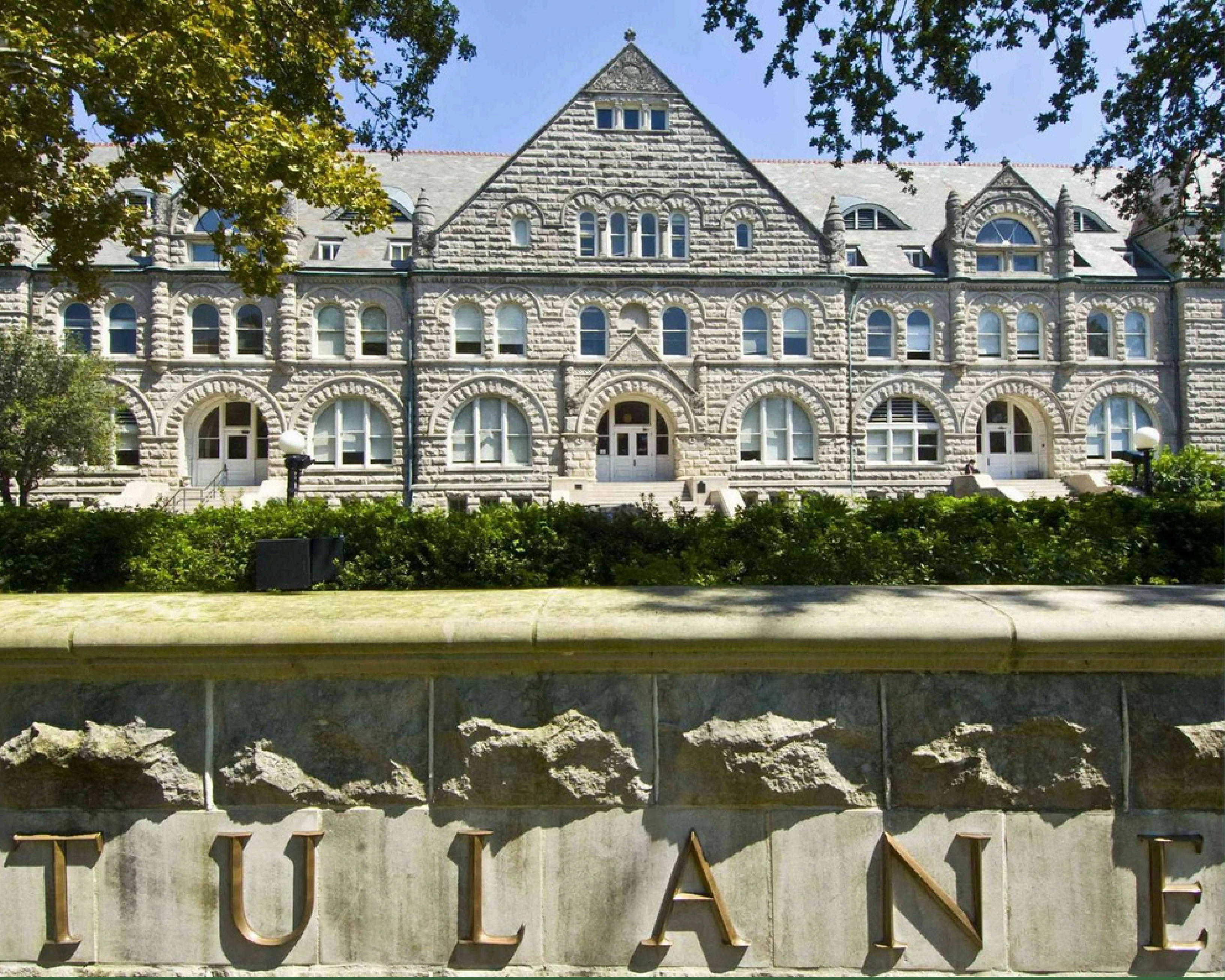


GULF COAST POLYMER CONFERENCE 2025

November 8, 2025
8:30 AM - 6:00 PM

Steven and Jann Paul Hall
Tulane University
New Orleans

Tulane University

APTEC

Conference Rundown

8:30 AM - 9:00 AM	**Registration & Breakfast**
9:00 AM - 9:30 AM	**Keynote Speaker** Dr. Emily Pentzer, Texas A&M
9:30 AM - 10:30 AM	**Workshop** Machine learning for polymer design
10:30 AM - 12:20 PM	**Oral presentation session I**
12:10 PM - 1:30 PM	**Lunch Time**
1:30 PM - 2:30 PM	**Oral presentation session II**
2:30 PM - 3:30 PM	**Career Panel**
3:30 PM - 5:00 PM	**Poster presentation session**
5:00 PM - 5:30 PM	**Closing Keynote** Dr. Austin Evans, University of Florida
5:30 PM - 5:45 PM	**Judges panel discussion**
5:45 PM - 6:00 PM	**Awards announcement and closing remarks**

Oral presentation session I

(10:30 am - 12:10 pm)

Time	Boggs Room 102	Boggs Room 104	Boggs Room 105
10:30 am - 10:50 am	**Joshua D. Marquez** **University of Florida** *Ultrahigh-Molecular-Weight Polystyrenics with Tunable Entanglement Molecular Weights as Latently Curable and Dimensionally Stable Monoliths*	**Christy Witcher Barker** **University of Tennessee** Correlating Chlorinated Polyethylene Molecular Structure to Compatibilization Efficiency for Mixed Polymer Waste	**Tongyao Wu** **Louisiana State University** *Roll-to-roll fabrication of three-dimensional self-folding polymer microstructures*
10:50 am - 11:10 am	**Jacob Michael Russell** **Louisiana State University** *Frontally Polymerized Acrylate Wood Adhesive*	**Robert J. Comito** **University of Houston** *Bimetallic Catalysts for Sustainable Polymerization and Depolymerization*	**Mason Jones** **University of Tennessee** *Pitfalls of High-Temperature Size Exclusion Chromatography in the Analysis of Model Polyethylene-Alkane Mixtures for Advanced Recycling Applications*
11:10 am - 11:30 am	**Khandakar Rakibul Hasan** **Louisiana State University** *Cure-on-demand powder coatings using thermal frontal polymerization of acrylates*	**Godwin Ochola** **University of Tennessee** *Tuning Copolymer Chain Lengths for Integral Membrane Protein Solubilization*	**Mahi Ahmad** **Tulane University** *Cyclization of linear ethylene brassylate via Click Chemistry*

Oral presentation session I

(10:30 am - 12:10 pm)

Time	Boggs Room 102	Boggs Room 104	Boggs Room 105
11:30 am - 11:50 pm	**Udayanidhi Ramesh Kumar** **University of Houston** *Controlled Expression of Type 1 Fimbriae in Escherichia coli: Consequences for Aggregation and Proliferation in Presence of Polymers*	**Bernard Chukwuemeka Ekeoma** **The University of Alabama** *Catalyst Support Acidity Influences Monomer Selectivity in H2-Free Reductive Catalytic Fractionation of Lignin 1 / 27 51%*	**Adisa Hassan Ademola** **The University of Alabama** *Supercritical Fluid Impregnation of Polyolefins for Sustainable Polymer Upcycling*
11:50 am - 12:10 pm	**Amman Nadeem** **Tulane University** *Elucidating Fragmentation Pathways of Cyclic and Linear Poly(dimethylpropanoate) via Tandem Mass Spectrometry and Ion Mobility Spectrometry*	**Shanta Biswas** **Louisiana State University** *Investigating the Effects of Macromolecular Crowding on the Mechanism of Protein-Polymer Complex Coacervation*	**Obiora Ebuka Muojama** **The University of Alabama** *Supercritical CO_2-Driven Surface Modification of Cellulose: Linking Additive Chemistry to Polymer-Fiber Interactions*

Oral presentation session II

(1:30 pm - 2:30 pm)

Time	Boggs Room 102	Boggs Room 104	Boggs Room 105
1:30 pm - 1:50 pm	**Jaewoo Choi** **The University of Alabama** *Depolymerization of Poly(vinyl chloride) to Value-Added Products via Ozonolysis*	**Joseph Previte Jr.** **The University of Southern Mississippi** *Investigation of Sub-Melting Degradation and Crosslinking in PEKK*	**Abdur Raafey** **University of Louisiana at Lafayette** *Development of a Self-Healing Polyimide Coating Incorporating Inhibitor-Loaded Zn-Al LDH Nanocontainers for Corrosion Protection of Carbon Steel in Oil & Gas Environments*
1:50 pm - 2:10 pm	**Titilayo Oluwole** **Louisiana State University** *Chemistry-Architecture Synergy Drives Interfacial Dynamics in Complex Polymers*	**Sulochana Ekanayaka Mudiyanselage** **Louisiana State University** *Phase Separation and Interfacial Behaviour of Mixed Surfactant Micelle-Polymer Complex Coacervates*	**Peter Edimeh** **University of Houston** *Microgel Softness Controls Nanoparticle Transport in Complex Fluids*
2:10 pm - 2:30 pm	**Shubhadeep Nag** **Louisiana State University** *Beyond Hydrophobicity: Multi-Scale Insights into Polymer-Drug Encapsulation from Single-Molecule to High-Throughput Simulations*	**Roya Gadimli** **Tulane University** *Enhancing the Mechanical Performance of Poly(3-hydroxybutyrate) by Modifying Crystallinity through Additive*	**Jimmy Lawrence** **Louisiana State University** *Precision Brush Polymers: Advancing Polymer Fundamentals and Applications*

Poster presentation session

(3:40 pm - 5:00 pm)

	Paul Hall
1	**Abdullah bin Bahir** **University of Louisiana at Lafayette** *Fabrication of High Sensitivity Glucose Bio Sensor Based on Glucose oxidase Immobilization on Polyaniline/Graphene Oxide Nano scrolls and Carboxymethyl Chitosan*
2	**Hariharan Jayakumar** **Louisiana State University** *Versatility of modified universal calibration in gel permeation chromatography: Pushing the limits of the RI using precision bottlebrush polymers*
3	**Susana Ferrufino** **Xavier University of Louisiana** *3D UV printing of polymeric ionic liquids with gold nanoparticle*
4	**Imogen Hoffman** **Southern Methodist University** *Visible Light 3D Printing of Polymeric Microneedles*
5	**Jordan Carden** **Louisiana State University** *Topological Design of Bottlebrush Polymer Surfactants with Machine Learning and Simulations*
6	**John Michels** **University of Southern Mississippi** *Understanding Degradation Pathways for Polybenzoxazines Through Aryl-Ether-Ketone Isomers*
7	**Christian Robert Dixon** **The University of Southern Mississippi** *Combining Thermomechanical and Structural Analysis to Probe Nanoconfinement Effects on CTE and Tg in PEKK Nanocomposites*

Poster presentation session

(3:40 pm - 5:00 pm)

	Paul Hall
8	**Shehbaz Ahmad** **Tulane University** *Carbon dioxide capture using PEI/MXene Composite*
9	**William Bernfeld** **Tulane University** *Synthesis and characterization of bis-MPA dendrons for alternating linear-dendritic polymers*
10	**Kira Phillips** **Loyola University of New Orleans** *Post-Curing Effects on the Structural and Mechanical Behavior of 3D-Printed Shape Memory Polymers*
11	**Lavinia Palmer** **Tulane University** *Advancing PEG-based Hydrogel Design Through Thiol-yne Click Chemistry*
12	**Meen Sung Koo** **Louisiana State University** *Structural and Chemical Modification of Cellular Wood Composite for Enhanced Strength, Fire and Biological Resistance*
13	**Ragab Abouzeid** **Louisiana State University** *Polyethyleneimine/Phytic Acid/Halloysite Nanoclay Hybrid for Enhanced Flame Retardancy in Wood Materials*
14	**Jonathan Mason** **University of South Alabama** *Environmentally Resistant Two-Step Polydopamine/Glucosamine Antifouling Surface Modification of Poly(vinylidene fluoride) Microfiltration Membranes*

Poster presentation session

(3:40 pm - 5:00 pm)

