Fall 2023 - Departmental Seminars

- Paulette Clancy (Johns Hopkins)(8/28/23)
    - Title: The Rise of Machine Learning to Advance Materials Discovery: Challenges and Progress
    - Abstract
        - There are many problems at the forefront of materials chemistry that are stymied by their inherent complexity. Such problems are characterized by a rich landscape of parameters and processing variables that is combinatorially too large for either an experimental or a computational approach to solve through an exhaustive search. In such cases, the usual approach is an Edisonian trial-and-error approach, which inevitably leaves areas of parameter space largely or wholly unexplored. The problems that we have explored are also characterized by a scarcity of data, since the data are expensive to acquire, both experimentally and computationally. This makes it an ideal candidate to solve using a Bayesian optimization (BayesOpt) approach, which provides a strategy for a global optimization of "black box" functions lacking a functional form.
        - For much of a decade, we have used a Bayesian optimization approach to study the solution processing of metal halide perovskites, a promising class of materials for solar cell development. Solution processing offers a low-energy-use and deceptively simple protocol to create electronically active thin films with high solar cell efficiency. In this talk, we will cover our accomplishments, challenges and outlook for what Bayesian optimization might achieve to help us understand, and hence control, these processes. I will end with some ideas of where we are taking BayesOpt in terms of having the ability to model nucleation and growth of metal halide perovskites and the algorithm development we will need to get us there.
    - Bio
        - Paulette Clancy, the Edward J. Schaefer Professor of chemical and biomolecular engineering, is the director of research for the AI-X Foundry, associate director of the Johns Hopkins Center for Integrated Structure-Mechanical Modeling and Simulation (CISMMS), and a fellow of the Hopkins Extreme Materials Institute (HEMI) and AIChE. Clancy leads one of the top groups in the country studying atomic- and molecular-scale modeling of semiconductor materials, ranging from traditional silicon-based compounds to all-organic materials. Her group's research comprises four main areas: advanced organic materials (covalent organic frameworks, antibacterial oligomers, organic electronics); algorithm development (force field development, machine learning, and Bayesian optimization); electronic materials (particularly III-IV semiconducting materials; and nucleation and crystal growth (hybrid organic/inorganic perovskites and quantum dot nanocrystals). Her lab focuses on studies of advanced materials processing and nucleation, including understanding the links between processing, structure, and function. Her group is at the forefront of developing new Bayesian optimization methods to encode expert knowledge and intuition, creating optimal conditions for making energy-efficient solar cells, close-to-perfect quantum dots,

and discovering polymorphs of electronic materials for shape memory applications.

- Joseph S. Kwon (Texas A&M)(9/11/23)
    - Title: Transformer-based Hybrid Modeling and Control of Evolving, Nonlinear Processes
    - Abstract
        - Traditionally, the dynamic modeling of chemical processes has relied on first-principles models grounded in fundamental physics and chemistry laws. These models, primarily formulated through differential equations with constant parameters, enable the calculation of control actions optimizing process operations, taking both process and actuator limitations into account. However, the ever-evolving and nonlinear nature of chemical processes frequently calls for models with time-varying parameters. Relying on constant-parameter models for control of complex process systems, especially those with evolving behaviors, poses significant challenges. For example, factors such as the presence of microorganisms in large-scale fermentation or unaccounted factors causing performance degradation can limit the applicability of first-principles modeling with constant parameters. In response, data-driven models, notably recurrent neural networks, offer a means to capture such evolving dynamics. However, they come with their own set of issues, including interpretability, extrapolation limitations, data dependency, and the risk of overfitting, which have limited their widespread adoption. Motivated by these challenges, we have developed hybrid models that integrate system-agnostic first-principles dynamics with system-specific data-driven, time-varying parameters.
    - Bio
        - Joseph S. Kwon is an Associate Professor in the Department of Chemical Engineering at Texas A&M University (TAMU), where he holds the esteemed Kenneth R. Hall Career Development Professorship. He earned his B.S. in Mathematics and Chemical Engineering from the University of Minnesota, Twin Cities. Subsequently, he obtained his M.S. in Electrical Engineering from the University of Pennsylvania and a Ph.D. in Chemical Engineering from University of California, Los Angeles. Dr. Kwon specializes in the development of computational models and frameworks within the field of Process Systems Engineering (PSE). His research focus encompasses multiscale modeling, hybrid modeling, model predictive control, and optimization for diverse chemical and biological process systems.
- Brent S. Sumerlin (UFlorida)(9/18/23)
    - Title: Photoactivation for Polymerization, Depolymerization, and Additive Manufacturing
    - Abstract
        - Relying solely on mild ultraviolet or visible irradiation of thiocarbonylthio compounds, a new avenue to polymer-protein conjugates, semi-telechelic polymers, and well-defined ultra-high molecular weight (UHMW) block polymers has been developed. This photomediated polymerization approach reaches number-average molecular weights in excess of 8.00 106 g/mol with

