]충남대학교

3D printing technology, also known as Additive Manufacturing (AM), is revolutionizing the manufacturing industry by directly producing products based on technological advances such as the development of the internet, software, and computing power. Also, the range of applications has been expanded from personal desktop printers to countless industries, including electronics, automobile, medical, and aerospace. Abrasion resistance is a property that a material can resist damage from wear. Such materials are used in various fields such as tiers, bearing, brake pads, shoe outsole, etc., and it is necessary to develop high abrasion-resistant materials for industrial use. Conventionally, carbon black has been used as an abrasion-resistant reinforcing filler, and its surface treatment and dispersing agent mainly have been studied. It is possible to improve the dispersibility of filler in the polymer matrix through surface modification, however, it has limitations, so it is necessary to study the structural aspects of the filler. In this study, high abrasion resistant composite with electrically exfoliated graphite (EG) was fabricated, as a new material for applications of 3D printing. Carbon materials were introduced to thermoplastic polyester elastomer (TPE) via multi-extrusion processes. The composites filled with EG and surface modified EG showed improved abrasion resistance compared with neat polymer and carbon black composites. Since EG has a layered structure like graphene and has a high aspect ratio, it is more advantageous than carbon black. In addition, various types of EG/TPE composite specimens such as tires and insoles were printed through the fused deposition modeling process. We expect that the composites and 3D printing technology could be applied for customized personal sports and leisure products requiring abrasion resistance.

포스터 발표 (IV)

전력산업분야 고분자 복합소재 개발 및 응용

4PS-1 이현지

Fabrication and Characterization of Acrylic Polymer Binders Used in Temperature Sensitive Paints

이현지, 김예진, 정서현, 임보규, 정유진, 박종목, 황도훈[1], 공호열[†] 한국화학연구원; [1]부산대학교

Among various external stimuli, physical stimuli such as temperature are difficult to grasp visually. Therefore, a visualization technology that can easily give information in real time is very important. Recently, research on various visualization techniques for temperature stimulation has been conducted. Among them, paint that changes color in real time according to temperature does not require an external power supply and has the advantage of being easy to use. In this study, we made acrylic polymers that can be used as binders in temperature sensitive paints. The structure and thermal properties of basic acrylic polymers were analyzed and the binder properties suitable for paints were compared and optimized.

4PS-3 보딘공딘

Enhancement of Oxidative Stability of PEM Fuel Cell by Introduction of HO · Radical Scavenger in Nafion Ionomer

보딘공딘, 김덕준[†] 성균관대학교

The coordination complex of 18-crown-6 ether/cerium ions (CRE/Ce) is embedded in Nafion ionomer between catalyst and membrane layers in fabrication of membrane electrode assembly (MEA). The anti-oxidation effects of CRE/Ce on ionomer and MEA are investigated not only by Fenton's test but also by FT-IR and XPS, ex-situ and in-situ fluoride ion (F^-) emission rate, and cell performance measurements. While Ce^{3+} plays an excellent role in scavenging $HO^{\bullet}$ radicals, CRE alleviates migration of cerium ions out of the ionomer during cell operation. Both ex-situ and in-situ degradation rate tests show that the systems containing CRE/Ce emits much lower amount of fluoride and sulfonate (SO_3^-) ions than those without CRE/Ce. The open-circuit voltage (OCV) test at low humidity (30%) show that the cell containing the CRE/Ce is still alive even after 300 h operation, while other cells without it are terminated before it.

4PS-5 김대환

바나듐 레독스 흐름 전지를 위한 저가 고품질 복합막개발

김대환[†], 허양일[1] ㈜에너지공조/전남대학교; [1]전남대학교

최근 UN에서 주최한 파리협정 이후로 세계적으로 온실가스 감축에 다양한 방안이 마련되고 있는 가운데 국내에선 신재생과 연계한 LIB(Lithium-ion Battery) ESS(Energy Storage System) 시장이 급 성장중에 있으나, 지속적인 LIB ESS 화재로 인하여 바나듐 레독스 흐름전지를 통한 ESS 대안기술 마련에 많은 관심이 이루어지고 있다. 바나듐 레독스 흐름전지는 바나듐 이온을 함유하는 전해액과 음 · 양극 두 종류의 바나듐용액이 혼액되는것을 방지하기위한 고분자 전해질막을 구성하여 전지를 완성하게된다. 고분자 전해질막으로 가장많이 알려진 제품은 듀퐁사에 Nafion 117 제품이나 고가격과 바나듐이온이 크로스오버되는것에 단점들을 내재하고있다. 본 연구는 상기의 단점들을 극복하기위하여 다공성 지지체에 이오너머를 함치시킨 형태의 복합막과 상용막인 Nafion 117과 성능을 비교하였다. 복합막 기술도입으로 가격면에서는 이오너머의 양에 감소 및 막 두께감소를 통해 절감되는 것을 알수 있었으며, 충 · 방전 성능면에서는 셀저항감소와 바나듐 이온의 투과도 축소로 궁긍적으로는 에너지효율이 개선되는 것을 알 수 있었다.

차세대 기능성 고분자젤과 응용

4PS-7 이재연

Application of Separator to Lithium-ion Batteries through Amphiphilic Polymer

이재연, 문주용, 박정태[†] 건국대학교

In recent years, many research on various energy storage devices is increasing, and research on lithium-ion batteries is also actively underway. Among them, cathodes, electrolyte, and seperator are being studied to solve the stability problem of Li ion battery, and this study aims to improve the stability through seperator. The goal of this study was to synthesize a amphiphilic polymer suitable for use in the seperator of lithium batteries. Through ATRP reaction, hydrophilic monomer was polymerized in hydrophobic backbone to synthesize grafted polymer, and these structure improve the movement of Li ion within the separator and inhibit the formation of Li dendrite, showing the stability improvement. PVDC was used for backbone and PHEMA was used for monomer. Composition was confirmed through FT-IR, GPC, and NMR, and CV and GCD measurements were performed by applying them to battery cells using Li metal to measure electrochemical performance after manufacturing the seperator.

4PS-9 신준혁

Enlarging Out-of-plane Deformation of Active Actuating Multilayer Structure with Analytical Studies Using Electroactive Polymer

신준형, 이수안, 최수석† 포항공과대학교
Electroactive polymers are active materials capable of converting electrical signals into mechanical forces. Analytical studies using ferroelectric polymers, there are increasing researches into highly flexible devices such as displacement. In addition, studies have been conducted on the multilayer structure of EAP to improve driving force for deformable displays. In this study, a ferroelectric polymer-based multilayer PVDF driving device having a sandwich structure (Electrode-PVDF-Electrode) was analyzed using theoretical structural modeling by the finite element method. We studied the behavior of strain properties and out-of-plane strain along the stacked EAP layer and dipole moment direction. It was also possible to achieve two-layer operation by using a tensile strain and a compressive strain together. As a result, it was found that in a stacked multi-layer device, the out-of-plane deformation of the curved tip was significantly improved compared to single layer device.

4PS-11 람 뚜옛 니

Microfluidic Fabrication of Highly Stretchable Soft Strain Sensor Based on Natural Rubber

람 뚜옛 니, 김도완, 윤진환† 부산대학교
Recently, wearable strain sensors have gained considerable attention due to its promising applications in human motion detection, soft robotics and smart clothing. In this study, we prepared a mechanically tough and stretchable elastomer conducting microfiber by combining latex and conducting fillers by using microfluidic devices comprising co-axial aligned micro capillaries. The elastomer microfiber demonstrates a highly stretchable with wide sensing range and high linearity. The microfiber also exhibits good sensitivity (gauge factor (GF) = 3.85) and fast resistance change based on stretch through the connection/partial disconnection of conductive network. The developed elastomer microfibers are promising for health-care monitoring by detecting human motions like bending of joint, walking and running.

4PS-13 김보경

Adaptive Solar Control Smart Window Films Comprising Thermo-responsive Hydrogels

김보경, 김도완, 윤진환† 부산대학교
Smart windows powered by thermal energy can save electric energy by controlling indoor solar penetration with the adaptive modulation of optical transparency. Even though traditional glass-based smart windows have been extensively studied, it is difficult to manufacture the curved or flexible glazings. In this study, we developed film-type smart windows, which is achieved by using the thermosensitive hydrogel and transparent PET film. The thermosensitive hydrogel precursor was injected in the space between the PET films, and the optical transition from transparent to opaque state can be induced by the phase transition of the thermosensitive hydrogels. It would be promising that the developed smart window film can be easily installed on the existing window by attaching on the glass.

고분자구조 및 물성

4PS-15 황희동

Mechanically Robust and Thermally Stable Electrochemical Devices Based on Star-Shaped Random Copolymer Gel-Electrolytes

황희동, 김진곤† 포항공과대학교
We synthesized 6-arm star-shaped PS-*r*-PMMA copolymers ($(S-r-M)_6$) for mechanically robust and thermally stable ion gels. The $(S-r-M)_6$-based gels exhibited higher elastic modulus (E ~1.67 x 10^5 Pa), which is more than five-times that (~0.29 x 10^5 Pa) of linear PS-*r*-PMMA-based gels. In addition, they showed outstanding thermal stability. For example, the T_{gel} of $(S-r-M)_6$ gels was ~72 ℃, compared with that (~56 ℃) of linear PS-*r*-PMMA-based ion gels. These physical properties of gels were further improved by increasing total molecular weight and the fraction of Sty, giving E of ~3.8 x 10^5 Pa and T_{gel} of ~163 ℃. The resulting gels were functionalized by introducing ECL luminophores. By utilizing the mechanical robustness of the $(S-r-M)_6$ gels, we fabricated emissive displays through 'cut-and-stick' process. Moreover, the thermally stable $(S-r-M)_6$ gels indicated good dimensional stability, offering a chance to demonstrate ECL devices that operate even at high temperatures.

4PS-17 황명원

Isothermal Crystallization of PHBHx Using IRRAS and 2D-COS

황명원, 박연주, 정영미† 강원대학교
Poly(3-hydroxybutyrate-*co*-3-hydroxyhexanoate) (PHBHx) is one of biodegradable polymers. It is widely studied as a potential substitute for petroleum-based thermoplastics. To explore isothermal crystallization mechanism under ambient condition of PHBHx with different 3-Hx molar fraction, infrared reflection absorption spectroscopy (IRRAS) and two-dimensional correlation spectroscopy (2D-COS) were used. Details on the results of isothermal crystallization of PHBHx using IRRAS and 2D-COS will be discussed in this presentation.

4PS-19 현유진

Biodegradation Behavior of Poly(butylene succinate) with Accelerated Degradation Environment

현유진, 오수빈, 진형준† 인하대학교
Petroleum-based plastics have been widely used due to their ease of use and their proven strength and lightweight properties. However, concerns about resource depletion and non-degrading properties of petroleum plastics always threaten the global environment. Poly(butylene succinate) (PBS) is one of the biodegradable aliphatic polyesters that can be degraded by microorganisms. In this study, the addition of surfactants and UV irradiation conditions set as conditions for accelerating the degradation of PBS, and the biodegradation behavior was investigated. For the physicochemical characterization of PBS according to the biodegradation behavior, FE-SEM, FT-IR, GPC analysis and tensile experiments were performed. As a result, both the surfactant and the UV irradiation environment accelerated the biodegradation of PBS. In particular, the surfactant has a considerable impact on the reduction of molecular weight and the UV irradiation on the decrease of mechanical properties.

4PS-21 한상석

Shape Effect of Magnetic Particle on Magnetorheological (MR) Properties and Sedimentation Stability

한상석, 서용석† 서울대학교
MR properties were investigated for suspensions of CI, bulk and flake shaped sendust particles under the external magnetic field. The surface morphology was observed by SEM. The magnetic properties of each sample were investigated by using a VSM and a rotational rheometer. the flake shaped sendust showed exceptional movement which is a rapid ascent of the magnetic moment and yield stress at low magnetic field. At high magnetic field, all suspension displayed similar MR behavior. And the master curves describing the apparent viscosity was obtained by appropriate adjustment, which showed a combination of dimensional analysis and flow curve analysis with yield stresses obtained from the prediction models, Bingham and Seo-Seo model. Finally, the sedimentation stability was tested using a Turbiscan apparatus. The MR suspension with the flake shaped sendust exhibited remarkable improvement of stability compared to those of CI and bulk shaped sendut due to the drag coefficient.

4PS-23 최제원

Antifreeze Hydrogel with Reversibility Based on the Hydrogen Bonding Moiety

최제원, 김세영, 최수형†, 차국헌† 서울대학교; †홍익대학교
Hydrogels based on physical junctions have attracted immense interests due to the dynamic property of junctions which endow the self-healing or injectability to the hydrogels. In this study, we synthesized the random copolymer hydrogel containing the large amount of qudruple hydrogen bonding (~50 mol%). Structure of the hydrogel was identified by small-angle X-ray scattering (SAXS) and the presense of water-impermeable domain was confirmed. From this structural feature, the water molecules are captured between the nanoscale water-impermeable domain. As a result, they are hardly crystallized during the freezing process and become metastable state (i.e., cubic or amorphous) even if they become ice crystals. In addition the hydrogel is self-healable and injectable due to the reversible nature of junctions. We hope that this finding will aid in designing of functional materials and broaden the versatility of reversible non-covalent bonds.

4PS-25 최인화

Mechanical Properties of Internally Plasticized Styrene-co-Methacrylic Acid Copolymers

김준섭†, 최인화 조선대학교
In this study, after preparing a styrene-co-methacrylic acid (PSMAA) copolymer containing about 31 mol% of acid repeating units, the acid functional group was converted to amide using n-alkylamine (C_4, C_6, C_8, C_{12}, C_{18}). The mechanical properties of these copolymers were measured by DMA. It was found that as the amount of n-octyl (C_8) amine increased, the degree of amide formation increased from 3.5 to 7.8 mol%. It was also observed that the degree of amidation increased as the chain length of the n-alkylamine increased from C_4 to C_{18}. In the course of this study, it was found that the glass transition temperature of the copolymer was significantly influenced by both the amidation degree and the acid content of the copolymer. Especially, the former effect was more operative than the latter effect, which was due to the internal plasticization by the long alkyl chains of the alkylamines.

4PS-27 최원영

High-Performance Gel Electrolytes Based on Copolymer Gelators with Random Configuration

최원영, 김용민, 문홍철† 서울시립대학교
Gel polymer electrolytes (e.g. ion gels) are promising future wearable platforms due to their mechanical robustness and high ionic conductivity. In this study, two types of copolymers, poly(ethyl methacrylate-*ran*-styrene) (PEMA-*r*-PS) and fully disordered poly(ethyl methacrylate-*block*-styrene) (PEMA-*b*-PS), are prepared to investigate the correlation between gel properties and gelator configuration. For fair comparison, each polymer is synthesized to have similar molecular weight (M_n~62 kg mol^{-1}) and the fraction of styrene (~35 mol%). When the random copolymer was employed, the resulting gel indicated 40% higher elastic modulus (~40.1 kPa) at the same fraction of ionic liquids, compared to that of the block copolymer-based gel (~28.6 kPa).

4PS-29 최선희

Physical Properties Controlled Vitrimers for FDM 3D Printing

최선희, 박성민[1,†] 한국화학연구원/고려대학교; [1]한국화학연구원

The 3D printing of polymers has drawn attention on various industry and research fields recently. Fused Deposition Modeling (FDM) is simple and widely used method of 3D printing technique, but thermoplastic polymer filament, which is typically used for FDM method has poor mechanical properties and solvent resistance compared to thermoset polymer. To overcome this drawback, simple epoxy–acid vitrimers were utilized in this study. Dynamic covalent network bonds in vitrimer provide mechanical and dimensional stability, and allow reshape and reuse of 3D printed objects. To make vitrimers suitable for FDM 3D printing, the physical properties were tuned through control of chemical formulation and catalyst concentration. The controlled properties were investigated using dynamic mechanical analysis (DMA), and universal testing machine (UTM).

4PS-31 최두영

다공성 골드 박막을 이용한 트립신 감지용 분자각인 전도성 고분자 전기합성 및 전기화학적인 센서 특성평가

최두영, 박진영† 경북대학교

트립신은 췌장에서 불활성 전구체 트립시노겐으로 생성되는 소화효소로써 외분비 췌장의 기능을 제어한다. 인체 내에서 트립신의 수준은 췌장 기능의 변화를 확인할 수 있기에 구체적인 진단 바이오 마커로 활용되고 있다. 최근까지 전압 전류법, 표면 강화 라만 분광법, 형광 분석 및 임피던스 분광법 등 다양한 트립신 검출 방법이 보고되고 있다. 특히, 표적 단백질을 인식하기 위해 설계된 공극을 갖는 생체 모방형 합성 수용체인 분자각인 고분자를 이용한 임피던스 분광법이 광범위하게 활용되고 있다. 본 연구에서는 표적단백질 농도 변화에 매우 민감하게 감응할 수 있도록 하기 위해 콜로이드 리소그래피를 통해 제작된 다공성 골드 박막을 도입하였고, 그 표면 상에 트립신 및 O-페닐렌다이아민을 순환전압전류법을 사용하여 전기합성하였다. 평면 및 구조화된 분자각인 전도성 고분자의 트립신에 대한 민감도 및 선택성은 순환전압 전류법과 임피던스 분광법을 이용하여 분석하였다.

4PS-33 최기원

A Novel Window Cover Film Based on Functional Polyimide with Fluorinated Urea Oligomer for Flexible Displays

최기원, 김태용[1], 김용주, 전혜련[1], 황성연, 고성연, 홍성우[1], 고민재† 한양대학교; [1]한국생산기술연구원

A novel transparent polyimide based on fluorinated urea oligomer is synthesized and its optical and mechanical properties are examined. The fluorinated urea oligomer with amine groups at both ends is synthesized and reacted with 3,3',4,4'-biphenyltetracarboxylic dianhydride (BPDA) and 4,4'-(hexafluoroisopropylidene) diphthalic anhydride (6FDA) to prepare the fluorinated polyimide with urea oligomer (uoFPI). 2,2'-bis(trifluoromethyl)-[1,1'-biphenyl]-4,4'-diamine (TFDB), BPDA, and 6FDA are polymerized to prepare conventional fluorinated polyimide (cFPI) as a reference. Interestingly, uoFPI shows more outstanding optical and mechanical properties than cFPI owing to the unique supramolecular network. This results from the strong interaction between urea oligomeric blocks and imide groups in the uoFPI chains where urea groups are serially connected in urea blocks.