	Paul Hall
15	**Alexandra Aucoin** **Louisiana State University** *Investigating Fluid Flows Produced by Frontal Polymerization in Thin Layer Acrylate Coatings via Particle Imaging*
16	**Josie Callahan-Santo** **University of Southern Mississippi** *Inhibiting Biofilm Formation on Polymer Substrates via Bacteriophages in Flow Cells*
17	**Jian Zheng** **University of Southern Mississippi** *Pyrolysis and Pore Formation of Crosslinked Polystyrene-block-polybutadiene-block-polystyrene for Ordered Mesoporous Carbon Synthesis*
18	**Jeff Aguinaga** **University of Southern Mississippi** *Degradable aromatic polyester thermosets with high fracture toughness from epoxy and amine components*
19	**Alejandro Ramirez** **Louisiana State University** *Tuning Glass Transition with Precision: Discrete Macromonomers as Polymer Building Blocks*
20	**William H. Hotaling** **Tulane University** *Biopolymer Stability Investigations Using Membrane Mediated Dialysis*
21	**Olumide Alonge** **Tulane University** *Synthesis of Linear-Dendritic Alternating Copolymer via Williamson Coupling Reaction*

Poster presentation session

(3:40 pm - 5:00 pm)

	Paul Hall
22	**Windfield Swetman** **University of Southern Mississippi** *Harnessing Supramolecular Polymers to Engineer Tunable Targeted Protein Degrader*
23	**Madeline McHugh** **Tulane University** *Synthesis of Branched Poly(ethylene brassylate) as a Biodegradable Alternative to Polyethylene*
24	**Sarah Crowsey** **University of Southern Mississippi** *Utilizing Polymers with Arginine Mimetic Guanidinium Groups as an Environmentally Friendly Pest Control Method*
25	**Md Abdullah Al Mahmud** **Louisiana State University** *A novel approach to cure-on-demand coatings using ammonia to catalyze thiol-acrylate and thiol-epoxy reactions*
26	**Sheila Njoroge** **Louisiana State University** *Ring Opening Alkyne Metathesis Polymerization (ROAMP) of Conjugated Strained Nanohoops*
27	**Ethan Rose** **University of Southern Mississippi** *Sterically Congested, Citric-Acid-Derived Epoxy-Amine Thermosets: Synthesis, Thermomechanical Properties, and Free Hole Volume Study*
28	**Nadish Tharindu Galwadu Acharige** **Louisiana State University** *Thermally Responsive Polymers-Grafted Nanoparticles for Biomimetic Repair of Microcracks*

Poster presentation session
(3:40 pm - 5:00 pm)

	Paul Hall
29	**Tongyao Wu** **Louisiana State University** *Roll-to-roll fabrication of three-dimensional self-folding polymer microstructures*
30	**Mason Jones** **University of Tennessee** *Pitfalls of High-Temperature Size Exclusion Chromatography in the Analysis of Model Polyethylene-Alkane Mixtures for Advanced Recycling Applications*
31	**Peter Edimeh** **University of Houston** *Microgel Softness Controls Nanoparticle Transport in Complex Fluids*
32	**Adisa Hassan Ademola** **The University of Alabama** *Supercritical Fluid Impregnation of Polyolefins for Sustainable Polymer Upcycling*
33	**Obiora Ebuka Muojama** **The University of Alabama** *Supercritical CO_2-Driven Surface Modification of Cellulose: Linking Additive Chemistry to Polymer-Fiber Interactions*
34	**Abdur Raafey** **University of Louisiana at Lafayette** *Development of a Self-Healing Polyimide Coating Incorporating Inhibitor-Loaded Zn-Al LDH Nanocontainers for Corrosion Protection of Carbon Steel in Oil & Gas Environments*
35	**Arianna Chisum** **Tulane University** *Design & Synthesis of High Density Thioether Dendrimers via Thiol-yne Click Chemistry*

Keynote Speaker

Dr. Emily Pentzer
Texas A&M University

Biography

Dr. Emily Pentzer is Professor of Chemistry and Presidential Impact Fellow at Texas A&M University where she also serves as the Associate Dean for Research in the College of Arts & Sciences. Her research addresses the design, synthesis, and application of composite soft matter for energy related applications, converging polymer chemistry and processing to solve complex societal challenges. She is the recipient of multiple honors and awards including the NSF CAREER award (2016), CWRU Faculty Diversity Excellence Award (2019), ACS WCC Rising Star Award (2021), and the Journal of Polymer Science Innovation Award (2024). She currently serves as inaugural Editor in Chief of RSC Applied Polymers and is a member of the third cohort of the New Voices program of the National Academies of Science, Engineering, and Medicine (2024-2026).

Polymerizations in Emulsions: Architecting Composite Structures

Abstract

This presentation will address the combination of polymer chemistry and Pickering emulsions to prepare composite structures and establish structure-function-application relationships. Emulsions are biphasic systems in which droplets of one liquid (e.g., oil) are dispersed in a continuous phase of another (e.g., water), and those stabilized by particles are called Pickering emulsions. When combined with polymerizations, the phase-separated emulsions provide an ideal platform for the production of composite structures. This presentation will discuss the Pentzer group’s use of oil-water, oil-oil, and ionic liquid-oil emulsions stabilized by 2D particle surfactants to fabricate capsules, foams, and armored particles. Examples include liquid-filled capsules for carbon capture or passive heat management, as well as functional additives for additive manufacturing (e.g., 3D printing).

Keynote Speaker

Dr. Austin Evans
University of Florida

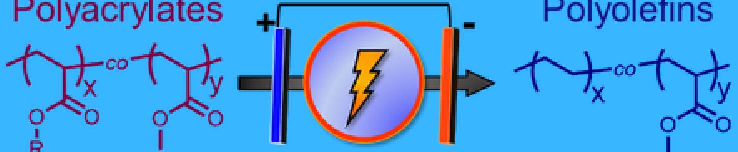
Biography

Austin M. Evans is an Assistant Professor at the University of Florida where he holds appointments in Chemistry and Materials Science & Engineering. Prior to joining the University of Florida, Austin studied at Columbia University as a Postdoctoral Schmidt Science Fellow. Before his postdoctoral training, Austin completed his Ph.D. in Chemistry at Northwestern University as an NSF Graduate Research Fellow and an International Institute for Nanotechnology Ryan Fellow. For his contributions to many areas of chemistry, engineering, and physics Austin has been recognized with numerous awards including the 3M Non-Tenured Faculty Award, ACS POLY Henkel Award, MOF2020 Early Career Award, Foresight Institute Vision Fellowship for Molecular Electronics, and the IUPAC-Solvay International Award for Young Chemists.

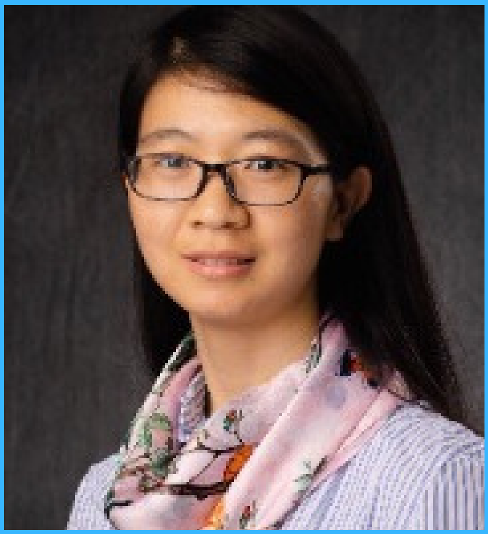
Electrifying Polymer Chemistry: New Strategies to Functionalize, Depolymerize, and Deconstruct Macromolecules

Abstract

Electrochemically induced decarboxylation provides a powerful method for post-polymerization modification and controlled degradation of polymers. Under mild electrochemical conditions, polymers containing N-(acryloxy)phthalimides generate transient alkyl radicals, enabling near-quantitative transformation into challenging copolymers such as poly(ethylene-co-methyl acrylate) and poly(propylene-co-methyl acrylate). This strategy also allows efficient depolymerization of all-methacrylate copolymers. Insights into the radical mechanisms further inspired routes to ultra-high-molecular-weight polymer synthesis, demonstrating the value of emerging radical chemistry in building and modifying macromolecules.



Workshop



Dr. Yaxin An
Louisiana State University

Biography

Dr. Yaxin An is an assistant professor at the Department of Chemical Engineering, at Louisiana State University. She completed her PhD at Virginia Tech in 2020. Prior to joining LSU, Dr. An was a Postdoctoral Scholar at Princeton University from 2021 to 2022. Her group has been working on computational simulations and machine learning for designing soft matter, e,g, polymers, proteins, and nanoparticles. Her research is supported by a Louisiana State grant and an NSF grant. Her expertise in computational tools, including coarse-grained molecular dynamics simulations and machine learning, has been applied to the design of functional polymers for energy and health applications.

Abstract

This workshop will offer an introduction to the fundamentals of Python programming, machine learning algorithms, and a focus on polymer property prediction using machine learning. Attendees will participate in a research-based project designed to provide hands-on experience with Python programming and machine learning workflows. No prior knowledge is required. This is a beginner-friendly workshop. In addition, advanced topics such as graph neural networks will also be covered. Join us to build your first machine learning model.

Career Panelists

Dr. Jimmy Lawrence
Louisiana State University

Biography

Dr. Jimmy Lawrence is an Assistant Professor of Chemical Engineering at Louisiana State University, where his research focuses on precision bottlebrush polymers and their applications in drug delivery and advanced materials. He is a recipient of the 2025 ACS PMSE Young Investigator Award, 2024 NSF CAREER Award, and 2023 NIH MIRA R35 Award. Prior to joining LSU, Dr. Lawrence was a postdoctoral researcher at UC Santa Barbara's Dow Materials Institute (2014-2018), and spent four years at Schlumberger, where he developed patented technologies for downhole fluid analysis as a Research Scientist in Cambridge, MA and Research Engineer in Yokohama, Japan. He also conducted fuel cell research at the University of Tokyo, where he earned his B.S. and M.S. in Chemical Engineering, followed by a Ph.D. in Polymer Science and Engineering from UMass Amherst. Dr. Lawrence holds 16 US patents and has published over 30 peer-reviewed articles (h-index: 24).

Career Panelists

Dr. Jessica Hoskins
AbbVie

Biography

Dr. Jessica Hoskins is a Principal Research Scientist at AbbVie where she and her team focus on Predictive Stability and Structure Elucidation to understand degradation pathways and other potential stability-limiting attributes for new synthetic molecule drug substances and drug products. She has a PhD in Organic Chemistry from Tulane University with Scott Grayson, where she first became interested in mass spectrometry for polymers. Prior to joining AbbVie, she was an Adolf Martens Postdoctoral Fellow at the Federal Institute for Materials Research and Testing (BAM) in Berlin, Germany, and worked as an analytical chemist at Stepan Company in the surfactant and polymer industry. She's an active member of the American Society for Mass Spectrometry and has co-organized several workshop sessions.

Career Panelists

Dr. Sam Bliesner
Bookoff McAndrews

Biography
Dr. Sam Bliesner works for the D.C.-based firm Bookoff McAndrews, specializing in patent prosecution and strategy. He draws heavily on his technical training in polymers and materials science in his patent practice. He previously managed a global patent portfolio and supported IP strategy for Entegris in Billerica, MA, and advised a variety of clients as a patent agent at Choate, Hall & Stewart in Boston, MA. Under Dr. Julie Albert at Tulane, he researched solvent processing methods for polymer thin films. His interdisciplinary collaborations included work in environmental aerosol chemistry, and he mentored graduate and undergraduate students with a focus on career development and inclusion in STEM. Prior to attending Tulane, he had a brief stint in manufacturing at DuPont's Kevlar Pulp business area. Sam's interest in IP began at Tulane's technology transfer office, where he conducted prior art searches, patentability assessments, and supported licensing efforts for university-developed technologies. Currently, Sam is pursuing his J.D. at the University of New Hampshire Franklin Pierce School of Law and is expected to graduate in 2028.

