2021

Chemical Engineering

Rising Stars Workshop

October 21-22, 2021

Massachusetts Institute of Technology

Chemical Engineering

Rising Stars 2021

A message on behalf of the 2021 Workshop Steering Committee:

Welcome to the 2021 Rising Stars in Chemical Engineering Symposium!

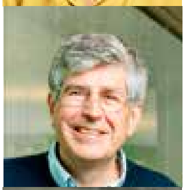
We are pleased to welcome you to this virtual event and look forward to hearing about your research and aspirations, as well as helping you to navigate the journey toward a successful and fulfilling academic career.

The goal of this event is to bring together the next generation of leaders in chemical engineering and help prepare them for careers in academia. We aim to help strengthen the academic pipeline for women in our field, and provide opportunities for you to develop your own network of peers as you decide your own next steps.

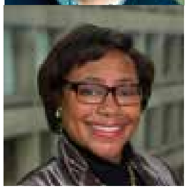
This 2021 workshop cohort represents some of the top early career women in chemical engineering today. We hope that the next two days of workshops, discussions and presentations inspire you as you find your way in your career.

We hope you find this event informative and inspiring. We look forward to meeting you!

Karen K. Gleason
Alexander and I. Michael Kasser (1960) Professor Emeritus



Klavs F. Jensen
Warren K. Lewis Professor of Chemical Engineering



Paula T. Hammond
Institute Professor
Department Head, MIT Chemical Engineering Department

Agenda Summary (all times EDT)

Thursday, October 21

10am	Welcome by Paula Hammond	
10:20am	Welcome and Introduction	Anantha Chandrakasan Dean of Engineering
10:30am	Thriving as a Professor	Krystyn Van Vliet Associate VP for Research Associate Dean
11:15am	Break	
11:30am	Senior Faculty Panel: Why Academia?	
12:15pm	Lunch with faculty	
1:30pm	Oral Presentations by Workshop Participants	
2:45pm	Panel Discussion: Getting the Job: Strategies for the Next 12 Months	
3:30pm	Faculty Applications 101	
4:45pm	Break	
5pm	Chalk Talk Workshop and Interview Day Strategies	

Friday, October 22

9:30am	Breakfast with Graduate Women in Chemical Engineering
10am	Early to Mid-Career Faculty Panel
10:30am	AIChE Virtual Meet the Faculty Poster Session Workshop
11:15am	Break
11:30am	Teaching Statement Workshop
12:15pm	Diversity Statement Workshop
1pm	Wrap-up

COMMUNICATION LAB

During the symposium, there will be several small workshops with Fellows of the MIT ChemE Communication Lab.

Launched in 2017 and modeled after the successful Communication Labs throughout MIT's School of Engineering, the ChemE Communication Lab offers coaching and resources for engineers, by engineers. It uses a peer-coaching model, in which specially selected ChemE graduate students and postdocs are trained to become exceptional communication coaches. These Fellows work one-on-one with ChemE clients, providing guidance for the effective creation of all forms of technical communication.

Caitlin Stier
Manager, Chemical Engineering Communication Lab

Diana Chien
Senior Program Manager, School of Engineering Communication Lab

Sachin Bhagchandani
Graduate Student, Johnson, Irvine, and Langer Labs

Camille Bilodeau
Postdoctoral Associate, Jensen Lab

Aditya Limaye
Graduate Student, Willard and Manthiram Labs

Yayuan Liu
Postdoctoral Associate, Hatton Lab

Pradeep Natarajan
Graduate Student, Chakraborty Lab

Bertrand Neyhouse
Graduate Student, Brushett Lab

Julie Rorrer
Arnold O. Beckman Postdoctoral Fellow, Román Lab

Jingfan Yang
Graduate Student, Strano Group

Chemical Engineering

Rising Stars Cohort
2021

Yasemin Basdogan
California Institute of Technology

Camille Bishop
National Institute of
Standards & Technology

Rose K. Cersonsky
École Polytechnique Fédérale
de Lausanne

Yaxin Chen
Northwestern University

Pavani Cherukupally
Imperial College

Anush Chiappino-Pepe
Harvard/MIT

Raisa Ela
University of Minnesota, Twin Cities

Kara Fong
UC Berkeley

Sri Bala Gorugantu
Northwestern University

Chrysoula Kappatou
Imperial College

Chunzi Liu
Stanford University

Lesli O. Mark
University of Wisconsin-Madison

Mehnaz Mursalat
New Jersey Institute of Technology

Kathryn E. O'Harra
University of Alabama

Doris Oke
Northwestern University

Pranjali Priyadarshini
Georgia Institute of Technology

Ambika Somasundar
Princeton University

Alice Stanton
MIT

Jing Tang
Stanford University

Aleczandria S. Tiffany
University of Illinois Urbana Champaign

Jingyuan Xu
Karlsruhe Institute of Technology

Sarah J. Yang
UC Berkeley

Yiran Yang
California Institute of Technology

Joy Zeng
MIT

Hannah Zierden
University of Maryland

Yasemin Basdogan

California Institute of Technology

Dr. Basdogan completed her BSc's degree in Chemical and Biological Engineering at Koç University (Istanbul, Turkey) in 2015. She then continued her studies to obtain a PhD in Chemical Engineering from University of Pittsburgh in 2020. Her PhD thesis focused on understanding solvation environments in chemical systems. In 2019, she was awarded the "Dr. James M. Coull Memorial Fellowship Award" from University of Pittsburgh, given to the top outstanding senior PhD student in the department, and the "Computational Molecular Science and Engineering Forum (CoMSEF) annual Graduate Student Award" by AIChE, which recognizes significant contributions to research in computational molecular science and engineering by graduate students. Currently, she is a postdoctoral researcher with Prof. Zhen-Gang Wang working on polymer membranes for gas separation applications in the Division of Chemistry and Chemical Engineering at The California Institute of Technology.

Tuning Ether Motifs in Polymers Membranes for CO_2/N_2 Separation

Polymers are attractive membrane materials for gas separation technologies due to their low carbon and energy footprints, as well as easy processability and tunable physicochemical properties. Developing polymer membranes with high gas permeability and selectivity remains a grand challenge in navigating climate change and global warming. We first studied PEO-based membranes for CO_2/N_2 and CO_2/O_2 separation with group contribution method based on perturbed-chain statistical associating fluid theory equation of state and molecular dynamics simulations. We showed that the ether oxygen moiety is a unique functional group that exhibits affinity towards CO_2 but not N_2, which leads to high CO_2 solubility and CO_2/N_2 solubility selectivity. Our results indicate increasing the ether oxygen content in the polymer membrane increases the CO_2 solubility and CO_2/N_2 solubility selectivity however does not increase the CO_2 permeability. Now, we are working on designing new polymer membranes with optimal permeability and selectivity by Machine Learning (ML) assisted polymer engineering and high throughput screening. We use mixed supervised/unsupervised ML techniques to correctly predict the gas diffusivities and solubilities in polymer membranes. Later, we will use a Genetic Algorithm (GA)–guided by our trained ML model–to effectively sample the polymer materials space and identify high performance polymers for CO_2/N_2 separation.