4PS-35 조웅비

Designable Building Blocks for 3D Hierarchical Collective Structures via Residual Stress Engineering

조웅비, 위정재† 인하대학교

Conversion of the 2D pattern into desired 3D architectures has drawn a great attention in materials community. Herein, we employed frontal photo-polymerization (FPP) to rapidly realize curvilinear 3D structures without a supporter at time scale of several seconds. Upon exposure to 365 nm UV light onto a patterned photocurable mixture and light-absorbing agent, a light intensity gradient develops inside the mixture. The generated light intensity gradient builds up residual stress, resulting in the curvilinear deformation. The morphology and dimensions of the 3D structures can be programmed by designing the photomask patterns and regulating the spatiotemporal light irradiation. First, we investigate geometric effects on the shape-morphing of photo-cured polymers with a rectangular pattern by varying aspect ratios and areas. Then, we demonstrate multi-leg patterns and a chiral-leg patterns. Finally, we introduce a strategy to construct 3D hierarchical structures by collective assembly.

4PS-37 조승연

Adsorbed-Layer Dependent Lamellar Orientation and Order-to-Disorder Transition Behavior of PS-b-P2VP Copolymers

조승연, 류두열†, 김영식, 이우섭 연세대학교

We suggest the role of non-functional random and block copolymer chains as physically adsorbed neutral layers for lamellar orientation via transition behavior of polystyrene-b-poly(2-vinylpyridine) (PS-b-P2VP) films. For lamellar orientation, population of perpendicular lamellae in PS-b-P2VP film increases as adsorbed-layer thicknesses (had) of P(S-r-2VP) increases to 4.0 nm due to the corresponding increase in the surface neutrality toward BCP films. On the other hand, an extremely thin (1.7 nm) adsorbed layer consisting of LMW PS-b-P2VP offer enough surface neutrality and further increase in had up to 4.0 nm rather decrease the surface neutrality. Interestingly, the order-to-disorder transition temperature in LMW PS-b-P2VP films further exhibit the consistent had dependency, implying that the physically adsorbed layers prepared from the copolymers feasibly provide surface neutrality toward PS-b-P2VP films.

4PS-39 정윤관

Mechanical Properties of Nylon 6/Poly(ethyl acrylate-co-acrylic acid) (PEAA) Blends

김준섭†, 정윤관 조선대학교

In this study, mechanical properties of nylon 6 and random poly(ethyl acrylate-co-acrylic acid) (PEAA) ionomer blends were measured. In this experiment, the PEAA content of the Nylon 6/PEAA blends were 5, 10, 20, 30 wt%. In additon, the acid groups of the copolymers were completely neutralized with LiOH and Zn(CH_3CO_2) to make PEAA ionomers. UTM was used to measure the mechanical properties, and the results showed that Nylon 6 blended with PEAA showed higher elongation but lower tensile strength than pure Nylon 6. Tensile strength was 30% lower than Nylon 6 blended with PEAA than pure Nylon 6, and elongation was 2 ~ 3 times higher than that of pure Nylon 6. On the other hand, comparing the tensile strength and elongation of the Li-ionomer blends and the Zn-ionomer blends showed no difference. It was found that the mechanical properties of nylon 6 were affected by the blended content rather than the type of cations of the ionomer.

4PS-41 정강훈

Self-Assembly of Conjugated Polymers in Solution Using a Non-Solvent Vapor Approach for Organic Field-Effect Transistors

정강훈, 장민철† 전남대학교

We demonstrate a facile solution-processing approach to well-ordered nanofibrillar structures of conjugated polymers using a non-solvent vapor treatment, which results in an improvement to the charge carrier mobility of the polymers. The amount of crystalline poly(3-hexylthiophene) (P3HT) nanofibers was precisely controlled by simply varying the exposure time of P3HT solutions to non-solvent vapor. The effects of non-solvent vapor exposure on the molecular ordering and morphologies of the resultant P3HT films were systematically investigated using UV-vis spectroscopy, polarized optical microscopy, grazing incidence X-ray diffraction, and atomic force microscopy. The non-solvent vapor facilitated the π-π stacking in P3HT to minimize unfavorable interactions between the poor solvent molecules and P3HT chains. P3HT films deposited from the non-solvent vapor-treated P3HT solutions exhibited a 5.6-fold improvement in charge carrier mobility as compared to that of pristine P3HT films.

4PS-43 전소희

Electrically Conductive and Flexible Cellulose Nanofiber/Poly(3, 4-ethylenedioxy-thipohene) Composites

전소희, 심봉섭† 인하대학교

The development of biocompatible and flexible conductive materials has recently received much attention. Poly(3,4-ethylenedioxythiophene) (PEDOT), a representative biocompatible conducting polymer, is electrically conductive. However, it does not meet the criteria of electrical and mechanical performance, to use as electrodes. Thus, doping and reinforcement materials are required. In this paper, Cellulose nanofibers (CNF) were extracted from a natural source, tunicate. Flexible CNF/PEDOT composite was prepared via *in situ* chemical polymerization. The synthesis of CNF/PEDOT was conducted under various conditions, and the effect of each conditions on the conductivity, morphology and crystallinity of CNF/PEDOT were analyzed. It is expected that the electrically conductive and flexible CNF/PEDOT composite can be used in various fields such as biosensors, implantable electrodes, and electronic tattoos that require biocompatibility.

4PS-45 장형석

카르복시메틸셀루로오스로부터 용융 염을 이용한 전기이중층 커패시터용 다공성 탄소 재료 제조

장형석, 이병민[1], 윤제문[2], 최재학[1,†] 충남대학교; [1]충남대학교 고분자공학과; [2]동의대학교 신소재공학부

본 연구에서는 용융 염을 이용하여 계층적 기공 구조를 가지는 다공성 탄소(HPC)를 제조하였으며 전기 이중층 커패시터(EDLC) 전극으로의 적용 가능성을 평가하였다. 카르복시메틸 셀룰로스(CMC)/염 수용액을 얼음 주형법을 이용하여 다공성 CMC/염 모노리스를 제조한 후 탄화시켜 HPC를 제조하였다. 제조된 HPC는 ~1900 m^2/g의 높은 비표면적과 ~1.50 cm^3/g의 큰 기공 부피를 나타내었다. 제조된 HPC를 이용한 EDLC 전극은 6 M KOH 전해질을 사용하여 삼전극 시스템에서 전기화학적 분석을 실시한 결과 1 A/g에서 ~350 F/g의 높은 비축전용량, 100 A/g에서는 ~200 F/g의 우수한 용량 유지율, 100 A/g에서 10,000 회 사이클 후 100%의 우수한 사이클 안정성을 보여 매우 우수한 전기화학 성능을 나타내었다. 따라서 본 연구에서 제조된 HPC는 고성능 EDLC용 전극 재료로 사용될 수 있을 것으로 보인다.

4PS-47 장준호

Improvement of Stretchability and Contact Charging by Hollow Sphere-embedded PDMS

장준호, 이주현, 김진곤† 포항공과대학교

Triboelectric nanogenerator (TENG) is a clean energy, and has been spotlighted as the next generation energy using energy harvesting. Studies on polymer insulators having dielectric properties in TENG have been actively conducted, and based on charge series. However, recent studies have revealed phenomena that cannot be explained in series, such as charges generated even when the same materials are in contact with each other. Among the theory of contact electrification, the mass transfer theory recently shows the explanation of the charge between polymer

insulators. So, people started making series based on specific parameters like modulus. Here, the PDMS was physically optimized for the charge density, and then, an empty space was provided in the structure to increase elongation and charge density.

4PS-49 장민구

Enhanced Molecular Ordering and Charge Transport of P3HT Nanowire Films via Solvent–Vapor Annealing

장민구, 장민철† 전남대학교

Solvent vapor annealing (SVA) has emerged as an effective strategy that can control the morphologies and molecular ordering of conjugated polymer films. In this study, we demonstrate that charge carrier mobility of P3HT nanowire (NW) films can be improved simply by a SVA technique. The effects of solvent vapor annealing on the molecular ordering and morphologies of the resultant P3HT films were systematically investigated using ultraviolet–visible (UV–vis) spectroscopy, polarized optical microscopy (POM), grazing incidence X-ray diffraction (GIXRD), and atomic force microscopy (AFM). A good solvent vapor led to better self-organization of P3HT chains than a poor solvent vapor, resulting in an enhanced charge transport of the P3HT films. Consequently, the mobility of the P3HT NW-films was increased by a solvent vapor annealing with chlorobenzene from 0.08 to 0.12 $cm^2 V^{-1} s^{-1}$.

4PS-51 장기철

Microbial Degradation(Inherent Biodegradability) Test and Evaluation on 3,4–Dichloroaniline

장기철, 박성만, 송광식, 김영훈, 김영랑, 백정주, 허윤정, 이효선, 배근열, 신교직, 최경호† 한국생산기술연구원

환경 유해성 시험의 미생물분해시험 중 화학물질이 호기조건의 물 속에서 미생물에 의해 잘 분해될 가능성이 있는지를 산소흡수량 측정으로 평가하는 제한된 조건의 엄격한 시험법인 이분해성(Ready Biodegradability) 시험에서 낮은 분해성을 나타내는 화학물질에 대해 분해되기 용이한 조건의 본질적 분해성(Inherent Biodegradability) 시험을 진행하였다. 시험에 사용된 화학물질은 3,4-dichloroaniline이며, 폐수처리장 및 하천 등 10군데 이상의 장소에서 채취하여 한달이상 배양된 미생물 접종원을 사용하였다. 시험에 사용된 시험물질과 접종원의 농도는 각각 30ppm, 100ppm이며, 비생물학적 대조군, 시험물질군, 활성도 대조군, 바탕시험군의 4가지 시험군을 준비하여 생물화학적 산소요구량 측정기기(BOD-meter)를 이용해 20일간/25±2[℃] 환경에서의 생물화학적 산소요구량(BOD)을 측정하고, 생분해도를 산출하였다. 또한, 시험이 끝난 후 잔류 화학물질 농도를 확인하기 위해 HPLC를 활용한 화학분석에 의한 분해도를 산출하여 호기조건의 물 속에서 미생물에 의한 분해 가능성을 평가하였다.

4PS-53 자오밍거

하전 고분자의 사슬 구조 변화와 그 혼합물의 상거동 관계 연구

자오밍거, 장신위에, 조준한† 단국대학교 고분자공학과

연속 공간 상태 방정식과 장이론 모사법을 이용하여 하전 고분자 혼합물의 상 거동을 연구하도록 한다. 사용되는 분자론적 상태방정식은 강구 사슬계에 전하가 도입된 것이다. 고분자 혼합물은 유전 상수를 갖는 배경 매체에 놓여져 primitive way로 다루어 진다. 고분자는 다양한 사슬 기하를 갖도록 설계되고, 단일 고분자이거나 양친매성 고분자 등이 다루어 질 것이다. 하전 고분자 혼합물은 시스템 전체의 전기적 중성을 만족하기 위해 반대이온이 혼입된다. 먼저, 비결합 단량체 간, 그리고 단량체와 반대이온 또는 반대이온 간에 van der Waals 인력이 없는 경우를 우선 고찰한다. 이후 van der Waals 인력을 포함시켜 구성 단량체 간의 비친화 에너지를 도입하도록 한다. 고분자 단량체의 밀도장과 회합, 이온-이온 간의 상관 관계, 그리고 단량체 간의 비친화인력이 상거동에 미치는 영향에 대해 논의될 것이다. 특히, 상 거동에 미치는 압력 효과를 상태 방정식 성질을 이용하여 고찰하고 여러 자극 응답형 고분자 물질 설계 등을 논의할 것이다.

4PS-55 이현정

Synthesis of Electroconductive Polydopamine with High Conductivities of by Electrochemical Method

이현정, 심봉섭† 인하대학교

생체적합성은 낮은 전기화학적 임피던스, 높은 전하충전용량과 더불어 생체 일렉트로닉스에서 가장 중요한 요소 중 하나이다. 전도성 고분자는 기존 금속기반의 전극이 충족시키지 못한 이러한 요구조건을 효과적으로 만족시지만, 여전히 장기적 응용에 있어 한계점을 가지고 있다. 폴리도파민은 자연에 풍부하게 존재하는 접착성분으로, 생체적합성 및 공액 구조를 가지는 고분자이다. 본 연구에서는, 전기화학적 중합을 통해 개선된 전기화학적 임피던스를 지니는 폴리도파민 구조체를 개발하였다. 이 결과를 통해 폴리도파민의 잠재적 전기화학적 응용을 기대할 수 있다.

4PS-57 이현승

Aligned Nanostructure of Nafion Membrane by Micromolding in Microcapillaries

이현승, 배인성† 한남대학교

Proton Exchange Membrane Fuel Cells (PEMFCs) are eco-friendly and Nafion, a representative material to PEM, have long-side chains with hydrophilic sulfonic acid groups. The sulfonic acid groups form the ion clusters for transporting protons. However the ion clusters are placed randomly, it tend to reduce the capability of ion conductivity. In this study, we researched alignment of Nafion's nanostructures to improve the ion conductivity with microcapillaries. The Poly(dimethylsiloxane) (PDMS) molds which was patterned 5, 10 and 20 um lines were prepared and The patterned Nafion membrane was prepared by various methods with the PDMS molds. The line pattern was confirmed by AFM, SEM and OM. Through the AFM images, The phase separation and partial alignment of Nafion was observed. Finally, the proton conductivity of the patterned Nafion membrane was improved by alignment of ion clusters.

4PS-59 이진은

Study on Phase Transition of Poly(N-propargylamide)s Depending on Solvent and Temperature

이진은, 곽기섭† 경북대학교

Monosubstituted polyacetylenes having a very high stereoregularity can be obtained through the polymerization with rhodium-based transition metal catalyst. Among them, poly(N-propargylamide)s are known to maintain a very stable cis-transoid helical structure in a solution by intramolecular hydrogen bonding between the side chain amide groups. Previously, in our laboratory, the intramolecular hydrogen bonding of a monosubstituted poly(phenylacetylene) having the similar helical-spring structure has been precisely controlled in solution state by solvent and temperature, and the polymer showed a reversible helix-coil phase transition accompanied with significant changes of color and viscosity. In a similar way, poly(N-propargylamide)s were also examined in this study for the effects of solvent and temperature on the phase transition on the basis of the ultraviolet-visible absorption and circular dichroism spectroscopies, and the results were discussed from the thermodynamic perspectives.

4PS-61 이진우

Highly Efficient and Mechanically Robust Polymer Solar Cells Using Polymer Acceptor Additive

이진우, 마부수, 정다현, 김택수, 김범준† KAIST

We report a both highly efficient and mechanically robust polymer solar cells (PSCs), employing high molecular weight (MW) polymer aceptor (PA) additives into highly efficient PSC system. In the conventional ITO-based architectured PSCs, reference PSC system showed 15.4% of maximum PCE without PA additive, and the PCE maintained up to 14.0% with incorporating 30% of the additive. With further loading of the PA additive, the PCE decreases rapidly showing 8.7% at the 50% of the PA loading. Notably, the engineering crack onset strain (COS) sharply increases in proportional to the loading amount of the PA additives, from 2.3 at the 0% to 12.4% at the 30% of the additive loading. We revealed both the PCE maintanence and the skyrocketed mechanical robustness with loading of the PA additive are mainly attributed to the formation of chain entanglement and tie molecules due to long PA chains.

4PS-63 이정현

Changes in Structure and Property of Polycarbonate through Accelerated Photodegradation Test and the Effects of Adding Benzotriazole-based UV Absorbers

이정현†, 김동환, 여영우 FITI시험연구원

폴리카보네이트(PC)는 비스페놀 A(BPA)와 포스젠의 연쇄 구조로 이루어진 무정형 고분자로서 가시광선투과율이 80~90%로 높은 투명성을 가지고 있을 뿐만 아니라 플라스틱으로 제조할 경우, 타 엔지니어링 플라스틱(포리메틸메타크릴레이트(PMMA), 아크로니트릴부타디엔스티렌(ABS) 등)과 비교하여 상대적으로 높은 내충격성을 가지고 있어 다양한 용도로 활용되고 있다. 하지만 폴리카보네이트(PC)의 경우 옥외 태양광에 장시간 노출될 경우 자외선에 의해 변색, 표면 형태 변화, 기계적 물성 저하 등의 다양한 문제가 나타나게 된다. 본 연구에서는 폴리카보네이트(PC) 수지를 용융압출시켜 제조한 PC시트를 RS-KORAS-FITI-046(광열화 가속시험 방법-제논아크) 평가기준에 부합하는 가속내후성 장비를 사용하여 연간 조사량에 대한 등가시간 추정을 통해 최대 5년에 해당하는 광량을 조사하여 폴리카보네이트(PC) 구조 및 특성변화를 분석하였다. 한편, 자외선에 의한 영향을 최소화하기 위해 벤조트리아졸계 자외선 흡수제의 첨가가하여 상해를 줄이는 방법에 대해서도 함께 검토하였다.

4PS-65 이재원

Three-dimensional Continuous Curvature Design Based on Spatio-temporal Stress Analysis on Locally Actuated Shape Morphing Polymer Film by Thermal Stimulus

이재원, 최준찬, 안수민, 이종혁[1], 원수경[1], 이재경[1], 위정재[1], 김학린† 경북대학교; [1]인하대학교

Three-dimensional (3D) curvature morphing based on two-dimensional (2D) shape memory polymer (SMP) has received great attention due to its curvature reconfiguration property. In terms of designing the intended 3D configuration, the analysis of the stress convolution effect which causes the shape morphing should be preceded. In this study, the 3D curvature morphing of bi-axially pre-strained polystyrene (PS) film actuated by the thermal stimulus is computationally modeled for performing the spatio-temporal simulation. When the locally patterned area on PS film is actuated, the stress convolution effect between patterned and non-patterned areas occurs resulting in 3D reconfiguration. Finally, the curvature morphing process with the final 3D configuration is predicted by spatio-temporal simulation. Acknowledgment: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No 2019R1A2C1005531).

