

Southeast Polymer 2026 Poster Presentation Title and Abstracts

Presenter: Jihye Choi

Title: ***Harnessing Transient and Self-healable Adhesion in Pressure-Sensitive Adhesives***

Abstract:

Pressure-sensitive adhesives (PSAs) are widely utilized across diverse applications due to their ability to bond under light pressure, without the need for solvent evaporation, heat, or UV curing. Traditional PSAs are often limited to single use due to their mechanical degradation over time or their nature of irreversible adhesion. Moreover, PSA design faces an inherent trade-off between strong adhesion and clean removability. Conventional systems that provide high adhesion strength often leave residue, whereas those designed for clean removal exhibit weaker adhesion. Herein, we present a self-healable, bottlebrush-like polymer with low-entanglement architecture that achieves both strong pressure-sensitive adhesion and clean removal. The synthesized polymer exhibits self-healing behavior at room temperature, driven by hydrogen bonding and chain mobility. Dynamic mechanical analysis reveals high $\tan \delta$ across a wide temperature range, indicating high damping properties. Tensile testing demonstrates a nonlinear strain-dependent mechanical response, with an increase in yield strength at higher strain rates. Frequency sweep rheology tests further confirm its strain-stiffening property, where adhesive properties can be altered by applied force. The bottlebrush-like polymers containing hydrogen-bonding demonstrate multi-cycle adhesion, while maintaining clean removal via adhesive failure. This decoupling of adhesion strength and removability arises from strain-stiffening properties, which promote interfacial debonding without cohesive residue. The combination of self-healing, multi-cycle adhesion, and strain-stiffening properties will pave the way to develop a new class of reusable, easily removable pressure-sensitive adhesives.

Presenter: Hayden Moran

Title: ***Data- and Theory-Driven Framework for the Physically Insightful Analysis and Interpretation of Organic Macromolecular Spectroscopy***

Abstract: N/A

Presenter: Jamie Hemstock

Title: ***Controlling Reversible Carbamate Exchange for High-Purity Polyether Polyol Recovery during Polyurethane Foam Glycolysis***

Abstract: N/A

Presenter: Xiao Sun

Title: ***Multifunctional Fiber Systems for Next-Generation Energy Storage, Electronics, and Sensing***

Abstract:

Copper is the dominant conductor for modern power transmission; however, its limited electrical conductivity and associated Joule heating lead to significant energy losses during long-distance delivery. Addressing this inefficiency requires conductor architectures that simultaneously enhance electronic and thermal transport. In this study, we develop a carbonized hollow fiber-based hybrid conductor to overcome these limitations. Using a custom-designed nozzle for dry-jet wet spinning, PAN/PMMA composite fibers were fabricated, where PMMA served as a sacrificial component to generate a uniform hollow structure upon carbonization. The resulting carbonized hollow PAN fibers provide a lightweight and mechanically robust scaffold. Copper was subsequently electrodeposited within the lumen to form a conformal metallic core, followed by the formation of a conductive carbon layer on the Cu surface. The carbon layer introduces additional conductive pathways for electron transport while acting as an effective thermal-spreading layer to mitigate resistive heating under high current densities. Structural characterization confirms uniform Cu deposition and continuous carbon coverage. Transport measurements demonstrate enhanced electrical conductivity and reduced thermal resistance compared with conventional Cu fibers. Beyond power transmission, the carbon-copper hybrid structure also enables sensitive surface charge interactions, making it suitable for volatile organic compound (VOC) gas-sensing applications. This work presents a scalable strategy for engineering carbon-copper hybrid conductors supported by carbonized hollow fibers, offering a promising route toward reducing transmission losses while extending functionality to sensing applications in advanced electronic systems.

