



7<sup>th</sup> Annual Applied Polymer Technology

Extension Consortium Symposium

Polymer Science Beyond the Academic Realm

Louisiana State University

Baton Rouge, LA

November 2, 2019



Hosted by LSU Cain Department of Chemical Engineering  
and Chemical Engineering Graduate Student Association



College of  
Engineering  
Cain Department of  
Chemical Engineering

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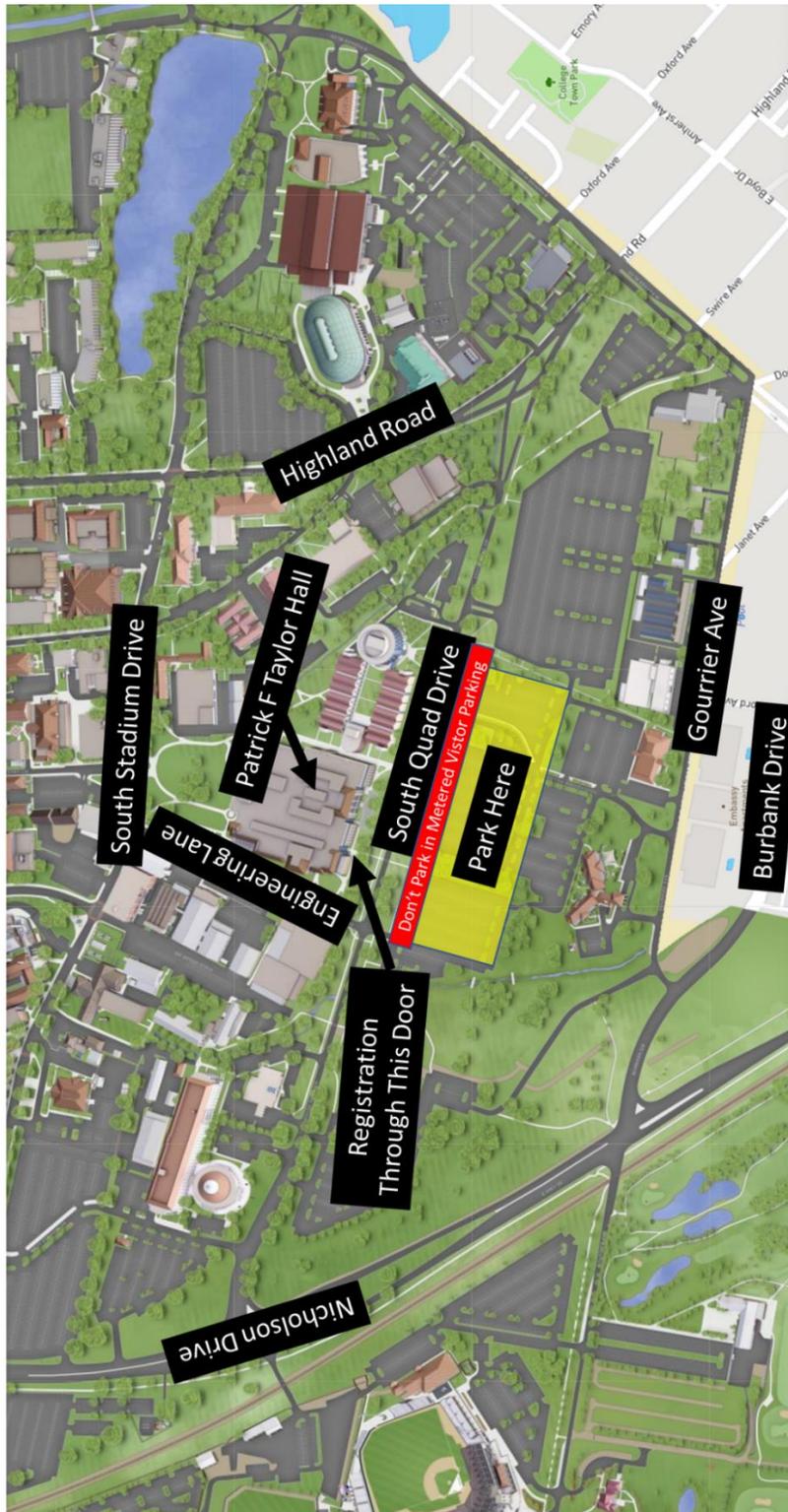
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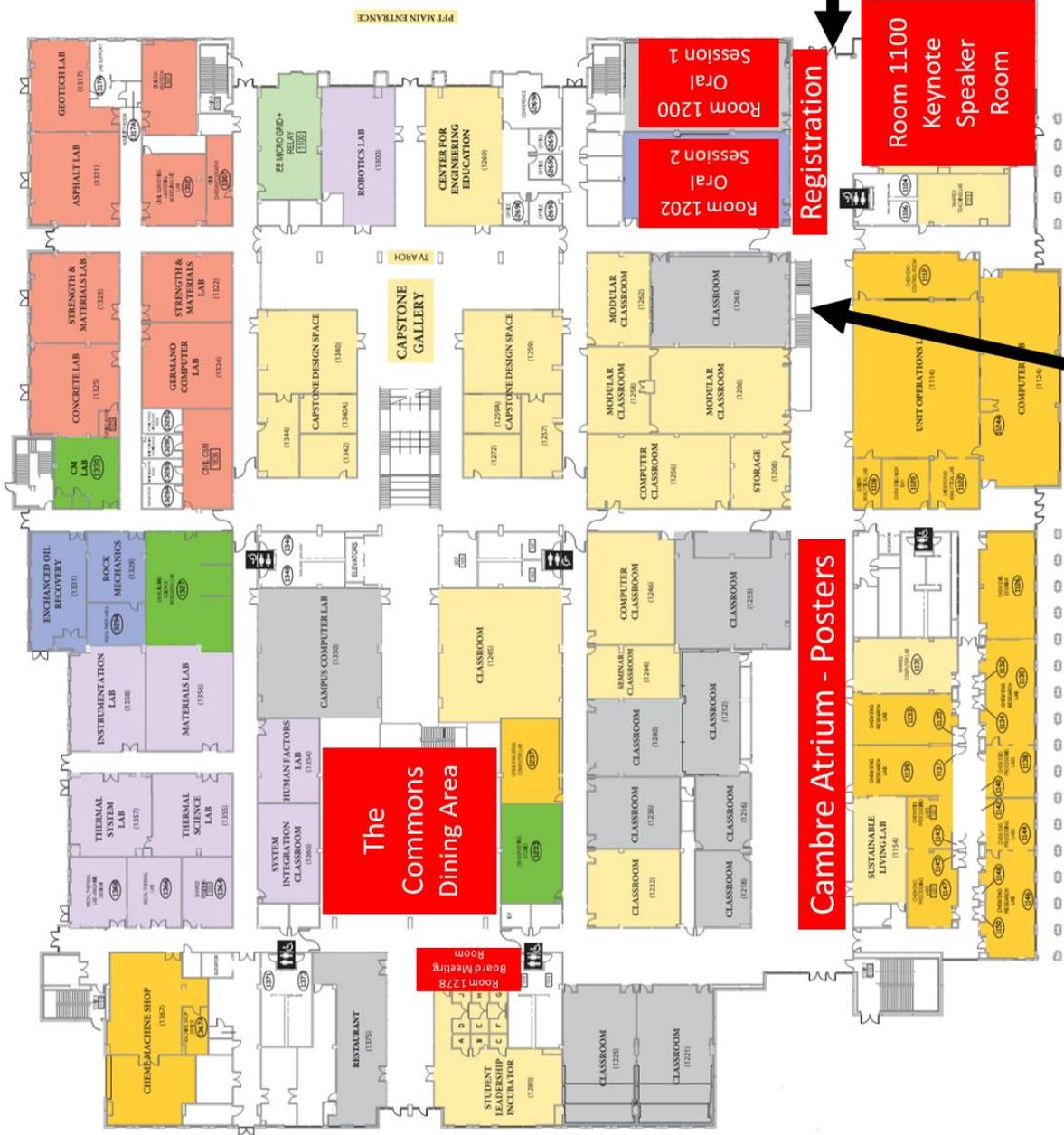
# Where Do I Park?:



# Patrick F. Taylor Hall Building Map:

Parking Lot

Enter Building  
Through This Door



Stairs to Networking Reception – PFT 3134

## Symposium Schedule:

Registration	<i>PFT 1100 Foyer</i>	8:00 a.m. – 12:00 p.m.
Poster Setup	<i>Cambre Atrium</i>	8:00 a.m. – 9:00 a.m.
Breakfast	<i>The Commons</i>	8:00 a.m. – 9:00 a.m.
Opening Remarks	<i>PFT 1100</i>	9:10 a.m. – 9:20 a.m.
Keynote Speaker: Young-hye Na (IBM) <i>“Functional Materials for Sustainable Water and Energy Applications”</i>	<i>PFT 1100</i>	9:20 a.m. – 10:00 a.m.
Oral Presentations Session 1 <i>Moderator: Matthew Jordan</i> 1. <i>Amit Jain</i> 2. <i>Oluwapelumi Kareem</i> 3. <i>Tianyi Yu</i> 4. <i>Joshua Tropp</i> 5. <i>David Siefker</i>	<i>PFT 1200</i>	10:10 a.m. – 11:50 a.m.
Oral Presentations Session 2 <i>Moderator: Deepra Bhattacharya</i> 1. <i>Samuel Bliesner</i> 2. <i>Julia Siqueira</i> 3. <i>Indika Chandrasiri</i> 4. <i>Jeehye Kim</i> 5. <i>Tharindu Ranathunge</i>	<i>PFT 1202</i>	10:10 a.m. – 11:50 a.m.
Keynote Speaker: Mike Yandrasits (3M) <i>“Proton Conducting Fluoropolymers for Hydrogen Fuel Cells”</i>	<i>PFT 1100</i>	12:00 a.m. – 12:40 p.m.
Lunch	<i>The Commons</i>	12:40 p.m. – 1:40 p.m.
Poster Presentations	<i>Cambre Atrium</i>	1:45 p.m. – 2:45 p.m.
Keynote Speaker: Dave A. Clemons (BASF) <i>“Polymers, They’re All Around Us”</i>	<i>PFT 1100</i>	2:55 p.m. – 3:35 p.m.
Networking Social Reception *Announcement of Presentation Awards*	<i>PFT 3134</i>	3:35 p.m. – 5:35 p.m.
APTEC Board Meeting	<i>PFT 1278</i>	3:35 p.m. – 4:35 p.m.

# **Conference Menu**

## **Breakfast**

Scrambled Eggs  
Cheese Grits  
Hash browns  
Biscuits  
Scones  
Coffee

## **Lunch**

### Entrées

Jambalaya with Sausage & Chicken  
Chicken Alfredo over Penne Pasta  
Red Beans/Sausage & Side Pan of Rice  
Crawfish Etouffee with side pan of rice  
Ricotta Cheese Stuffed Shells in Marinara (vegetarian option)

### Side Dishes

Potato Salad  
Macaroni & Cheese  
Spinach & Artichoke Dip

### Dessert

Crème Cake Tray  
Bread Pudding

Sweet tea, Lemonade, Water

## **Networking Social Reception**

Ultra, Bud Light, Red & White Wine  
Bacon Wrapped Chicken  
Boudin Eggrolls  
Chicken Fingers  
Brownies  
Mississippi Mud Pie

## **Abstracts for Oral Presentations:**

Session 1 in PFT 1200:

### **Selective removal of target ionic contaminants from water using electrosorption**

*Amit Jain, Rice University*

Capacitive deionization (CDI) is an energy-efficient water treatment technology that removes ionic contaminants from water by utilizing electric potential between two porous carbon electrodes. Currently, industrial application of CDI is limited to the desalination of low salinity waters due to its nature of not being able to remove toxic ionic contaminants selectively. In this work we are developing a selective CDI approach to selectively remove ionic contaminants such as scale forming divalent ions, heavy metals other harmful ions. Divalent ions such as calcium and sulfonates, cause scale deposition problems for various industrial operations such as membrane-based desalination systems, oil and gas exploration systems, heat exchangers etc. Similarly, various heavy metals ( $\text{Cu}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Hg}^{2+}$  etc.) and other toxic contaminants (Arsenic, Nitrates, Chromium etc.) needs to be removed from various source water for drinking water and waste water treatment and reuse applications. Activated carbon based porous electrodes were prepared using a scalable flow coating technique followed by the deposition of ion-exchange layer on the top of the as prepared electrode. Ion-exchange functional groups are incorporated in these ion-exchange coating layers which leads to enhanced desalination performance as well as imparts selectivity towards the removal of the desired contaminants. Our proof of the concept experiments demonstrates good removal selectivity for  $\text{Ca}^{2+}/\text{Na}^{+}$  and  $\text{SO}_4^{2-}/\text{Cl}^{-}$ .