4PS-67 이재경

Contactless Construction of Multi-functional and Transparent 3D Architectures by Patterned Adhesives

이재경, 원수경, 박정은, 위정재† 인하대학교 첨단소재연구실

Contactless construction of 3D non-Euclidean architecture from 2D flat geometry has recently drawn a great attention from materials communities. In particular, photothermal heating of black ink pattern method suggested facile localized contraction of shape memory polymers. However, the remaining ink patterns induce potential undesirable actuation from external stimuli. In this study, we demonstrate a facile construction of transparent 3D curvilinear structures using patterned black adhesives. Under exposure to near infrared light, temperature of the pre-stretched film is elevated at adhesive patterned areas above the glass transition temperature. After 3D shape-morphing, the adhesive patterns are simply removed to achieve

transparent polymers to prevent further actuation. In this presentation, we will discuss radial and chiral pattern designs for complex 3D architectures and utilization of non-responsive flexible materials as well as conductive substance to endow multifunctionality.

4PS-69 이연배

Modulation of Ion Gel Properties Using Side Chain Crystallization in Random Copolymers

이연배, 김희인, 김상원† 인하대학교

Random copolymer architecture containing crystallizable side chains was used to realize polymer electrolyte composites, also known as ion gels. Ion gels exhibit relatively high ionic conductivity, compared with solid electrolytes, while the network architecture suppresses the electrolyte leakage. Ion gels can be applied to various flexible applications, such as electronic skins, thus requiring ion gels to exhibit mechanical toughness as well as desirable electrical characteristics. To achieve these requirements, we designed random copolymers comprising amorphous monomers and monomers with crystallizable side chains as a scaffold in fabricating ion gels. We studied the effect of side chain engineering on the thermal, mechanical, and electrical properties of the ion gels.

4PS-71 이승준

Microneedles Combined with Hair Growth Factors

최다혜, 조수진, 이승준† 서원대학교

In modern society, it is important not only to diagnose and treat the disease, but also to improve the quality of life, such as hair loss, acne and cosmetic surgery. Among them, hair loss is a common disease with a high proportion of adult men. Recently, these disease has been also increasing in women steadily. First, for this experiment, microneedles(MNs) were prepared by combining liquid hair growth factors (M(K)) according to concentrations (0%, 1%, 3%, 5%). And the experiment was conducted to check the skin delivery potential and stability of the factors. The morphology of the prepared MNs was confirmed using a scanning electron microscope (SEM), and skin permeability was measured using a porcine skin. Variation in viscosity was confirmed according to the difference in concentration. The efficacy of M(K) and cytotoxicity of MNs bound to MNs were analyzed using the MTT-assay. Finally, the stability of the factor component bound to MNs was confirmed by XPS.

4PS-73 이승준

Preparation and Characterization of Biodegreable Gelatin Microspheres via Free Fall Microdroplets Technique

황의주, 한청수[1], 이승준† 서원대학교; [1](주)케이런

Gelatin, a natural macromolecule, is widely used in biomedical and biotechnological applications and is a good candidate for preparation of microspheres and microcapsules for the purpose of controlled release applications of drugs. Gelatin Microspheres (GMs), one of the applications as biomaterials, are being used for drug delivery system, embolic, and injectable filler. The aim of this study was to investigate the influence of stability as the various storage condition on GMs chemico-physical characteristics. In this study, GMs were prepared by free fall microdroplets technique (FFMt) and were investigated using analytical methods, such as pH, viscosity, SEM, and XPS. The changing value of GMs from external condition was measured at different gelatin concentrations (1%, 2%, 3% w/v) and temperatures during a particular period of time. Also, characteristics of GMs structure including size, appearance, and uniformity of particles and elemental composition was investigated.

4PS-75 이승준

Fabrication of Biocompatible Micro-Patterned PET Film via UV Imprint Lithography Technique

정민희, 육지호, 이승준[1,†] 인하대학교; [1]서원대학교

In the imprint lithography process using ultraviolet (UV) curing, UV-curing resin is pressed at a constant pressure using a mold (template) with various micro-size patterns, UV irradiated, and then removed from the mold. In the present study, various micro-size patterns (triangle, square, hexagon, and pillar hexagonal) were implemented onto PET film using super-hydrophobic UV curing resins to improve its hydrophobicity, and their surface characteristics and biocompatibility were evaluated. The super-hydrophobic UV curing resins were prepared by various combinations of fluorine-free acrylic monomers and various additives. The pillar hexagonal pattern had a contact angle of ~140°, which was the most hydrophobic. The cell survival rate on the micro-patterned PET films was higher than 80%.

4PS-77 이승준

Effect of Artemisia Extract on Stability in Cubic Phase Gel Formulation

구민지, 김범기, 유종완[1], 이승준† 서원대학교; [1](주)베이바이오텍

Nano particle of Monoolein cubic phase has thermodynamically stable lipid bilayer by MO-water system. Cubic phase appeared honeycomb structure it can be include water solubility, lipoid solubility, poorly watersoluble Drugs. Cubic phase self-assembled and its not toxic even if it accumulated in the body due to natural, biocompatibility, biodegradable features in addition it is easy to release control. In this study, to assess stability according to storage temperature -25 ℃, 4 ℃, 25 ℃, 40 ℃ cubic phase and Artemisia Extract(Newaple) in cubic phase in dark condition incubator. Then evaluated the change in formulation of physical, chemical properties. In addition, the effect on stability was confirmed through viscosity, pH and formulation shift compare with cubic phase and Newaple in cubic phase. To check the persistence of the Newaple in cubic phase observing peak at 222 nm wavelength by UV-Visible spectrometer.

4PS-79 이병민

리튬 이차전지 Si-alloy 음극용 폴리에테르이미드 바인더의 열처리 온도에 따른 전기화학특성 평가

이병민, 노미소[1], 홍성권[1], 김성수, 최재학† 충남대학교; [1]충남대학교 고분자공학과

리튬 이차전지의 음극 활물질로 Si 혹은 Si-alloy를 사용하기 위해서는 새로운 바인더의 개발이 필요하다. 본 연구에서는 음극 활물질로 Si-alloy, 바인더로 폴리에테르이미드를 이용하여 리튬 이차전지 음극을 제조하였다. 제조된 음극을 다양한 온도(300 ~ 600도)에서 열처리 한 후 물리화학적 및 전기화학적 특성을 평가하였다. 평가 결과 바인더의 부분 탄화로 인하여 충/방전 특성, 사이클 안정성 등 전기화학적 성능이 향상되는 것을 확인할 수 있었다.

4PS-81 윤형건

Synthesis and Analysis of Hexagonally Packed DNA-like Double Helical Phase (H_2) with A_1BA_2C Tetrablock Terpolymer

윤형건, 김진곤† 포항공과대학교

We synthesized and observed the DNA-like double helical structure with linear tetrablock terpolymers polystyrene-block-polyisoprene-block-polystyrene-block-poly(2-vinylpyridine) S_1IS_22. Sample was synthesized by sequential anionic polymerization. This structure has different kinds of strands (PI and P2VP) twisted together and the rest is filled with PS. We first observed a heterogeneous twisted strand structure that was not found in block copolymer self-assembly and it is a unique property of tetrablock copolymer. This result were good agreement with self-consistent mean field theory (SCFT). This tetrablock terpolymers were characterized by gel permeation chromatography and nuclear magnetic resonance. Morphology of terpolymer was characterized by TEM and small angle X-ray scattering

4PS-83 원수경

Effects of Concentration and Dispersion of Nanoparticles on Orbital Maneuver of Multiple Magnetic Soft Robots

원수경, 박정은, 이재용[1], 전지수, 김용주, 김진곤[1], 위정재† 인하대학교; [1]포항공과대학교

Parallel manipulation of multiple magnetic soft robots has been challenged since necessary of real-time control of complicate three-axial coordination of electromagnetic field impedes actuation of the multiple soft robots individually. Recently, we demonstrated facile orbital magnetomotility of multiple soft robots in response to rotating permanent magnets underneath a substrate, capable of collective behavior of soft robots. Upon varying the rotational frequency of the magnets, rotation and resultant hierarchical revolution facilitate on-demand control of orbital radius, velocity, and pathway of multiple soft robots. The soft robots are consisted of nanocomposites of thermoplastic polyurethane matrix and iron oxide nanoparticles. In this presentation, we will discuss the effects of concentration and dispersion of nanoparticles on the polymer nanocomposite robots in the perspective of structure-property-performance relationships.

4PS-85 오정택

비스페놀 A 폴리카보네이트의 광 열화거동을 고려한 물성 예측 시뮬레이션 및 사용 환경을 고려한 최적 설계 가이드 수립

오정택, 송민우, 김형섭[1,†] FITI시험연구원; [1]건국대학교

비스페놀 A 폴리카보네이트는 사용 환경 조건 하에서 광 열화에 의한 광학특성(황변, 투과율 등)변화, 미세크랙 발생 및 강도 저하가 발생하며, 이는 제품의 품질을 저해하는 요인으로 작용한다. 본 연구에서는 소재의 열화 거동 과정의 고찰결과를 설계에 반영하여 제품의 용도와 사용 환경에 적합한 제품을 개발/생산할 수 있는 기초지식을 제공하고자 한다. 서로 다른 환경을 가지는 옥외폭로시험장(애리조나, 플로리다)에서 21개월간 노출된 시험편을 대상으로 3개월 단위로 시험편을 채취하여 환경 차이에 따른 인장거동의 변화를 비교, 고찰하였다. 처리 시간이 증가함에 따라 소성 특성이 취성으로 변화하였으며, 각각의 소성과 취성의 특성을 반영하여 물성을 예측할 수 있는 모사과정을 수립하였다. 실제 측정값과 예측값의 비교를 통해서 두께, 광량(처리시간) 및 응력을 고려한 최적 설계 가이드 수립 및 사용 환경 하에서의 사용 수명을 예측할 수 있는 기초데이터를 확보하였다.

4PS-87 오솔미

Achieving Highly Ordered Nanoparticles Structures in Dense Polymer/Nanoparticle Solution

오솔미, 김소연† UNIST

Highly ordered nanoparticle structures in polymeric materials have drawn extensive attention due to their collective properties which are not shown in randomly dispersed or aggregated structures. To achieve those structrues, polymer grafting onto paritlcees is generally require with self-assembling agent, which often involves complicated synthetic procedures. In this work, we report that highly ordered structures of particles can be achieved by simply dispersing them in poly(ethylene glycol) derivative solution. Even without chemical grafting and self-aseembling agent, the strong hydrogen bonding between nanoparticles and the PEG complex could retain the superstructures in the liquid-phase in the presence of water. We also found that the presece of water leads to the stronger rheological response. The systematic investigation was carried out by varying molecular weight/concentration of polymers/nanoparticles with small-angle X-ray scattering and oscillatory rheometer experiments.

4PS-89 여용호

Dual Crosslinkable Methylcellulose/Chitosan Oligomer Composite Hydrogels

여용호, 박원호† 충남대학교

메틸셀룰로스는 C-2, C-3, C-6의 하이드록시가 메톡시기로 치환되어 있는 수용성 셀룰로오스 유도체이다. 또한 메틸셀룰로스 수용액은 온도감응 특성인 LCST거동을 보이는데, 이를 이용하여 바이오메디컬 분야로 적용하기 위한 온도감응형 수화젤의 제조에 관련된 다양한 연구들이 진행되고 있다. 그러나, 단순한 온도감응성 수화젤의 경우 낮은 기계적 물성으로 인해 응용 범위가 제한적이며, 이를 해결하기 위해 화학적 가교결합의 도입이 필요하다. 따라서, 본 연구에서는 과요오드산나트륨을 이용하여 메틸셀룰로스의 산화를 유도하였으며, 고리구조의 파괴 및 알데하이드기의 형성에 따른 유변학적 특성을 레오미터를 통하여 분석하였다. 또한, 하이드로젤의 강도를 보강하기 위해 키토산 올리고머를 사용하여 이중가교형 수화젤을 제조한 후, 다양한 특성분석을 진행하였으며 마스크팩으로서의 적용 가능성을 살펴보았다.

4PS-91 양진철

2D Aligned Pore Formation of Formaldehyde Imprinted Polymer Using Hard Lithography Technique and Its Sensing Characterization

양진철, 박진영, 곽기섭† 경북대학교

Lithographic micro/nano structuring has been actively utilized in various fields such as superhydrophobic surface, display and chemical/bio sensor due to high-functionality resulting from designed surface structuring. Highly aligned patterns of functional polymers have been applied to molecularly imprinted technique to develop improved sensitive sensors using lithography techniques such as colloid, soft, hard, photo and E-beam. In particular, the use of hard stamps (also called hard lithography) is well suited in micro/nano structuring for the recognition of a specific gas in a polymer film. In this study, 2D aligned pore structured molecularly imprinted polymer (MIP) film were fabricated to recognize formaldehyde gas using a hemispherical SiO_2 replica mold. Furthermore, various sensing properties (i.e., sensitivity, selectivity and LOD) were analyzed via piezoelectric quartz crystal microbalance (QCM).

4PS-93 안성현

Order to Order Transition from Cylindrical to Lamellar Microdomain upon Heating for Linear Tetrablock Copolymer

안성현, 김진곤† 포항공과대학교

We investigated the order to order transition (OOT) of polystyrene-block-polyisoprene-block-polystyrene-block-polyisoprene ($S_1I_1S_2I_2$) linear tetrablock copolymer at the symmetric volume fraction of total PS and PI blocks but asymmetry of PI block ($\tau_{PI} = f_{PI1}/(f_{PI1}+f_{PI2}) = 0.19$), in which f_{PI1} and f_{PI1} are the volume fractions of PI in the second and forth blocks, respectively). Very interestingly, this block copolymer showed cylindrical to lamellar microdomains transition upon heating. This behaviour is the exactly opposite to commonly observed OOT for linear AB diblock and A_1BA_2 triblock copolymers with upper critical ordering transition, where lamellar microdomains have been transformed to cylindrical microdomains upon heating. This interesting transition sequence is due to the chain architecture of linear tetrablock copolymer with two PS and two PI blocks.

4PS-95 신진용

Neutral-Layer-Free Directed Self-Assembly of Block Copolymer in Trench Using Capillary Force-Induced Meniscus

신진용, 김봉훈† 숭실대학교

두 개의 서로 다른 고분자가 공유결합으로 연결된 블록 공중합체(Block Copolymer, BCP)는 대표적인 자기조립(self-assembly) 물질로 나노패턴 제작 소재로 많은 관심을 받고 있다. BCP는 부피 분율에 따라 5~50 nm 크기를 가지는 구(sphere), 실린더(cylinder), 라멜라(lamellae) 구조의 제작이 가능하며, 이를 활용하기 위하여 두 고분자 블록에 대한 neutral layer가 (PS-b-PMMA의 경우, 약 contact angle 75~85도) 요구된다. 본 연구에서는 이러한 neutral layer없이, Capillary force에 의해 유도된 Meniscus를 이용 해서 엔트로피 패널티를 조절하여 PS-b-PMMA 나노 구조를 수직하게 배향 가능함을 보여준다.

4PS-97 신재환

전자선 가교에 의한 전선용 폴리올레핀계 컴파운드의 물성 변화에 관한 연구

신재환, 이병민[1], 박종석[2], 최재학[1,†] 충남대학교; [1]충남대학교 고분자공학과; [2]한국원자력연구원

최근 자동차 산업 등에서 고내열 고난연 성능을 갖는 가교 전선에 대한 요구가 증가하고 있다. 기존 가교 전선을 제조하기 위한 화학가교 방법은 고온, 고압 하에서의 가교에 의한 핀홀 발생으로 인한 물성 저하, 부산물에 의한 악취, 불연속 공정 등의 문제가 있는 것으로 알려져 있다. 이러한 문제점들을 해결하기 위하여 본 연구에서는 전자선 가교가 가능한 폴리올레핀계 컴파운드를 제조하였으며, 전자빔 조사에 의한 가교율, 난연성, 내열성, 열적, 기계적 물성 등의 특성 변화를 평가하였다.

4PS-99 신민중

Lyotropic Phase Behavior of Amphiphilic Random Copolymer in Aqueous Solution

신민중, 서명은† 한국과학기술원

Amphiphilic molecules containing both hydrophilic and hydrophobic moieties aggregate into micelles in aqueous medium, and further self-assemble into lyotropic mesophases such as vesicles, cylinders, and lamellae at higher concentration. Amphiphilic random copolymers consisting of non-ionic hydrophilic and aliphatic alkyl side chains are known to fold into single chain micelles in a dilute aqueous solution. Here, we report unique mesophases found in concentrated amphiphilic random copolymers solutions in water. Small angle X-ray scattering study suggests the phase behavior is driven by both the hydrophilic-phobic balance and the backbone length scale. Origin of the complex mesostructure formation is attributed to the thermodynamic drive to order at the macromolecular and molecular levels.

4PS-101 신나리

Phase Behavior of AB/AC Binary Blend Having Complementary Hydrogen Bonding

신나리, 김진곤† 포항공과대학교

Polymers containing nucleobases can have complementary multiple hydrogen bonding between nucleobases, and the strong multiple hydrogen bonding is expected to have an effect on phase behavior of block copolymer blends. For this purpose, we synthesize nucleobase-functionalized block copolymers polystyrene-b-poly(1-(4-vinylbenzyl) thymine) and polystyrene-b-poly(9-(4-vinylbenzyl)adenine) using reversible addition-fragmentation chain-transfer polymerization first. Then we characterized block copolymers using GPC and NMR, also we studied morphology of the block copolymers using transmission electron microscopy and small-angle X-ray scattering patterns. Additionally, when we change base pair from thymine-adenine to guanine-cytosine, strength of the hydrogen bonding can be controlled

4PS-103 시범민

Effect of Surface Structuring on Molecular Imprinting Polymer Film and Recognition Properties

시범민, 박진영† 경북대학교

Surface molecular imprinting has attracted significant attention as an effective method to fabricate recognizable cavities for detection of specific species. The number of recognizable cavities can be controlled by changing surface structure. Various approaches have been reported to enhance sensing properties by surface structuring using particles, beads, rods and fibers as sacrificial templates. Particularly, fibrous surface structure has a potential to improve recognition properties in sensing target molecule due to extremely increased surface area. In this study, we were successfully fabricated a molecular imprinting polymer (MIP) film using the fibrous structure mold. The morphology and recognition properties of the MIP film was analyzed using field emission scanning electron microscopy (FE-SEM) and quartz crystal microbalance (QCM).