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Camille Bishop

National Institute of Standards & Technology

Dr. Bishop is an NRC Postdoctoral Research Fellow at the National Institute of Standards and Technology (NIST), working with Dr. Dean DeLongchamp to develop and apply soft X-ray scattering measurements to measure amorphous interfacial packing in semi-crystalline polymers. She completed her PhD with Professor Mark Ediger at the University of Wisconsin-Madison with her dissertation "Vapor deposition rate modifies order in highly structured glasses", in which she vapor deposited glasses with high levels of liquid crystal-like order. Outside of research, she is passionate about outreach, and has heavily participated in middle school tutoring and science programs.

Manipulating and Measuring Nanoscale Structure in Amorphous Materials

Amorphous materials are generally thought to be structurally isotropic; however, the presence of interfaces can induce anisotropic molecular packing. For example, in posaconazole, a molecule with no bulk liquid crystalline phases, X-ray absorption measurements reveal a highly oriented layer with liquid crystal-like order. We exploit this highly oriented layer using physical vapor deposition to prepare a bulk glass with interface-like, liquid crystalline order. Interfacial anisotropy occurs frequently within the bulk of amorphous materials as well, such as in semi-crystalline polymers and their blends. While many characterization methods exist to measure bulk orientation, it is more difficult to measure molecular orientation within only the first few nanometers of an interface. To help address these problems, we use polarized resonant soft X-ray scattering (p-RSoXS) and absorption (NEXAFS) to probe interfacial molecular orientation in semi-crystalline and blended materials. Using an improved understanding of interfacial structure in amorphous materials, we can design better materials with unique, controllable nanoscale structures that can be used in a range of organic electronics applications.

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Rose K. Cersonsky

École Polytechnique Fédérale de Lausanne

Rose K. Cersonsky received her Bachelor of Science degree in Materials Science and Engineering from the University of Connecticut in 2014, serving as commencement speaker and earning the School of Engineering's Award for Outstanding Academic Achievement. She then went on to obtain her Ph.D. in Macromolecular Science and Engineering from the University of Michigan in 2019 under Professor Sharon C. Glotzer, the John Werner Cahn Distinguished University Professor of Engineering, where Rose's doctoral thesis was titled "Designing Nanoparticles for Self-Assembly of Novel Materials." She is currently working as a postdoctoral researcher in the Laboratory of Computational Science and Modeling (COSMO) at École Polytechnique Fédérale de Lausanne (EPFL) in Lausanne, Switzerland.

Multiscale Machine Learning: The Search for Novel Mesoscale Materials

In her doctoral work at the University of Michigan, Rose focused first on the role of particle shape in nanoparticle self-assembly, demonstrating the thermodynamic stability and phase transitions motivated by imperfections in nanoparticle shape and proving the non-causality of Pauling packing rules in determining self-assembled structures. Then, turning her focus to the optical applications of colloidal crystals, Rose conducted a high-throughput study of crystallographic targets for photonic crystals, re-examining long-held design principles in the colloidal community and providing new targets for synthesis. Since joining COSMO at EPFL, Rose has focused on applying machine learning to problems at the atomistic scale. In particular, she has made significant contributions to methods development for dimensionality reduction in chemical studies, providing new algorithms and tools for understanding the correlations between crystal structure and materials properties. In the future, she hopes to extend these techniques to problems beyond the atomic scale, with the goal that the community can accelerate simulation and gain a greater understanding of the behavioral similarities across multiple length scales.

Yaxin Chen
Northwestern University

Dr. Chen completed her BSc's and PhD degree in Environmental Science and Engineering at Fudan University (Shanghai, China) in 2014 and 2019, respectively. There, her research work mainly focused on environmental catalysis, including the rational design of atomically dispersed silver catalysts for complete oxidation of volatile organic compounds (VOCs) and development of deNOx catalysts for NO emission control. Currently, she is a postdoc in Chemical & Biological Engineering at Northwestern University. Her research focuses on proton-water/methanol interactions in confining zeolite pores.

Active Sites of Supported Metal Catalysts

Dr. Chen's research focuses on environmental catalysis, which plays an important role in the control of air pollutants. She developed a high-temperature atom-trapped method for synthesizing stable atomically dispersed catalysts and used this method to synthesize a series of model catalysts to study the relationship between the structure and catalytic activity. In addition, mechanisms of catalyst deactivation under actual working conditions were also investigated, which can guide the development of new practical environmental catalysts. Indeed, based on the research, a honeycomb catalyst has been designed and used for chain furnace flue gas treatment, which performs much better than the commercial catalyst.

Pavani Cherukupally

Imperial College

Dr. Pavani Cherukupally received BEng from Osmania University, India, and an MEng and PhD from the University of Toronto, Canada, all in Mechanical Engineering. Currently, she is a Research Associate at the Department of Chemical Engineering at Imperial College London. Pavani invented sponge-based adsorption technology for oil field wastewater remediation and residual crude oil recovery. The sponge technology is currently being scaled up to reform the Zero Liquid Discharge policy in the Canadian oil industry. At Imperial, she develops antimicrobial sponges to combat emerging antibiotic-resistance bacteria and prevent water-borne infectious diseases in resource-constrained communities. Beyond research, Pavani is passionate about mentoring and has trained 10+ graduate students in mechanical, chemical, and biological engineering disciplines, who have gone on to pursue PhDs and R&D positions in the industry and national labs.

Nanocomposite Sponges: Emerging Low-Cost Solutions for Environmental and Health Applications

Growing up in India, I experienced firsthand the problems associated with water, environment, and public health. These formative experiences shaped my life-long ambition to develop affordable solutions that transcend academia and industry in addressing these issues. For example, the global oil industry generates 100 billion liters of oily wastewater annually. I developed reusable sponge-based adsorption technology for ultrafast capture and recovery of residual crude oil from wastewater across broad pH, temperature, and salinity conditions to bridge the affordable technology gap. Next, waterborne infectious diseases cause 2 million deaths globally each year. These diseases are prevalent in low- to medium-income communities and predominantly affect children under five. I tailored inexpensive sponges using nanocoatings to adsorb and kill pathogenic bacteria, including E. coli, P. aeruginosa, and S. aureus, from the wastewater. Due to its ultrafast biocidal properties, the reusable sponges can prevent waterborne diseases and associated costs in affected communities. Finally, I developed material and process characterization methods for world-leading industries, including BASF, DuPont Inc., and General Motors, to reduce pharmaceuticals degradation, desalination membranes scaling, and carbon emissions from automotive painting. In the future, I aim to advance the multifunctional capabilities of the sponges and other established technologies to address climate change and emerging antibiotic-resistance bacterial challenges.