Career Panelists

Dr. Jie Xu
Argonne National Lab

Biography
Jie Xu is a scientist at Argonne National Lab. Her research focuses on precision engineering of functional polymers through molecular packing structure engineering, chemical design, and self-driving laboratories (https://www.anl.gov/cnm/polybot). Jie earned her PhD in chemistry from Nanjing University, specializing in nanoconfined soft matter, and completed postdoctoral training at Stanford developing stretchable electronics. She received the Materials Research Society Postdoctoral Award and is named to the MIT Technology Review's list of Innovators Under 35, Newsweek list of America's Greatest Disruptors as a budding disruptor, 2023 Polymeric Materials: Science and Engineering Early Investigator Honoree by the American Chemical Society, 2025 Scialog fellow in Automating Chemical Laboratories.

Oral presentation session I

Joshua D. Marquez, University of Florida

Ultrahigh-Molecular-Weight Polystyrenics with Tunable Entanglement Molecular Weights as Latently Curable and Dimensionally Stable Monoliths

Abstract

I will describe a new limit in ultra-entangled linear polymers. Specifically, I will discuss a versatile platform for producing ultra-high molecular weight (UHMW, >10^6 Da) styrenic copolymers with tunable viscoelastic and thermomechanical properties via mild photoiniferter polymerization. These polymers exhibit a high density of primary chain entanglements (>>10), enabling exceptional mechanical strength, dimensional stability at elevated temperatures, and excellent melt and solution reprocessability with no change in molecular weight or thermomechanical behavior over multiple cycles. The entanglement molecular weight (Me) is systematically tuned across 40,000–160,000 Da via pre- and post-polymerization modification with n-alkyl side chains, which allows us to modulate the Young's moduli of these materials from 0.04 to 69 MPa. This tunability also enables unique room-temperature shape memory, which is difficult to achieve in other materials. Incorporation of 4-vinylbenzocyclobutene, a well-known latent crosslinker, yields highly entangled systems that function as single-component, latently curable materials that maintain shape integrity even during curing processes conducted >150 °C above Tg. These UHMW materials resist deformation due to long relaxation times and support high-resolution, mold-free thermoset formation. Together, these results establish a new class of shape-retaining, entangled UHMW polymers with decoupled processability and dimensional control, enabling advances in structural composites, patterning, and advanced manufacturing technologies.

Oral presentation session I

Christy Witcher Barker, University of Tennessee

Correlating Chlorinated Polyethylene Molecular Structure to Compatibilization Efficiency for Mixed Polymer Waste

Abstract

End-of-life plastics threaten the environment due to limited recycling of waste plastic into valuable products; a challenge compounded by the immiscibility of difficult-to-sort waste plastics. Such mixtures often exhibit poor properties because weak interfacial adhesion drives phase separation. To address this, compatibilizers are commonly employed to strengthen these interfaces and stabilize blend morphology. Previous research by our group studied commercial chlorinated polyethylene (c-PE) as a compatibilizer for polyvinyl chloride (PVC) and polyolefin elastomers (POE). However, the molecular-level processes that enhance interfaces in this amorphous-semicrystalline blend remain unclear. To address this, we synthesized a series of gradient c-PE copolymers via ring-opening metathesis polymerization (ROMP) using varying ratios of dichlorinated cyclooctene and cyclooctene. These copolymers were evaluated for their ability to improve PVC/POE interfacial adhesion and were compared to the performance of commercially available blocky c-PEs. Herein, we identify how compatibilizer crystallinity and molecular sequence distribution influence compatibilizer efficacy. Our findings show that commercial blocky samples enhance adhesion as a function of increasing c-PE crystallinity and blockiness, while the synthesized gradient copolymers improve adhesion with increasing PE-like segment block length. This suggests that while co-crystallization between semicrystalline components plays a key role in compatibilization, interphase entanglement is also essential and strongly influenced by comonomer sequence distribution. These results provide insight into how crystallinity, molecular sequence, and chain architecture govern compatibilizer performance. Such understanding may guide the molecular design of compatibilizers for phase-separated amorphous-semicrystalline blends, particularly those relevant to mixed waste streams in polymer recycling.

Oral presentation session I

Jacob Michael Russell, Louisiana State University

Frontally Polymerized Acrylate Wood Adhesive

Abstract

Glues and epoxies that are targeted towards bonding wood together are commonly known as wood adhesives. Wood adhesives are an integral part of everyday life commonly being used in enhancing structural stability, helping in arts and crafts, and assisting in woodworking. Commercially available wood adhesives often show similar limitations; their shortcomings include long cure times, a need for premixing, and low structural stability in thin layers. The frontal polymerization of acrylates aims to address these inadequacies by showing the ability to have rapid cure times (in the order of minutes), being able to form thin-layer bond gaps, and the fact that they are only one-pot mixtures. Frontal polymerization is a system in which an initial reaction site can start a reaction front in which liquid monomer is converted to solid polymer. For this presentation, the overlap shear strength of different acrylate monomer systems with varying peroxide initiators was tested to determine the strengths of various adhesive mixtures. As well as adhesive mixtures, adding Zoltek (carbon fiber) was also tested to see its effect on the adhesive strength of the system. The results show the potential that this system has in overcoming the shortcomings of commercially available wood adhesives.

Oral presentation session I

Robert J. Comito, University of Houston

Bimetallic Catalysts for Sustainable Polymerization and Depolymerization

Abstract

The sustainability of the polymer economy will depend on the development of biodegradable materials, the more efficient use of biomass, and the use of earth abundant and nontoxic metal catalysts. My program addresses all three of these needs through the development of main group and first-row transition metal bimetallic catalysts, for polymerization and depolymerization. This talk will cover the synthesis of bimetallic complexes from binucleating ligands. Our main group catalysts are selective for the synthesis of degradable polyesters and polyaldehydes, with unusual sequence selectivity in copolymerization. Our divanadium complexes give efficient aerobic depolymerization of lignin. Through mechanistic analysis, we provide a conceptual basis for cooperativity in bimetallic catalysts.

Khandakar Rakibul Hasan, Louisiana State University

Cure-on-demand powder coatings using thermal frontal polymerization of acrylates.

Abstract

Powder coating systems require heating at elevated temperature for many minutes after application of the resin powder. The current study explores the creation of a cure-on-demand powder coating system using diatomaceous earth that has absorbed an acrylate/initiator solution. Two acrylates were studied: pentaerythritol triacrylate (PETIA) and trimethylolpropane triacrylate (TMPTA) Luperox-231 was the peroxide initiator. We demonstrated that the free-flowing powders could be spread on a wood surface, which could then support a self-propagating polymerization front after initiation from a localized heat source. This is first example of frontal polymerization in such a system.

Oral presentation session I

Godwin Ochola, University of Tennessee

Tuning Copolymer Chain Lengths for Integral Membrane Protein Solubilization

Abstract

Integral membrane proteins (IMPs) mediate a wide range of essential cellular processes and remain primary targets for therapeutic development, yet their extraction and characterization continue to present major challenges due to the limitations of conventional detergent-based approaches, which frequently disrupt annular lipid interactions, destabilize tertiary structure, and compromise function. Amphiphilic copolymers have emerged as a promising alternative, enabling the direct solubilization of native protein–lipid complexes without the deleterious effects associated with small-molecule detergents; however, their performance remains variable, and the physicochemical parameters governing solubilization efficiency are poorly defined. This study systematically investigated the role of copolymer chain length (molar mass) in the solubilization of trimeric Photosystem I (PSI) from thylakoid membranes and uncovered a strong correlation between copolymer self-association behavior and solubilization activity. Copolymers of intermediate molar mass ($M_n \approx$ 6–9 kg/mol) achieved the highest solubilization efficiency, significantly outperforming both shorter and longer analogues as well as binary blends. Small-angle x-ray scattering (SAXS) revealed that these optimal mid-range copolymers preferentially self-assembled into homogeneous elliptical micelles, whereas smaller and larger polymers formed spherical aggregates that correlated with reduced solubilization capacity. Furthermore, polymer blends exhibited concentration-dependent shifts in micellar morphology, which paralleled changes in extraction efficiency, underscoring the sensitivity of the process to self-assembly dynamics. These findings establish polymer chain length as a critical design parameter that directly governs micellar architecture and thereby modulates membrane protein solubilization efficiency, providing mechanistic insight for the rational design of next-generation copolymers tailored to diverse IMP systems.

Oral presentation session I

Mahi Ahmad, Tulane University

Cyclization of linear ethylene brassylate via Click Chemistry

Abstract

Ring-opening polymerization (ROP) of polyesters has been extensively studied; however, macrocyclic monomers such as ethylene brassylate (a seventeen membered ring) have received comparatively less attention. In this study, ethylene brassylate was selected due to its underexplored nature and cost-effectiveness (less than $30 per kilogram). To synthesize linear poly(ethylene brassylate) (PEB), we used propargyl alcohol as the initiator and 5,7-triazabicyclo[4.4.0]dec-5-ene (TBD) as the catalyst. Size exclusion chromatography (SEC) analysis revealed PEB with molecular weights ranging from 4 to 11 kDa and dispersities between 1.30 and 1.90. The major product was the expected linear PEB initiated by propargyl alcohol, featuring a terminal hydroxyl group. However, side reactions occurred during polymerization: cleavage of both ester bonds in ethylene brassylate released ethylene glycol, which acted as an alternative initiator, resulting in a minor byproduct with two hydroxyl end groups. Additionally, another byproduct with two alkyne end groups was observed, attributed to the reactivity of ethylene brassylate's carbonyl with propargyl alcohol. Both byproducts were identified via matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-ToF MS). The major product, α-propargyl-ω-hydroxy-PEB, was subsequently functionalized via esterification with 6-azidohexanoic acid, which also converted the dihydroxy byproduct into a diazide derivative. Cyclization of the primary product was then achieved using copper(I)-catalyzed azide-alkyne cycloaddition (CuAAC) “click” chemistry. The two byproducts: one bearing two azide end groups, and the other two alkyne end groups, were also capable of mutual cyclization via CuAAC. The structures of both linear and cyclic PEBs were confirmed by nuclear magnetic resonance (NMR), SEC, and MALDI-ToF MS.

Oral presentation session I

Udayanidhi Ramesh Kumar, University of Houston

Controlled Expression of Type 1 Fimbriae in Escherichia coli: Consequences for Aggregation and Proliferation in Presence of Polymers

Abstract

Bacteria are living, active colloids that alter their behavior, including growth and expression of surface-anchored structures like fimbriae, flagella, and curli, in response to environmental conditions. Bacteria are surrounded by polymers and other macromolecules in their natural habitats — e.g., mucin and F-actin in the airways of patients with cystic fibrosis, and exopolymers in the oceans. Non-motile bacteria lacking flagella behave like passive colloids and can aggregate upon addition of non-adsorbing polymers due to polymer-induced depletion attractions. How surface-anchored structures, such as the type 1 fimbriae that play important roles in virulence and adhesion, alter growth and aggregation in polymer solutions is not well understood. Here, we explore how type 1 fimbriae expressed on the surface of Escherichia coli affect aggregation induced by non-adsorbing polymers such as sodium polystyrene sulfonate (NaPSS) and Ficoll. Using synthetic biology, we engineer fimbrial expression in a fliC knockout mutant (lacking native expression of fimbriae and flagella) and investigate the effect of fimbriation on initial aggregation and long-time growth in the presence of polymers using sedimentation assays and microscopic imaging techniques. We find that fimbriae reduce polymer-induced aggregation in E. coli. In addition, we demonstrate that fimbriated cells form string-like structures, in contrast to the cable-like structures formed by the non-fimbriated fliC knockout mutant, as they grow in non-adsorbing polymer solutions. This finding could help understand how cells organize themselves into polymer-secreting bacterial communities known as biofilms which can foul medical and industrial equipment, and provide insights into the mechanisms of chronic bacterial infections and flocculation processes relevant to wastewater treatment.