4PS-105 쉬 멍

Entropy-Driven Assembly Behavior of Nanoparticles within Emulsion-Evaporative Block Copolymer Particles

쉬 멍, 윤홍석, Kin Liao[1], 김범준† 한국과학기술원; [1]Khalifa University

Controlling the spatial alignment of inorganic nanoparticles (NPs) within the polymer matrix is of great importance due to its great potential. Herein, we demonstrate the spatial distribution tuning of polystyrene-grafted Au NPs (Au@PS) within lamella forming polystyrene-*block*-poly(4-vinylpyridine) (PS-*b*-P4VP) particles. Spatial distributions of Au@PS showed a strong dependence on the various entropy-related parameters, including the molecular weight ratio between the polymer matrix to the ligand, the core size of Au NPs, the grafting density of Au@PS. The hybrid particles with weak entropic interactions between Au@PS and polymer matrix showed a "crusted onion" structure with Au@PS forming hexagonal packing on the particle surface. In contrast, Au@PS stacked within inner PS domains in hybrid particles with strong entropic interactions. The phenomena will be explained by considering the interdigitations between matrix chains and PS ligands on the Au NP surface.

4PS-107 송기철

Octadecylamine을 이용하여 아마이드화 시킨 PSMA 공중합체에 의한 아스팔텐 분산성 향상

김준섭†, 송기철 조선대학교

본 연구에서는 octadecylamine을 이용하여 부분적으로 아마이드화 시킨 스타이렌 메타크릴산(PSMA) 공중합체가 아스팔텐 분산성에 어떠한 영향을 미치는지에 대해서 알아보았다. 공중합체를 아마이드화 시킨 정도가 아스팔텐의 분산성에 영향을 미치는지 알아보기 위해 31.8 mol% PSMA (Mw = 10K) 공중합체를 합성한 후, 부분적으로 16.4, 11.0, 7.5 mol% 정도 아마이드화 시켰다. 분산성 실험 결과 알 수 있었던 것은 부분적으로 아마이드화 시킨 PSMA 공중합체의 카르복실산 함량이 적어질수록 분산성이 좋아짐을 알 수 있었다. 이는 카르복실산 함량이 많아질수록 공중합체의 극성이 강해지므로 아스팔텐과 상호작용하지 않고 극성작용기끼리 서로 상호작용하기 때문이다.

4PS-109 손영곤

알리파틱 폴리케톤/나일론 6 블렌드의 혼화성에 관한 연구

권홍구, 손영곤† 공주대학교

이 연구에서는 알리파틱 폴리키톤 (PK)에 나일론 6 (PA6)를 혼합하여 모폴로지, 열적 특정, FTIR 및 기계적 물성을 관찰하여 두 고분자의 혼화성을 연구하였다. 모폴로지 및 열적 특성을 관찰한 결과 두 고분자는 상분리된 구조를 가지며 부분적 상용성도 없는 것으로 판단되었다. 블렌드의 기계적 물성은 각 성분 물성의 평균 값보다 높은 positive deviation 을 보였다. PK와 PA6의 접착력 test 결과, PK/PA6의 접착력은 일반적인 비상용성 고분자들의 접착력에 비해 아주 높고, PA6/말레인산이 그라프트된 PE의 계면 접착력보다도 높은 값을 가지는 것을 관찰하였다. 또한 FTIR 분석결과 두 고분자가 계면에서 반응을 하여 비상용성이면서 우수한 물성을 가지는 것을 알 수 있었다.

4PS-111 서홍대

Polystyrene-based Multiblock Copolymer Membrane for High Density of Ion Channel in PEMFCs

서홍대, 권후근[1], 배인성† 한남대학교; [1]한남대학교 화학과

Proton Exchange Membrane Fuel Cells (PEMFCs) have been researched as eco-friendly energy resources that are alternative to fossil fuels. Since hydrocarbon

ionomers are less expensive than fluorinated ionomers, improving efficiency of hydrocarbon ionomers are one of the key subjects for commercializing fuel cells. The multiblock copolymers based polystyrene which has sulfonic acid functional groups can be expect to induce high density of ion channel and high degree of phase segregation. Poly(ether sulfone) was copolymerized the polystyrene-based material for thermal stability and stable chemical structure. By adjusting the degree of polymerization of the two each polymers, the ion exchange capacity (IEC) and swelling degree was managed. It was confirmed that the membranes form the phase separation and ion clusters by AFM and TEM. Finally, the proton conductivity of the membranes was measured higher than Nafion membrane in high humidity condition.

4PS-113 서수덕

Importance of Tuning Aggregation Behaviors of BDT-based Polymers for Achieving Additive- and Annealing-Free High-Performance All-Polymer Solar Cells

서수덕, 김진석, 김범준† 한국과학기술원(KAIST)

The morphology of polymer is in charge of critical roles in the performance of all-polymer solar cells (All-PSCs). Thus post-treatments such as additive, annealing are used for optimized film morphology. Herein, we suggest a simple solution for optimizing morphology with as-cast process by extending conjugation with well-transition of aggregate from solution to film. Specifically, we introduce PBDB-S which is derivatives from PBDB-T by enlarging conjugation region. PBDB-Bz showed increasing at intermolecular interaction in solution and superial morphology at film without post-treatment than PBDB-T as evidenced by UV-vis absorption and grazing incidence X-ray scattering (GIXS). In all-PSCs, compared to the 7.4% efficiency of PBDB-T: P(NDI2OD-T2) while PBDB-S showed 8.5% of efficiency, and 9.5% of efficiency was achieved by temperature controlled condition. Our work provides detailed design with charateristic analysis for revealing relation between aggregation and film morphology.

4PS-115 배형한

Single-Step Production of Doubly Re-entrant Microstructures through Reaction-Diffusion Photolithography for Omniphobic Surfaces

배형한, 김종빈, 김신현† 한국과학기술원

Most of omniphobic surfaces are fabricated by rigid materials such as silicon or metal and also coated by chemical reagent. So, omniphobic surfaces using such methods are not bio-friendly. Doubly re-entrant structures with polymer emulated from omniphobic springtail skin are omniphobic, flexible and not treated chemical reagent. Methods such as etching or 3D printing are mainly used for these re-entrant structures. Here, we use Reaction-Diffusion Photolithography (RDP) for doubly re-entrant structure generation. Because conventional photolithography is to irradiate UV on the photoresist through the design of photomask, it has a limitation which can form only 2D structures. RDP overcomes this limitation and can fabricate complex structures by utilizing the oxygen gradient in the substrate. RDP process, radical polymerizations consist of initiation, propagation and termination. Because oxygen first reacts radicals and form peroxide molecules, we can utilize oxygen concentration gradient.

4PS-117 박현정

The Study of Regioregularity Driven Liquid-crystalline Phase Transition

박현정, 김형준, 김범준† KAIST

The thermotropic LC phase transition of regioregularity-controlled poly(3-dodecylthiophene) (RR-controlled P3DDTs) are investigated as a function of RR. This is great system because it can produce different strengths of LC interactions as well as the same molecular structure to exclude the additional factors. As the RR reduces, they exhibit decreased transition temperatures upon heating. Since the P3DDTs with lower RR consist of more regio-defects, they finally yield weaker interchain interactions and faster rod-to-coil conformations and disruption of ordered/oriented LC structures with heating. Furthermore, the formation of Form2 polymorph and the increasing ratio of Form2/Form1 polymorphs towards to lower RR are founded. Considering both the higher melting entropy of Form2 and faster breakdown of Form2 scattering peak upon heating, it is proposed that larger Form2/Form1 can promotes fatigues of LC structures, resulting in lower transition temperatures at lower RR.

4PS-119 박연주

Study on Phase Transition of PNiPAAm-*co*-PEG Hydrogel by 2D IR Correlation Spectroscopy

박연주, 김민경[1], 황명원[1], 정영미[1,†] 강원대학교 강원방사선융복합연구지원센터; [1]강원대학교 화학과

Poly(*n*-isopropylacrylamide) (PNiPAAm), which is one of the thermosensitive hydrogels, has been used for many fields in sensing, drug delivery, tissue engineering, and so one. However, it has limited application to the body, because of its toxicity and slow degradation time. To overcome this problem, PNiPAAm has copolymerized with poly(ethylene glycol) (PEG) having highly biocompatibility and biodegradability. In this study, we characterized the thermal behavior of PNiPAAm-*co*-PEG hydrogel using infrared spectroscopy and two-dimensional correlation spectroscopy (2D-COS). The details of this study will be discussed in this presentation.

4PS-121 박세원

하이드로차/셀룰로오스 나노 섬유 기반 고성능 수처리 분리막 제조 및 염료 제거능 평가

박세원, 김형섭† 건국대학교 공과대학 화학공학부

본 연구에서는 열수탄화 공정 조절을 바탕으로 크기 조절된 하이드로차를 제조하고, 셀룰로오스 나노 섬유와의 복합화하여 수처리 분리막을 제조하였다. 열수탄화 시간을 증가시키면서 크기가 증가된 하이드로차를 제조하고, 주사전자현미경 및 동적광산란광도계를 이용하여 특성 분석 하였다. 하이드로차와 셀룰로오스 나노섬유의 가교를 위해 칼슘 이온을 도입하였으며, 이에 따른 하이드로차-셀룰로오스 나노섬유간의 상호작용을 유변학적 거동을 통해 고찰하였다. 막다른여과법을 통해 분리막을 제조하고 시간당 유량을 측정하였으며 자외-가시 분광광도계를 활용하여 염료 제거율을 평가하였다. 하이드로차의 크기와 관계없이 모두 99%이상의 염료 제거율을 가졌으며, 도입된 하이드로차의 크기가 클수록 높은 유량을 갖는 분리막 제조가 가능함을 확인하였다.

4PS-123 박상희

Dynamic Mechanical Properties of PLA and Sulfonated Polystyrene (SPS) Ionomer Blends

김준섭†, 박상희 조선대학교

In this study, to use PLA (polylactic acid) at high temperatures, PLA was blended with sulfonated polystyrene (SPS) ionomers. To prepare SPS ionomers, 95% of the acid groups of poly(styrene-co-sulfonic acid) copolymer was neutralized with LiOH. The mechanical properties of the blend were investigated as a function of temperature. In the case of PLA, the glass transition temperature (T_g) increased by about 4 degrees when blended with the ionomer. In addition, the storage modulus above T_g of PLA gradually increased as the amount of ionomer increased. Thus, we concluded that PLA and Li ionomers could be partially miscible, to some extent, by the formation of ion- coordination interactions between the Li^+ cations of the ionomers and the functional groups of PLA.

4PS-125 박상현

할로이사이트 나노튜브/셀룰로오스 복합 필름 기반 고감도 산화 탄소나노튜브 가스 센서 성능평가 및 고찰

박상현, 김형섭[1,†] 건국대학교; [1]건국대학교 화학공학부

탄소나노튜브를 이용한 가스 센서는 감도가 낮고 분산이 어려워 용액공정이 어렵다는 한계를 지닌다. 본 연구에서는 탄소나노튜브의 분산성을 높이고, 기판과의 점착성을 높이기 위해 탄소나노튜브를 산화시킨 후 물에 분산시켜 셀룰로오스 기판에 분사하여 가스센서를 제조하였다. 또한, 탄소나노튜브의 가스에 대한 접촉면 증가를 위해 할로이사이트 나노튜브를 도입하여 기판의 비표면적을 증가시켰다. 다량의 친수성기를 갖는 셀룰로오스를 기판으로 활용한 가스 센서는 기존에 활용되는 실리콘 웨이퍼와 대비하여 향상된 감도를 보였으며 비표면적 증가에 따라 가스 감응 감도는 획기적으로 향상되었다. 본 연구결과는 친환경 셀룰로오스 필름에 전도성 나노물질의 간단한 스프레이 도포를 통해 고성능 가스 센서로의 활용이 기대된다.

4PS-127 박민주

Hierarchical Helical Array of Ferroelectric Polymer

박민주, 황준호, 장예주, 이은지† 광주과학기술원

Helical nanostructure of the conjugated polymer has generated great interest in optoelectronic devices such as optical information processing, security-enhanced optical communication, etc. due to its circularly polarized light detection ability. As the requirements for miniaturized, wearable, and stretchable electronic devices with advanced memory capabilities have increased recently, interest in ferroelectric polymer has increased significantly. A molecular engineering for helicity control is highly desired in a controlled manner of dimension and size. Herein, we report the helical assembly of ferroelectric polymers based on a conducting nanowire template that prevents neutralization of ferroelectric polarization. Solution-state helical assembly promoted by additives involves the sergeant-soldier effect of ferroelectric polymers. Amplified chirality of resultant hybrid was clearly observed in a circular dichroism spectroscopy.

4PS-129 박규하

Interpretation of Polydiacetylene Nanosome-based Carriers: Internanosomal Behaviors, Endocytosis and Enhanced Fluorescence

박규하, 조성무, 서성백[1,†] KIST 한국과학기술연구원; [1]부산대학교

Polydiacetylene (PDA) is well-known for colorimetric and fluorescent sensing material used for bio molecule detection platform. Nevertheless, PDA nanosome has not yet been considerably interpretat into the living cells environment. The intercolloidal behaviors and stability of PDA nanosomes. In incubation tests with various neocortical metal ions, The PDA nanosome which phenolic lipid added is believed to contribute to the interliposomal bridging interaction. Localized Surface Plasmon Resonance (LSPR) is potentially useful for amplifying fluorescence of PDA nanosome. The low concentration of negative AuNPs were amplified PDA nanosomes fluorescence. Based on real-time cell imaging and cell viability assessment by the H-aggregated PDA nanosome with R6G, the most highly polymerized nanosomes were found to be less toxic to cells. Moreover, it was revealed that the R6G quenched nanosome complex dissociates at cell environment, the PDA nanosome penetrates into cells.

4PS-131 박강희

Synthesis of Silica Nanoparticles Tethered with Fluorophore-Attached Polymer Brush

박강희, 팽기욱[1], 김명웅† 인하대학교; [1]성균관대학교

The interface between the filler material and polymer chains has been of interest to understand underlying principle in the changes of physical properties in inorganic/organic composite materials. In order to observe the interfacial behavior, we attempt to examine the movement of fluorescent probe near the surface of the filler. However, the localization of the probe is challenging; herein, we demonstrate the synthesis of fluorophore-attached polymer brush anchored on the surface of silica nanoparticles (SNPs) with a controlled size. The fluorophore attached telechelic

PMMA and PS were synthesized by ATRP and CDI coupling. Immobilized alkyne functionality on SNPs allows grafting-to approach for the target structure. The resultants were thoroughly characterized with SEM, light scattering, XPS, and CLSM. Presented rational design of chemical route further highlight a feasible approach to build-up the composite materials with high complexities.

4PS-133 민성배

Optimizing Marangoni-driven Patterning in Polymer Thin Film

민성배, 김현정, 마세연, 김채빈† 부산대학교

The Marangoni effect is a phenomenon describing fluids flow from regions of low surface energy to regions of high surface energy. In thin polymer films, this effect could offer a practically useful route to manufacture patterned surfaces. Previous research has shown that the mixing a photosensitizing compound with polymer enables significant increases in feature aspect ratio and expands the applicability of the Marangoni patterning method to more readily available light sources and other classes of polymers. In this poster presentation, we will present a way to further optimize/maximize the feature aspect ratio of the Marangoni-driven patterns using a 9,10-dibromoanthracene and polystyrene thin film model system. To highlight versatility of our patterning method, the patterned polymer film was used for cell alignment.

4PS-135 문성민

Bioinspired Architectures of Cellulose Nanocomposites with Clay and Chitosan

문성민, 심봉섭† 인하대학교

Tunicate nanocellulose has been highlighted for its straightness and high crystallinity. Here, we demonstrate the bio-inspired nanostructure of cellulose nanofiber (CNF) through two different assembly techniques. Firstly, a binary system of montmorillonite (MMT) and CNF forms the nanostructured film via vacuum filtration. The nanocomposite was fabricated with its hierarchically aligned structure of nacre. The superior mechanical properties and fire retardancy compare to pure CNF film have been shown, while maintaining high transparency and flexibility. Secondly, we prepared the layer-by-layer (LbL) film using chitosan and CNF. LbL film of chitosan/CNF shows varying transmittance and interference of reflected light depending on the number of bilayers. As a result, the controllable structural coloration was obtained with different thicknesses. The nanocomposite of eco-friendly biomaterials has the potential to be used in diverse industrial fields.

4PS-137 김형준

Ionoelastomer Junctions Between Polymer Networks of Fixed Anions and Cations

김형준, Ryan Hayward[1,†] KAIST; [1]University of Massachusetts Amherst

Soft solids capable of conducting ions offer promise for the design of entirely new classes of highly deformable and bio-inspired devices. Here, we introduce ionoelastomers soft polymer networks capable of selectively conducting either anions or cationsto demonstrate liquid-free, elastic, and stretchable ionic diodes and transistors that operate entirely via non-Faradaic processes. We show that the junction of two oppositely charged ionoelastomers yields an 'ionic double layer', analogous to the depletion layer in a semiconducting p-n junction. This enables the design of ionic devices for rectifying and switching non-Faradaic ionic currents. Further, soft and stretchable ionoelastomer junctions provide fundamentally new functionalities including: 1) low voltage reversible electro-adhesion and 2) electro-mechanical transduction, i.e., the conversion of mechanical deformation into electrical signals.