Chemical Engineering

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Anush Chiappino-Pepe

Harvard/MIT

Anush Chiappino-Pepe is a Postdoctoral fellow in the Department of Genetics at Harvard Medical School, Boston, where she is advised by Professor George M Church. Anush is also a research affiliate in the Department of Chemical Engineering at the Massachusetts Institute of Technology, Boston, where she is advised by Professor Gregory Stephanopoulos. Anush completed her Ph.D. in 2018 at the École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland. In 2013, Anush completed a diploma (combined bachelor and master) at the Complutense University of Madrid, Spain, and the Karlsruhe Institute of Technology, Germany. Anush is a first-generation Ph.D., Latina (Argentinian origins), and lifelong immigrant. She is an advocate for a friendly, diverse, and safe environment in academia. She is passionate about teaching and mentoring. Outside of the laboratory, Anush enjoys doing yoga and being in nature.

Decoding and Expanding Catalytic Functions in Organisms

Anush's research focuses on understanding the design principles of genomes and metabolism following systems and synthetic biology approaches. She is engineering genomes, proteins, and media to optimize and expand the cell's naturally occurring functions. These experiments are guided by her newly developed computational models. During her Ph.D., Anush led the computational efforts of an interdisciplinary and international project called MalarX aiming to identify new ways to target malaria parasites. Anush developed genome-scale models of metabolism of two malaria parasites and optimization-based methods to study (among others) the metabolic function throughout the parasites' life cycle. She also studied antimalarial drug action mechanisms. During her Post-Doc, Anush is developing comprehensive mathematical models of the function and design of genomes and proteins. With these, Anush is aiding in the construction of a 57-codon strain of Escherichia coli and the expansion of its properties, e.g., biocontainment and virus resistance. This strain will allow the incorporation of multiple non-standard amino acids into proteins. Anush is also exploring the effect of combinatorial nutritional stimuli on the cell function.

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Raisa Ela

University of Minnesota, Twin Cities

Dr. Ela is a Postdoctoral Associate at the NSF Center for Sustainable Polymers in the Department of Chemical Engineering and Materials Science at the University of Minnesota, Twin Cities under the supervision of Professor Paul J. Dauenhauer. Prior to holding this position, she completed a Bachelor of Science and a Master of Science in Chemical Engineering at the University of New Mexico, Albuquerque. There, she explored various avenues of research. She investigated the electrochemical performance of graphene nanosheets supported catalysts for the oxidation of organic acids, polypeptide cloning, and mesoporous lipid-coated silica nanoparticles as drug delivery systems. From there, she attended Michigan Technological University and obtained a PhD in Chemical Engineering under the direction of Professor Rebecca G. Ong. Specifically, her dissertation centered on producing innovative, sustainable, bio- and environmentally friendly lignin-based wood fungicides from black liquor, a byproduct from the pulp and paper industry, and she was twice awarded the 2nd place at the Executive Advisory Board Graduate Research Poster Competition. Besides scientific research, Dr. Ela is passionate about mentorship, outreach, inclusion, equity, diversity and women empowerment initiatives.

Renewable butadiene production from biomass-derived tetrahydrofuran on boron-, phosphorus-, and sulfur-containing siliceous zeolites

Dr. Ela's research centers around two main principles: firstly, developing a fundamental understanding of the macro- and microscopic properties of lignocellulosic biomass-derived industrial byproducts and waste products, and secondly, designing and optimizing innovative systems for the efficient purification and transformation of biomass-derived substances into bio-friendly, eco-friendly, carbon-neutral valuable products, chemicals and materials. In our present work we investigate the catalytic tandem ring-opening and dehydration of tetrahydrofuran on phosphorus (P)-, sulfur (S)-, and boron (B)-containing silicalite-1 to selectively produce 1,3-butadiene. Tetrahydrofuran can be produced from biomass-derived furfural, a common byproduct of the acid hydrolysis of biomass. 1,3-butadiene is the the most significant conjugated diene, deployed in the synthesis of functional polymers, including cis-1,4-polybutadiene and styrene-butadiene rubber, both are primary constituents of tires. Notably, we focus on understanding the effect of catalyst morphology, the properties of active sites (Brønsted acidity and chemical composition), and reaction process conditions on the activity, stability, and selectivity of the catalyst as a propitious route towards process optimization.

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Kara Fong

UC Berkeley

Kara Fong is a PhD candidate and NSF Graduate Research Fellow in the Department of Chemical & Biomolecular Engineering at the University of California, Berkeley, where she is co-advised by Prof. Bryan McCloskey and Prof. Kristin Persson. She earned a B.S. in Chemical Engineering at Stanford University in 2016, then completed an M.Phil. in Materials Science at the University of Cambridge through the support of a Churchill Scholarship. Her current research focuses on understanding transport phenomena in electrolyte solutions for Li-ion batteries using molecular dynamics simulations and non-equilibrium thermodynamics.

Understanding ion transport in electrochemical systems across length and time scales

Improved understanding of transport phenomena in electrolyte solutions has important implications in the fields of energy storage, water purification, biological applications, and more. This understanding should ideally persist across length scales: we desire both continuum-level insight into macroscopic concentration and electric potential profiles as well as a molecular-level understanding of the mechanisms governing ion motion. However, the most common theories describe continuum-level electrolyte transport in terms of parameters which lack clear interpretation at the molecular level and cannot be directly computed from molecular simulations. This presents significant challenges in deciphering the mechanisms of ion motion from experimental measurements and understanding the physical phenomena that may be limiting an electrolyte's performance. My research focuses on developing theory to connect our understanding of electrolyte transport at the molecular and continuum levels through the integration of nonequilibrium thermodynamics, continuum mechanics, and electromagnetism. This theoretical framework generates a quantitative mapping between macroscopic transport parameters and molecular-scale correlations in ion motion, providing a powerful lens for intuitively interpreting transport and allowing us to easily calculate transport properties that may be challenging to characterize experimentally. In applying this approach to Li-ion batteries, I have elucidated the mechanisms of ion motion in potential next-generation battery electrolytes, specifically polyelectrolyte solutions and polymerized ionic liquids.

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Sri Bala Gorugantu

Northwestern University

Sri Bala Gorugantu completed her undergraduate degree in Chemical Engineering from BMS College of Engineering (India) in 2012. She then graduated with an M.S. (research) from the Indian Institute of Technology Madras (India) in 2015. She was also a visiting student at Karlsruhe Institute of Technology (Germany) under the IIT-DAAD scholarship program. She obtained a Ph.D. from Ghent University, Belgium, in 2020. Her graduate research at the Laboratory for Chemical Technology focused on obtaining insights into fast pyrolysis kinetics of lignocellulosic biomass, identifying critical reaction pathways for producing green chemicals. Dr. Gorugantu is currently a postdoctoral researcher at the Broadbelt Research Group, Department of Chemical and Biological Engineering at Northwestern University. Her current research focuses on developing mechanistic models to elucidate the chemical recycling of polymers.