Oral presentation session I

Bernard Chukwuemeka Ekeoma, The University of Alabama

Catalyst Support Acidity Influences Monomer Selectivity in H2-Free Reductive Catalytic Fractionation of Lignin 1 / 27 51%

Abstract

Ex situ H2-free reductive catalytic fractionation (RCF) deconstructs lignin into functionalized phenolic monomers under mild conditions, utilizing transfer hydrogenolysis and hydrogenation pathways facilitated by non-volatile, H-donor solvents. This study demonstrates the synergistic influence of catalyst support acidity and solvent molecular structure on H-transfer pathways and monomer selectivity. Pt-nanoparticle catalysts supported on materials with varying acidity (e.g., C, TiO2, Al2O3, ZrO2, faujasite) were evaluated alongside glycerol-derived ethers (GDEs) with diverse molecular structures as H-donors. While all catalysts achieved comparable monomer yields (theoretical: 1.06–1.30 mol mol-1; 18.56–22.81 wt%), support acidity significantly influenced product selectivity. Non-acidic supports such as Pt/C and Pt/TiO2 favored metal hydride transfer, enhancing selectivity for monomers with alkyl or alkenyl sidechains, including, 4-ethylguaiacol, 4-propylguaiacol, isoeugenol, and eugenol. In contrast, acidic supports promoted direct H-transfer via Meerwein–Ponndorf–Verley (MPV) mechanisms, favoring oxygenated monomers such as coniferaldehyde, vanillin, and vanillic acid. GDEs with longer terminal alkyl chains led to decreased selectivity of monomers with oxygenated sidechains formed via MPV-mechanisms due to increasing steric hindrance. HSQC NMR and MALDI-TOF MS analyses confirmed that depolymerized lignin functionality is modulated by support acidity. Model compound studies with coniferyl alcohol further revealed that catalyst support acidity governs dominant reaction pathways, specifically, hydrodeoxygenation to isoeugenol or MPV reduction to coniferaldehyde, ultimately shaping downstream product selectivity. Collectively, these findings elucidate the interplay between catalyst support and H-donor solvent structure in modulating lignin monomer selectivity under mild, H2-free RCF conditions, aligning with green chemistry principles.

Oral presentation session I

Amman Nadeem, Tulane University

Elucidating Fragmentation Pathways of Cyclic and Linear Poly(dimethylpropanoate) via Tandem Mass Spectrometry and Ion Mobility Spectrometry

Abstract

Tandem mass spectrometry (MS^2) has recently become an essential tool for structural elucidation, end-group and sequence analysis, fragmentation pattern characterization, and identification of side products in synthetic polymers. Fragmentation of polyesters and polyamides having a C_α adjacent to an ester or an amide linkage typically proceeds via 1,5- and 1,3-proton rearrangements. However, the neopentyl carbon in poly(dimethylpropanoate) (poly(DMP)) inhibits typical 1,5-proton rearrangements common in other polyesters. This work investigates the fragmentation behavior of both linear and cyclic poly(DMP). Cyclic polymer undergoes ring-opening at various points before fragment generation, resulting in a mixture of ring-opened linear species, while linear polymer predominantly fragments through single bond cleavage. Additionally, fragmentation pathways are influenced by polymer end groups, with distinct patterns observed for hydroxyl-, halogen-, and pyridinium-terminated polymers. Moreover, IM-MS effectively distinguished isomeric fragments in cyclic poly(DMP) based on the differences in collision cross-section of cyclic precursor and the resulting linear fragment ions.

Oral presentation session I

Shanta Biswas, Louisiana State University

Investigating the Effects of Macromolecular Crowding on the Mechanism of Protein-Polymer Complex Coacervation

Abstract
Biomolecular condensates formed via liquid-liquid phase separation (LLPS) play a central role in cellular organization. Complex coacervation, a type of LLPS, has been widely used as a model to investigate condensate formation. In this study, we examined a model protein-polymer coacervation system in both dilute and crowded environments to mimic the crowded cytoplasm where biomolecular condensates naturally form. To recreate crowding, we used two macromolecular crowders, PEG and Ficoll. Our results show that the formation mechanism of coacervation differs markedly between dilute and crowded conditions. In dilute solutions, charge neutrality is essential for coacervate formation. In contrast, in the presence of crowders, polymers adopted highly coiled conformations that assembled into overlapping networks before protein addition. These pre-formed polymer networks served as a framework for coacervation, effectively lowering the threshold for condensate formation and eliminating the need for charge neutrality. Interestingly, although the formation pathways differed, both PEG and Ficoll were excluded from the coacervate phase, resulting in condensates with similar structures under crowded and dilute conditions. These findings suggest that crowding promotes LLPS by facilitating pre-organized polymer networks that reduce the reliance on charge neutrality. Overall, our work highlights how macromolecular crowding alters the mechanism of complex coacervation, offering insights into how condensates can form more readily and dynamically in cellular environments. This framework may help to explain the adaptability of biomolecular condensates and their ability to assemble under diverse cellular conditions.

Oral presentation session II

Jaewoo Choi, The University of Alabama

Depolymerization of Poly(vinyl chloride) to Value-Added Products via Ozonolysis

Abstract

The drive toward plastic circularity has paved way for chemical recycling as a promising strategy to recover end-of-life plastics, especially through upcycling processes that avoid the quality losses common in thermomechanical routes. Poly(vinyl chloride) (PVC), while commonly used across many industries, remains one of the least recycled plastics, primarily due to its susceptibility to thermal degradation. In this work, we introduce and demonstrate a scalable two-step chemical recycling scheme for PVC based on controlled dehydrochlorination followed by ozonolysis and oxidative work-up. PVC resin is first dehydrochlorinated in THF with NaOH to form a soluble DHPVC intermediate. This solution is then treated with a stream of ozone and undergoes oxidative work-up to produce carboxylic acid-terminated low- and ultra-low-molecular-weight PVC products (LMW-PVC and ULMW-PVC, respectively). Quantitative analysis shows a substantial reduction in molecular weight (LMW-PVC) and generation of oligomeric products (6–30 PVC repeat units of ULMW-PVC), as confirmed by conventional characterization methods. Additionally, the ULMW-PVC stream was incorporated (30 wt%) into virgin PVC K65 and cast into dog bones; mechanical characterization revealed increased elongation at break, a decrease in modulus and a significant decrease in glass transition temperature. These results illustrate that this approach not only enables partial depolymerization of PVC, achieving both polymeric and oligomeric product streams, but also produces value-added additives compatible with existing PVC formulations. The process runs at ambient temperature, uses minimal catalyst or exotic reagents, and generates minimal waste streams, offering a viable path toward PVC upcycling. Future work will focus on increasing yields of the liquid fraction, optimizing complete conversion of end-groups, and exploring subsequent dechlorination for further depolymerization.

Oral presentation session II

Joseph Previte Jr., The University of Southern Mississippi

Investigation of Sub-Melting Degradation and Crosslinking in PEKK

Abstract
Polymer-derived carbon (PDC) materials are an expanding research topic because of their thermal stability at extreme temperatures. Cheap, high charring thermosets, such as phenolics and benzoxazines, dominate this area since they retain their geometry through carbonization temperatures. However, these materials are difficult to shape, and complex parts are next to impossible to form. Poly (aryl ether ketones) (PAEKs) are potential alternative materials due to their high char yield, a necessity for carbon applications. As thermoplastics, their challenge is that they melt and lose their dimensionality as they are heated to carbonization temperatures. To combat this issue, it has been discovered that poly (ether ketone ketone) (PEKK) undergoes intramolecular degradation originating at the ether linkages below the melting temperature. This unlocks the possibility of utilizing traditional thermoplastic processing to form PEKK into the desired PDC shape, followed by inducing intramolecular degradation below the melting temperature to maintain the geometry through carbonization. This work seeks to further establish and characterize PEKK degradation below the melting temperature to provide it with dimensional stability for use in carbon applications.

Oral presentation session II

Titilayo Oluwole, Louisiana State University

Chemistry-Architecture Synergy Drives Interfacial Dynamics in Complex Polymers

Abstract

The utilization of surface-active materials spans diverse applications, including emulsification, coating, and stabilization of multiphase systems. However, their adsorption to fluid interfaces is not instantaneous but governed by molecular diffusion and conformational relaxation, making it a time-dependent process. Bottlebrush polymers, a class of macromolecular surfactants with densely grafted side chains, have gained attention for their remarkably low critical micelle concentration (CMC) and strong affinity for interfaces. Yet, their adsorption kinetics are considerably slower than those of small-molecule surfactants, often requiring 2-3 orders of magnitude longer to reach equilibrium. To address this, we exploit the synthetic precision of discrete oligomeric side chains to prepare two distinct bottlebrush architectures, with differences in side-chain rigidity and flexibility. We demonstrate how changes in molecular parameters, such as side-chain chemistry and architectural design, contribute to the dynamic interfacial adsorption behavior and the monolayer behavior of the amphiphilic bottlebrush polymer.

Oral presentation session II

Sulochana Ekanayaka Mudiyanselage, Louisiana State University

Phase Separation and Interfacial Behaviour of Mixed Surfactant Micelle-Polymer Complex Coacervates

Abstract

Complex coacervation offers a versatile and tunable platform for the design of stimuli-responsive materials with diverse functional applications. Surfactant micelle-polymer complex coacervates can encapsulate and deliver hydrophobic compounds via micellar domains while remaining responsive to environmental stimuli. In this study, we investigate the phase behavior and interfacial characteristics of a model system composed of mixed surfactant micelles and a cationic polymer. Varying micelle composition shows that the ionic surfactant fraction controls micelle charge, conformation, and polymer-micelle interaction strength.These factors collectively govern the transition between soluble complexes, liquid-liquid coacervates, and precipitated aggregates.Iso-ionic dilution experiments reveal the occurrence of dilution-induced complex coacervation (DICC), where coacervate formation is driven by a reduction in total macromolecular concentration while maintaining constant ionic strength and stoichiometry. The boundaries of the coacervation window can be tuned by adjusting micelle charge density and polymer-to-surfactant mass ratio, providing a means of controlling phase stability. The interfacial behavior of the resulting coacervates was examined using contact angle analysis. The coacervates exhibited efficient spreading on both hydrophilic and hydrophobic substrates, outperforming corresponding micelle solutions in terms of wetting efficiency. Enhanced spreading was particularly evident on hydrophobic surfaces with multiscale roughness. This behavior is attributed to the viscoelastic network structure of micelle-polymer complexes within the coacervate phase, which facilitates cooperative surfactant adsorption and surface anchoring.Overall, these findings highlight the potential of mixed micelle-polymer coacervates as tunable, stimuli-responsive systems for applications in controlled wetting, surface coatings, and targeted delivery of hydrophobic agents.

Oral presentation session II

Shubhadeep Nag, Louisiana State University

Beyond Hydrophobicity: Multi-Scale Insights into Polymer-Drug Encapsulation from Single-Molecule to High-Throughput Simulations

Abstract

Polymer nanoparticles are widely applied for the targeted delivery of small therapeutic molecules to cancer tissues. Encapsulation of small drugs within amphiphilic polymer matrices is typically rationalized by the partition coefficient (log P) representing the hydrophobicity of small drugs, is often considered the principal determinant of encapsulation efficiency. However, recent studies reveal systematic deviations from this assumption, suggesting that additional molecular features govern encapsulation behavior. This raises a fundamental question: what molecular features, beyond simple hydrophobicity, determine how drugs are incorporated into and released from a polymer complexes? In this work, we first use Martini 3 coarse-grained molecular dynamics simulations to investigate the self-assembly of individual PEG-doxorubicin and PEG-SN38 conjugates. We demonstrate that despite similar log P and molecular topology, these two systems form distinct nanostructures driven by interaction energies rather than hydrophobicity alone. Building on these insights, we then apply the same simulation techniques to a larger set of more than 100 drug-like molecules with different log P and molecular topology, encapsulated in PLA-PEG complexes. We show that incorporating normalized interaction terms provides a far better prediction of encapsulation efficiency than log P alone. Our findings offer a unified framework for designing polymer-based drug delivery systems, highlighting that key molecular interactions and structural features are critical to achieving predictable encapsulation beyond simple hydrophobicity scales.