### **Analyzing the effect of solvent quality on the solution size of linear and dendrimer analogues**

*Oluwapelumi Kareem, Tulane University*

Dendrimers are multi-functional, monodisperse, spherical molecules with high structural fidelity. They are made up of a series of branched polymeric arms that emanate from a central core leading to many end groups at the dendrimer's periphery. These peripheral end groups form what is referred to as the "outer shell". This outer shell represents the primary interface between the dendrimer and solvent, therefore, changes in surface functionalization can have a significant impact on the solvent compatibility of these polymers. Though the impact of solvent quality on the solution size of various linear polymers has been explored in detail, solvent effects on dendritic molecules has not been explored to the same extent. Due to their "spherical" nature, it is assumed that the relative size of a dendrimer does not change greatly between solvents as opposed to linear polymers. This may be due to the inability of the branched arms to significantly expand or collapse relative to the core (comparative to linear polymers), especially at higher generations. It is expected that a linear polymer of an equivalent molecular weight would have a greater degree of size change relative to the quality of the solvent due to its innate flexibility and access to a wide range of conformations.

## **Investigation of amphiphilic polypeptoid-functionalized halloysites nanotubes as stabilizer towards oil spill remediation**

*Tianyi Yu, Louisiana State University*

In this contribution, we designed a novel biopolymer-functionalized clay nanoparticles as a class of environmentally benign emulsion stabilizers for oil spill remediation application. We investigated the functionalization of halloysite nanotubes (HNTs), a class of naturally abundant clay nanoparticles, with amphiphilic polypeptoids, an emerging class of biocompatible and biodegradable polymers. The hydrophilic-lipophilic balance (HLB) characteristic of the grafted polymers can be systematically controlled by the ratio of the hydrophilic and hydrophobic NCA monomers used in the polymerization, thus allowing the surface wettability of the HNT particles to be systematically adjusted. We assessed the performance of polypeptoid-functionalized HNTs (g-HNTs) as stabilizers for oil-in-artificial sea water (ASW) emulsions and it was found that the peptoid functionalized halloysites can stabilize the oil-in-ASW emulsion to varying extent, which is strongly dependent on the HLB characteristic of the grafted polypeptoids. Characterization of the emulsion index and the size of oil droplets in emulsion over time has revealed that the functionalized HNTs having relatively high hydrophobic content (HLB = 12.0-15.0) afforded the most stable oil-in-water emulsions containing the smallest oil droplet sizes. This has been attributed to the augmented interfacial activities of polypeptoid-functionalized HNTs, enhancement of thermodynamic propensity of the HNT particles to partition at the oil-water interface and increased emulsion viscosity relative to the pristine HNTs. In addition, cell culture studies have revealed the g-HNTs affect the bacterial growth profile with notably more cell proliferation towards *Alcanivorax Borkumensis*, a dominant alkane degrading bacterium found in the ocean after oil spill.

## **Detection and discrimination of seawater pollutants using conjugated polymers**

*Joshua Tropp, University of Southern Mississippi*

This project outlines the design of a four-year collaborative enterprise to design new sensing technologies for deployment in the marine environment for detection of pollutants (phosphates, polycyclic aromatic hydrocarbons (PAHs), and heavy metals). New modular receptor-analyte interactions capable of transducing an analyte-binding event into a useable signal were designed and evaluated. The reported approaches span a wide range of disciplines including synthetic chemistry, polymer science, analytical chemistry, and statistics. Modular synthetic approaches, thiol-ene click chemistry, linear discriminant analysis, and the inner filter effect were leveraged to detect marine pollutants using conjugated polymer-based sensors. Inorganic phosphate was detected at parts-per-billion concentrations ( $\pm 6$  nM) in seawater conditions, a mixture of 16 PAHs was detected and discriminated, and a complex mixture of heavy metals was detected and discriminated in aqueous solution at parts-per-billion concentrations. The comprehensive set of approaches outlined should offer valuable insight toward future sensing technologies utilizing conjugated polymers.

# **Suppressing Termination Events in the Ring-Opening Polymerizations of Amino-Acid Derived N-thiocarboxyanhydrides towards Well-defined Polypeptides**