Presenter: Chathurika J. Kosgallana

Title: ***Molecular Organization of Carbonic Anhydrase at a Chitosan Interface: Insights from Molecular Dynamics Simulations***

Abstract:

Chitosan is a biocompatible polysaccharide capable of forming hydrated thin films, making it an attractive platform for enzyme immobilization at soft interfaces. Carbonic anhydrase (CA) catalyzes the hydration of CO₂ to bicarbonate and is of interest for applications in carbon capture and biocatalysis. Understanding how the hydrated structure of chitosan influences protein organization at the polymer interface is essential for designing functional enzyme-immobilization platforms yet remains challenging because of the diffuse and highly hydrated nature of these systems. In this work, we investigate the adsorption and interfacial organization of CA on highly deacetylated chitosan thin films using neutron reflectometry (NR) and X-ray reflectometry (XRR), complemented by ellipsometry and quartz crystal microbalance with dissipation (QCM-D). Reflectometry provides nanometer-scale resolution of interfacial structure, with neutron scattering offering sensitivity to isotopic composition and X-ray reflectometry providing complementary electron-density profiles. To enhance contrast between the enzyme and polymer matrix in NR measurements, deuterated CA was employed, enabling direct characterization of the protein distribution within the hydrated chitosan layer. Ellipsometry and QCM-D were used to characterize film formation and adsorption behavior, while multi-contrast NR measurements on the same interface were used to constrain structural models. XRR provided complementary structural information and helped validate film thickness and density profiles. Preliminary combined neutron and X-ray reflectometry analysis indicates substantial swelling of the chitosan film under hydrated conditions. The reflectivity profiles are consistent with a distributed protein-containing region within the swollen polymer layer, suggesting that enzyme adsorption is coupled to the hydrated

structure of the chitosan interface. These results demonstrate how isotopic labeling combined with complementary neutron and X-ray reflectometry can resolve polymer-protein organization at hydrated soft interfaces and provide structural insight relevant to the design of functional chitosan-based materials.

Presenter: Qixuan Xiang

Title: ***Image-Guided Predictive Optimization of Multimaterial Direct Ink Writing for High-Fidelity Lamellar Architectures***

Abstract:

Precise control over internal material interfaces is essential for translating multimaterial additive manufacturing into functional biological and electronic systems, yet conventional extrusion-based printing remains largely constrained by nozzle-defined feature sizes and empirical process optimization. Here, we present an image-guided multimaterial direct ink writing (MDIW) strategy that combines hierarchical stream multiplication with predictive process optimization to program PAN/PAN-CNT lamellar architectures across multiple length scales. A video-based computational framework integrates spatiotemporal image segmentation, morphology-based printability quantification, and Gaussian-process optimization to establish processing conditions for high-fidelity multilayer formation. Using this approach, continuously printed architectures with internal features as small as approximately 3.4 μm were achieved while retaining macroscopic processing throughput. More importantly, the programmed interfaces provide distinct functional states: before carbonization, lamellar spacing regulates cell localization and mechanobiological responses, whereas thermal conversion transforms the same architecture into anisotropic conductive carbon networks capable of rapid Joule heating to above 1300 °C. These results establish a processing–architecture–function framework in which image-guided optimization governs structural fidelity and programmed interface spacing directs application-specific biological and electrothermal functionality.

Presenter: K M Nazmus Sakib

Title: ***Nanostructural heterogeneity in starch granule revealed by microfocused simultaneous small-angle / wide-angle X-ray scattering study***

Abstract: N/A

Presenter: Rahul Kumar

Title: ***Graph-Theoretic Analysis of Star Copolymer Self-Assembly***

Abstract: N/A

Presenter: Sivakumar Irla

Title: ***Liquid Crystal Elastomers with Covalently Incorporated Ionic Segments for Multifunctional Electromechanical Applications.***

Abstract:

Multifunctional liquid crystal elastomers (LCEs) that integrate thermomechanical actuation with electrical responsiveness offer promising opportunities for soft active materials and electromechanical applications. However, incorporating ionic functionality into LCE networks can disrupt liquid-crystalline organization and affect their mechanical and electromechanical properties. Previous ionene LCE systems synthesized in our laboratory via a one-pot thiol–acrylate approach relied on relatively low ionic content in the elastomer backbone and exhibited electrical instability due to the leaching of non-covalently bound ionic species from the polymer matrix, limiting their potential for electromechanical applications.