4PS-139 김필곤

End-on Orientation of Poly(3-alkyl thiophene)s by Microphase Separation of Lamellar Forming Amphiphilic Diblock Copolymer

김필곤, 우도경, 김진곤† 포항공과대학교

To fabricate end-on orientation of P3AT, amphiphilic diblock copolymers consisting of P3ATs were synthesized. We synthesized poly(3-dodecyl thiophene)-block-poly(3-(2-(2-(2-methoxyethoxy)ethoxy)ethoxy)methyl thiophene) copolymer (P3DDT-*b*-P3TEGT) using the GRIM method. The synthesized P3DDT-*b*-P3TEGT showed lamellar microdomains, confirmed by SAXS. The thin film morphology measured by AFM and GIWAXS showed parallel oriented lamellar microdomains. This is because of a large difference of surface tension between hydrophobic P3DDT and hydrophilic P3TEGT blocks. Thus, both P3DDT and P3TEGT backbone chains were oriented perpendicularly to the lamellar layer, and the end-on orientation of P3DDT chains was obtained. P3DDT-*b*-P3TEGT film showed much improved hole mobility compared with neat P3DDT film in spite of presence of P3TEGT block with low hole mobility. This indicates that end-on orientation is very effective for designing high performance vertically operating devices.

4PS-141 김태호

Rheological Observation on the Phase Transition Change of Cellulose Solution According to HNT Addition

김태호, 김형섭[1,†] 건국대학교 나노 바이오 시스템 연구실; [1]건국대학교 화학공학부

본 연구에서는 Halloysite nanotube(HNT)의 도입에 따른 셀룰로오스/이온성액체 용액의 상전이 및 유변학적 거동을 관찰하였다. 용액의 상전이는 편광현미경(Polarized optical microscope)로 확인하였으며, 상전이에 따른 유변학 특성 변화는 회전식 레오미터(Rotational type rheometer)를 통하여 측정하였다. 제조된 고농도의 셀룰로오스 용액에서의 HNT의 분산성을 향상시키기 위해 Sodium dodecanoate(NaL)을 이용해 HNT의 표면을 개질하였다. 용액 중 개질된 HNT의 함량이 증가함에 따라 더 낮은 셀룰로오스 농도에서 이방성상이 관찰되었다. 이는 첨가된 HNT가 부피배제효과를 발생시켜 국부적으로 실제 용액농도의 증가에 기인한 것으로 추정된다. 셀룰로오스 용액의 액정상의 안정한 형성은 섬유 방사 및 전기 방사와 같은 제조 공정에 유용하게 적용이 가능할 것으로 기대된다.

4PS-143 김진우

Development of Reversibly Light-responsive BCP Particle by Introducing Photo-responsive Surfactants

김진우, 윤홍석, 구강희[1], 이영준, 이준혁[2], Kin Liao[3], 김범준† KAIST; [1]MIT; [2]한국생산기술연구원; [3]Khalifa University

We developed light-responsive block copolymer (BCP) particles, whose shape can be reversibly controlled. The main idea for forming light-dependent, reversibly shape changeable BCP particles is to design the surfactant containing light-active groups, which can light-dependently modulate interfacial activity in reversible manner. We designed and synthesized reversibly light-responsive surfactant, SP-DTAB, which amphiphilicity can be tuned by wavelength controlled light irradiation. With irradiating 365nm UV light, sphere particles with onion-like inner morphology are formed. On the other hand, ellipsoidal particles with axially stacked lamellar domain structures are formed under irradiating visible light. In addition, reversible particle shape transformation between sphere and ellipsoid is achieved by a chloroform vapor annealing with UV/visible light irradiation. We expect that these reversibly light-responsive BCP particle can be applied to a lot of field such as sensor, display.

4PS-145 김종우

Properties and Microstructural Variation in a Complex Polylactic Acid/Polypropylene Blending System

김종우, 민병각† 한국교통대학교

Various Polylactic Acid (PLA)/Polypropylene (PP) blending systems were prepared by using an extrusion molding technique at the extrusion temperature of 210 ℃. The mechanical and thermal properties of the blending systems as a function of PLA concentration, heat stabilizer and Compatibilizer concentration have been investigated. For mechanical properties, tensile and flexural tests, were carried out, and heat distortion temperature was measured for thermal characterization. In addition, the fractured surfaces of the corresponding blending systems were observed by using a scanning electron microscope (SEM) for phase separation studies. All the property data were interpreted in terms of each material parameter concentration and compared to the respective SEM micrographs. This was supported by Korea National University of Transportation in 2020.

4PS-147 김영규

Directed Self-Assembly of Metal Nanoparticles Induced by Soft Line Patterns

김영규, 이동현† 단국대학교

We report the directed self-assembly (DSA) of metal nano particles (NPs) on soft line patterns of poly(tetrafluoroethylene) (PTFE). As a bar of PTFE is dragged across a flat Si wafer surface above the melting point of PTFE, topographic line patterns parallel to the dragging direction are produced to the substrate. Then the substrate with the PTFE line patterns is chemically modified with polymer brushes. Afterwards, as metal NPs solution is spin-coated, the NPs are instantly self-assembled between soft PTFE lines. We think that this observation may be due to the synergetic effect of height contrast of soft PTFE lines and surface energy difference imparted by polymer brushes. To investigate the effect of polymer brushes on the DSA of NPs, their chain length and types of monomers are controlled. Finally, by applying RIE process, only uniform arrays of the NPs are remained on the wafer, but all organic components are removed. The DSA of NPs is characterized by using AFM and SEM.

4PS-149 김아란

A Study of UV-cured Optical Clear Adhesives (OCAs) with Rheological Analysis

김아란, 현 규[1], 최우잔[2,†], 이재흥[2] 한국화학연구원/부산대학교; [1]부산대학교; [2]한국화학연구원

UV-cured OCAs are being widely used and getting more importance in the display industry. Especially, with the commercialization of the foldable display, the rheological properties of the OCAs which were inserted among functional films in a foldable display module are becoming more important. The properties of OCAs depends on the OCA composition as well as UV curing condition. In this study, we investigated the effects of UV curing process (i.e, UV intensity and irradiation time) and OCA composition on the rheological properties of OCAs. We found that OCA's rheological properties (e.g., storage modulus, elongational viscosity, etc.) was changed as the UV Intensity and the content of IBOA(Isobornyl acrylate).

4PS-151 김수현

UV경화형 폴리우레탄 아크릴레이트와 실리카 나노입자를 이용한 초발수 및 초발유 스프레이 코팅

김수현, 이승구† 울산대학교

본 연구에서는 UV 경화형 폴리우레탄 아크릴레이트와 실리카 나노입자를 용매에 분산하여 간편한 스프레이 코팅을 통해 초발수 및 초발유 표면을 제작하였다. 용매의 종류, 고분자의 농도, 분 사량 조절에 따른 코팅 표면 구조의 변화를 확인하였으며, 물과 오일의 접촉각 측정을 통해 초발수 및 초발유 특성을 정량화 하였다. 스프레이 코팅 표면의 re-entrant 구조를 분석하여 초발수 및 초발유 특성이 극대화된 스프레이 코팅의 메커니즘을 제시하였다. 최적화된 스프레이 코팅 조건을 적용하여 제조된 표면의 물과 오일의 접촉각 hysteresis는 각각 2°, 30° 이하이며 오일 방울이 표면에서 튈 정도 로 우수한 초발수 및 초발유 특성을 보였다.

4PS-153 김성은

Effective Control of Domain Orientations in Block Copolymer Thin Films Using the

Air-Water Interfacial Layer of Short Block Copolymers

김성은, 김동협, 김소연† 울산과학기술원

Block copolymer (BCP) nanopatterning has been considered as one of the promising candidates overcoming the limitations of conventional lithography methods. To employ BCP in nanopatterning, perpendicular domain orientation of BCP is required. However, to control the domain orientation is often challenging because of the intrinsic surface energy difference between blocks and thus the perpendicular orientation is usually obtained with additional processes such as brush polymer grafting and grapho/chemoepitaxy. Here, we introduce a facile method to obtain perpendicular domain orientation of BCPs using the air-water interfacial layer (AWIL) of short BCPs. By coating AWIL onto various target substrates using Langmuir-Blodgett method, the surface of substrates can be easily neutralized and therefore, induce perpendicular orientation for overlying BCP films. In addition, AWIL can neutralize the free surface: even high-χ BCP is successfully self-assembled with perpendicular orientation.

4PS-155 김상훈

Improved Plasmonic Properties of Highly Conductive Polymers Confined in Nanopores

김상훈, 김진곤† 포항공과대학교

Conductive polymer such as poly(3,4-ethylenedioxythiophene:sulfate) (PEDOT:Sulf) can provide high electrical conductivity and metallic behavior. Due to its metal-like behavior, PEDOT:Sulf nanodisks can function as plasmonic metasurface only with organic materials and act tunable by redox reactions. However, it is still necessary to improve the plasmonic properties by increasing the electrical conductivity in the way as chain alignment and low defects. Here, we propose high density array of PEDOT:Sulf nanopillars based on anodized aluminum oxide (AAO) template for enhanced electrical conductivity and plasmonic properties. PEDOT:Sulf nanopillars have improved electrical conductivity by effectively aligning chains in nanopore, which improves the plasmonic properties of PEDOT:Sulf. Also, we expect to show complex and anisotropic permittivity by chain alignment along vertical direction, it can be applied to hyperbolic metamaterials.

4PS-157 김민형

키틴 나노 섬유/셀룰로오스 나노 결정 혼합 분산액의 액정 거동 및 복합 필름 제조

김민형, 김형섭[1,†] 건국대학교 유기나노시스템공학과 나노바이오시스템 연구실; [1]건국대학교 화학공학부

본 연구에서는 친환경 소재인 셀룰로오스 나노 결정(CNC)의 액정 거동에 대한 키틴 나노 섬유(ChNF)의 영향을 확인하기 위해 혼합 수분산액을 제조하고 성분비에 따른 거동을 관찰하였다. 표면전기 특성이 다른 두 소재의 상호작용은 제타 전위 및 광학적 특성, 정적/동적 유학적 거동을 통하여 고찰되었다. ChNF의 함량이 증가함에 따라 혼합 분산액의 제타 전위는 감소하고 겉보기 점도와 전단 박하율은 증가하였다. 또한 혼합 분산액 내에서의 CNC 액정상은 ChNF의 함량 증가에 따라 도메인 크기가 작아졌다. 액정상이 조절된 수분산액으로 복합필름을 제조하고 ChNF 함량 변화에 따른 모폴로오지, 배향도 및 역학적 특성을 관찰하였다. 제조된 CNC/ChNF 필름은 보고된 친환경 필름과 유사한 정도의 인장율과 탄성률을 보였다. 이를 활용해 배향 특성이 조절된 광학 필름 또는 식품 포장 필름으로의 응용이 가능할 것으로 기대된다.

4PS-159 김민수

Enhanced Conductivity Network of Transparent PEDOT:PSS Electrode by Alcoholic Solvent Post-treatment Process Improved PCE (%) of Organic Photovoltaics

김민수, 장웅식, 김선주, 왕동환† 중앙대학교

The conductive polymer poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT:PSS) has been used recently in various organic based semi-conductors in order to improve charge transfer. It has good electrochemical, mechanical properties and appropriate energy level as hole transport layer or transparent electrode. In this research, we demonstrated high conductivity of PEDOT:PSS thin film electrode that was enhanced from 2.4 to 762 S/cm by simple and effective processing protocol via 2-Chloroethanol (2-CE). It is important to understand the modifying mechanism of conductivity which conformational changes through the elimination of PSS chain in the PEDOT and PSS network. As a result, we characterized organic photovoltaic devices using the conducting polymer anodes and found that the 2-CE post-treated electrode resulted high transmittance, low sheet resistance and advanced electrical device performance compared to the commonly used dimethyl sulfoxide (DMSO) additive.

4PS-161 김동협

Universal Interfacial Control through Polymeric Nanomosaic Coating to Control Domain Orientations in Block Copolymer Thin Films

김동협, 김소연† UNIST

Block copolymer (BCP) self-assembly has achieved great advances in nanotechnology over the past several decades. The precise control of interfacial properties in BCP thin films is crucial to obtain a perpendicular domain orientation in nanopatterning. Herein, the effective and universal interfacial engineering of polymeric nanomosaic (PNM) coating is introduced. The PNM patterns derived from the air/water interfacial self-assembly of BCPs can be tuned with a few-nm-resolution and transferred to substrates, which enables accurate control of surface energy of the substrates. Overlying BCPs on the PNM coated substrates successfully self-assembled to have a perpendicular domain orientation. The PNM coating can be applied to curved, flexible, and three-dimensional substrates in an extensive spectrum of materials. Furthermore, the PNM can be utilized as an etching-free, shear-inducible, and reusable topcoat imparting free surface neutralization for the high-chi BCP thin films.

4PS-163 김기승

A Highly Self-Healable Heterocyclic Elastomer Based on Isosorbide Oligomer with Excellent Surface Hardness

김기승, 김진실, 문경민, 홍평화, 최기원[I], 고민재[I], 홍성우† 한국생산기술연구원; [1]한양대학교

A new heterocyclic elastomer based on isosorbide oligomer (HEIO) is synthesized and its self-healing and mechanical properties are studied. To prepare HEIO, an isosorbide oligomer with hydroxyl groups at both ends is synthesized and reacted with acrylate-based polyol (aPo) and crosslinker with multiple isocyanate groups (Xlinker). To compare the self-healing and mechanical properties, aPo is reacted with Xlinker to prepare conventional elastomer (CE) and isosorbide and aPo are reacted with Xlinker to generate heterocyclic elastomer with randomly distributed isosorbide moiety (HEI). Interestingly, HEIO exhibits outstanding self-healing efficiency compared to CE without isosorbide moiety. In addition, HEIO shows more enhanced surface hardness than CE or HEI. These results demonstrate that the conventional elastomer can achieve both excellent self-healability and mechanical surface properties by introducing isosorbide oligomer where heterocyclic isosorbide compounds are connected.

4PS-165 곽병진

Self-healing of Sulfonated Poly(ether ether ketone)/PVA-CBA Membrane for Proton Exchange Membrane Fuel Cell

곽병진, 배인성† 한남대학교

Self-healing of polymers have been studied as an important topic for restoring original functions from the mechanical damages in Proton Exchange Membranes (PEMs). Among various PEMs, sulfonated poly(ether ether ketone) (SPEEK) has been explored to be a promising substance in PEM Fuel Cells (PEMFCs). The membrane blending with the SPEEK and poly(vinyl alcohol) (PVA) immersed in 4-carboxybenzaldehyde (CBA) solution. Since the CBA allows chemical bonding between the polymer chains of the blend membrane, mechanical behaviors of the membrane are improved including not only a stability for water swelling but also self-healing reaction after cracks. Water uptake, swelling and proton conductivity of the membranes were measured as the according to time of soaking in CBA solution. It is confirmed that the addition of CBA prevents swelling degree of the membrane and induces the self-healing of the membrane.

4PS-167 강연주

Tensile Properties of Bisphenol-A Polycarbonate (BPA PC) Ultra-thin Films

강연주, 최우진[1,†], 이재흥[1], 홍성권[2] 한국화학연구원/충남대학교; [1]한국화학연구원; [2]충남대학교

Ultra-thin polymeric films are readily found in many flexible devices. The reliability and performance of the flexible devices depends on the mechanical properties of thin films within multilayered structures. In this study, we made an ultra-thin film tensile tester and measured the tensile properties of BPA PC. With lab-made tensile tester, the stress-strain curves of ultra-thin films were obtained successfully and these curves were comparable with bulk BPA PC. In this study, the effects of thickness, annealing history, and molecular weight on the tensile properties of BPA PC are reported.

4PS-171 Busra Ozlu

Melanin-like Nanoparticles for Multimodal Synergistic Therapy of Cancer

Busra Ozlu, 심봉섭† Inha University

Cancer is the reason for one in six deaths, and the number of new cases increased to 18 million in 2018. The development of more effective and less toxic drug delivery systems for the treatment of cancer is crucial due to the serious side effects of currently used clinical procedures. Recently, nanoparticles became attractive candidates in drug delivery research by overcoming several limitations of conventional therapies. Melanin is a natural dark pigment with good biocompatibility, biodegradability, intrinsic photoacoustic properties, and the ability to bind drugs. In this study, a melanin-like nanoparticle-based drug delivery system was designed for near-infrared light controlled trimodal therapy in which photodynamic therapy, photothermal therapy, and chemotherapy are combined to produce synergistic therapeutic effects. The in vitro anticancer effect of MNPs was investigated in terms of photothermal efficiency, stimuli-responsive drug release, and therapeutic efficacy.

고분자합성 (III)

4PS-173 엄건희

Removal of Hexavalent Chromium from Wastewater by Using Nanoengineered Polypeptides

엄건희, 김 일† 부산대학교 고분자공학과 고분자합성연구실

Nanoengineered polypeptides can be synthesized by *N*-heterocyclic carbene catalyzed ring-opening polymerization of α-amino acid *N*-carboxyanhydrides (NCAs). Linear, hinged, star polypeptide can be easily accessible simply by changing the type of amine initiators. Copolypeptide is also prepared by tuning the type of NCAs. The degree of polymerization was measured by infrared spectroscopy and

the structure of polypeptide was confirmed by nuclear magenetic resonance. Since hexavalent chromium is negatively charged, it can be adsorbed by polypeptides with positive end groups like Lysine or Histidine. Hexavalent chromium is detected by using Ultraviolet-Visible Spectroscopy at 540 nm.

4PS-175 심 용

Synthesis and Photovoltaic Properties of D-π-A Type Polymers Containing the Oxadiazole Side Chains of Diketopyrrolopyrrole (DPP) Acceptor Central Unit with Different Donor Units

심 용, 김태동† 한남대학교

After the first report in 2008, the polymer photovoltaic materials based on diketopyrrole (DPP) were studied in depth. Moreover, polymers based on DPP can also be transformed into electron acceptor materials through wise structural modification, and some exciting progress has been made recently. For example, the changes of donor receptor structural units, the types of alkyl substituents and conjugated bridges, and the end-capped groups were studied. In this paper, we investigate whether different donor units (TVT, DTT) can improve The power conversion efficiencies (PCEs) in the case of diketopyrrolopyrrole (DPP) – based conjugated polymers with oxadiazole side chains. The best power conversion efficiency was obtained from PADPPOXA-TVT (0.540%) and PADPPOXA-DTT (0.173%) respectively.