Chemical Kinetics in Enabling Circular Economy

Plastics have become an integral part of day-to-day living, resulting in an enormous waste at both industrial and consumer levels. Chemical recycling methods have the potential to either recover the monomers from waste plastics or upcycle them to produce fuels and other products. Such processes require a thorough understanding of the underlying chemistry for efficient recycling. Dr. Gorugantu's current research involves developing mechanistic models to unravel the depolymerization chemistry of plastics, such as polyethylene terephthalate (PET) and polyurethanes (PU). These studies are targeted towards monomer recovery via solvolysis. The modeling approach includes reconstructing the initial polymer computationally, listing all the important reaction families, reaction and product species, and simulating the polymer solvolysis using the Kinetic Monte Carlo approach. In addition to this, she briefly worked on the kinetic modeling of polyethylene pyrolysis to gain new insights into its thermal decomposition pathways.

Chrysoula Kappatou
Imperial College

Dr. Chrysoula D. Kappatou is a Research Associate in the Computational Optimization Group at the Department of Computing at Imperial College London. She holds a Diploma Degree (300 ECTS, M.Eng. equivalent) in Chemical Engineering obtained from National Technical University of Athens, Greece, in 2015, and a doctoral degree (Dr.-Ing.) from RWTH Aachen University, Germany, in 2020, advised by Professor Alexander Mitsos. Her research focuses on the development of optimization theory and algorithms for intensification and control of bioprocesses.

Computational optimization in biopharmaceutical manufacturing

My research relies on foundations of optimization theory and their application to engineering problems. My current research aims at automating the process of creating and updating chemometric models for Process Analytical Technology applications. Smart chemometrics are for me a new challenging and highly promising field to work with, considering the benefits of swifting to automation technologies to transform process information to explainable process models. What I find extremely appealing in this research, is the interface between chemical engineering and computing on the front-end of developing cutting-edge optimization methods and coupling them to industrially-relevant applications.

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Chunzi Liu

Stanford University

Chunzi Liu is a Ph.D candidate in the Department of Chemical Engineering at Stanford University, where she is advised by Professor Gerald G. Fuller. Her research focuses on understanding the altered interfacial properties of ocular epithelia in dry eye patients. As a Bio-X Bowes fellow, Chunzi pioneered a cellular-based mucin-deficient dry eye model in collaboration with Professor Carolyn Bertozzi and designed an experimental pipeline to test the efficacy of new topical administered treatments. Prior to her graduate studies, she completed a B.S. in Materials Science and Engineering with a focus on polymer and textile at Georgia Tech. There, she investigated the structural coloration mechanisms of blue butterfly wing scales under Professor Mohan Srinivasarao at Georgia Tech and Professor Doekele Stavenga at University of Groningen, Netherlands. Outside research, Chunzi enjoys teaching and mentoring high school students about kitchen science. In her future academic career, Chunzi would like to utilize her background in interfacial rheology and mucin biophysics to understand the pathology of epithelial diseases and engineer precision medical solutions in collaborations with clinicians and polymer chemists.

Interfacial properties of ocular epithelial surfaces

Every day we blink about 15,000 times, but the mechanism keeping our eyes lubricated remains elusive because of the intertwined biophysical and biochemical processes at the ocular surface. Combining confocal microscopy and live-cell rheometry (LCR), Chunzi presents the first comprehensive study of lubrication on living cell surfaces under mechanical shear. Despite continuous efforts since the 1960s, the investigation of bio-lubrication mechanisms has been hindered by a lack of physiologically relevant model systems and suitable measurement techniques. During her graduate research, Chunzi developed the first in vitro mucin-deficient ocular surface model to study lubrication dysfunction in dry eye patients. The results confirmed for the first time in live-cell models that the presence of mucin-like glycoproteins is critical for sustained lubrication at ocular surfaces. In addition to rheological behaviors, Chunzi designed a series of experimental methods to measure the shear adhesive strength of epithelial layers with contact angle goniometers. The contact angle hysteresis measurements demonstrated an unexpected mechanism in which a high surface roughness improves the epithelial lubrication properties through an increased retentive force against the fluid film. The results pave the way towards therapeutic developments for diseases caused by lubrication dysfunction, such as dry eye symptoms.

Rising Star 2021

Lesli O. Mark

University of Wisconsin-Madison

Dr. Mark is an Arnold O. Beckman Postdoctoral Fellow in Chemical Instrumentation in the Department of Chemistry at the University of Wisconsin – Madison where she is advised by Dr. Ive Hermans. Dr. Mark completed her BSc and PhD in Chemical and Biological Engineering at the University of Notre Dame (2015) and the University of Colorado, Boulder (2020), respectively. Her research is focused on the development of heterogeneous catalysts for sustainable chemistries. Dr. Mark's graduate studies – under the advisement of Dr. J. Will Medlin – focused on the fundamental, surface science understanding of the molecular interactions of furfuryl alcohol, a biomass probe molecule, on Pt and zeolite-coated Pt surfaces. During her time at CU Boulder, Dr. Mark received the DOE Office of Science Graduate Student Research Program (SCGSR) award to complete a portion of her thesis work at Brookhaven National Lab. In her postdoctoral work, Dr. Mark has worked on various projects including the development of improved catalysts for oxidative dehydrogenation of propane, the development of a high-pressure modulation excitation spectroscopy cell (for which she received the A.O.B. Postdoc Fellowship), and plastic depolymerization and upcycling.

Molecularly designed materials for sustainable chemistries and separations

Sustainable chemistries and separations are key technologies for abating climate change, preserve the earth's biodiversity, and developing a greener society. For example, the application of chemical upcycling technologies for plastic reutilization could mitigate environmental pollution, while the development of molecular separations materials could drastically reduce energy usage in the chemical industry. The adoption of such technologies relies on the development of high performing heterogeneous catalysts and highly selective membrane materials. As such, Dr. Mark's research aims to develop useful materials for the transformation of recalcitrant feedstocks to value-added chemicals (i.e., plastic and rubber reutilization, biomass upgrading) and selective molecule separations (i.e., chemical separations, toxin removal from water, air toxin sensing and removal). The projects will utilize kinetic studies, theoretical calculations (DFT, MD, and machine learning), and multiscale characterization (surface science to technical scale). Further, the studies will include a variety of in-situ/operando spectroscopy and microscopy techniques, including high resolution electron energy loss, infrared, Raman, and x-ray spectroscopies as well as electron microscopy, to systematically study the interactions that control the performance and separations selectivity of the materials.