degrees of polymerization above 85,000, making these, to our knowledge, the highest molecular weight polymers ever achieved via a living polymerization. Ironically, the same chemistry that enables the synthesis of these polymers can also be harnessed to facilitate reversion to monomer (i.e., depolymerization), suggesting programmed polymer design can enable a low-energy approach to polymer life-cycle circularity. The utility of these techniques is further demonstrated in the area of soft-matter additive manufacturing.

    - Bio
        - Brent Sumerlin is the George Bergen Butler Chair in the Department of Chemistry at the University of Florida. He received his undergraduate degree in Textile Chemistry from North Carolina State University in 1998 and later earned his PhD in Polymer Science & Engineering at the University of Southern Mississippi under the guidance of Charles McCormick. After completing his PhD, Sumerlin worked as a Visiting Assistant Professor/Postdoctoral Research Associate at Carnegie Mellon University under Krzysztof Matyjaszewski. In 2005, he took a faculty position at Southern Methodist University before moving to the University of Florida in 2012. Sumerlin is an associate editor for ACS Macro Letters and a Fellow of the Royal Society of Chemistry.
- Christopher Muhich (ASU)(9/25/23)
    - Title: Renewable Energy Generation and Storage through Thermochemical Cycles-A Combined Theory and Experimental Approach
    - Abstract
        - Economic conversion and storage of solar energy into electricity and chemicals is a Grand Challenge of Engineering in the 21st Century because it will underpin the transition away from the fossil chemical and energy landscape to a renewable and sustainable future. Thermochemical cycles provide a route to both converting solar heat into feed stock H2 and CO molecules by water and carbon dioxide splitting, and thermochemical energy storage. Thermochemical reduction/oxidation cycles exploit temperature dependent oxygen exchange between gas and metal oxides to convert heat to chemical energy, which can then be used to drive chemical reactions or merely as a storage device. In this lecture, we will use a combination of computational and experimental approaches to understand these cycles and the active materials. This understanding will be used to improve their efficiency and economic performance through materials and system design. Using state of the art atomistic simulations and thermodynamic modeling techniques we will develop a fundamental understanding of the atomic level thermodynamics controlling reduction and oxidation and then use this insight to design new materials. This will be coupled to system models which direct materials design. Lastly, experimental efforts are used to validate and enhance computational modeling.
    - Bio
        - Christopher Muhich is an Assistant Professor of Chemical Engineering at Arizona State University. His research uses computational chemistry techniques to fundamentally understand and design materials to facilitate renewable energy

generation and storage, and environmental remediation processes. Research efforts in his group include renewable energy storage and generation by chemical looping, and adsorbent and single atom catalysis design for remediation of nitrates, organohalides, and toxic oxoanions from drinking water. He earned a bachelor's degree in Chemical Engineering from the University of Michigan in 2009 before completing a doctorate at the University of Colorado at Boulder in 2014. After graduate school, he spent two years as a postdoctoral researcher at ETH Zurich (Swiss Federal Institute of Technology) before joining ASU in 2018.

- Yong Zeng (UFlorida)(10/16/23)
    - Title: Advancing Cancer Liquid Biopsy with Engineered Biosystems
    - Abstract
        - Liquid biopsy is an appealing paradigm in early diagnosis, prognosis, and precision treatment of cancer, as tissue biopsy is highly invasive, costly, and often infeasible to repeat. Extracellular vesicles (EVs), including exosomes, are emerging as a new modality of liquid biopsy for cancer diagnosis and precision medicine. However, it remains challenging to isolate and measure these diverse nanosized vesicles in biological samples. In this talk, I will discuss our recent progress in engineering of microfluidic systems, nanomaterials-based biosensors, and the CRISPR/Cas12a system to substantially improve isolation and molecular profiling of tumor-derived EVs with minute sample consumption. Adaptation of these new technologies to clinical profiling of circulating EVs will be demonstrated for diagnosis and monitoring of a variety of solid tumors, including breast cancer, ovarian cancer, and pediatric Ewing Sarcoma. Our technologies were seen to improve the diagnostic power of the EV-based liquid biopsies compared to the conventional tests, which suggests their potential of translation into biomedical research and clinical utilities. Overall, these multi-modal engineered systems would provide enabling biosensing capabilities to promote early diagnosis of tumors and precision oncology.
    - Bio
        - Yong Zeng is an associate professor and the head of Analytical Division in the Department of Chemistry at the University of Florida. He is also an affiliate faculty of UF Biomedical Engineering and a member of UF Health Cancer Center. His research draws on chemistry, material sciences, bioengineering, and medicine to develop innovative micro and nanoscale tools to advance precision medicine of challenging diseases, in particular cancer. His technology innovations span from biomolecular assays to lab-on-a-chip systems and to smart biosensor powered by robotics and artificial intelligence (AI) for sensitive and quantitative measurements of liquid biopsies and biomarkers, including extracellular vesicles (EVs), proteins, and nucleic acids. Specifically, he is internationally recognized for his pioneering research in developing microfluidic technologies for isolation and analysis of tumor-derived EVs, an emerging paradigm of liquid biopsy for cancer diagnostics and therapeutics. He is devoted to translational research to bring the technological innovations from the benchtop to bedside, working with biologists and clinicians.