Here, we investigate an alternative strategy for covalently incorporating higher ionic content into the polymer backbone through a two-step process. Diallylimidazolium (IM) and 2,2'-(ethylenedioxy)diethanethiol (EDDT) were first reacted via UV-initiated thiol–ene polymerization to form ionic prepolymer chains, followed by incorporation of RM82 during secondary network formation to produce ionically modified LCE films. Varying the RM82:EDDT ratios resulted in a broad range of mechanical stiffness and extensibility, with several formulations exhibiting substantial thermomechanical strain and work output under applied load. Ionic liquid (IL) doping further enhanced ion mobility, increasing the electrical conductivity by two to three orders of magnitude while maintaining mechanical compliance. An optimal formulation was identified that provided a favorable balance of mechanical properties, thermomechanical response, and electrical conductivity, highlighting the potential of covalent ionic incorporation for developing multifunctional LCE networks.

Presenter: Shucong Li

Title: ***Air-permeable hydrogels through viscoelastic phase separation of aerogels***

Abstract:

Hydrogels are widely used in biomedical interfaces, in which effective gas exchange (for example, O₂, CO₂) within a water-rich environment is essential. However, hydrogels show intrinsically limited air exchange efficiency, owing to the low solubility (C) and diffusivity (D) of non-polar gases in the polar water medium¹. This limitation poses a substantial bottleneck in long-term applications, such as wearable health monitors and tissue engineering. Existing methods to enhance air permeability suffer from poor robustness and/or an inherent trade-off between permeability and water content (for example, <50 vol%). Here we introduce a viscoelastic phase separation (VPS)-enabled strategy to create a non-collapsible, air-rich network in high-water-content hydrogels, achieving a record-high oxygen permeability of 185 barrer with 70 vol% water—a tenfold increase compared with pristine hydrogels. VPS, a ubiquitous phenomenon in soft matter, is used to drive hydrophobic, dry gas particles within a hydrophilic, wet medium into a thin, stable three-dimensional network. This approach allows the facile and scalable fabrication of air-permeable hydrogels across diverse chemistries and form factors. Physiological tests over a 10-day continuous wear condition confirmed their effectiveness in preventing fluid accumulation and maintaining skin health. This strategy paves the way for hydrogels in long-term biomedical applications in which efficient and sustained air exchange becomes critical.

Presenter: Tianyu Zhu

Title: ***Counterion Engineering of Polybenzimidazole Electrolytes for Durable High-Temperature PEM Fuel Cells***

Abstract: N/A

Presenter: Anusree Puthiyarakkal

Title: ***Modulation of Structure, Assembly, and Degradation in Polyester-Based Nanomaterials through Aryl-Substituted Caprolactone Design***

Abstract: N/A

Presenter: Isaiah Dishner

Title: ***Making and breaking sequence controlled copolyamides with enzymes.***

Abstract:

Monomer sequence profoundly impacts polymer performance. While many strategies have been developed to control sequence, most involve laborious synthetic protocols and/or iterative synthesis. Moreover, sequenced copolymers are particularly difficult to adapt to emerging chemical recycling strategies because solvolytic depolymerization randomly cleaves bonds along the polymer backbone. These limitations highlight the need for new methods of synthesizing and recycling sequenced copolymers. Here, we demonstrate two complementary strategies using enzymatic catalysis to control monomer sequence across both polymerization and depolymerization cycles. The first strategy uses enzymatic coupling to chemoselectively build sequence-defined tetrad building blocks. These tetrads are polymerized to form alternating copolyamides. The second strategy uses enzymatic hydrolysis to regioselectively depolymerize this polymer to the original tetrad. Overall, these results demonstrate that the substrate specificity of enzymatic catalysis provides an efficient route for both synthesizing and recycling polymers with advanced microstructures. We anticipate that this work will provide the foundations for in-depth studies of sequence-property relationships and support the engineering of sophisticated enzymes with greater efficiency and substrate specificity.