Oral presentation session II

Roya Gadimli, Tulane University

Enhancing the Mechanical Performance of Poly(3-hydroxybutyrate) by Modifying Crystallinity through Additives

Abstract

Poly(3-hydroxybutyrate) (P3HB) is a biodegradable, semicrystalline polymer suitable for use in marine and terrestrial environments where it is degraded by natural microbial processes, typically within a few years. However, its high crystallinity (55-60%) causes brittleness and poor mechanical properties, which has hindered its widespread adoption for many applications. This research investigates strategies to adjust the crystallinity of P3HB, aiming to enhance mechanical properties through the incorporation of plasticizers, anti-aging agents, nucleating agents, and blending with other biodegradable polymers. Modified materials were characterized using a comprehensive set of analytical techniques. Differential scanning calorimetry (DSC) and wide-angle x-ray scattering (WAXS) provided insights into crystallinity and phase behavior, while small-angle x-ray scattering (SAXS) was employed to elucidate the long-period associated with crystalline lamellae. Mechanical performance, primarily flexibility, durability, and brittleness, was evaluated using bending tests conducted on an Instron universal testing machine. Changes in viscosity and melting temperature were also noted during sample preparation, and processing methods were adjusted accordingly. In general, additives enhanced the flexibility and durability of P3HB, while also improving processability. These findings demonstrate the potential for developing advanced, high-performance biodegradable polymer systems.

Oral presentation session II

Jimmy Lawrence, Louisiana State University

Precision Brush Polymers: Advancing Polymer Fundamentals and Applications

Abstract

Architectural precision in polymer synthesis has enabled us to solve two longstanding problems in polymer science and medical imaging.

First, we will address the glass transition temperature challenge. For decades, researchers reported contradictory results: some found that adding longer side chains increased Tg, while others saw it decrease in similar systems. We discovered a simple governing principle through molecular simulations and synthesis of discrete polymers across three chemical families. A single parameter—the stiffness ratio between side chains and backbone—predicts whether Tg increases or decreases and by how much. This led to a universal master curve that collapses all our data, turning thermal property design from guesswork into prediction.

Second, the medical imaging challenge. Fluorine-based MRI contrast agents could replace toxic gadolinium compounds, but they have faced a longstanding trade-off: making them water-soluble usually broadens the signal. Using discrete bottlebrush polymers with precisely placed fluorinated groups, we achieved signals multiples times stronger than early designs despite much lower fluorine content. The key insight: architectural precision and fluorine mobility matter far more than cramming in more fluorine atoms.

Oral and poster presentations

Tongyao Wu, Louisiana State University

Roll-to-roll fabrication of three-dimensional self-folding polymer microstructures

Abstract

Self-folding technology provides a promising alternative to conventional microfabrication methods for producing complex three-dimensional (3D) polymer microstructures, especially those with hollow geometries and thin walls. By exploiting controlled imbalanced stresses within multilayer polymer films, planar layers can autonomously transform into pre-defined 3D forms without external manipulation. Despite their potential in biomedical and electronic applications, the fabrication of self-folding polymer structures has largely remained at the laboratory scale, limiting their broader implementation. In this study, we present a novel roll-to-roll (R2R) fabrication platform for high-throughput production of polymer-based self-folding films. The R2R setup continuously stretches and bonds a pre-cured PDMS (polydimethylsiloxane) film to another PDMS film supported by a PET (polyethylene terephthalate) carrier layer. This creates a bilayer polymer film with imbalanced stress, causing it to self-fold into 3D shapes upon patterning and releasing. The R2R setup achieves a production rate of 96 cm^2 min^{-1}, reducing fabrication time from several days (in spin-coating and baking methods) to only minutes. The R2R-fabricated polymer films yielded multiple 3D geometries—including hollow microcarriers (HMCs), finger-like, and tubular structures—with high uniformity and reproducibility. Moreover, this process enables surface-selective functionalization of inner and outer surfaces for customized biointerfaces. HMCs fabricated from self-folding polymer film demonstrated excellent biological performance by supporting the expansion of HEK293 cells, achieving exponential growth and normal doubling times. Overall, this R2R-based fabrication strategy establishes a scalable, efficient pathway for polymer film processing, advancing the industrial-scale production of 3D self-folding polymer microstructures for biomanufacturing, tissue engineering, and flexible microdevice applications.

Oral and poster presentations

Mason Jones, University of Tennessee

Pitfalls of High-Temperature Size Exclusion Chromatography in the Analysis of Model Polyethylene-Alkane Mixtures for Advanced Recycling Applications

Abstract

Polyolefins dominate modern plastic production, and as such, there is a recent surge in research efforts to develop applicable chemical recycling and depolymerization methodologies. Because of their limited solubility, polyolefins are routinely characterized by high-temperature size exclusion chromatography (HT-SEC), which is increasingly being applied to polyolefin depolymerization mixtures that extend below the typical molar mass ranges for commercially available columns. Herein, we evaluate the product identification accuracy of triple-detection HT-SEC using a series of model recycling product mixtures, such as short polyethylenes (M_n = 465 and 2722 g/mol) and discrete short-alkanes hexatriacontane (507 g/mol), dotriacontane (451 g/mol), and octadecane (254 g/mol). Despite these short alkanes having molar masses below the lower chromatographic limits of the general-purpose columns used, the mixtures were readily resolved. However, their calculated molar masses diverged sharply from their known values. Mixtures containing of the short-alkanes/-polyethylenes likewise produced well- resolved chromatograms but also yielded inaccurate molar masses. These deviations stem two primary factors: (1) the molar mass dependence of the refractive index increment ($\partial n/\partial c$) in low molar mass species, and (2) the insufficient size (R_g) of small molecules in solution to produce reliable light scattering signals. These results suggest that triple-detection HT-SEC using general-purpose columns, while capable of resolving model recycling product mixtures that contain species below the column's lower molar mass exclusion limit, systematically misrepresent molar masses for low molar mass species. For recycling applications this limitation highlights for necessity for accurate interpretation of HT-SEC data and recognition of these systematic errors to avoid mischaracterization of recycling products.

Oral and poster presentations

Peter Edimeh, University of Houston

Microgel Softness Controls Nanoparticle Transport in Complex Fluids

Abstract

The elasticity of polymer microgels governs both their bulk rheological response and the transport of embedded tracer particles. How elasticity and microgel concentration affect the tracer dynamics across different concentration regimes, however, remains incompletely understood. Here, we synthesize dual-stimuli-responsive poly(N-isopropylacrylamide-co-acrylic acid) (PNIPAM-co-PAA) microgels with tunable softness by varying the crosslink density. The microgels undergo a swelling transition near 32°C as they are cooled, and we exploit this transition to modulate microgel concentration in situ. We characterize the dynamics of fluorescent polystyrene tracers in microgel matrices as they are cooled from the collapsed to swollen state and reach final volume fractions of $\zeta \approx 0.4$ (dispersed), $\zeta \approx 0.6$ (contacting), and $\zeta \geq 1.0$ (jammed or compressed). Using differential dynamic microscopy and single-particle tracking, we determine relaxation times τ and diffusivities D for the tracer particles as functions of temperature and the final (swollen) ζ. At low $\zeta \approx 0.4$, τ and D of the tracers monotonically increase and decrease upon cooling, respectively, for both soft and stiff matrices. At intermediate $\zeta \approx 0.6$, however, τ and D exhibit non-monotonic dependences on temperature, with local extrema near 34 °C, in stiff but not soft matrices. At high $\zeta \approx 1.0$, this non-monotonic behavior occurs in both soft and stiff matrices. Our results show how elastic compression modulates penetrant transport in microgel networks, which can be applied to the design of biological scaffolds and theranostics.

Oral and poster presentations

Adisa Hassan Ademola, The University of Alabama

Supercritical Fluid Impregnation of Polyolefins for Sustainable Polymer Upcycling

Abstract

Polyolefins are the most extensively produced synthetic polymers (~60% global plastic waste). Their resistance to environmental degradation presents a persistent challenge, contributing to ecosystem pollution. Mechanical recycling remains the most established industrial approach; however, its effectiveness is constrained by the progressive deterioration of polyolefin properties such as thermal stability and crystallinity. In this study, we investigated the application of supercritical carbon dioxide (scCO2; Tc = 31.0 °C, Pc=73.8 bar) as a tunable solvent medium to modify the physicochemical characteristics of polyolefins and to facilitate additive incorporation. scCO2 promotes polymer swelling and enables alterations in structural, mechanical, and thermal properties. Our study advances current understanding by elucidating the relationship between molecular and structural modifications in polyolefins. Initial experiments demonstrate that scCO2 treatment at 180 °C and 200 bar enhances thermal stability, as evidenced by thermogravimetric analysis showing a rightward shift in decomposition temperature of up to 50 °C. DSC revealed elevated melting points, while X-ray diffraction attributed these changes to recrystallization phenomena. Further, we performed SCI on polyethylene using metal-aliphatic organic additives to assess their influence on molecular structure, crystallinity, thermal behavior, and mechanical integrity, as well as their role in promoting degradation. The impregnation process achieved additive sorption of ~0.06 g g^{-1} PE and reduced crystallite size from 7.05 nm to 6.12 nm. Time-resolved studies indicated that the presence of these additives induced molecular and mechanical changes consistent with accelerated oxidative degradation pathways. This dual functionality - structural modification and degradation facilitation - highlights the potential of scCO2 as a versatile processing platform for mitigating the environmental persistence of polyolefins.

Oral and poster presentations

Obiora Ebuka Muojama, The University of Alabama

Supercritical CO_2-Driven Surface Modification of Cellulose: Linking Additive Chemistry to Polymer-Fiber Interactions

Abstract
Supercritical carbon dioxide ($scCO_2$) impregnation (SCI) presents a sustainable and cost-effective strategy for functionalizing cellulose, the most abundant biopolymer on Earth. As a food-grade, non-toxic solvent with tunable properties, $scCO_2$ enables the delivery of hydrophobic additives into cellulosic substrates, offering a pathway to moisture-resistant materials without the need for multilayer plastics. Previous work demonstrated that SCI of ethyl oleate into cellulose achieved high additive uptake (>0.9 g g^{-1} at 110 °C, 120 bar, 10 min) and produced hydrophobic surfaces with contact angles approaching 120°. Notably, sorption of ethyl oleate into cellulose shifted the balance between intra- and inter-molecular hydrogen bonding, as shown by ATR-FTIR peak deconvolution. These findings indicate that SCI conditions and additive molecular structure can be leveraged to tailor macromolecular and surface properties of cellulosic materials. Building on this foundation, the present study evaluates the influence of aliphatic additive structure, including chain length, branching, and terminal functional groups (e.g., alkyl, hydroxyl, carbonyl) on SCI-modified cellulose. Saturated aliphatic compounds formed surface films that enhanced hydrophobicity (contact angle SCI-Cerotic ~ 125° and SCI-Stearic acid ~ 124°), while unsaturated analogs exhibited greater additive sorption but reduced surface hydrophobicity. To further probe structure-property relationships, dynamic vapor sorption and thermomechanical analysis were used to assess humidity uptake and swelling kinetics. These results reveal that additive architecture significantly affects both retention and responsiveness of SCI-treated cellulose. Collectively, this work demonstrates the utility of SCI and molecularly tailored additives to engineer moisture-resistant, stimuli-responsive cellulosic materials for advanced applications in smart packaging, controlled release systems, and environmentally adaptive technologies.

Oral and poster presentations

Abdur Raafey, University of Louisiana at Lafayette

Development of a Self-Healing Polyimide Coating Incorporating Inhibitor-Loaded Zn–Al LDH Nanocontainers for Corrosion Protection of Carbon Steel in Oil & Gas Environments

Abstract

Corrosion of steel pipelines and equipment in the oil and gas industry particularly in sour environments containing CO_2 and H_2S continues to be a major and ongoing issue. Traditional coatings often fail due to microcracks, physical damage, or adhesion loss under high temperatures and chemical exposure, resulting in continual deterioration and expensive upkeep. To tackle this, the research aims to create a smart, self-healing polymer coating that offers long-lasting, active protection to steel surfaces in harsh conditions. This system uses a high-temperature-resistant polyimide (PI) matrix embedded with Zn–Al layered double hydroxide (LDH) nanoparticles loaded with an imidazoline corrosion inhibitor. These LDH nanoparticles serve as nanocontainers, releasing the inhibitor when corrosion starts triggered by localized pH changes or the penetration of chloride or sulfide ions thereby forming a protective barrier that stops further corrosion. The study will focus on synthesizing and modifying the surface of the LDH–inhibitor particles, evenly dispersing them into the polyimide precursor, and developing a stable coating formulation. The goal is to produce a durable, thermally stable, and pH-responsive self-healing coating that significantly prolongs the lifespan of steel structures in oil and gas environments.