Mehnaz Mursalat

New Jersey Institute of Technology

Mehnaz Mursalat is a PhD Candidate in the Otto H. York Department of Chemical and Materials Engineering advised by Professors Edward L. Dreizin and Mirko Schoenitz. Her research focuses on reactive interfaces in nano-composite powders prepared by mechanical milling. She aims to improve the energy density, reaction rate and flowability of such reactive material powders working with aluminum-based thermites, alloys and boron. In her research, she designs and performs custom experiments characterizing ignition and combustion behaviors of the powders along with their rheological properties targeting potential applications of these materials in additive manufacturing, propellants and pyrotechnics. Prior to her graduate studies, Mehnaz received her bachelor in chemical engineering degree from Bangladesh University of Engineering and Technology. She currently holds the position of a teaching assistant. She has mentored three undergraduate students and one first year PhD student. Besides her research, Mehnaz is active in several student life activities and is currently the president of the Graduate Society of Women Engineers at NJIT.

New Generation of Engineered Spherical Composite Powders Prepared by Mechanical Milling

Mehnaz’s research involves exploration of ball-milling induced mechano-chemistry for the synthesis of different powders of interest to advanced energetics. In addition to investigating reaction mechanisms of different aluminum and boron-based energetic systems, her research also addresses the development of a novel, single-stage, scalable process for the production of uniformly sized fine spherical composite powders. The process involves ball milling of irregularly-shaped powders in the presence of two immiscible liquids, generating an emulsion and causing the refined particles to get entrapped inside the droplets. This technique has the potential to significantly improve powder flowability due to the attained narrow and uniform size distributions. The particle size is tunable by changing different milling parameters. Spherical powders can be prepared using a wide range of materials including elemental, alloyed, ceramic, polymer, or composite particles. Experiments show that the change in morphology introduced by this method contributes to improved reactivity as well.

Chemical Engineering

Rising Star 2021

Kathryn E. O’Harra

University of Alabama

Dr. Kathryn (Katie) O’Harra is an Assistant Professor spearheading a partner program in the College of Engineering and Honors College: Engineering Positive and Intentional Change (EPIC). Katie possesses a distinctively creative and technical background, with educational and experiential investment in the arts and engineering. In addition to her passions for teaching, collaborative problem solving, and educational outreach, O’Harra enjoys the balance provided by her creative outlets including ballet and competitive ballroom, painting, sewing, and baking. Katie is thrilled to contribute and merge her skills in the Honors College, as she works to develop STEAM-themed transdisciplinary courses and innovative programs. Katie serves as a mentor to undergraduates in the EPIC Scholars Program, which aligns with her teaching philosophy and focuses on developing DEI advocates and fostering well-rounded, diversified scholars, with an appreciation for the intersection of culture, humanities, and engineering.

Molecular Design of High-Performance Imidazolium Ionenes as Gas Separation Membranes and 3D Printing Materials

Dr. O’Harra completed B.S., M.S., and PhD in degrees in Chemical Engineering, alongside a B.A. in Dance with a Mathematics Minor, from the University of Alabama. During her graduate work, Katie published over 20 peer-reviewed journal articles, presented her research at numerous national and international conferences, contributed as an inventor on several US patent applications, and gained teaching experience to support her pursuits in academia. Her research focused on the design of high-performance ionic polymers for membrane-based gas separations and additive manufacturing applications. Her technical experience pertaining to environmental and energy sectors, in addition to her leadership experience and DEI advocacy, serves as the foundation for her work with EPIC. Katie is excited to be a part of the development of this unique program which will provide each yearly cohort with the resources to be active agents of change in their future workplaces with an understanding of how engineering disciplines are intertwined with environmental responsibility, society, energy, resources, policy, empathy, & humanity.

Doris Oke

Northwestern University

Doris Oke earned her Master's and PhD degrees in Chemical Engineering from the University of the Witwatersrand in South Africa. Her PhD thesis focused on developing mathematical framework for simultaneous optimization of water and energy in hydraulic fracturing process using superstructure-based optimization technique. She joined the Northwestern-Argonne Institute of Science and Engineering in 2020 as a Post-Doctoral Research Fellow.

Co-deployment of electrification and biofuels for decarbonization of transportation sector

Doris's research focuses on applying mathematical optimization with life cycle assessment in studying emerging technologies taking into consideration their energy and environmental impacts such as water and energy consumption as well as greenhouse gas emissions. Her works place emphases on analyzing systems-level energy and environmental benefits of co-optimization of liquid fuels and engines in the light-duty and heavy-duty sectors. She investigates how this approach to reducing energy consumption and emissions in transportation is complementary to the electrification of light- and heavy-duty vehicles. Her other research interest is developing continuous-time frameworks for the synthesis of batch plants and process integration techniques for integrated water and membrane network systems. She applies continuous time frameworks for scheduling of batch processes and simultaneous water and energy optimization in process industries using mathematical modeling approach.

Pranjali Priyadarshini

Georgia Institute of Technology

Dr. Pranjali Priyadarshini completed her B.E. (bachelor's in engineering) in Chemical Engineering from Birla Institute of Technology and Science (BITS), Pilani in India. She obtained her Ph.D. from University of Illinois at Urbana-Champaign advised by Prof. David W. Flaherty. Her research focused on understanding the role of promoters on metal nanoparticles in a heterogeneous catalytic system. Currently, she works as a postdoctoral researcher in Prof. Christopher Jones's lab in Georgia Institute of Technology where her work focusses on developing materials for carbon dioxide capture.

Impact of promoters on reaction rates and selectivities in a heterogeneous catalytic system

Promoters are commonly added to a heterogeneous catalytic process to enhance the yields and rates of the process. However, the mechanism by which a promoter increases the rates and selectivities are generally not well known. In our study, we used direct synthesis of hydrogen peroxide from hydrogen and oxygen on palladium nanoparticles as a probe reaction to understand how different promoters (such as inorganic acids, metal halide salts, phosphonic acid-based ligands) interact with the catalyst active sites and reaction intermediates to give elevated rates. Our works show that promoters can strongly bind to the metal nanoparticles as well as the support and change the electronic and geometric properties of the metal active sites and change the activation barriers for product formation thus leading to changes in rates and selectivities. The insight into the fundamental reason for the effect of promoters on catalysis can help design catalysts and process to optimize reaction conditions to generate maximum rates and selectivities of the desired products and suppress (or reduce) unwanted products.