4PS-177 심규원

Investigation of Chain Sequence of Polyphenylene Sulfide Copolymers and Monomer Reactivity in Melting Sulfur Polymerization Condition

심규원, 정현민†, 이재훈[1], 최성민 금오공과대학교; [1]구미전자정보기술원

슈퍼엔지니어링 플라스틱으로 polyphenylene sulfide(PPS)는 좋은 열적, 기계적 특성, 우수한 내화학 특성으로 관심을 받고 있다. PPS 중합 방식중 sulfur를 사용한 용융중합에서 p-diiodobenzene(p-DIB), diiodo화합물을 단량체로 적용한 PPS 공중합은 새롭게 연구되는 분야로 PPS물성향상을 위한 방법으로 개발되고 있다. 공중합 단량체로서 (4-iodophenyl)methanone(BIPM)를 공중합 단량체로 적용하여 PPS물성을 향상시키는 연구가 진행 중이며 본 연구에서는 용융중합에서의 반응성을 조사하였다. 이 연구에서 p-DIB와 BIPM의 상대적인 용융중합 반응성에 대해 반응진행에 따른 단량체의 감소량을 NMR을 통해 정량하여 상대 반응속도를 확인 후PPS공중합체 사슬에 포함되는 단량체의 시퀀스는 sulfur 및 중합 조절제로 diphenyldisulfide(DPDS)를 사용하여 이합체, 삼합체 및 올리고머 크기의 생성물을 얻어 MALDI-TOF분석을 통해 성분을 조사하고 단량체들의 연결관계를 분석하였다. 이를 바탕으로 단량체들간의 상대적인 반응비를 확인하여 p-DIB와 BIPM의 sulfur 용융중합에서의 사슬 시퀀스를 예측하였다. 또한 FT-IR분석을 통해 공중합체의 성분비를 분석하였다.

4PS-179 신종찬

Synthesis and Characterization of Ionic Polyurethanes Based On Pyrrolidinium Ionic Liquid Monomers

신종찬, 이민재† 군산대학교

A series of ionic polyurethanes containing pyrrolidinium cations on the polymer backbone is synthesized from dihydroxy alkylene pyrrolidinium ionic liquid monomers, and polyethylene glycol (PEG), and 4,4'-diphenylmethane diisocyanate (MDI). ^{1}H NMR and FT-IR analyses are used to see the reaction completion and mole ratio between the ionic and non-ionic ratio in the synthesized polyurethanes. The ionic polyurethanes containing PEG units show higher thermal stabilities than those of the polyurethane with no PEG. The polyurethane with PEG-4000 and PF_6^- anions shows highest thermal stability, up to 350 ℃. The polyurethanes with PEG-4000 may have crystalline phases below their melting temperatures, however the other polyurethanes are amorphous. The copolymers of PEG-4000 show higher conductivities; the polyurethane with PEG-4000 and PF_6^- anions shows 1.84×10^{-4} S/cm at 50 ℃.

4PS-181 신요섭

Thermal Conductivity Analysis of Phase-Separated Polyimide Film Containing Amorphous Boron Nitride

신요섭, 이승우†, 강인수 영남대학교 화학공학부

The thermal conductivity along the out-of-plane direction in polyimide (PI) blend films containing amorphous Boron Nitride (BN) was investigated. PI blend films composed of a sulfur-and a fluorine-containing PI were prepared via spin-coating and thermal curing of precursor solutions containing BN. Microphase-separated structures with “vertical double percolation (VDP)” morphology were spontaneously formed in the films, in which two phases were separately aligned along the out-of-plane direction, and BN were preferentially interacted in the sulfur-containing PI phase. The blend film exhibits 350% enhancement of thermal conductivity at 25 vol% of BN, whereas only 90% enhancement was observed in the monophase PI film containing homogeneously dispersed BN. These results indicate that the VDP structure with selective incorporation of BN functions as an effective thermal conductive pathway.

4PS-183 손일오

Synthesis of Super-Hydrophobic Monomer Based Polymeric Micelles for pH-Responsive Drug Delivery Systems

손일오, 김병수† 연세대학교

To overcome drawback of the drug, releasing the drug at a desired site is essential. Due to the acidic pH of tumor cell, pH-responsive acetal bond can be exploited as a key chemistry for stimuli-responsive drug delivery systems (DDS). In this study, we synthesized the novel diblock copolymers composed of super-hydrophobic epoxide monomer of cyclohexyloxy ethyl glycidyl ether (CHGE) via anionic ring-opening polymerization (AROP) using organic superbase, *t*-BuP$_4$. After the polymerization, the acetal group in PCHGE was deprotected to hydroxyl group in acidic conditions and converted to biocompatible polyglycerols. The *m*PEG-*b*-PCHGE were carefully characterized by ^{1}H NMR, GPC, and DSC. The *m*PEG-*b*-PCHGE was able to self-assemble into a polymeric micelles in aqueous conditions. The selective cleavage of the acetal bond under acidic conditions led to a sustainable release of the drug. We anticipate this super-hydrophobic monomer based polymeric micelles will provide new means for a smart DDS.

4PS-185 서희란

Octadecylamine-grafted Partially Unzipped Carbon Nanotubes (PUCNT-C18) Incorporated Thin-film Nanocomposite (TFN) Reverse Osmosis (RO) Membrane with High Separation Performance

서희란, 공새롬, 정경화, 김문현, 이종찬† 서울대학교

Thin-film nanocomposite (TFN) membranes containing carbon nanotubes (CNTs) are known to exhibit higher water permeability than conventional thin-film composite (TFC) membranes. However, CNTs has the poor dispersion stability to most of solvents. Thus, to incorporate CNTs into polymer membrane without aggregation it should be oxidized and dispersed in aqueous phase during the interfacial polymerization (IP). The aim of this study is to increase the dispersion stability of CNTs to the organic solvent by modifying CNT to partially unzipped carbon nanotube (PUCNT) and grafting octadecylamine on PUCNT. TFN membrane fabricated by introducing PUCNT-C18 as a filler of organic phase could maximize the manifestation of the properties of CNTs. Also, TFN with PUCNT-C18 showed much higher pure water flux than TFC, which was comparable to that of TFN with oxidized CNT. These results indicate that controlling the position of nanomaterials could improve the performance of TFN membrane.

4PS-187 서정희

Anionic Polymerization of Isoprene and Functionalization by Thiol Derivatives

서정희, 류상욱† 충북대학교

Anionic polymerization is a method that can control molecular weight distribution and molecular weight. In this study, the polyisoprene(PI) was synthesized by anionic polymerization and it found that they have stereoregularity which determined by reaction solvent and temperature. In fact, PI having a high ratio of 1,2-/3,4-structure was synthesized using sec-butyllithium and tetrahydrofuran as initiator and solvent. Then, the synthesized PI was functionalized by using 2-aminoethanethiol, benzyl mercaptan, methyl 3-mercaptopropionate, and 1-dodecanethiol with radical initiator under mild conditions. As a result the thermal properties and solubilities were changed dramatically after functionalization. Also it was confirmed that block copolymer can be synthesized at -10 ℃ for 24 hrs in Ar atmosphere.

4PS-189 배소영

Optimization of PEDOT:PSS Linearity by Sequential Addtion Process

배소영, 김중현†, 이홍주, 김영노 연세대학교

Poly(3,4-ethylene dioxythiophene):poly(styrene sulfonate) (PEDOT:PSS) has gained immense attention as a next-generation transparent electrode. However, in order to realize its practical application, it is imperative that its optical and electrical properties should be improved. Generally, acid dopants are added to improve optical and electrical properties. In this study, however, we replaced the batch process used for manufacturing PEDOT:PSS with a sequential addition process to improve its optical and electrical properties efficiently without additional additives. In this process, the rate of polymerization and the structure of the product could be regulated by controlling the amount of monomer and catalyst. The proposed approach was used to increase the linearity of PEDOT and the proportion of PEDOT attached to the PSS chain to improve transmittance by 6.2% (73 to 79.2% at 100 ohm) and conductivity by 39.68% (446 to 623 S cm^{-1}).

4PS-191 박희경

Synthesis and Evaluation for Cross-linkable Organic/Inorganic Hybrid Polymer via Quaternization

박희경, 최슬기, 김재훈, 정진주, 이정수† 조선대학교

In this study, we have designed breakthrough complex process (cross-linking and composite technique) to efficiently enhance the physical properties of polymer in simple one step. Thus, the cross-linkable organic/inorganic hybrid polymer was successfully obtained by quaternization of Poly(4-vinly-pyridine) with unique functional moiety containing ethoxysilane. To determine the enhanced properties of polymer prepared through cross-linking(silanol) reactions occurred by thermal treatment, the thermal properties of prepared samples were analyzed through DSC and TGA, and chemical structures were confirmed by H^1-NMR and FT-IR spectroscopy. The resultant physical properties lead to the improvement in the performance of the organic/inorganic hybrid polymer composite were expected to be used as promising materials for a wide spectrum of science fields.

4PS-193 박효진

Synthesis of Chemical Sensors Based on Azobenzene and Detection of Heavy Metal Ions

박효진, 이승우†, 이유정 영남대학교 화학공학부

A variety of techniques for the determination of heavy metal ions have been investigated intensively in the literature including spectroscopy, chromatography, electrophoresis, and fluorescence detection.[1,2] Sensing technologies for cations

have become very important for both biological and environmental applications. in response, a large class of cation sensors based on coordination chemistry has been developed. Several are selective for both alkali and alkaline earth metals, such as lithium, sodium, potassium, zinc, calcium and magnesium, in which detection is necessary to monitor and regulate a number of cellular functions. Heavy metal cations such a lead and mercury have also been studied, due to their deleterious effects on biological system. In addition, there are several other environmental concerns were prepared by diazotization reaction.

4PS-195 박형주

Preparation and Properties of Protective Material for Electronic Device Based on Crosslinked Poly(imide-siloxane)

박형주, 최주영, 진승원, 이승현, 최윤제, 김담비, 정찬문† 연세대학교

Power semiconductor has become important device for power system applications such as high voltage direct current transmission. It is known that materials and protecting technologies play more important roles in the field of power electronic protecting. Electronic device uses silicone as the base protective material, limiting junction operating temperature below 150 ℃. To solve the limitation, more and more attention has to be paid to protecting technologies and materials. Poly(imide-siloxane) has excellent properties such as high thermal, insulation and mechanical properties. In this study, we prepared crosslinked poly(imide-siloxanes) through hydrosilylation reaction and studied their properties. The resultant crosslinked poly(imide-siloxane) showed high decomposition temperature (T_{10}) over 450 ℃ and low thermal conductivity of 0.11. These exceptional characteristics make crosslinked poly(imide-siloxane) suitable for protective materials of electronic device.

4PS-199 박연희

Synthesis of Vinyl Terminated Poly(dimethyl-co-methylvinyl) Siloxane (VPDMS-co-VPVMS)

박연희, 강호종†, 권수미, 김재옥 단국대학교

PDMS는 유연한 구조에 따른 우수한 물성으로 다양한 산업 소재로 사용할 수 있으나 최근 요구되는 산업 소재로는 다양한 기능성 부여를 위한 반응이 가능한 Siloxane에 대한 연구가 필요하다. 본 연구에서는 PDMS의 합성과는 달리 cyclic vinyl methyl siloxane을 단량체로 사용하고 바이닐기를 가진 말단 캡핑제를 이용하여 Vinyl-terminated Poly (dimethyl-co-methylvinyl) siloxane 공중합체를 합성하였다. 그리고 합성 조건이 분자량과 수율, 분자량분포와 공중합체의 구조에 미치는 영향을 살펴보았다. 높은 온도에서 합성될수록 공중합체의 분자량이 증가하고 수율은 감소하며 좁은 분자량분포를 가지며 공중합체의 바이닐 함량이 증가함을 확인하였다. 반면 말단 캡핑제의 함량이 높아지면 분자량과 수율은 감소하고 좁은 분자량분포를 갖고 바이닐기의 함량이 감소함을 확인하였다.

4PS-201 박상우

Metal-Free Synthesis of Poly(Carbonate Ester)-Based Thermoplastic Elastomers

박상우, 김 일† 부산대학교 고분자공학과 고분자합성연구실

Thermoplastic elastomers have attacked increasing attention as alternatives to traditional rubbers due to a combination of rubber-like properties such as high flexibility and heat resistance, along with their thermoplastic nature like extrusion and injection molding. In this study, we have synthesized poly(carbonate ester)-based thermoplastic elastomer (TPCE) using metal-free catalytic procedure. TPCEs were prepared in the presence of acid-base organocatalyst using dimethyl-2,6-naphthalenedicarboxylate as hard segment (HS), cyclic carbonates and lactones as soft segment (SS), and 1,6-hexanediol as chain extender. TPCEs with different HS and SS ratios were successfully produced and their mechanical properties were then investigated by universal testing machine, differential scanning calorimetry, dynamic mechanical analysis.

4PS-203 민 주

Glycolysis Reactivity of Glycols for Chemical Recycling of Copolyesters

민 주, 정현민†, 이진석, 호 린 금오공과대학교

Recently, glycolysis has appeared to be an essential and commercial process for the recycling of waste PET plastic, in which transesterification occurs in the polymer chains with diols to form valuable products. The diols used in the glycolysis process vary from linear to rigid cyclic, bicyclic structures such as diethylene glycol (DEG), 1,4-cyclohexanedimethanol (CHDM), and D-isosorbide (ISB). In this study, we investigated the reactivity of diols toward transesterification/glycolysis reactions with PET and its model compound bis(2-hydroxyethyl) terephthalate (BHET). The influence of chemical structure was confirmed by considerably reduced reactivity in order of DEG, CHDM, ISB. The reaction rate for reactions involving DEG was 230 times and 1.2 times higher than that of CHDM and ISB, respectively. Besides, the glycolysis of terephthalate copolyesters consisting of ethylene glycol (EG), CHDM, and ISB moieties with DEG showed identified degradation rates as the above processes.

4PS-205 류태욱

Synthesis and Characterization of Gel Polymer Lithium Ion Battery Containing Lithium Salt Using Thermal Curing Method

류태욱, 윤수진, 진레이, WEI ZHANG, 김대호, 이용훈, 장호현, 김환기† 건국대학교

This study aims to improve the low thermal stability and flexibility of liquid electrolyte lithium ion batteries. As a substitute, gel polymers have attracted much attention as an electrolyte with excellent fire resistance, high efficiency and chemical stability. Thermal polymers broadly include monomers, oligomers, polymers or mixtures of the above-mentioned materials, where chemical reactions occur when heat is applied, resulting in profound changes in structures that substantially alter chemical and mechanical properties. Herein, we fabricated a single li-ion conducting blending polymer electrolyte, consisted of lithium poly[(p-styrenesulfonyl) (fluorosulfonyl) imide] (LiPSFSI) and poly (ethylene glycol) dimethacrylate (PEGDMA). Afterwards, the thermal properties and cell performances of as-prepared electrolyte were investigated.

4PS-207 도주혁

Synthesis and Characterization of Cyclic, Hyperbranched and Graft Polymers Using a Sulfoxide-based Vinyl Protected Macroinimer

도주혁, 김동우, 김연지[I], 이하나[I], 전흥배[I], 백현종† 부산대학교; [1]광운대학교

We synthesized hyperbranched, cyclic, and graft polymers using a sulfoxide-based vinyl protected macroinimer. The vinyl protected macroinimer was synthesized via atom transfer radical polymerization (ATRP) using a protected ATRP initiator, which has methacrylic group of double bond protected by sulfoxide. Through thermal sulfoxide cleavage, the macroinimer were deprotected. When the macroinimer is reacted under conventional ATRP conditions, a hyperbranched polymer was synthesized by self-condensing vinyl polymerization (SCVP). On the other hand, a cyclic polymer was synthesized by atom transfer radical cyclization (ATRC) in diluted concentration. Also, if nitroxide-mediated polymerization (NMP) is used, the macroinimer acts as a macromonomer because ATRP initiation does not occur. So, Graft polymer was synthesized via NMP with 4-acetoxy styrene as a comonomer. The synthesized polymer architectures were successfully characterized by SEC, 1H NMR spectroscopy, MALDI TOF-MS.

4PS-209 도민석

Near-Infra Red Shielding Effect of PAni:PSS Particles According to Acid Dopant Difference

도민석, 임소은, 박찬일, 김중현† 연세대학교

Semi-transparent heat insulation coatings are an essential next-generation green technology. In this study, we report the synthesis of conducting polymer PAni:PSS particles with different acid dopant for metal-free near-infrared (NIR) shielding material by controlling the chemical composition without adding any chemicals and applying extra treatment. A PAni:PSS particles were polymerized via oxidative polymerization, using the series of different acid dopant, such as Sulfuric acid (H_2SO_4), Perchloric acid ($HClO_4$), Hydrochloric acid (HCl) and Naphthalenesulfonic acid (NSA). The maximum NIR-shielding efficiency of the film was 90% with 60% transmittance. This powerful NIR shielding performance of PAni:PSS make it an ideal candidate for heat-insulating materials that find application in semi-transparent heat-insulator-coated windows.

4PS-211 노지영

Polymerization of Polyacrylonitrile (PAN) Copolymers Containing Methyl Acrylate (MA) and Itaconic Acid (IA) as Comonomer for PAN Carbon Fiber Precursor

노지영, 임정혁, 김경민† 한국교통대학교

Carbon fiber has excellent specific strength, elastic modulus, thermal and chemical resistance. Due to these advantages, carbon fiber has been extensively applied in high-tech fields such as aerospace, defense areas, and civil engineering as reinforcing material. However, PAN homopolymer has hardly been used because it has poor processability and mechanical properties. Moreover, PAN carbon fibers are highly affected by the method of polymerization, chemical structure of comonomer, and its content. Therefore, acidic or neutral comonomers have been used to improve processability and mechanical properties. In this study, poly(acrylonitrile-co-methyl acrylate-co-itaconic acid) terpolymer containing different contents of comonomers were synthesized by water-based and solution polymerization. The characteristics of PAN copolymers with different weigh ratio of comonomers were characterized by NMR, FT-IR, DSC, GPC, XRD and viscometer.