Poster presentation session

Abdullah bin Bahir, University of Louisiana at Lafayette

Fabrication of High Sensitivity Glucose Bio Sensor Based on Glucose oxidase Immobilization on Polyaniline/Graphene Oxide Nano scrolls and Carboxymethyl Chitosan

Abstract

Creating a flexible glucose biosensor designed for extreme environments like space missions, where microgravity disrupts body fluids and complicates health monitoring. Our sensor combines three smart materials: graphene nano scrolls (GONS) for efficient electron flow, conductive polyaniline (PANI) for bendable conductivity, and biocompatible carboxymethyl chitosan (CMC) to safely trap glucose-sensing enzymes. This trio solves the challenge of making devices that stay accurate while flexing with the body under harsh conditions. To build it, we first transformed graphene oxide into scrolls using liquid nitrogen freezing and freeze-drying, creating tubes that prevent graphene stacking and boost surface area by 300%. We then modified natural chitosan into CMC gel through chemical reactions to make it enzyme-friendly, and synthesized conductive PANI in an ice-cold bath to ensure optimal conductivity. These components were blended into a flexible film where enzymes were securely attached. Key results revealed a sponge-like structure full of nano-pores (perfect for enzyme loading), confirmed conductive PANI through its characteristic XRD peaks at 25.5° and FTIR bands at 1560/1476 cm^{-1}, and showed well-formed GONS with graphite-like XRD at 26.4° that enhance electron transfer. We concluded this material combination overcomes traditional trade-offs: GONS prevent clumping, PANI stays conductive when bent, and CMC keeps enzymes active. It's ideal for space-ready wearables needing minimal power and durability. By thoughtfully blending biology and electronics, we've created a trustworthy sensor platform for Earth and beyond, proving smart design beats single-material limitations for real-world health monitoring.

Poster presentation session

Hariharan Jayakumar, Louisiana State University

Versatility of modified universal calibration in gel permeation chromatography: Pushing the limits of the RI using precision bottlebrush polymers

Abstract

The universal calibration curve of synthetic polymers in gel permeation chromatography (GPC) is a long-sought-after research area, where studies have been able to predict various calibration parameters, of which Log[η]M was a notable contender due to its accuracy and emphasis on hydrodynamic volume. Over the past few decades, the need for absolute molecular weights and universal calibration for non-linear polymer architectures has made triple detector systems indispensable. This study aims to establish a correlation between relative molecular weights obtained from RI and absolute molecular weights from MALS detectors, thereby creating a universal calibration curve by refining the Mark-Houwink-Sakurada equation using precision bottlebrush polymers (Đ~1.0), which eliminates the need for triple detector GPC systems.

Susana Ferrufino, Xavier University of Louisiana

3D UV printing of polymeric ionic liquids with gold nanoparticle.

Abstract

Polymeric ionic liquids (PILs) are emerging as promising conductive materials for next-generation flexible electronics. However, their inherently low conductivity limits practical use. In this research, we introduce photocurable PIL-based resins designed for 3D ultraviolet printing, offering both improved conductivity and compatibility with modern additive manufacturing. Our formulations combine a synthesized imidazolium-based ionic liquid monomer and crosslinker with gold nanoparticle fillers to produce conductive, printable materials. Using these resins, we fabricated centimeter-scale structures, both free-standing and substrate-bonded, directly via commercial 3D printers. The resulting gold nanoparticle-embedded PIL structures achieved conductivity in the range of 10^{-4} S/cm.

Poster presentation session

Imogen Hoffman, Southern Methodist University

Visible Light 3D Printing of Polymeric Microneedles

Abstract

Readily available acrylate and alkene-functional monomers along with co-initiators and a photoredox catalyst (PRC) were used in a one-pot system to generate defined polymeric microneedle arrays. Although the acrylate-functional system had exclusively been applied to 3D printing and employed in various forms, our novel approach set out to utilize the photoresin system in concert with our Digital Light Processing (DLP) fluorescence microscope to generate microneedles. Trimethylolpropane triacrylate (TMPTA) served as the tri-functional acrylate ester to crosslink with co-monomer N,N-dimethylacrylamide (DMA). Rose Bengal played a dual role in photoinitiating the polymerization and subsequently participating in a catalytic cycle in reaction with co-initiators. Blue light exposure successfully facilitated photoresin activation, resulting in 3D patterned microneedle arrays that propagated in the z-direction with distinct feature quality. Notably, blue light exposure conditions directly correlated with microneedle growth. This interaction promoted overall dimensional control, which was achieved through variation of LED exposure of the polymer photoresin, with a direct relationship emerging between exposure time and needle length. Shape sizes within the projected patterns also afforded control over size and shape of the polymeric microneedle arrays. Complementary fluorescence studies revealed dye loading capacity within the microneedles. These results demonstrated achievable coating of the polymeric needles and subsequent release of dye to the surrounding media, with observable dependence on incubation time. The findings from this loading model provided evidence these microneedles could be successfully implemented in drug delivery systems.

Poster presentation session

Jordan Carden, Louisiana State University

Topological Design of Bottlebrush Polymer Surfactants with Machine Learning and Simulations

Abstract

Bottlebrush polymers (BBPs) are a unique class of polymers with a backbone and densely grafted side chains, resembling a bottlebrush or a comb. When used as surfactants, the grafted side chains contain both hydrophilic and hydrophobic groups, i.e. being amphiphilic. Bottlebrush polymer surfactants offer distinct advantages and properties, e.g. high surface activity, stability, and tunability. Leveraging these advantages requires the fundamental understanding of the relationship between BBP molecular architecture and interfacial properties. However, the topological diversity of BBPs hinders understanding, as traditional trial-and-error studies are costly and often limited by synthetic feasibility. Computational simulations are more efficient in exploring the large topological space. Moreover, the complicated relationship between the topology and interfacial properties can be captured by developing machine learning models. We constructed a dataset of over 500 topologies by varying backbone length, hydrophilic (PEO) and hydrophobic (PS) side-chain lengths, spatial arrangements, and side-chain length dispersion. Interfacial area coverage, radius of gyration (Rg), and radial distribution function (RDF) peak positions were calculated from coarse grained molecular dynamics for each architecture. Topologies were mapped to graphs with nodes encoding bead type (backbone, PEO, PS). Graph neural networks (GNNs) were trained to predict interfacial area, radius of gyration Rg, and RDF peak intensity. Cross-validated RMSEs were 763.5 ± 90.8, 0.461 ± 0.039, and 0.0841 ± 0.0090, respectively. To achieve inverse design with single and multiple properties, the GNN model was integrated with a CMA-ES optimizer. Topologies with targeted property values were successfully generated. Overall, our machine-learning-driven approach integrated with simulations accurately establishes the structure-property relationship, accelerating the target design of BBP surfactants

Poster presentation session

John Michels, University of Southern Mississippi

Understanding Degradation Pathways for Polybenzoxazines Through Aryl-Ether-Ketone Isomers

Abstract

Polybenzoxazines, a modernized phenol-formaldehyde for carbon-carbon applications, have gained growing research interest in recent years attributed to superior structural modularity without condensation during cure. Despite well-established literature describing molecular structure changes during cure for this class of polymer, the progression of mass-loss degradation during carbonization is not well understood. This work investigates isomeric aryl-ether-ketone polybenzoxazines incorporating targeted scission sites to elucidate the propensity of individual bond cleavage during pyrolysis. The use of simultaneous thermal analysis (STA) and mass spectroscopy (MS), degradation events and products are monitored, while the use of x-ray diffraction (XRD) visualizes the changes in carbon structure and graphitic crystallite development. The inclusion of degradative cross-linking mechanisms attributed to these isomers further connects how molecular design may be used to manipulate degradation through pyrolysis and ultimately influence carbon structure. Future research will develop additional data trends through adjacent isomer structures for other thermoset chemistries.

Poster presentation session

Christian Robert Dixon, The University of Southern Mississippi

Combining Thermomechanical and Structural Analysis to Probe Nanoconfinement Effects on CTE and Tg in PEKK Nanocomposites

Abstract

The coefficient of thermal expansion (CTE) in polymer nanocomposites is typically modeled using the rule of mixtures, which assumes additive contributions from the polymer matrix and filler based on their volume fractions. However, the assumptions of the rule of mixtures does not account for filler-matrix interactions, such as the local confinement of chain mobility near nanoparticles. In this study, a combined thermomechanical and structural approach is presented to directly measure the individual CTEs of an amorphous PEKK matrix and a graphitic nanoplatelet (GNP) filler. Using dynamic X-ray diffraction (XRD), thermal expansion of the matrix from the amorphous halo was independently characterized from the graphitic (002) reflection. Bulk CTE was then calculated from the rule of mixtures and compared to thermomechanical analysis (TMA) measurements. Deviations between measured and calculated bulk CTE at higher GNP loading levels suggest nanoconfinement influences thermomechanical properties beyond the assumptions of the rule of mixtures. To elucidate the influence of nanoconfinement on polymer chain mobility, glass transition temperature (Tg) was determined via dynamic XRD, TMA, and differential scanning calorimetry (DSC). Tg as measured by DSC was the highest, reflecting the thermodynamic transition without an external force. TMA yielded an intermediate value due to viscoelastic deformation under applied force, and XRD characterized Tg at the lowest temperature as atomic-scale mobility preceded long-range bulk transitions. For all analysis methods, Tg decreased with increasing filler content. This research demonstrated how filler-matrix interfacial interactions determine the thermal, mechanical, and structural behavior of amorphous PEKK/GNP, highlighting the limitations of conventional models that treat the composite as a simple mixture.

Poster presentation session

Shehbaz Ahmad, Tulane University

Carbon dioxide capture using PEI/MXene Composite

Abstract
Carbon dioxide is a major greenhouse gas whose atmospheric concentration has been shown to correlate strongly with global temperature rise since late 19th century. Thus, effective carbon dioxide mitigation technologies are essential. MXenes (Mn+1XnTx,), where M is a transition metal, X is C or N, and Tx represents terminal functional groups (e.g., F, O, OH), are novel 2D materials that have large surface areas and porous structures, and these properties make them promising materials for carbon dioxide capture. Amine chemistries have been used to capture carbon dioxide with excellent results. In this study, we combined the structural benefits of MXene with the amine chemistry for carbon dioxide capture. Polyethyleneimine (PEI) was added to MXene in different amounts (5-50 wt%) and analyzed using X-ray scattering (SAXS and WAXS). The d-spacing for the pure MXene was 1.20 nm and increased to 1.25 nm with the addition of 20 wt% PEI. Further loading of PEI to 50 wt% completely disrupted the MXene layered structure. The 20% sample was further characterized using scanning electron microscopy (SEM) to visualize the structure and thermogravimetric analysis (TGA) to measure carbon dioxide uptake. SEM images confirmed retention of the MXene layered structure after addition of 20 wt% PEI. TGA analysis showed the 20 wt% PEI loaded MXene sample captured more carbon dioxide (0.69 mmol/g) than pure MXene (0.05 mmol/g) and pure PEI (0.19 mmol/g). These results provide evidence that PEI/MXene composites may be effective materials for carbon dioxide capture.