Ambika Somasundar

Princeton University

Dr. Ambika Somasundar is currently a Material Science Postdoctoral Fellow at the Princeton Center for Complex Materials (PCCM) working with Dr. Howard Stone. Her current research encompasses the study of particle transport and interactions with and within bacterial biofilms. She earned her PhD in Chemical Engineering from the Pennsylvania State University in 2021 while working with Dr. Ayusman Sen and Dr. Darrell Velegol. Her PhD thesis dealt with elucidating the transport and motility mechanisms of enzyme-powered micro and nanomotor systems. Prior to her graduate studies, she earned her bachelor's degree in chemical and biomolecular engineering from the National University of Singapore (NUS) in 2014. During this time, she developed her expertise in the fabrication and surface characterization of drug-polymer microparticle formulations and microfluidic emulsion generators.

Understanding colloidal interactions at the nano-bio interface

My research primarily deals with answering fundamental questions at the intersection of material science, chemical engineering, biochemistry, and soft matter physics. During my PhD, I studied the transport and motility behavior of both active and passive components in systems such as enzyme-lipid vesicles, supported lipid bilayers, emulsions and coacervates in gradients of reactant/ solute. Zooming into the lipid bilayer of the vesicle, I also investigated the ability to control the movement of individual lipid molecules through active enzymatic reactions. Prior to my PhD education, I worked to characterize various drug-polymer microparticle formulations for a variety of purposes such as crystallization, ocular drug delivery, functional food, and microfluidic scale up. Currently, I am exploring avenues for particle penetration into bacterial biofilms. In doing so, I aim to increase my knowledge in the areas of biophysics and multiphase systems to develop technologies for eradicating biofilms. Such technology may have potential applications in the realm of personal health care products and for medical/clinical applications.

Alice Stanton

MIT

Dr. Alice Stanton is engineering the next-gen of mini-tissues to accelerate drug discovery and translation for personalized medicine. She engineers cell-instructive materials and harnesses the extracellular matrix to develop in vitro models towards understanding and mimicking the body and disease and developing treatments to advance human health. She is particularly interested in neurological disease and has developed a mini-brain model complete with all 7 brain cell types, engineering a brain-mimetic hydrogel matrix promoting cell network self-assembly and neuronal maturation. She is an NIA Ruth L. Kirschstein NRSA Postdoctoral Fellow in the Robert Langer Laboratory at Massachusetts Institute of Technology and has been named a Rising Star in Engineering in Health by Johns Hopkins and Columbia University and as a Rising Star in Chemical Engineering Rising Star by MIT. She received her Ph.D. in Bioengineering from Stanford University and B.S.E. in Chemical Engineering from Princeton University. She trained in the laboratory of Marc Tessier-Lavigne at Rockefeller University and in the department of Biochemical and Cellular Pharmacology at Genentech.

Engineering Vascularized Mini-Brains for Accelerating Drug Discovery and Translation with Cell-Instructive Materials

Up to 1 in 6 people worldwide, 1 billion people, are estimated to be afflicted with a neurological disorder, costing over $500B in the US alone. These disorders have been characteristically challenging to treat and drug development has been met with an over 99.6% failure rate. For Alzheimer’s Disease there is still no pharmacologic treatment available that can slow or stop the neuronal damage and we still do not understand the molecular mechanisms underlying the disease. A major bottleneck to understanding disease mechanisms and developing effective therapeutics is in having in vitro systems mimetic of brain tissue that can recapitulate the complexity of the disease. To this end I have engineered a vascularized mini-brain model (miBrain), combining (1) iPSC technology enabling the derivation of 7 different neural cell types from a single source and for individuals from different genetic backgrounds in a diverse cohort and (2) biomaterial engineering of a brain-mimetic hydrogel scaffold to mimic the extracellular matrix in native brain tissue. I have demonstrated the successful co-culture of all 7 brain cell types, formation of 3D tissue architecture with microvasculature and neuronal networks, enhanced neuronal phenotypes and neuronal network activity, and recapitulation of AD pathological hallmarks of phosphorylated tau and amyloid accumulation. Refining this model, we can develop miBrains that mimic healthy and diseased states of the human brain and build computational models integrating transcriptional and cellular-dynamics information with histological transformations that lead up to the end-states observed in post-mortem brains from AD patients. These models enable modeling in real-time the pathological progression of AD across large, patient-specific cohorts of healthy and diseased brains. These longitudinal pathological maps from genetically diverse healthy and AD individuals will provide mechanistic insight into AD pathogenesis and create a platform for the discovery and validation of neuro-therapeutics. To precisely examine the contribution of genetic risk factors such as APOE4 to AD pathogenesis, we are using CRISPR/CAS9 genome editing to generate isogenic miBrains. This multimodal strategy will shed light on how genetic variation influences AD pathogenesis and therapeutic response, opening new avenues for discovery and translation of effective therapeutics to the clinic. It will result in a highly monitorable, interrogable, and perturb-able platform that can be deployed for addressing many mechanistic questions and for therapeutic testing and for establishing an accelerated drug development pipeline that could be harnessed for many other neurological diseases.

Rising Star 2021

Jing Tang

Stanford University

Jing Tang is currently a postdoctoral fellow at Stanford. She works on bioinspired materials and devices for health and sustainability. Prior to Stanford, she was a research fellow jointly at Harvard and MIT, working on neurological disorder therapies from biomaterials to smart drug delivery systems. Her graduate work at Fudan University focused on bioelectronics for artificial vision. She is a Columbia University Rising Star in Engineering in Health; a Review Editor for Frontiers in Bioengineering and Biotechnology. She was selected as one of the MIT Technology Review 35 Innovators Under 35 (MIT TR35, 2020); she received the Young Investigator Award from the Northern California Chapter of the American Association of Physicists Symposium (2019), Baosteel's National Grand Prize Award (Ranked #1 Nationally, 2015). She chaired invited talks at the Materials Research Society Fall Meeting.

Bio-inspired materials for Carbon Capture and Healthcare

Bio-inspired materials and processes offer an exciting range of possibilities in sustainability and biomedicine. Carbon capture and sequestration have been widely recognized as strategies for achieving carbon neutrality. Adopting carbon capture at a fossil fuel-burning power plant, such as in a post-combustion capture process, however, typically requires an increase in energy consumption and high costs. The cost impacts may be mitigated by the development of large-scale and cost-efficient solid adsorbents. To this end we explore amine-appended melamine porous networks (MPN) created via dynamic combinatorial chemistry (DCC) as platforms for spontaneous CO_2 chemisorption at gram scales. Multinuclear solid-state nuclear magnetic resonance (NMR) reveals the mechanism of the CO_2 chemisorption. I also designed hierarchical nanoporous membranes (HNMs), a class of nanocomposites combined with a carbon sphere and graphene oxide. The materials thus developed show a high volatile organic compounds/CO_2 physisorption capacity, which reveals promising application to carbon-capture strategies to mitigate global warming. Our study substantially expands the potential for HNM applications in the environmental and energy fields.