4PS-213 김혜진

Polybenzimidazole Composite Membranes Having Imidazole Functionalized Graphene Oxide Showing High Proton Conductivity and Improved Physicochemical Properties

김혜진, 김정환, 김기현[I], 한주성, 고태윤, 이종찬† 서울대학교; [1]경상대학교

Polybenzimidazole composite membranes are fabricated using imidazole functionalized graphene oxide (ImGO) as a filler material for high temperature proton exchange membrane fuel cell applications. Through the reaction of o-phenylenediamine with graphen oxide (GO), ImGO is prepared. The PBI composite membrane having ImGO exhibits improved physiochemical properties and larger proton conductivity compared with the pure PBI and PBI composite membrane having GO because of the better compatibility of ImGO with PBI matrix. For example, PBI composite membrane having 0.5 wt% of ImGO shows enhanced tensile strength (219.2 MPa) with minimal decrease of elongation at break value (28.8%) compared with PBI composite membrane having 0.5 wt% of GO (215.5 MPa, 15.4%) and pure PBI membrane without any filler (181.0 MPa, 34.8%). The proton conductivity of this membrane, at 150 ℃ under anhydrous condition, is 77.52 mS cm^{-1}.

4PS-215 김형준

Synthetic Approach to Produce Poly(ester-amide)s Using Bio-based Diols for Engineering Plastics

김형준, 김무송, 안철희† 서울대학교

According to the current global production of bioplastics in 2019, PET and polyamide are the top two engineering plastics worldwide. PET exhibits disadvantages due

to relatively low physical strength and T_g. One way to modify PET to yield a higher T_g and better mechanical properties is to combine polyesters and polyamides. PEAs are attracting widespread interests in many researchers. Though much effort has been involved into PEAs, to the best of our knowledge, only a few studies have been conducted in PEAs for engineering plastics. In this study, for the development of bioplastics having mechanical properties superior to PET, various diols were synthesized with amino acids and dimethyl esters which were non-edible bio-based materials. In the same process as PET, thermal bulk polymerization was succeeded. Thermal analysis showed that the T_g was nearly twice as high as that of PET, which enabled to utilize PEAs in applications requiring much wider temperature range.

4PS-217 김하은

Silica Dispersibility and Its Correlationship with Properties of Silica/SBR Compounds Using Cellulose Dispersant

김하은, 임승호, 권용록, 홍석주, 김정수, 김동현† 한국생산기술연구원

In silica-SBR rubber compound at tire tread, silica has a hydrophilic group and does not mix well with the rubber, resulting in some agglomeration phenomena. The mechanical properties, and wear resistance of the rubber compound are related to the silica dispersibility. To improve silica dispersibility, the wet masterbatch (WMB) process was introduced and there is also increasing interest in silica dispersants. We evaluated an eco-friendly cellulose as a dispersant of the rubber compound in the WMB process. The vulcanization properties and processability of silica/SBR compounds using cellulose dispersant were compared using a Moving Die Rheometer and Mooney Viscometer, respectively. The DIN abrasion of silica/SBR compounds with cellulose dispersant improved by up to 29%.

4PS-219 김태형

Functionalization of Poly(2-ethynylpyridinium bromide) via Copper-catalyzed Azide-alkyne Click Chemistry

김태형, 김상율†, 제갈영순[1,†] KAIST; [1]경일대학교

Poly(2-ethynylpyridinium bromide) is one of the conjugated polyacetylenes containing ionic pendent groups. Since poly(2-ethynylpyridinium bromide) can be prepared by the direct polymerization of 2-ethynylpyridine and propargyl bromide under mild reaction condition, several kinds of function groups have been introduced into the polymer chains. In this study, the copper-catalyzed azide-alkyne click (CuAAc) chemistry is applied as a method of introducing functional groups into poly (2-ethynylpyridinium bromide). For CuAAc reaction, we prepared poly(N-propargyl-2-ethynylpyridinium bromide) having a "clickable" propargyl side chain. By using the copper catalyzed reaction between the propargyl group of poly(N-propargyl-2-ethynylpyridinium bromide) and azide containing compounds, we demonstrate that several functional groups are successfully introduced into the side chain of the ionic conjugated polymer through post-polymerization modification.

4PS-221 김태은

Effects of CNT-COOH on the Stabilization of Polyacrylonitrile Copolymers

김태은, 임정혁, 김경민† 한국교통대학교

Polyacrylonitrile (PAN) homopolymer is rarely used as a precursor of carbon fibers due to high stabilization temperature and low processability. To overcome above problems, PAN copolymer using various comonomers were generally synthesized. The high cyclization initiation temperature causes thermal damage to PAN surface during the stabilization process, which raise the degradation of mechanical properties of carbon fibers. As a method for lowering the stabilization temperature, acidic comonomers with a carboxyl group such as Itaconic acid (IA) or Acrylic acid (AA) is generally used. Carbon-based filler, such as Carbon nanotube (CNT), have high thermal conductivity and excellent mechanical properties, so addition as reinforcements to PAN precursors can promote cyclization reaction. In this study, we designed a series of Poly(acrylonitrile-co-itaconic acid) with thermally conductive CNT-COOH. Finally, Characteristics of PAN/CNT-COOH composites were analyzed by various analytical tools.

4PS-223 김지수

Efficient Synthesis of the Ag-Hollow Spherical Porous Polymer with Excellent Catalytic Effect on Dye Degradation

김지수, 쑹원리양[†], 김 일† 부산대학교; [1]부산대학교 고분자공학과 고분자합성연구실

In this work, we present a synthesis of the Ag nanoparticle decorated on the hollow porous organic nanospheres (Ag@OH-HPONs) by simple combination of the Lewis acid-base interaction mediated self-assembly and followed impregnation reduction method, in which the OH-HPONs were prepared via a Friedel-Crafts reaction by using 1,4benzenedimethanol as monomer. Then, the OH-HPONs is modified to convert the OH group to the COOH group. Owing to the abundant carboxyl groups on the wall of the COOH-HPONs, the Ag nanoparticles can be successfully decorated on the COOH-HPONs to produce of Ag@COOH-HPONs via electrostatic (ion-dipole)interactions with [Ag(NH3)]2+ following by an in-situ reduction of PVP(polyvinylpyrrolidone). The obtained Ag@COOH-HPONs exhibit the high catalytic activities for the dye degradation. This approach for fabricating the metal decorated porous organic polymers may provide guidance for the new type of the morphological controlled catalysts for practical applications.

4PS-225 김종원

멤브레인용 투명 폴리이미드/PVA 블렌드 필름의 특성 연구

김종원, 장진해[1,†] 금오공과대학교; [1]금오공과대학교 고분자공학과

무수산 4,4'-(hexafluoroisopropylidene)-diphthalic anhydride(6FDA)와 아민계인 2,2-bis(3-aminophenyl)hexafluoropropane(6FAm) 또는 2,2-bis(3-amino-4-hydroxyphenyl)hexafluoropropane(6FAm-OH)을 N,N′-dimethylacetamide(DMAc) 용매 속에서 중합하여 폴리아믹산(poly(amic acid), PAA)을 얻었다. 다양한 함량(0-5 wt%)의 PVA를 PAA 용액에 첨가하여 blending 후 열 이미드화 방법을 통해 투명한 복합체 polyimide(PI)/PVA 복합체 필름을 합성하였다. PAA와 PVA의 blending에 의해 필름 속에 분산된 수용성의 PVA는 수중에서 용해되어 일정하게 분산된 마이크로 크기의 pore를 형성하였다. PVA의 양에 따른 pore의 분포도와 블렌드된 PI필름의 열적 성질과 광학적 특성을 조사하였으며, pore의 분포도는 field emission scanning electron microscope (FE-SEM)으로 관찰하였고, 열적 성질은 differential scanning calorimetry (DSC), themogravimetric analyzer(TGA)를 이용해 측정 하였고 광학적 특징은 Ultraviolet- visible spectroscopy(UV-spectroscopy)와 spectrophotometer로 관찰하였다.

4PS-227 김종원

폴리이미드와 PVA 블렌드를 이용한 무색 투명 멤브레인 필름의 특성 연구

김종원, 장진해[1,†] 금오공과대학교; [1]금오공과대학교 고분자공학과

무수산인 4,4′-(4,4′-Isopropylidenediphenoxy)bis(phthalic anhydride)(BPADA)와 아민인 Bis(3-aminophenyl) Sulfone(APS)을 N,N′-dimethylacetamide(DMAc) 용매 속에서 중합하여 폴리아믹산(poly(amic acid), PAA)을 얻었다. 다양한 함량(0-5 wt%)의 PVA를 PAA 용액에 첨가하고 특정 온도에서 blending 후 열 이미드화 방법을 통해 투명한 polyimide(PI)/PVA 복합체 필름을 합성하였다. 얻어진 복합체 필름의 두께는 대부분 20 마이크론의 두께를 가졌다. PI와 PVA의 blending에 의해 필름 속에 분산된 수용성의 PVA는 수중에서 완벽하게 용해되어 일정하게 분산된 마이크로 크기의 pore를 형성하였다. PVA의 양에 따른 pore의 분포도는 field emission scanning electron microscope (FE-SEM)으로 관찰하였고, 열적 성질은 differential scanning calorimetry(DSC), themogravimetric analyzer(TGA)를 이용해 측정하였다. 광학적 투과도 특성과 Yellow Index(YI)은 Ultraviolet-visible spectroscopy와 spectrophotometer로 관찰하였다.

4PS-229 김정수

The Enhancement of the Liquid Permeability of Biomass-based Superabsorbent Terpolymer

김정수† 한국생산기술연구원

Superabsorbent polymer (SAP) can absorb and retain water more than several ten times of their dry mass by their three-dimensional hydrophilic structure. Conventional SAP is mainly composed of poly(acrylic acid sodium salt) derived from petrochemicals. We try to reduce the use of the petrochemical moiety and replace them with biomass-based materials. Firstly, we prepared core-SAP using the terpolymerization of itaconic acid, vinylsulfonic acid, and cellulose. We found the optimal conditions of terpolymer composition according to material input ratio. And then, the core-SAP was surface-crosslinked through esterification reaction with butane diol to improve its liquid permeability and absorbency under load (AUL). Liquid permeability was measured by the amount of 0.9 wt% NaCl solution that has passed between the swollen SAP particles under a given pressure. AUL was estimated the weight of 0.9 wt% NaCl solution absorbed under 0.3psi pressure.

4PS-231 김은지

유해물질 발생 저감을 위한 자동차 선루프용 친환경 폴리우레탄 수지 제조 및 특성 연구

김은지†, 백인규, 김창겸† 한국신발피혁연구원; [1](주)대진에스앤티

최근 자동차, 선박 등 산업용 수송기기 분야에서 에너지를 절감하는 환경친화적 컨셉과 고기능/고성능화, 공정 단축 등 새로운 기술적 패러다임이 등장함에 따라 자동차 산업의 메가트렌드로 인간 친화 및 친환경 기술을 꼽을 수 있어 친환경 자동차 소재에 대한 연구가 증대되고 있다. 새 차에는 내장재에 사용된 고분자 소재로 인해 휘발성 유기화합물(VOCs)이 발생하는데, 이는 이산화탄소 발생 및 지구 온난화의 주원인으로 최소화할 수 있는 수계화 및 분체화 기술이 요구된다. 또한, 자동차 선루프 원단은 색상, 외관, 내식성, 내스크래치성 등 요구되는 특성이 있어 이를 모두 만족할 수 있는 친환경 수지가 개발되어야 한다. 따라서 본 연구에서는 폴리에스테르계, 폴리에테르계, 폴리카보네이트계, 폴리실록산계 수분산 폴리우레탄 수지를 합성하고 최적 배합 조건을 확립함으로써 비 친환경적인 유기 용제를 대신할 수 있는 수분산 폴리우레탄 수지를 제조하고 그 특성을 평가하였다. *본 연구는 중소벤처기업부와 중소기업기술정보진흥원이 지원하는 "지역특화산업육성사업"으로 수행된 연구결과입니다(과제번호:S2874947).

4PS-233 김용주

Highly Transparent Polyimide Film Synthesized Using Fluorinated Amide-Imide Oligomer for Flexible Displays

김용주, 최기원, 김태용[†], 노아현, 전혜련[†], 이예진[†], 홍성우[†], 고민재† 한양대학교; [1]한국생산기술연구원

A novel transparent fluorinated polyimide based on amide-imide oligomer (aiFPI) is synthesized and its optical and mechanical properties are examined. The precursor of amide-imide oligomer (pAIO) with amine groups at both ends is synthesized using trimellitic anhydride chloride and 4,4'-methylenebis(2-methylcyclohexylamine). pAIO is then reacted with 3,3',4,4'-biphenyltetracarboxylic dianhydride (BPDA), 4,4'-(hexafluoroisopropylidene) diphthalic anhydride (6FDA) followed by chemical imidization to prepare aiFPI. In order to prepare conventional transparent fluorinated polyimide (cFPI) as a reference, 2,2'-bis(trifluoromethyl)-[1,1'-biphenyl]-4,4'-diamine (TFDB), BPDA, and 6FDA are polymerized. Interestingly, the polymeric film based on aiFPI shows more outstanding optical properties than that based on cFPI, which results from the unique supramolecular interaction between amide-imide oligomeric blocks and imide groups in the aiFPI chains.

4PS-235 김성종

Colorless and Thermostable Poly(amide-imide)s with Controlled CTE

김성종, 김상율†, 변태준, 이병용 한국과학기술원
Among the high temperature polymers, poly(amide–imide)s (PAIs) have been known as one of promising materials for many applications due to their high thermal stability and mechanical properties together with balanced processability. Also, several properties such as optical property and thermo–dimensional stability could be controlled by modifying monomer structures. In this study, we synthesized two diacid monomers, containing an alicyclic ring, which is fastened with phenyl pendant groups, and a biphenyl group with bulky trifluoromethyl groups. Transparent PAIs were prepared by polyamidation with different ratio of diacid monomers. Detailed synthetic route and their properties will be presented.

4PS-237 김상헌

Solid–Phase Colorimetric Sensing Platform for Bromide Ions Based on a Tough Hydrogel Embedded with Silver Nanoprisms

김상헌, 우희철, 김문호† 부경대학교
Triangular silver nanoprisms with sharp corners exhibit fascinating optical properties, but their shapes make them thermodynamically unstable. Thus, these shapes cannot be used for sensing applications because of their tendency to aggregate or transform in a solution state. In this study, we used this intrinsic instability to develop a colorimetric and naked–eye sensing system for detecting bromide ions (Br^-) in an aqueous medium based on the localized surface plasmon resonance (LSPR) properties of Ag nanoprisms with sharp tips. Our solid–phase hydrogel sensing platform can successfully determine a wide range of bromide ion concentrations based on the rate of change of the color and spectral features. In particular, compared to the solution state sensing system, our hydrogel based colorimetric solid sensor showed several advantages for detecting bromide ions. Therefore, our findings suggest that the as–proposed sensing platform shows an outstanding potential analytical tool.

4PS-239 김상민

자동차 헤드라이닝 내장재 저밀도 기재 개발에 대한 연구

김상민†, 조하니, 박장석 대한솔루션
최근에는 전세계적으로 친환경차에 대한 관심이 높아지며 국가별 환경규제 강화와 연비 감축을 위한 자동차의 경량화 요구가 증대되고 있다. 자동차 경량화 방법은 구조, 공법, 소재의 경량화로 구분되며 이 중 소재 경량화가 가장 높은 효율을 보인다. 따라서, 자동차 내장재인 헤드라이닝의 경량화를 목표로 연구를 진행하였다. 본 연구에서는 헤드라이닝에 적용되는 기존 폴리우레탄 폼을 저밀도 폴리우레탄 폼(Low Density Polyurethane Foam)으로 대체하여 원가 감소와 경량성을 충족시키는 제품을 고안하였으며 성형성과 물성을 기존 대비 동등이상 수준으로 만족시키려 하였다. 이를 위해 저밀도 폴리우레탄 폼의 밀도, 수축률, 공극률 및 기계적 특성(굴곡강도, 굴곡탄성률)을 측정하여 물성을 검증하고 흡음성을 평가하여 음향학적 특성을 확인하였다. 또한, 저밀도 폴리우레탄 폼이 적용된 헤드라이닝의 성형성을 평가하여 양산성을 검증하였다.

4PS-241 김령일

Structure–Property Relationships of 3D–Printable Chain–Extended Block Copolymers with Tunable Elasticity and Biodegradability

김령일, 이성수, 이정현[1], 황승상† 한국과학기술연구원; [1]고려대학교
Patches for the treatment of myocardial infarction, implanted into the heart, must be biocompatible and biodegradable with a certain level of elasticity. Therefore, this study synthesized 3D patch material and then proceeded to filament extrusion and 3D printing. Polyethylene glycol, polycaprolactone, and polylactid were used as biocompatible and biodegradable materials. By controlling the PEG content, PCL–PEG–PCL and PLA–PCL–PEG–PCL–PLA blockcopolymer were synthesized and then polyurethane(PU) was synthesized. The structure and polymer growth of the block copolymer was confirmed by ^{1}H NMR and GPC. Also, the chemical bond was confirmed through FTIR. PU properties according to the PEG composition and PLA addition was confirmed by UTM. In the biodegradability test, tensile strength change, weight loss and appearance change were compared over time. After confirming the Tm through DSC analysis, the filament was extruded, and the desired patch shape was finally produced using a 3D printer.

4PS-243 김동휘

Supramolecular Chirality of Triphenylamine Derivatives Having Multiple Hydrogen Bondings

김동휘, 김상율†, 정성욱 한국과학기술원
Triphenylamine (TPA) derivatives are easily oxidized in chlorinated solvents under light irradiation due to the generation of chlorine radicals. Our previous study has shown the formation of TPA based chiral supramolecules with circularly polarized light (CPL). However, the supramolecular chirality did not have enough stability in solution and deteriorated gradually despite of the photo–polymerization of the self–assembled chiral supramolecules. In this study, triphenylamine derivatives having multiple hydrogen bondings (TPA–2a–SDA) were synthesized and their self–assembly behavior with CPL was investigated in chlorinated solvents. The supramolecules having increased number of hydrogen bondings showed the enhanced chiral stability.