- Jason K. Cheung (Merck)(10/20/23)
    - CBE Special Seminar: From Modality-Specific to Boundaryless Analytics-Delivering the Pipeline of Tomorrow
    - Abstract
        - The pharmaceutical industry continues to evolve from an industry that had traditionally focused on chemically synthesized and purified, low molecular weight small molecule drugs to biologically derived and/or expressed higher molecular weight protein-based drugs. Recent advancements have included the bridging of the small and large molecule modalities (drug conjugates) that combine the specificity of a targeting agent (like an antibody) with the potency of a small molecule drug. Merck is a leading industry biopharmaceutical company that develops traditional small molecule products (think pills), biotherapeutics (think antibodies), and vaccines. In this mentoring seminar, I will share my experiences and growth in both technical and managerial roles at Merck.
    - Bio
        - Jason K. Cheung PhD is a Distinguished Scientist in the Biologics Analytical Research and Development organization at Merck & Co. Jason received his BS in Chemical Engineering at Tufts University and his PhD in Chemical Engineering at The University of Texas at Austin. Upon graduating from Univ. of Texas, Jason started his career at Merck. During his 15+ years at Merck, Jason has held technical and managerial roles of increasing responsibility in process, analytical, and product development areas including Product and Formulation Development, Preformulation Sciences, Bioprocess Development, and Analytical Development. In addition, Jason has led numerous biologics program development teams in both the early and late-stage, and he was a key contributor to the approvals of NOXAFIL-iv, KEYTRUDA, ZINPLAVA, AND LUSDUNA.
- Carnley Norman (Kite Pharma)(10/27/23)
    - CBE Special Seminar: Modeling Flow Distribution in Large-Scale Chromatographic Columns using Computational Fluid Dynamics
    - Abstract
        - Column chromatography remains a key unit operation in downstream processing of biopharmaceuticals. For most commercial processes, two to three chromatography steps are used to remove process- and product-related proteins, DNA and adventitious agents. As the biopharmaceutical industry has increased its product offerings and related demands, downstream processes have fast become a bottleneck. Many commercial and clinical processes include a number of cycles on one or more chromatography steps to process the harvest from a single production batch. Up-scaling of chromatography steps has been the natural response. Theoretically, scale-up is elegantly achieved by increasing the diameter of a column (1–2 m), maintaining the same linear velocity, keeping the bed height a constant and assuming a uniform flow distribution. This approach, however, presents a challenge for design and process engineers to ensure that larger-diameter columns deliver the same quality of flow distribution as smaller bench-scale (or pilot) columns. Although several designs exist for column head

plates and distributors to achieve that goal, limited work has been done so far to study flow distribution in chromatography columns. Dye studies have mostly been used in studying it. Such studies can be performed only after fabrication, and they are resource intensive. A complementary approach is needed to help us understand flow distribution and thus aid in fabrication and efficient testing of large-scale chromatography columns. We present one such approach by using computational fluid dynamics (CFD) to gain a fundamental understanding of fluid and mass transfer inside a large-scale packed chromatography column.