I also generated atomically dispersed metal for electrochemical interfaces and healthcare applications. What is more, I developed the NanowireRetina—a new generation of implantable artificial retina to restore vision. My study will shed light on the development of a new generation of optoelectronic toolkits for subretinal prosthetic devices. Through printing, pharmacological, optical, electrical, and computational toolsets, I aim to develop effective therapeutic solutions to neurological disease states. These results, along with a discussion of future neural interfaces, aim to improve our understanding of the nervous system and to inform new therapeutic approaches for biomaterials and bioelectronics. I have also developed bioinspired single-atom-based devices for mental health. I plan to expand on this exciting work in my future research.

Rising Star 2021

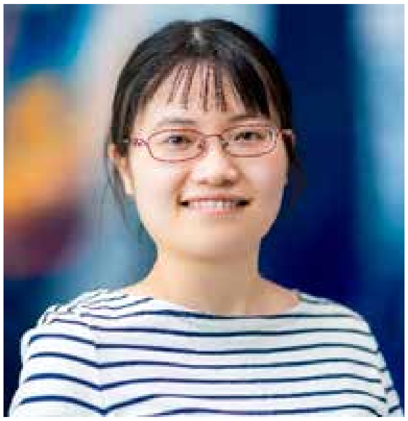
Aleczandria S. Tiffany

University of Illinois Urbana-Champaign

Aleczandria Tiffany is a Ph.D. candidate in Dr. Brendan Harley's lab at the University of Illinois Urbana-Champaign where she studies biomaterials for bone tissue engineering. She also spent 10 months researching abroad in Sydney, Australia in Dr. Kris Kilian's lab as part of her doctoral studies. Prior to her graduate studies, she attended the University of Southern California and received a B.S. in chemical engineering with a biochemical emphasis. She is a recipient of the NSF Graduate Research Fellowship and the Alfred P. Sloan UCEM Scholarship. She aims to expand her research skills to develop biomaterial platforms for studying cell biology in aging and disease. She is also passionate about mentoring underrepresented students in STEM and participating in outreach with K-12 students. Outside the lab, Aleczandria enjoys playing Stardew Valley, cooking, and watching movies.

The Development of Biomaterials to Study Aging and Disease

Aleczandria is enhancing mineralized collagen biomaterials to improve the repair of large, complex bone injuries by altering mineral and biomolecular composition. Trauma-related bone injuries are often large and complex in size and geometry and cannot be repaired with external fixtures alone, and current clinical solutions are limited by availability and implant rejection. Thus, there is a clinical need for alternative solutions to address critically sized bone injuries. The Harley Lab has developed mineralized collagen biomaterials for bone regeneration that promote mineral deposition in vitro and in vivo. Aleczandria has altered the mineral composition of these biomaterials and shown improved cell proliferation and mineral deposition via zinc supplementation. She has also altered the biomolecular composition and shown that sequential sequestrations can be used to incorporate and retain growth factors with the potential to improve cell migration and vessel formation. The Harley Lab has demonstrated the osteogenic capability of these materials, and Aleczandria is now exploring the impact of these materials on angiogenesis and bone resorption.



Jingyuan Xu

Karlsruhe Institute of Technology

Dr. Jingyuan Xu is a Research Fellow at Karlsruhe Institute of Technology (KIT). Prior to joining the KIT, Dr. Xu worked as a research associate at Imperial College London and a Postdoctoral Research Fellow at University of Cambridge. Dr. Xu received her Ph.D. degree from Technical Institute of Physical and Chemistry, Chinese Academy of Science in 2018. Dr. Xu's research focuses on clean energy technologies for providing cooling, heating, and power, including but not limited to the topics on refrigeration, high-performance power conversion, solar energy unitization, waste heat utilization, and thermoacoustics, aiming to achieve efficient energy conversion for sustainable future. She is the recipient of the Carl von Linde Award from the International Institute of Refrigeration (IIR).

Advanced Thermoacoustic Cooling: From Recycling Low-Grade Heat To Ultra-Low Temperatures

Developing alternative carbon-neutral and sustainable cooling technology has become increasingly urgent. Thermoacoustic cooling involves using heat directly to power cooling systems, requiring no harmful ozone-depleting gases, electricity, or mechanical moving parts. This presentation tackles two key issues which have limited the successful implementation of thermoacoustic cooling in real-life applications: (a) improving the efficiency and cooling power density for air-conditioning applications, and (b) extending the lowest possible temperature achievable for cryogenic cooling. Key novel modifications have been proposed which can overcome above barriers: for air-conditioning application, a doubling of efficiency results from the elimination of the phase-shifter; for cryogenic application, a novel hybrid gas-liquid resonator is deployed which allow ultra-low cooling temperatures to be reached.

Rising Star 2021

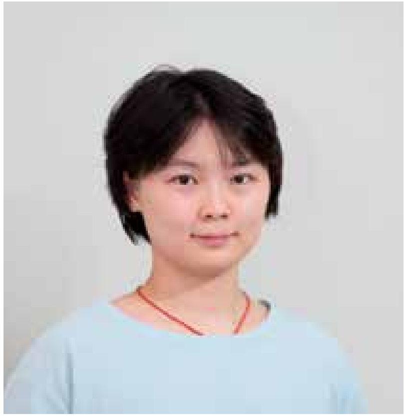
Sarah J. Yang
UC Berkeley

Sarah J. Yang is a PhD Candidate in the department of Chemical and Biomolecular Engineering at the University of California, Berkeley co-advised by Professor David Schaffer and Professor Markita Landry. She received a B.S. from Columbia University's Fu Foundation of Engineering where she studied Chemical Engineering and minored in Sociology. Her current research seeks to bring together tools from neuroscience and nanotechnology to study changes in striatal dopamine release over the course of Huntington's Disease at the spatio-temporal resolution of single release sites. Sarah has served as the president of the UC Berkeley Chemical Engineering Graduate Student Advisory Council, as a student representative on the Departmental Diversity, Equity, and Inclusion Committee, and as a Graduate Assistant for the UC Berkeley Amgen Scholars Program. She is a recipient of the NSF Graduate Research Fellowship and the UC Berkeley Outstanding Graduate Student Instructor Award.