Poster presentation session

William Bernfeld, Tulane University

Synthesis and characterization of bis-MPA dendrons for alternating linear-dendritic polymers

Abstract

Linear-dendritic polymers constitute a wide class of macromolecules whose tunable properties and self-assembly behavior have attracted significant interest due to their prospective applications in molecular encapsulation, theranostics, and drug delivery systems. Common linear-dendritic architectures involve dendrons with one reactive group at their focal point, which are used to end-functionalize linear macromonomers at one or both terminal groups, forming tadpole and dumbbell-shaped architectures. Alternating linear-dendritic (ALD) copolymers, however, are defined by repeating linear and dendritic regions along a singular chain. These structures consist of dendrons with two reactive groups at their focal point (A2) and linear monomers (B2), which are coupled in an A2, B2 step-growth polymerization. We aim to synthesize and characterize a dendritic monomer with a focal point containing two reactive alcohols in order to be used as a monomer for ALD copolymers. A third-generation dendron was synthesized using bis-MPA (2,2-bis(hydroxymethyl)propionic acid), a common building block in dendrimers and linear-dendritic polymers. The terminal alcohol groups of the dendron are protected with benzylidene acetals. However, these terminal groups can easily be deprotected in order to produce successive generations of bis-MPA dendrons while preserving the acetonide protecting group on the focal point. The dendron and its intermediates were synthesized and characterized via 1H NMR and MALDI-TOF MS. Future work entails deprotecting the acetonide focal point to form a dendritic monomer with two reactive alcohols and coupling with linear polymers via Williamson ether synthesis.

Poster presentation session

Kira Phillips, Loyola University of New Orleans

Post-Curing Effects on the Structural and Mechanical Behavior of 3D-Printed Shape Memory Polymers

Abstract

Shape memory polymers (SMPs) are rising as an optimal material for aerospace engineering due to their ability to deform and return to their original shape upon stimulus. SMPs also possess self-healing properties that enhance their ability to resist cracking under mechanical stress. A recent study by Li et al. introduced a recyclable and 3D-printable SMP, though the effects of post-curing with ultraviolet (UV) light remain underexplored. UV post-curing can be used to rapidly induce additional polymerization, potentially improving the mechanical performance of printed structures(2019). This project investigates the effects of UV post-curing on a 3D-printed smart polymer resin to determine the optimal exposure rate by analyzing changes in molecular structure and mechanical behavior. Post-curing increases crosslink density by forming covalent bonds between polymer chains, resulting in a stiffer, more rigid material, and enhancing strain rate and peak strain values during stress testing. Fourier Transform Infrared Spectroscopy (FTIR) supports these findings by showing a decrease in the C=C bond peak, indicating consumption of double bonds and successful photopolymerization. Further characterization methods such as Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), Dynamic Mechanical Analysis (DMA), and Scanning Electron Microscopy (SEM) will be used to validate these trends. However, excessive UV exposure may lead to brittleness or reduced elasticity, emphasizing the importance of optimizing post-curing conditions. Enhancing the mechanical performance of SMPs improves their self-healing behavior and resistance to failure in demanding environments.

Poster presentation session

Lavinia Palmer, Tulane University

Advancing PEG-based Hydrogel Design Through Thiol-yne Click Chemistry

Abstract

Hydrogels are three-dimensional polymeric materials composed of hydrophilic chains linked by covalent crosslinks, with network structure strongly influencing their mechanical and functional properties. Their high-water content and structural versatility make them useful for biomedical applications such as wound healing, tissue scaffolds, and drug delivery systems. While many synthetic methods for hydrogel fabrication have been developed, several remain insufficiently explored. Expanding these chemistries offers opportunities to tailor network structure and performance. This research explores the use of dithiol-yne click chemistry as a new route for the synthesis of poly(ethylene glycol) (PEG)-based hydrogels. The reaction involves a sequential thiol addition to alkynes, yielding disubstituted linkages that promote higher crosslink density and tunable network morphology. Hydrogels are prepared by reacting PEG chains of different molecular weights with various dithiol linkers under optimized conditions. Starting material synthesis is verified using NMR spectroscopy, Gel Permeation Chromatography (GPC), and Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry (MALDI-ToF MS). The resulting hydrogel structure and swelling behavior are characterized by Scanning Electron Microscopy (SEM) and water absorption analysis. The combination of biocompatibility, structural integrity, and chemical flexibility positions these PEG-based hydrogels as promising candidates for regenerative medicine applications.

Poster presentation session

Meen Sung Koo, Louisiana State University

Structural and Chemical Modification of Cellular Wood Composite for Enhanced Strength, Fire and Biological Resistance

Abstract

Wood is a renewable structural material but remains vulnerable to fire, decay, and termite attack. Industrial preservative systems, while effective, often rely on leachable or toxic compounds and offer limited improvement in structural performance. A sustainable approach combining chemical modification and physical processing is needed to achieve both durability and mechanical enhancement.Sequential modification through delignification, chemical impregnation, and densification can integrate flame-retardant and biological protection functions while reinforcing the wood structure. This strategy offers an eco-compatible pathway beyond conventional preservation techniques. Develop a delignified-densified wood impregnated with amino-functionalized polyglycerol phosphate (APGP) and disodium octaborate tetrahydrate (DOT). Integrate mechanical reinforcement, flame retardancy, and termite resistance through a dual-phase system of phosphorus-nitrogen char formation and borate barrier chemistry.

Ragab Abouzeid, Louisiana State University

Polyethyleneimine/Phytic Acid/Halloysite Nanoclay Hybrid for Enhanced Flame Retardancy in Wood Materials

Abstract

Wood is a renewable and versatile material, but its flammability and moisture sensitivity limit its use in advanced construction. Developing eco-friendly flame-retardant treatments is essential to enhance wood's safety, durability, and performance without compromising sustainability. To develop a multifunctional wood composite by integrating polyethyleneimine (PEI), phytic acid (PA), and halloysite nanoclay (HNC) into delignified and densified wood, aiming to simultaneously enhance flame retardancy, mechanical strength, and moisture resistance for sustainable construction applications.

Poster presentation session

Jonathan Mason, University of South Alabama

Environmentally Resistant Two-Step Polydopamine/Glucosamine Antifouling Surface Modification of Poly(vinylidene fluoride) Microfiltration Membranes

Abstract

The increasing scarcity of freshwater due to climate change and rapid population growth has intensified the demand for efficient wastewater treatment. Membrane microfiltration represents a promising approach for large-scale wastewater treatment owing to its high purification efficiency, operational simplicity, and recyclability. However, the intrinsic hydrophobicity of polymeric membranes such as poly(vinylidene fluoride) (PVDF) promotes foulant adsorption and pore blockage, leading to severe flux decline and reduced lifespan. To overcome these limitations, we developed bioinspired hydrophilic coatings based on polydopamine (PDA) and glucosamine (Gluc) to enhance the antifouling properties of PVDF microfiltration membranes. The PDA layer was first deposited on the membrane surface, followed by glucosamine grafting to form a stable PDA/Gluc composite coating. The surface of the modified membranes was characterized by Fourier-transform infrared spectroscopy (FT-IR) and atomic force microscopy (AFM). AFM analysis confirmed increased surface roughness after PDA and PDA/Gluc deposition. Filtration tests using pure water and bovine serum albumin (BSA) solutions demonstrated that glucosamine grafting significantly improved water and BSA fluxes compared to uncoated and PDA-coated PVDF membranes. Glucosamine grafting also reduced BSA adsorption compared to unmodified PVDF membranes. The PDA/Gluc-modified membranes maintained high hydrophilicity and antifouling performance over multiple filtration cycles, indicating robust coating stability. This facile and environmentally friendly surface modification strategy offers a scalable route to improve the hydrophilicity and fouling resistance of polymeric membranes for sustainable water treatment applications.

Poster presentation session

Alexandra Aucoin, Louisiana State University

Investigating Fluid Flows Produced by Frontal Polymerization in Thin Layer Acrylate Coatings via Particle Imaging

Abstract

Coatings are essential for most materials, providing benefits such as protection, waterproofing, and corrosion resistance. Thin-layer acrylate coatings are typically used in various applications due to their versatility, rapid curing rate, and ability to be applied in thin layers. Frontal polymerization (FP) of thin-layer acrylates creates cure-on-demand coatings with long pot lives, which prevents the need for additional cure times, extensive mixing, and the release of volatile organic compounds (VOCs). FP is an innovative type of polymerization reaction that occurs in a localized, self-propagating manner in the form of a “front” that moves across the material. This process occurs when a polymerization reaction is initiated at a specific point (most often by a heat source) and then spreads outward through the material. The front continues to propagate through the liquid monomer solution, leaving polymer in its wake. In frontal polymerization, fluid flows are primarily produced due to the significant temperature gradients generated by the rapidly propagating exothermic reaction front. This can significantly impact front dynamics, often distorting the front shape, altering front velocity, and inducing instabilities. Particle imaging is used to investigate fluid flows produced by FP in thin-layer acrylate coatings. Particle imaging is a non-destructive imaging technique that utilizes fluorescent tracer particles to track fluid flow. Using this method allows for a better understanding of FP’s nonlinear dynamics in thin-layer coating applications.

Poster presentation session

Josie Callahan-Santo, University of Southern Mississippi

Inhibiting Biofilm Formation on Polymer Substrates via Bacteriophages in Flow Cells

Abstract

Medical devices and implants are prone to the accumulation of bacterial biofilms on their polymeric surfaces, leading to a vast range of costly infections. Bacterial viruses (or bacteriophages) have been utilized to treat or prevent associated bacterial infections. Bacteriophages have an advantage over antibiotics in combating infections due to their highly selective nature towards their bacterial hosts, their ability to evolve alongside bacteria, and their benign impact on humans. The project aim is to study the efficacy of Φ11 bacteriophages covalently attached to polymer surfaces in preventing the formation of Staphylococcus aureus (S. aureus) biofilms in dynamic flow conditions. Medical grade polypropylene (PP) and ultra-high molecular weight polyethylene (PE) substrates are modified via plasma reaction in the presence of maleic anhydride, followed by the covalent attachment of Φ11 bacteriophages. The modified polymer substrates are characterized via infrared spectroscopy to confirm successful surface modification. PE and maleic acid modified PE substrates are introduced to S. aureus via a flow cell device under dynamic flow conditions, simulating the in vivo conditions that medical implants experience. Optical density measurements and crystal violet staining are used to quantify biofilm growth on the polymer substrates. Results demonstrate that PE and maleic anhydride modified PE substrates do not inhibit S. aureus biofilm formation in the flow cell and establish future methods to quantify biofilm formation on bacteriophage-modified polymer substrates in dynamic flow conditions.

Poster presentation session

Jian Zheng, University of Southern Mississippi

Pyrolysis and Pore Formation of Crosslinked Polystyrene-block-polybutadiene-block-polystyrene for Ordered Mesoporous Carbon Synthesis

Abstract

Thermoplastic elastomers (TPEs) have recently attracted attention as low-cost precursors for ordered mesoporous carbons (OMCs). However, the pyrolysis behavior of crosslinked TPEs remains insufficiently understood. In this work, we studied the thermal decomposition and pore formation of sulfonated polystyrene-block-polybutadiene-block-polystyrene (SBS) using thermogravimetric analysis coupled with mass spectrometry (TGA-MS) and nitrogen physisorption. The results reveal a multi-step decomposition process accompanied by the evolution of distinct volatile species and the gradual development of mesoporosity with increasing temperature. Kinetic analysis further indicates that bond cleavage within aromatic and unsaturated structures requires high activation energies. These insights help clarify how crosslinked TPEs transform into OMCs and provide guidance for optimizing pyrolysis conditions of porous carbon materials.

Jeff Aguinaga, University of Southern Mississippi

Degradable aromatic polyester thermosets with high fracture toughness from epoxy and amine components

Abstract

Structure-property relationships of of several closely related polyester thermosets derived from ester-containing diepoxide and ester-containing diamine monomers. Substitution pattern and inter-ester spacer length varied. Thermal, thermomechnical, ambient temp. mechanical properties of polyester thermosets compared to one another and to conventional aromatic diepoxide-diamine systems. Degradability via ethylene glycolysis among the polyesters compared.

Poster presentation session

Alejandro Ramirez, Louisiana State University

Tuning Glass Transition with Precision: Discrete Macromonomers as Polymer Building Blocks

Abstract

Discrete bifunctional macromonomers provide molecular-level control over the glass transition temperature (Tg). Glassy macromonomers show relatively high Tg values, while rubbery counterparts exhibit lower Tg. Bifunctional macromonomers that integrate both glassy and rubbery segments can display either a single intermediate Tg or broadened transitions, thereby encoding diblock-like thermal contrast within a single sidechain. This sidechain-based strategy establishes an architectural motif distinct from conventional diblock copolymers and demonstrates how discretization enables the predictable placement of thermal domains. These results highlight discrete macromonomers as precision building blocks for designing bottlebrush polymers and related architectures with tunable glassy-rubbery balance.