Presenter: Juan Jose Sandino Trejos

Title: ***Development of Polyaniline Derivatives with Improved Electrochemical Stability and Processability***

Abstract:

Conductive materials are crucial for the development of new electronic devices; however, they are often rigid inorganic materials that are unstable in ambient environment. Consequently, there is a need to develop new materials that exhibit similar conductive properties but are flexible and more environmentally benign. Conducting polymers (CPs) have conductivity on the order of some metals but with mechanical properties similar to plastics. They have been used to address the rigidity and environmental stability of inorganic conductive materials. Among the many CPs, polyaniline (PANI) stands out as one with great properties such as good air and moisture stability, redox reversibility, and high electrical conductivity. However, PANI is known for having poor processability and redox instability, which limits its applications in the industry. Efforts to solve these issues have proven ineffective.

In this presentation we will discuss some new PANI-like polymers with good environmental stability, electrical conductivity, and improved redox stability to circumvent the issue of poor stability and processability of PANI. These new PANI derivatives have superb film properties and high conductivity. The polymers were characterized by ¹H-NMR, GPC, UV-Vis, and EPR and their conductivity was measured using four-point probe.

Presenter: Walimuni Dewage Thushni Sadana Wickramarathna

Title: ***Synthesis and Characterization of DMDPP-Based Vinyl Flanked Conjugated Polymers for Conductive Materials Applications***

Abstract: N/A

Presenter: Zhefei Yang

Title: ***Reprogrammable Polymer Brush Interfaces Enabled by Reversible Amine – N-Oxide Conversion***

Abstract: N/A

Presenter: Kyoungmin Kim

Title: ***Selective Ion Transport in Precision Polyanion Membranes***

Abstract: N/A

Presenter: Nduka D. Ogbonna,¹ Yuan Yue,² Robert Sacci,¹ Catalin

Gainaru,¹ Uvinduni Premadasa,¹ Jeff Foster.^{1*}

Title: ***Network Design Governs Photomechanical Softening and Tunable Surface Wettability in Low- T_g Amorphous Azobenzene Networks***

Abstract:

Azobenzene network designs often rely on the cooperative alignment of azo units within a liquid crystalline (LC) matrix to achieve large-scale photo-actuation. However, the photoisomerization dynamics of azobenzene in non-liquid crystalline network matrices remain insufficiently explored. Here, I will describe the synthesis of an unaligned, low- T_g amorphous network incorporating azobenzene moieties while varying the azobenzene content, crosslink density, and position of azobenzene groups. We demonstrate, via UV-rheology, that under UV-irradiation: (1) increasing the crosslink density restricts azobenzene pendant chain motion and network mechanical response; (2) azobenzene motifs constrained within bi-functional crosslinkers afford a larger mechanical response compared to those installed as pendant groups; and (3) in low- T_g amorphous networks, mechanical recovery occurs rapidly (< 2 min) and is decoupled from the molecular thermal *cis*-to-*trans* isomerization lifetime of azobenzene. Beyond bulk mechanical adaptation, photoisomerization also induces reversible surface reorganization, enabling light-controlled modulation of surface wettability. Overall, these results establish design principles for smart, photoresponsive non-LC networks, expanding their potential multifunctional applications beyond traditional LC systems.

Presenter: Wyatt George

Title: ***Conformational restriction and degradability as design parameters in epoxy-amine networks***

Abstract: N/A

Presenter: Amy Coronado

Title: ***Blending bis-benzoxazine vitrimers to understand the impacts of monomer design variables on dynamic behaviors***

Abstract: N/A

Presenter: Erik Spain

Title: ***Lewis acid mediated photoiniferter (LAMPI) as a strategy for sequence tunable copolymers in controlled radical polymerization***

Abstract: N/A

Presenter: Zoe Gunter

Title: ***Interfacial welding of 3D-printed thermoplastics via controlled swelling***

Abstract: N/A