Illuminating disruptions in dopamine release in R6/2 Huntington's Disease model mice with Near-Infrared Catecholamine Nanosensors

Dopamine neuromodulation is a critical process that facilitates learning, motivation, and movement. Disruption of dopamine is implicated in several neurological disorders, including Parkinson's Disease and Huntington's Disease (HD), though exact disease mechanisms are still not understood. In contrast to classical neurotransmitters, dopamine diffuses beyond the synaptic cleft to influence the excitability of neighboring neurons. As such, studying dopamine spread and release at the spatio-temporal resolution of single dopamine release sites (μm, ms) is critical to understanding disease mechanisms and developing novel therapies. We utilize near-infrared fluorescent catecholamine nanosensors (nIRCats) to image dopamine release in R6/2 HD mice. These adept dorsal striatal dopamine sensors exhibit a 24-fold $\Delta F/F$ in the optimal 1000-1300 nm fluorescence emission window and show that stimulated dopamine release decreases with motor degeneration, consistent with findings from established probes. Notably, nIRCats improved spatial resolution reveals previously hidden changes in dopamine hotspot number and performance with disease course. Furthermore, nIRCats' compatibility with dopamine pharmacology allows investigation into changes in D2-autoreceptor regulation of release as well as external calcium sensitivity. These findings have underscored the utility of nIRCats as a versatile new optical tool and provide a more detailed examination of dopamine disruption in HD and beyond.

Rising Star 2021



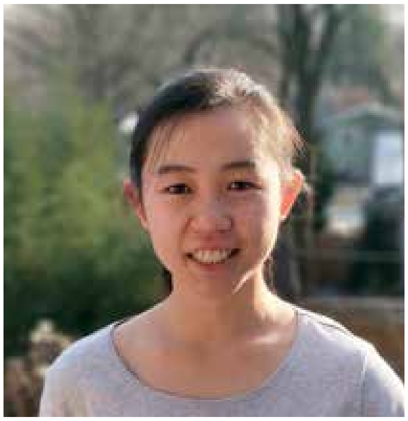
Yiran Yang

California Institute of Technology

Yiran Yang is a PhD candidate in the Department of Medical Engineering at California Institute of Technology, where she is advised by Prof. Wei Gao. Her research focuses on developing non-invasive wearable sensors for health monitoring and diagnosis. She received a Bachelor of Science in Bioengineering at Rice University and Master of Science in Medical Engineering at California Institute of Technology. She was the recipient of the Forbes 30 Under 30 in Science (Class of 2021) and the 2020 Baxter Young Investigator Award (first-tier).

Flexible Wearable Biosensors for Non-Invasive Health Monitoring

Circulating nutrients and metabolites offer rich information of human health, and their levels in biofluids can be used for diagnosis, prognosis and monitoring of therapeutic outcomes. Existing wearables are limited to vital sign detection and provide limited information of a person's health at molecular levels. My research focuses on the development of non-invasive biosensing platforms and strategies to detect and investigate biomarkers in human sweat related to various metabolic disorders. As an example we've developed a mass-producible, all-laser-engraved flexible lab-on-skin platform that enables efficient microfluidic sweat sampling, highly sensitive sweat analysis, and multiplexed vital sign monitoring based on laser-engraved graphene. With the platform we developed, sweat uric acid was studied in healthy and patient subjects for potential use in non-invasive gout management.



Joy Zeng

MIT

Joy is a graduate student in the department of Chemical Engineering at MIT where she is advised by Prof. Karthish Manthiram. Her doctoral research is themed around leveraging atomically precise motifs to quantitatively describe reaction kinetics and mechanisms at electrocatalytic interfaces. Previously, Joy received her B.S. in Chemical Engineering from Stanford University, where she worked in Prof. Bruce Clemens' lab and studied NiOx-coated nanowires for photoelectrocatalytic water oxidation. In addition to her research, Joy has mentored two undergraduates and has been involved with departmental service as both a Teaching Development Fellow and REFS-X (peer-to-peer counseling program) member.

Dissecting and designing (electro)catalytic interfaces with atomically precise motifs

Electric fields at electrocatalytic interfaces can provide highly potent physical handles for influencing the thermodynamics and kinetics of chemical reactions. However, the electrocatalytic interface is highly complex, and the interactions between electric fields, solvent, ions, and catalysts that influence reactivity are not well-understood. Atomically precise motifs can reduce aspects of this complexity and provide a useful starting point for deconvoluting these phenomena. In my thesis work, I am leveraging atomically precise motifs across several chemistries to intuitively and quantitatively describe unique ways in which catalysis is perturbed when it occurs at an electrified interface. These efforts have led to better understanding of reaction mechanism at well-known catalysts as well as the development catalysts for new electrochemical reactions.

Rising Star 2021

Hannah Zierden

University of Maryland

Dr. Zierden is currently a postdoctoral fellow at the University of Maryland School of Medicine working under the supervision of Dr. Tracy Bale in the Center for Epigenetic Research for Child Health & Brain Development. Her postdoctoral research focuses on understanding how placental extracellular vesicles may act as potentiators of maternal stress during pregnancy. In 2020, Dr. Zierden completed her PhD in Chemical and Biomolecular Engineering at Johns Hopkins University where she was co-advised by Drs. Laura Ensign and Justin Hanes in the Center for Nanomedicine. As an NSF Graduate Research Fellow, her thesis work involved investigating mechanisms of preterm birth, and engineering vaginally administered therapies to prevent preterm birth. Prior to her graduate studies, she earned a Bachelor of Science in Chemical and Biomolecular Engineering from The Ohio State University. Hannah is passionate about teaching and mentoring. During her graduate studies, she designed and taught several undergraduate courses, and mentored more than ten undergraduate and graduate student researchers.

Engineering bacteria membrane vesicles as therapies for maternal and fetal health

There is a significant lack of effective therapies for the prevention of preterm birth (PTB). Infection and inflammation, known causes of PTB, can be introduced to the uterine environment via the maternal vaginal microbiome. Unlike most microbial communities in the human body, an optimal vaginal environment consists of a low level of bacterial diversity, which is typically dominated by Lactobacillus species. Conversely, 30% of women in the U.S. are affected by bacterial vaginosis (BV), an imbalance in the vaginal microbiome marked by a polymicrobial microbiota comprised of anaerobic bacteria, including Gardnerella vaginalis. BV is associated with a higher risk for adverse gynecologic and obstetric outcomes, including sexually transmitted infections, pelvic inflammatory disease, PTB, and fetal brain injury. A possible potentiator of the adverse outcomes associated with BV, is signaling from membrane vesicles. Membrane vesicles (MVs) are bacterially-derived nanoparticles which enable host-microbe communications and impact immune responses. MVs are produced by both gram-positive and gram-negative bacteria, and facilitate horizontal gene transfer, defense against the host immune system, and transport of virulence factors. Bacteria are easily manipulated and easily cultured, making them easily scalable for therapeutic production. These inherent characteristics make MVs an ideal candidate for manufacturing biocompatible therapies for improving birth outcomes, minimizing postpartum complications, and mediating beneficial prenatal programming. My work focuses on understanding how MVs from vaginal microbes differentially impact pregnancy outcomes and long-term fetal development, and how we can manipulate these vesicles to engineer effective therapies for PTB prevention and improving fetal outcomes.

Chemical Engineering

Rising Stars
2021

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