*David Siefker, Louisiana State University*

Amino acid-derived N-thiocarboxyanhydrides (NTAs) are attractive substrates for polymerization to access polypeptides due to their enhanced thermal and hydrolytic stability relative to the N-carboxyanhydride (NCAs) counterparts. However, in contrast to NCAs, polymerizations of NTAs are challenging. Early reports on the polymerization of NTAs all resulted in low conversion regardless of the monomer structures. Previously, we reported a controlled polymerization of NTAs that proceed by normal amine mechanism (NAM) can be achieved by accelerating the release of carbonyl sulfide (COS) thus suppressing termination events (i.e., isocyanate formation by the release of hydrogen sulfide) in low polarity solvent (e.g., hexanes or heptane). The use of low polarity solvent results in heterogeneous reactions where both the monomer and polymer products have limited solubility resulting in molecular weight broadening due to the restricted access to the growing chain ends. Recently, I demonstrated the potential to synthesize polypeptides with controlled molecular weights and narrow molecular weight distribution ( $PDI < 1.1$ ) in a homogenous solution using a polar solvent (i.e.  $CH_2Cl_2$ ) at room temperature with the incorporation of a weak organic acid (e.g., acetic acid) in conjunction with a primary amine initiator. The weak acid is proposed to promote the polymerization of NTAs by accelerating the elimination of COS from the carbamate propagating intermediate to form the active amino propagating species and reducing side reactions by modulating the relative abundance of the active amino propagating species via acid-base equilibrium.

Session 2 in PFT 1202:

## **Solvent Vapor Annealing to Control Crystal Morphology in Polymer Thin Films**

*Samuel Bliesner, Tulane University*

Poly( $\epsilon$ -caprolactone) (PCL) is a semicrystalline, biodegradable polyester that has found applications in biomedical engineering, with it being extensively used in tissue scaffolding and as a drug delivery medium. However, researchers in the packaging industry have expanded its utility by exploiting its biodegradability for sustainable packaging materials. Degree of crystallinity, crystal morphology, and crystallite size are known to affect the rates of enzymatic degradation of PCL fibers and films, so morphological control is important to designing PCL coatings and films for its growing applications. Inspired by the literature related to solvent vapor annealing (SVA) in block copolymer films and solvent-induced crystallization in semicrystalline polymers, we are studying how SVA treatments impact crystal morphology. Using a suite of morphological characterization techniques, including atomic force microscopy and optical morphology, we investigate the roles both solvent choice and extent of film swelling play in the treated film morphology. Additionally, we utilize in-situ grazing incidence wide-angle X-ray scattering to determine when/if polymer crystals dissolve during solvent uptake and at what solvent concentrations recrystallization occurs during solvent removal.

## **Towards tailor-made automatically controlled compositional gradient copolymers**

*Julia Siqueira, Tulane University*

The technique called Automatic Continuous Online Monitoring of Polymerization Reactions (ACOMP) allows real time monitoring and control of key parameters of a polymer synthesis. ACOMP is the ideal process control system platform to continuously feed data into a closed loop feedback controller to produce polymers of desired specifications, such as fixed molecular weight and copolymer composition. Because the ACOMP system provides continuous, direct, real time measurements of molecular weight, monomer concentrations, and compositions a controller was developed to operate without recourse to a detailed kinetic model or reactivity ratios, making it theoretically suitable to any system. Copolymers of acrylamide (Am) and sodium styrene sulfonate (NaSS) were obtained following different trajectories for both molecular weight and composition by free radical polymerization in aqueous medium. This talk focuses on previous successful work using this controller and presents the next steps towards tailor-made compositional gradient copolymers. Through coupling with reversible addition-fragmentation chain-transfer polymerization (RAFT), changes in monomer concentration in the reactor led by the controller are directly reflected on each individual macromolecule, allowing for tailoring the gradient composition of the final product. Gradient copolymers show unique behavior in bulk and in solution due to the gradual change in composition within the polymer chains making them interesting for a wide range of applications. The use of this in-house built controller with RAFT will allow for producing copolymers with whatever desired compositional gradient distribution in an efficient and straightforward manner.

## **PAMAM-PCL/PLA Linear Dendritic Block Copolymers: Enhanced Drug Loading Efficiencies and Practical Approaches Towards Theranostic Nanomedicine**

*Indika Chandrasiri, University of Mississippi*

Over the last decade, there has been an exponential development of polymeric-based therapeutic systems for the treatment and diagnosis of cancer-related diseases. In contrast with traditional molecular-based therapeutic agents, these new polymers facilitate a higher level of versatility and functionality such as simultaneous delivery, targeting and imaging (i.e. theranostics). However, challenges in synthesis, solubility, preparation of monodispersed nanocarriers (with suitable size and morphology) have limited the potential of these systems in clinical use. Herein we present a successful approach towards overcoming those challenges by using “Janus-type” linear-dendritic block copolymers (LDBC). Two libraries of LDBC comprised of a hydrophilic polyamidoamine (PAMAM) dendron covalently linked to a hydrophobic polyester [polylactide and polycaprolactone] were synthesized and characterized. Nanoparticles ranging from 15-110 nm with positive zeta-potential values were observed. Systems which exhibit bilayer vesicle morphologies were further studied for potential nanomedical applications. Curcumin, a sensitive and potent anti-cancer drug with poor water solubility, was used for hydrophobic encapsulation studies and Rhodamine-B, a fluorescent dye, was used for hydrophilic encapsulation studies. Loading efficiencies (DD%) were shown to be up to 21% for hydrophobic drugs and up to 64% for hydrophilic model molecules. Up to 7% DD% was exhibited with a potent hydrophobic photothermal dye, C3. Dye loaded nano-aggregates were uptaken into S2 cells, HEK cells and Raw cells without inducing negative cytotoxicity responses from healthy cells. Results of the studies confirm that these polymeric systems have the potential to be promising candidates in theranostic nanomedicine.