4PS-245 김동우

Sulfoxide–base Vinyl Protection in ATRP Inimers

김동우, 도주혁, 강유영[1], 김연지[1], 전흥배[1], 백현종† 부산대학교; [1]광운대학교
We report vinyl–methacrylate, acrylate, and styrene–protection by unique sulfoxide chemistry applying to atom transfer radical polymerization (ATRP). Three sulfoxide–protected (SP) vinyl–functionalized ATRP inimers were synthesized. Latent vinyl–functionalized polymers were synthesized via ATRP using the SP inimers. Alpha end vinyl–functionalized polymers were prepared by deprotection through simple heating of the synthesized SP polymers. In kinetics study, the (meth)acrylate type was confirmed to faster for the deprotection reaction than styrene type. The methacrylate–functionalized product was exhibited a high vinyl functionality greater than 98%. This concept provides an efficient way to introduce vinyl functionality into well–defined polymers as the latent monomer moiety and thus has vast potential for macromolecular engineering applications.

4PS-247 김대환

Simple Preparation of Porous Polystyrene Microparticles in Ternary Mixtures and Their Application as Catalyst Support

김대환, 김문호† 부경대학교
Porous microparticles are of great significance for their potential application due to their high specific surface area and low density, which can be widely used in various fields such as catalyst, chromatography, drug–targeted delivery and release. In this study, an easy–to–use method was developed to produce monodisperse porous microparticles with well–defined porosity. When polystyrene solid microparticles prepared using modified dispersion polymerization were dispersed in an ethanol–water–toluene mixture at room temperature, they transformed into porous PS microparticles as a result of uptake of the continuous phase by the particles. Metal nanocrystals were produced in situ from metal precursors on the surface of porous polymer particles. When the hybrid particles were used as catalysts, they showed excellent catalytic performance and reusability at low catalyst concentration for the reduction of 4–nitrophenol to 4–aminophenol using sodium borohydride as the reducing agent.

4PS-249 김경호

Molecular Weight Distribution of Two Living Chains in Polystyrene Prepared by Nitroxide Mediated Polymerization

김경호, 이지은, 박미림, 이서희[1], 장태현[2], 전흥배[1], 백현종† 부산대학교; [1]광운대학교; [2]포항공과대학교
We report on the separation and characterization of living chains in polystyrene (PS) prepared by nitroxide mediated polymerization (NMP). There are two different living chains initiated from the alkoxyamine and self–initiation of styrene when an alkoxyamine based on 2,2,6,6–tetramethyl–1–piperidinyloxy is employed in NMP of styrene. To separate the two living chains, an alkoxyamine (R–T) was designed to have one hydroxyl group in the R moiety and two hydroxyl groups in T moiety. Each living chains bears a different number of hydroxyl groups and can be fully resolved by high performance liquid chromatography. Molecular structures of the fractionated living chains were confirmed by MALDI–TOF MS and 1H NMR. Molecular weight distribution (MWD) of the two living chains are quite different. MWD of the living chains derived from the alkoxyamine is narrow while the living chains from the self–initiation have broad MWD with significant tailing toward low molecular weight.

4PS-251 김경수

Controlled Photooxidation of Pyridinium Acylhydrazones to 1,3,4–Oxadiazoles by Inclusion Complexation with Cucurbit[7]uril

김경수, 김현우, 송창식† 성균관대학교
During the past decade, the cucurbit[n]urils (CB[n]) have been widely and intensively developed in various fields such as host–guest chemistry, molecular recognition, molecular assembly, catalysis. Here, we reported host–guest complexation of pyridinium acylhydrazones with cucurbit[7]uril (CB7). The binding mode and interactions of pyridinium acylhydrazone with CB7 were investigated by ^{1}H NMR, UV–Vis, and computational calculation. Additionally, we presented photo–driven oxidative cyclization of pyridinium acylhydrazones to the 1,3,4–oxadiazoles with no additional additives. Lastly, the effect of inclusion complex formation of bis–pyridinium acylhydrazones (**BH1**) on the oxidative cyclization reaction was studied in the DMSO solution using CB7 as a host.

4PS-253 김경민

A Low–temperature Cross–linked Polyimide Gate Insulator for Thin Film Transistors Using a (Hydroxymethyl)benzoguanamine as a Cross–linker

김경민, 유성미[1], 김윤호[1], 안 택† 경성대학교; [1]한국화학연구원
Synthesized soluble polyimide was further crosslinked with a (hydroxymethyl) benzoguanamine (HMBG) as cross–linking agent at very low temperature (160 °C). Thin film properties of a new low temperature crosslinked polyimide were systematically characterized such as chemical structures, surface properties, thermal stability, and capacitance, etc. A crosslinked DOCDA–6FHAB film showed low leakages current density in metal–insulator–metal devices. The leakage current density and breakdown voltage of a crosslinked DOCDA–6FHAB were found to be less than 9.1×10^{-10} A/cm^2 at 1 MV/cm and above 3 MV/cm. We have fabricated TFT using crosslinked DOCDA–6FHAB with HMBG as a gate dielectric with bottom gate–top contact configuration (channel length L = 100 μm and width W = 1500 μm). TFT showed field effect mobility as 0.205 cm^2/Vs and did not show any hysteresis during forward and reverse gate voltage sweep between –30 V and +10 V.

4PS-255 김경민

Preparation and Thin Film Properties of a Novel Polyimide/Tetrafluorophthalate Attached $BaTiO_3$ Namocomposite for Solution Processable High k Dielectric

김경민, 안 택† 경성대학교

In this study, we report on a novel polymer–nanocomposite dielectric based on tetrafluorophthalic acid functionalized barium titanate ($BaTiO_3$) nanoparticle as a dopant in crosslinkable polyimide (PI). We introduced the barium titanate nanoparticle to make a high k polyimide nanocomposite dielectric. To avoid the large leakage current and low breakdown strength, control over the particle–particle interaction and particle–polymer interface is essential. Thus, approaches to modify nanoparticles via robust chemical bonds are highly desirable. Therefore, the surface of $BaTiO_3$ was modified by TFP to increase the interfacial adhesion between polyimide and nanoparticle. And, we used crosslinked poly(4–vinylphenol) (PVP) as capping layer on polyimide nanocomposite layer to further improve leakage current and surface roughness. Polyimide nanocomposite bilayer film showed high dielectric constant (5.71) and low leakage current density (6.88×10^{-6} A/cm^2) in a metal–insulator–metal (MIM) device.

4PS-257 권용록

The Changes of Absorption Behaviors in Superabsorbent Copolymers Using Polycation Salts

권용록, 임승호, 홍석주, 김하은, 김정수, 장영욱[1], 김동현† 한국생산기술연구원; [1]한양대학교

SAP has a 3D poly network structure and expands in the process of absorbing water. We copolymerized itaconic acid (IA), vinyl sulfonic acid, and tetra(ethylene glycol) diacrylate to prepare SAP. IA based SAP has lower absorbency under load (AUL) than conventional acrylic acid based SAP. To solve this problem, we added polycationic salts when synthesizing SAP. Among the various polycationic salts, aluminum sulfate and zirconium sulfate were used. We analyzed SAP structure and compared the absorption characteristics of IA based SAPs according to the addition polycation salts. The structure of SAP was characterized by FT–IR. XPS analysis confirmed the presence of polycation salts in the SAP. The absorption performance of SAP were evaluated by measuring centrifuge retention capacity and AUL.

4PS-259 권기환

Synthesis of Carboxylic Acid Bearing Polyethers by Monomer–Activated Anionic Ring–Opening Polymerization

권기환, 김민성[1], 이상호[2], 김병수† 연세대학교; [1]UNIST; [2]한국화학연구원

We report a novel epoxide monomer, *tert*–butylglycidoxy acetate (*t*BGA) in this study. While the conventional anionic ring–opening polymerization does not provide a controlled synthesis of poly(*tert*–butylglycidoxy acetate) (P*t*BGA) due to the undesirable side reactions, the monomer–activated anionic ring–opening polymerization (MAROP) of a *t*BGA monomer, using tetrabutylammonium iodide as an initiator and triisobutylaluminum, Al(^{i}Bu)$_3$, as an activator affords the controlled polymerizations. Subsequent acidic deprotection of P*t*BGA yielded the corresponding polymers (PGA) with a large number of carboxylic acid functionality along the polyether backbone. Interestingly, the pH–dependent self–association based on the hydrogen bonding between the carboxylic acid groups was observed, leading to the formation of pH–responsive hydrogels. With its superior biocompatibility of P*t*BGA and PGA, we anticipate the prospective potentials for the applications in biological and biomedical fields.

4PS-261 궁찬영

Ion–Electron Conductive Cross–Linked Polymer Coated Cathode for Lithium–Sulfur Battery

궁찬영, 정다운, 이종찬† 서울대학교

Lithium–Sulfur Battery is getting tremendous attention because of sulfur's high theoretical capacity and abundant resources. However, lithium polysulfide (PS) which is reductive product of discharge process is the biggest problem as PS is soluble to electrolyte so undermine battery's performances. In this research, polythiophene and polyethylene glycol based cross–linked polymer coated sulfur–carbon composite cathode is studied. Polythiophene moiety introduced electron–conductivity and Polyethylene glycol moiety introduced lithium ion–conductivity. In addition, polymer coating had PS capturing ability, therefore, electrochemical performance of battery is enhanced. Synthesis of cross–linked polymer, polymer coated cathode's electrochemical performance, polymer's PS capturing ability is analyzed by H–NMR, IR, Coin Cell Test, UV–vis spectroscopy.

4PS-263 구모범

Iterative Convergent Synthesis of Large Cyclic Polymers and Block Copolymers with Discrete Molecular Weights

구모범, 이슬우, 이정민, 김경택† 서울대학교

We report here the synthesis of cyclic polymers and block copolymers consisting of discrete numbers of repeating units without linear contaminants. The synthesis utilizes the intramolecular cyclization of end–functionalized poly(rac–lactide) (PLA) and its block copolymers with as many as 512 lactic acid units (37 kDa), synthesized by the iterative linear convergence of orthogonally protected building blocks. By exploiting the change in hydrodynamic volume upon cyclization of the linear polymers, macrocyclic polymers were isolated without linear precursors by preparative size–exclusion chromatography as a purification method. Our procedure also allowed the synthesis of a monodisperse cyclic block copolymer in a desired block ratio as a single compound (14 kDa).

4PS-265 고혜윤

Uniaxial Orientation of Reactive Mesogens for Anisotropic Heat Managing Materials

고혜윤, 정광운† 전북대학교

To develop an advanced heat managing material (HMM) which can effectively dissipate the problematic heat in the electronic devices, reactive mesogen (RM) was newly synthesized as a building block for the HMM films. Based on the combined techniques of spectroscopy, scattering, and thermal analyses, it was confirmed that the synthesized RM formed a smectic A mesophase. The RM films were fabricated by the photopolymerization in both smetic A mesophase and isotropic phase. Due to their lattice structure of the RM core, the films exhibited outstanding thermal conducting properties over 1 W/mK. In addition, the heat conducting performance of RM film can be amplified in a certain direction by the anisotropic orientation of RM molecules in the network. The RM films can be used as a HMM for electronic devices. This work was supported by Basic Research Laboratory Program (2020R1A4A1018259), Ministry of Trade, Industry, and Energy (20011031).

4PS-267 강혜주

Synthesis and Properties of Photoisomerizable Azobenzene Side–Chain Polymers for Green and Red Color Rewritable Hologram

강혜주, 이예원, 가재원† 한국화학연구원

The hologram is a recording of 3D information of an object, and it is attracting attention as a next–generation realistic media. Materials which are reversibly changed in refractive index or transmittance after irradiation are being studied for rewritable hologram materials. In this study, we have investigated photo–induced refractive index change characteristic polymers containing azobenezene capable of isomerization. And we devised a structure containing an acetylene group with high birefringence to increase refractive index change with low energy light irradiation. The molecular structure and physical properties of the azobenzene polymer were confirmed by NMR, UV–vis, DSC and GPC. In this presentation, the synthesis of green hologram rewritable materials and hologram recording characteristics such as diffraction efficiency and change of refractive index after light irradiation will be discussed.

4PS-269 강현성

LLDPE 중합용 Ziegler–Natta 촉매연구

강현성, 허승현, 고영수† 공주대학교

에틸렌과 프로필렌의 중합촉매로서 Ziegler–Natta 촉매가 대표적이다. 본 연구에서는 촉매 합성 조건에 따른 촉매특성을 알아보기 위한 실험이 진행되었다. 다양한 알루미늄 화합물의 종류와 Al/Mg 비의 조건에서 Ziegler–Natta 촉매를 합성하였고, 이를 이용하여 에틸렌–1–헥센 공중합이 이루어졌다. 중합된 고분자는 DSC, SEM, NMR을 통해 분석하였다.

4PS-271 강인아

Preparation of Porous Polymers via Solvent–Assisted Curing

강인아, 윤영록, 김상율† KAIST

Herein, we report a new method for developing a porous network into polymeric materials. A simple thermal process of non–porous melamine–based polymers in aprotic solvents, namely solvent–assisted curing, affords porous characteristics with exceptionally high surface area. Swelling and exclusion of small molecules from the polymeric structure with the solvent promotes the formation of inner pores. Therefore, the physical property of porous polymers can be controlled by adjusting the monomer stoichiometry ratio that affects the degree of crosslinking. In addition, tailoring the shape of precursor materials provides the porous polymer in a variety of forms such as particles and a monolith.

4PS-273 강인수

Synthesis and Properties of PBO for Positive Photo Resist According to Various End Cappers

강인수, 신요섭, 이승우† 영남대학교

Polybenzoxazole was synthesized by polymerizing various polyhydroxyamide precursors and it was confirmed that Pattern performed well using SEM which was confirmed to be synthesized using FT–IR and FT–NMR. PHA was synthesized using 0.2 eq of phthalic, Succinic anhydride, and maleic anhydride was synthesized at 0.1, 0.2, 0, 3 eq. All PHA synthesized was well dissolved in a flying solvent such as NMP, DMAc, DMSO. All synthesized PHAs were well dissolved in solvents such as NMP, DMAc, DMSO and others. The silicon wafer was fabricated at 3 cm x 3 cm and spin coated at 1000 rpm for 50 sec. Prebake was at 130 ~ 150 ℃ for 5 minutes. Aligner uses MIDAS's MDA–400S and give energy of 450 mJ using the 365 nm I–line wavelength. Develop was carried out using tetramethylammonium hydroxide aqueous solution 2.38%, and the development time was adjusted in order to form the best line.

4PS-275 Quang Nguyen Ngoc

Injectable, Biocompatible Conjugated Catechol Chitosan Hydrogels with Iron Inducement and EDTA Treatment at Different Conditions

Quang Nguyen Ngoc, 손대원† Hanyang University

Chitosan (CS) is a natural polycationic polysaccharide and pH sensitive polymer with incomplete deacetylation from claiming chitin. It is a guaranteeing material in terms of pharmaceutical, chemical, and sustenance industry due to its exceptional structure including reactive $^-$OH and $^-NH_2$ groups. In this study, a catechol–modified chitosan (CCS) for an eminent level for substitution was synthesized and propelled by marine mussel cuticles in place on research those intricate connections between Fe^{3+} and catechol under acidic conditions. The hydrogels showed enhanced cohesiveness and shock–absorbing properties at lower pH and ethylenediamine–tetra–acetic acid (EDTA) treatment due to coordinate bonds. Thus, the gelation time,

rheological properties and the morphologic aspects were elucidated to describe those cross-linking components and the physical properties of the chitosan backbones and hydrogel frameworks.

4PS-277 Pradyasti Astrini

Synthesis of Ag-Ag_2S Nano-Heterostructures and Their Application for Dye Photodegradation

Pradyasti Astrini, 김대환, Biutty Merreta Noorenza, 유성일, 김문호† 부경대학교

Hybrid metal-semiconductor nanostructures have received significant interest due to their synergistic properties that arise from the interaction between the two components. In this study, a simple and rapid synthetic approach based on site-selective sulfidation of hexagonal silver (Ag) nanoplates was developed to prepare Ag-Ag_2S hybrid nanoparticles with new heterostructures. By controlling the sulfur precursor concentration during the sulfidation reaction, Ag-Ag_2S hybrid nanoplates with various compositions and morphologies were obtained, and both Ag and Ag_2S portions were exposed to the environment. Then, the as-synthesized Ag-Ag_2S hybrid nanoplates were employed as photocatalysts for the decomposition of methylene blue under solar irradiation, showing high photocatalytic activity and recyclability. Moreover, a facile chemical treatment strategy involving a galvanic replacement reaction was also developed to enhance the photocatalytic activity of the hybrid nanostructures.

4PS-279 ANJALI NAGAPADI PREMAN

Synthesis and Electrochemical Characterization of Three-dimensionally Crosslinked Copolymer Binders for Silicon-based Lithium Ion Battery Anodes

ANJALI NAGAPADI PREMAN, 손진하, 안석균† Pusan National University

Silicon has been acknowledged as a promising anode material for lithium-ion batteries due to their high theoretical capacity. However, a significant volume change of the silicon during charge/discharge causes pulverization in the anode, and thus becomes a major obstacle for commercialization. A potential way to solve this problem is to develop polymer binders that can alleviate volume change of silicon. For this purpose, we synthesized a series of copolymers of acrylic acid and n-butyl acrylate which were further crosslinked to improve the mechanical properties. Thermal and mechanical properties of the binders were tailored by tuning the composition of random copolymers and crosslinking density. Interestingly, the electrochemical performance of Si anode made from these binders showed satisfactory performance when the composition of soft n-butyl acrylate is maintained at 10-30 mol%. Comparison of the electrochemical performance of crosslinked and uncrosslinked binders revealed that moderately crosslinked binders give rise to superior performance in terms of initial discharge capacity and columbic efficiency.

한국고분자학회
The Polymer Society of Korea