William H. Hotaling, Tulane University

Biopolymer Stability Investigations Using Membrane Mediated Dialysis

Abstract

Utilizing Spectroscopic monitoring and a recently developed in-cuvette dialysis technique, stability and thermodynamics of Nucleic Acids are investigated to address: i.) how ionic, denaturant, and thermal environments influence the stability and reversibility of DNA and RNA, and ii.) the use of in-cuvette dialysis techniques to assist in generating energetic molecules. Ongoing research is also presented to address iii.) how RNA homopolymers can isolate base-specific contributions to nucleic acid stability.

Poster presentation session

Olumide Alonge, Tulane University

Synthesis of Linear-Dendritic Alternating Copolymer via Williamson Coupling Reaction

Abstract

Linear-dendritic polymers have been extensively researched due to their widespread applications in the fields of drug delivery and biomedical imaging. Their applications have also been seen in catalysis, environmental purification, and tissue engineering. However, there have only been a few studies on linear-dendritic alternating copolymers, which have amphiphilic properties resulting from equal spacing between the alternating linear polymers and dendrons. In addition, a polarity switch between the dendrons and linear polymers promotes self-assembly, resulting in the intramolecular formation of spherical micelles, followed by an intermolecular packing to form nanorods in water or organic solvents (e.g., hexane). Here, we report the synthesis of a first-generation dendron via fluoride-promoted esterification between acetonide-protected BisMPA and benzylidene-protected trimethylol ethane. This was followed by the step-growth synthesis of linear-dendritic alternating copolymers involving the polymerization of the di-hydroxy groups of the first-generation dendron with polyethylene glycol (PEG) dimesylate in a 1:1 ratio to obtain high molecular weight. Structural elucidation was confirmed using nuclear magnetic resonance spectroscopy (NMR), size exclusion chromatography (SEC), and matrix-assisted laser desorption/ionization time of flight mass spectrometry (MALDI-ToF MS). The unique self-assembly behavior and nanorod morphology of these linear-dendritic alternating copolymers further enhance their applications for biomedicals, sensors, and electronics.

Poster presentation session

Windfield Swetman, University of Southern Mississippi

Harnessing Supramolecular Polymers to Engineer Tunable Targeted Protein Degrader

Abstract

Neurodegenerative diseases currently have limited clinical treatment options due to the nature of the misfolded proteins implicated in their progression. Recent advances in targeted protein degradation (TPD) strategies have shown promise in selectively degrading intracellular "undruggable" proteins of interest, but these strategies have faced challenges in cellular internalization, effective targeting, and widespread applicability. Macromolecular approaches to TPD may be leveraged to address these issues, utilizing multivalent polymers with dynamic linker designs to push past the current limitations of this field. The focus of this work is inducing the TPD of a specific "undruggable" protein, α-Synuclein, which is implicated in the progressions of a family of neurodegenerative diseases called synucleinopathies. We are investigating α-Synuclein-targeting TPD-inducing supramolecular polymers utilizing bioactive peptide-based monomers. These monomers are designed to self-assemble into high aspect ratio polymeric nanofibers in aqueous solutions with bioactive epitopes presented on the surface of the polymers in tunable stoichiometries and densities. Copolymerization of these monomers allows for the simultaneous targeting of the protein of interest, α-Synuclein, and cellular machinery responsible for transport into the natural protein degradation pathway chaperone-mediated autophagy (CMA). Material characterizations such as transmission electron microscopy and circular dichroism were employed to confirm the formation of expected nanostructures. Following this, in vitro characterizations were completed to assess the viability, internalization, and TPD efficacy of the polymers. By deepening our understanding of the interplay between macromolecular chemistry and TPD, we can establish a robust framework for the effective targeting of a diverse range of therapeutic objectives.

Poster presentation session

Madeline McHugh, Tulane University

Synthesis of Branched Poly(ethylene brassylate) as a Biodegradable Alternative to Polyethylene

Abstract

Ethylene brassylate is a macrolactone derived from castor oil that serves as a renewable, non-toxic, and cost-effective monomer ($30/kg) for the synthesis of biodegradable polyesters. In this work, branched poly(ethylene brassylate) (b-PEB) with various degrees of branching were synthesized to mimic the structure of low-density polyethylene (LDPE) and high-density polyethylene (HDPE) both of which are non-biodegradable. b-PEB was synthesized via the ring-opening polymerization of ethylene brassylate using 1,1,1-tris(hydroxymethyl)ethane (TME) as a monomer and 5,7-triazabicyclo[4.4.0]dec-5-ene (TBD) as a catalyst. Varying the TME equivalents allowed control over the degree of branching which was determined via proton nuclear magnetic resonance (1H-NMR). The major product, b-PEB, was successfully obtained, while minor products including linear poly(ethylene brassylate) (l-PEB) and cyclic poly(ethylene brassylate) (c-PEB) were also identified using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-ToF MS). Molecular weights of 13, 6.2, 4.3, and 3.3 kDa were determined through gel permeation chromatography (GPC).

Poster presentation session

Sarah Crowsey, University of Southern Mississippi

Utilizing Polymers with Arginine Mimetic Guanidinium Groups as an Environmentally Friendly Pest Control Method

Abstract

Targeted pest control through RNA interference offers a species-specific strategy for combating agricultural pests by silencing key insect genes. The success of this approach relies on efficient delivery of interfering RNA molecules into pest cells. Cationic polymers are particularly suited for this purpose, as they are able to electrostatically associate with nucleic acids to form polyplexes that protect RNA and enable cellular uptake. The aim of this research is to develop a small polymeric library derived from homopolymers and copolymers of 3-guanidinopropyl methacrylamide (GPMA), a monomer of interest due to its arginine mimetic guanidinium group. By systematically varying polymer size, charge, and hydrophilicity, we will examine how these factors affect nucleic acid complexation and delivery efficiency. The fall armyworm (Spodoptera frugiperda) will serve as a model organism for assessing the gene knockdown efficacy of the resulting RNA-polymer complexes, providing insight into the structure-property relationships that influence effective nucleic acid delivery for agricultural pest control.

Poster presentation session

Md Abdullah Al Mahmud, Louisiana State University

A novel approach to cure-on-demand coatings using ammonia to catalyze thiol-acrylate and thiol-epoxy reactions

Abstract

Cure-on-demand thiol-acrylate and thiol-epoxy coatings have been developed using ammonia as a catalyst, following a step-growth polymerization process. Two sources of ammonia were employed: a commercially available 30% aqueous solution and the urea-urease clock reaction. This innovative technique leverages the urea-urease clock reaction to produce in situ ammonia and delaying the reaction to cover the reaction surface with aluminum foil otherwise the highly volatile and diffusive ammonia gas must be evaporated from the reaction surface. This approach proved advantageous over the direct use of ammonia. While the cure time for thiol-acrylate coatings was faster, their mechanical strength was weaker compared to that of thiol-epoxy coatings. A key challenge was overcome in this work was stabilizing the pot lives of the formulations before initiating the curing reactions.

Poster presentation session

Sheila Njoroge, Louisiana State University

Ring Opening Alkyne Metathesis Polymerization (ROAMP) of Conjugated Strained Nanohoops

Abstract

Alkyne metathesis has experienced significant growth in the number of efficient catalysts over the last three decades and the reaction has found broad applications in the synthesis of polymers, natural products, and supramolecular materials. Ring-opening and ring-expansion alkyne metathesis polymerization (ROAMP & REAMP, respectively) have garnered attention in recent years. Strained alkynes, or carbon-carbon triple bonds that are forcibly withheld from achieving ideal linear geometry, can undergo metathesis to form large linear or cyclic fully conjugated polymers. Conjugated polymers are essential building blocks for organic electronics such as OLEDs and chemical sensors. Herein, we demonstrate the development of cycloparaphenyleneacetylene (CPPA) carbon nanohoops as monomers and a family of Molybdenum alkylidynes as initiators for ROAMP. The goal is to develop a catalyst/nanohoop system that allows for the preparation of conjugated polymers with low polydispersity under chain growth/living conditions.

Poster presentation session

Ethan Rose, University of Southern Mississippi

Sterically Congested, Citric-Acid-Derived Epoxy-Amine Thermosets: Synthesis, Thermomechanical Properties, and Free Hole Volume Study

Abstract
Citric acid is an underutilized building block replacing petroleum-based feedstocks used to synthesize epoxy monomers. Herein, we explore a series of sterically congested, bio-based epoxy amine networks based on octahydro-2,5-pentalene diol (OPD) – an aliphatic bicyclic building block derived from citric acid. A library of bifunctional epoxy monomers was synthesized from OPD variants and cured with isophorone diamine. The trends in the thermomechanical performance and free hole volume of the resulting networks were elucidated. This work expands the scope of bio-derived monomers for epoxy-amine thermosets and will provide opportunities to explore renewable systems to address sustainability challenges.

Poster presentation session

Nadish Tharindu Galwadu Acharige, Louisiana State University

Thermally Responsive Polymers-Grafted Nanoparticles for Biomimetic Repair of Microcracks

Abstract

Inspired by the biological blood clotting process, we are developing polymer-functionalized silica nanoparticles intended for injection into microcracks sustained by impact. This injection involves field-driven (electric or magnetic) assembly followed by in situ crosslinking of the grafted polymer, creating a synthetic "clot". These particles will be grafted with a binary polymer complex. One polymer is intended to undergo a controlled lower critical solution temperature (LCST) thermal transition with increasing temperature, resulting in physical crosslinking, while the second polymer carries reactive Diels-Alder end groups intended to give rise to covalent crosslinking. The LCST polymer will have longer chain lengths relative to the second polymer to provide steric shielding of the reactive chain ends and thus inhibit covalent crosslinking of the particles at ambient temperature and low particle concentration. This presentation will focus on the synthesis of these polymer-functionalized particles using both grafting-from and grafting-to approaches and on their characterization by nuclear magnetic resonance (NMR), thermogravimetric analysis (TGA), Fourier transform infrared (FTIR) spectroscopy, and dynamic light scattering (DLS) to confirm successful grafting, quantify polymer loading, and evaluate colloidal stability and assembly behaviour under activation conditions.

Poster presentation session

Arianna Chisum, Tulane University

Design & Synthesis of High Density Thioether Dendrimers via Thiol-yne Click Chemistry

Abstract

Dendrimers are a specific class of branched polymers that are unique in the fact that they have an exact molecular weight and traditionally exist as a single molecular species, a characteristic known as monodispersity. Due to their globular structure, the physical and material characteristics of dendrimers are predominately dictated by the functional groups located on the periphery. In designing functional dendrimers, achieving a high density of surface groups alongside a low molecular weight is advantageous, as it enhances the potential charge density and functional group availability per molecule. In any given generation, the number of surface functionalities corresponds to the product of available coupling sites and the number of functional groups introduced per monomer and is referred to the branching motif. Most often a 1→2 branching motif is employed where the core is reacted with monomers bearing two deactivated functional groups which will later be reactivated to continue growth resulting in double the amount of coupling sites available relative to the previous generation. We have begun to synthesize a new family of thioether dendrimers which exhibit 1→6 branching motifs enabled by a novel tri-hydroxy thiol monomer in conjunction with thiol-yne click chemistry that permits the addition of two monomer units per alkyne. This study aims to further explore potential applications of dendrimers and to investigate the relationship between functionalization density via different monomers and cores, mainly focusing on dielectric properties.

Sponsors

Tulane University

Department of Physics & Engineering Physics

CBE

LOUISIANA SECTION ~ NEW ORLEANS ~

1906

AMERICAN CHEMICAL SOCIETY

TULANE

School of Science

& Engineering

Insperity®

HR that Makes a Difference®

TULANE UNIVERSITY

School of Science

& Engineering

Chemistry

Pojman Polymer Products

SolsticeDynamics.com