## **Nanotechnology-Based Transdermal Delivery System for Bioactive Compounds**

*Jeehye Kim, Louisiana State University*

The nanotechnology-based transdermal delivery system includes nano-emulsions, nano-some, and polymeric nanoparticles. The nano-systems are known as a useful tool for enhancing skin penetration of bioactive compounds due to the nature of nano-size, maximizing the surface area of a material per unit of mass. In the first study, the nanoemulsion system was prepared to examine how the nanosystem work in delivering bioactive compounds such as Capsaicin, a hydrophobic compound extracted from the chili pepper. The model compound was selected as it has excellent pharmacological activity through the epidermal/dermal layers in human skin. The experimental results revealed that the capsaicin-encapsulated nanoemulsion system effectively enhanced the penetration rate of capsaicin through the porcine skin compared to the control group (the same portion of capsaicin in 40 % of ethanol solution) by increasing the permeation rate of capsaicin up to 165 %. In the next study, gelatin-based nano-hydrogel was prepared for transdermal protein delivery. Bovine serum albumin (BSA) was used as a model hydrophilic compound. The polymeric nanoparticles didn't show any significant cytotoxicity and clearly enhanced the penetration of fluorescent-labeled BSA into the porcine epidermis and dermis. These two studies showed the nanosystem, including nanoemulsion and polymeric nanoparticles, has potential as a

transdermal delivery carrier used for hydrophilic/hydrophobic bioactive compounds. The follow-up study with fish gelatin methacryloyl (GelMA) nanogel demonstrated that the nanohydrogel has successfully delivered small-molecule drugs not showing any cytotoxicity. Three peer-reviewed journals have been published. The next study of nano-formulated transepidermal delivery for the skin-repairing peptide is under preparation.

## **Near IR-II Active Organic Semiconducting Ambipolar Copolymers via Electropolymerization**

*Tharindu Ranathunge, University of Mississippi*

As research in conjugated polymers increases, scientists have begun to seek more low-cost and straightforward strategies to chemical synthesis. Electropolymerization offers an alternative strategy that can overcome common failures associated with chemical synthesis to obtain highly efficient materials. Recently, our group synthesized benzothiadiazole containing thiophenes and furan polymers as tailored donor-acceptor type semiconductors with significant optical absorbance and emission for applications as efficient near infrared (NIR) probes. As an extension of the work, we present here the study of diketopyrrolo-pyrrole-bisthiophene and thienothiadiazole-bisthiophene for diblock copolymerization with tertiothiophene as a  $\pi$ -linker to form tunable narrow band gap polymers. The cyclic voltammograms (CV) of the diblock copolymers are unique in that they show appreciable currents in the entire potential domain from +1.2 V to -1.5 V demonstrating electrical conductivity at all potentials. The polymers suspended on thin films have similar redox characteristics of the monomers with potential shifts that prove the identity of the respective polymers. Electrochemical impedance measurements were carried out at different potential biases and high electronic conductivities were obtained at each potential, thus confirming the polymers to be intrinsically electrical conducting. Atomic ratios of the synthesized materials were calculated experimentally using energy dispersive x-ray analysis, which confirm the theoretical composition of the polymers. These doped polymers exhibit absorption in the visible to NIR region (800 - 1800 nm) in both solid and solution state. Incorporation of solubilizing groups afforded the formation of nanoparticles with sizes ranging from 80 - 200 nm. Results support an efficient strategy towards the creation of complex materials with various possible applications in optoelectronics.

## Titles of Poster Presentations:

- 1. Synthesis and characterization of a novel protected bis-MPA linear polyester**  
*Oluwapelumi Kareem, Tulane University*
- 2. Effect of graft density and graft length on the ordering of block copolymer grafted nanoparticles**  
*S M Al Islam Ovy, Louisiana Tech University*
- 3. Forcing single-chain nanoparticle collapse through hydrophobic solvent interactions in comb copolymers**  
*Cheyenne Liu, The University of Southern Mississippi*
- 4. RII Track–2 FEC Emergent Polymer Sensing Technologies for Gulf Coast Water Quality Monitoring**  
*Joshua Tropp, The University of Southern Mississippi*
- 5. Cationic, Anionic and Neutral Functionalized Polyamidoamine (PAMAM) - Fatty Acid Amphiphilic Janus Dendrimers for Therapeutic Applications**  
*Mahesh Loku Yaddehige, The University of Mississippi*
- 6. Uptake Studies of “Janus-type” PAMAM-Polyester Linear Dendritic Block Copolymers (LDBC) for Imaging and Drug Therapy**  
*Azaziah C. Parker, The University of Mississippi*
- 7. PAMAM Derivatives for Low-Toxicity Polymeric Biomaterials**  
*Briana Simms, The University of Mississippi*

**8. Synthesis and characterization of  $\alpha$ ,  $\omega$ -azido-polyvinylmethyloxane (PVMS) and  $\alpha$ ,  $\omega$ -alkyne-polystyrene (PS) for stipulated synthesis of cyclic- (PVMS-b-PS)**

*Md Fakar Uddin, Tulane University*

**9. Electropolymerization of Isoindigo Block Copolymers for NIR-II  
Theranostic Applications**

*Nicholas Sparks, The University of Mississippi*

**10. Viscosity Measurement of Polyvinyl Alcohol Solutions in Various Solvents**

*Brittany Trinh, Sekisui; Dylan Gilbert, Southeastern Louisiana University*

**11. The Synthesis of Bio-Inspired Amphiphilic Grafted Nanoparticles for  
Hydrophobic Molecule Encapsulation**

*Jason A Hyman, Tulane University*

**12. CO-ASSEMBLY BEHAVIOR OF NEUTRAL AND ZWITTERIONIC AMPHIPHILIC  
BLOCK COPOLYMERS IN THE FABRICATION OF POLYMER VESICLES**

*Elina Ghimire, The University of Southern Mississippi*

**13. Synthesis of poly(glycidyl phenyl ether) with precise topology and dipolar  
microstructure confirmed by MALDI-ToF MS and Broadband Dielectric  
Spectroscopy**

*Jordan Ochs, Donostia International Physics Center*

**14. Entropy and Enthalpy Mediated Segregation of Bottlebrush Copolymers  
to Interfaces**

*Hao Mei, Rice University*

**15. Elucidating Phase Separation of Precision Polymeric Ligands on Gold Nanoparticles**

*Jingya Xiao, Louisiana State University*

**16. Low resistant and thermally stable polymer electrolyte membranes for intermediate temperature applications**

*Gokul Venugopalan, Louisiana State University*

**17. Analysis of Linear and Dendritic Bis(hydroxymethyl)propanoic Acid-Based Polymers Lending to Advances in Understanding their Hyperbranched Analogues**

*Mckenna Redding, Tulane University*

**18. New ionomer materials for electrochemical separations and energy storage**

*Varada Menon Palakkal, Louisiana State University*

**19. Design of block copolymer templated electrocatalysts with extended surface metal nanostructure**

*Deepra Bhattacharya, Louisiana State University*

**20. Advanced metrology and molecular dynamics simulations for quantifying counterion condensation in block copolymer electrolyte thin films**

*Qi Lei, Louisiana State University*

**21. Chemoselective Ligation of Thiolated Sodium Lignosulfonate**

*Jorge Belgodere, Louisiana State University*

**22. Multiphysics Modeling of the Separation of Polymeric Materials into Discrete Species**

*Michael Dearman, Louisiana State University*

**23. Effect of block length on the water dispersibility of SiO<sub>2</sub>-poly(caprolactone)-b-poly(oligo ethylene glycol methyl methacrylate mono-methyl ether) amphiphilic grafted nanoparticles**

*Christopher Keller, Tulane University*

**24. Measurement of Thickness and Preservation of Thin Films at Maximum Wrapping Speed**

*Md. Enamul Hoq*

## Keynote Speaker Bio:

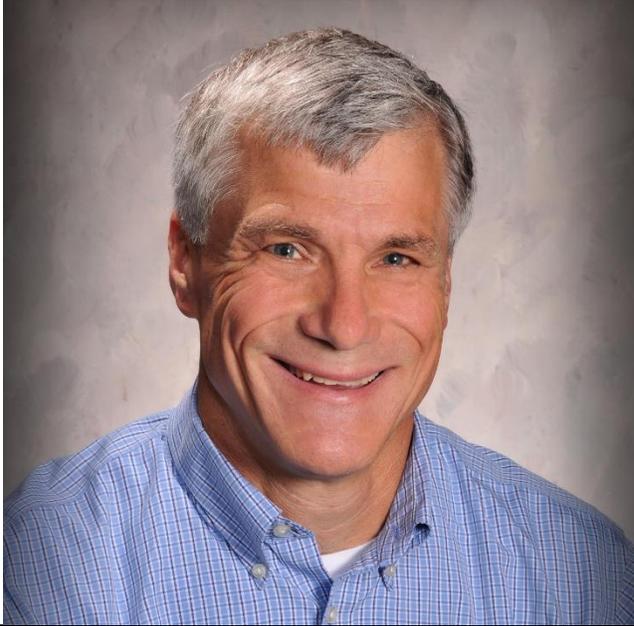


**Dr. Young-hye Na**  
Research Manager at IBM

Dr. Young-hye Na is a Research Manager for the Energy Storage Program at the IBM Almaden Research Center.

Young-hye received her Ph.D. in Nano and Material Chemistry from the Pohang University of Science and Technology in 2002. She completed postdoctoral studies under Paul Nealey at the University of Wisconsin-Madison and at the Center for Integrated Molecular Systems at the Pohang University of Science and Technology.

Dr. Na's expertise lies in surface chemistry, material science, and nanotechnology, with a focus on developing functional materials (polymers, organic thin films, nanocomposites, and nanoparticles) for various applications, including water treatment membranes and energy storage devices (i.e. next generation batteries).

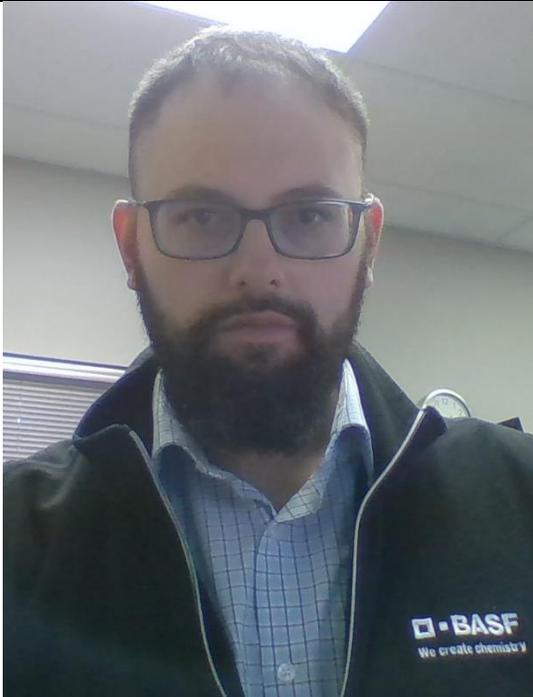


**Dr. Michael A. Yandrasits**  
Advanced Senior Specialist at 3M

Dr Mike Yandrasits is an Advanced Senior Specialist at Corporate Research Laboratory – Electrochemical Components Lab, 3M Center, St. Paul, MN.

Dr Yandrasits received his Ph.D. in 1991 and post doctorate in 1992 in polymer science from the University of Akron under the guidance of Stephen Cheng.

Dr. Yandrasits has worked in 3M’s research labs over twenty-four years, in the last 16 years in fuel cell membrane development. He has over 30 issued U.S. patents, primarily in the area of fuel cell technology.



**Dave Clemons**  
Analytical Services, Quality and  
Continuous Improvement Manger  
at BASF

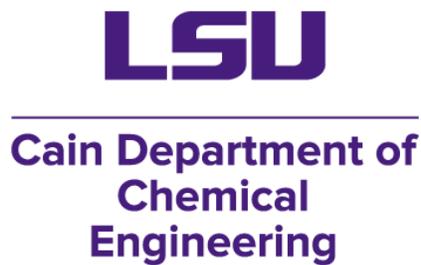
Mr. Dave Clemons is an Analytical Services, Quality and Continuous Improvement Manger at BASF.

Mr. Clemons received his Bachelor of Science in Chemistry and Biochemistry from the University of Michigan in 2006.

Mr. Clemons has worked at Dow Chemical Company from 2006 to 2015. Since 2015 he has been working at BASF and held several roles. He is an expert in alkoxylation chemistry.

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