    - Bio
        - Carnley Norman (Ph.D. ’00) earned a B.S. in chemistry from Morehouse College and a B.S. in chemical engineering from Georgia Tech before entering the Ph.D. program where he worked under the direction of Dr. P.K. Lim. Carnley has over 20 years of therapeutic protein and vaccine drug substance process development, characterization, technology transfer and manufacturing experience. He has held senior engineer positions at a number of pharmaceutical companies including Merck, Amgen, Medimmune and Novartis. Carnley held a number of executive roles at KBI Biopharma including Director of Downstream Process Development, VP of Manufacturing Operations and VP of Global Process Development. In 2021 Carnley was named VP and Head of Manufacturing Sciences and Technology at Kite Pharma.
- Richard H. West (Northeastern)(10/30/23)
    - Automating the Predictive Kinetic Modeling of Complex Chemical Reactions
    - Abstract
        - In the realm of chemical engineering, the pivotal processes of creating, using, and disposing of chemicals, fuels, and products, typically involve chemical reactions. Crucial for selecting, optimizing, and controlling these processes is an understanding of the competing chemical reactions. A comprehensive microkinetic model, detailed enough to predict or explain complex behavior, can encompass many thousands of reactions between intermediate species. Developing such models poses challenges. Our approach involves two flavors of computational chemistry: learning from the computer, and teaching the computer. Automating the computations, to benefit from supercomputers without human intervention has its own challenges. This seminar will describe our work on automated reaction mechanism generation, as applied to heterogeneous catalysis and halocarbon combustion.
    - Bio
        - Richard West is an Associate Professor of Chemical Engineering at Northeastern University in Boston. He earned his BA and MEng degrees from the University of Cambridge in 2004, and his PhD, modeling the synthesis of TiO2 nanoparticles, there in 2008. He conducted postdoctoral research at MIT, developing automated reaction mechanism generation methods, and in 2011 he founded the Computational Modeling in Chemical Engineering group at Northeastern University. His group focuses on automated reaction mechanism generation, mostly applied to combustion, heterogenous catalysis, and soon

electrocatalysis. His research is supported by ACS Petroleum Research Fund, the National Science Foundation, and the Department of Energy and ARPA-E.

- Jessica Schiffman (UMass)(11/13/23)
    - Title: Going Green to Improve Materials: From Biomedical Hydrogels to Water Separation Membranes
    - Abstract
        - By re-engineering materials using bioinspired or green chemistries, we can eliminate, or at least reduce the use of toxic solvents, which would benefit the design of medical devices, water purification membranes, wearable electronics, as well as countless additional devices. In this presentation, I will discuss a few examples from laboratory's ongoing research thrusts about the benefits of developing greener technologies. First, I will discuss the effect that the fundamental properties of polymer coatings (i.e., molecular architecture, stiffness, and thickness) have on the adhesion of bacteria under quiescent conditions. By decoupling the effects of molecular architecture, stiffness, and thickness from coating chemistry, we have unlocked specific structure-property relationships that can be tailored to control the initial stage of bacterial adhesion. By understanding how materials properties influence bacterial adhesion, we may be able to decrease the concentration of commercial antibiotics needed to combat microbial biofilms. As an example of our work on engineering greener water separation membranes, I will illustrate how we are using only water and salt to manufacture ultrafiltration membranes. These membranes are formed using the electrostatic complexation between oppositely-charged polymers. We have demonstrated that by exploiting salt-driven plasticization, we can enable the formation of membranes, as well as additional materials, such as robust textiles. The overall goal of this talk is to highlight some of our recent findings and how these results can guide the green engineering of multifunctional materials that improve human health and the environment.
    - Bio
        - Jessica D. Schiffman is a Full Professor and the Gary R. Lapidus Professor in the chemical engineering department at the University of Massachusetts Amherst. She is also a faculty member in the materials science and engineering graduate program. Schiffman received her B.S. in Ceramic and Materials Engineering from Rutgers University and her M.Eng. in Materials Science and Engineering, before working as an Engineer at Stryker Orthopedics. She next received her Ph.D. in Materials Science and Engineering from Drexel University before completing a postdoctoral position in Yale University's environmental engineering department. Since 2011, Schiffman has directed an imaginative research group that invents polymer-based materials that address grand challenges in human health, the environment, and industry. She has received several research awards, including the ACS Applied Materials & Interfaces Young Investigator Award and being named an Influential Researchers by Industrial & Engineering Chemistry Research. In recognition of her dedication to mentoring and teaching, Schiffman was awarded the Distinguished Graduate

Mentor Award, the ADVANCE Faculty Mentor Award, and the Outstanding Teaching Award. From 2021-2022, she served as the interim Department Head of the department of chemical engineering and prior to that as the associate Department Head. Schiffman currently is the Deputy Editor of ACS Applied Engineering Materials, an international and interdisciplinary forum devoted to original research.

- Rebecca Dunning (NCSU CALS)(11/17/23)
    - CBE Mentoring Seminar: Mentoring Up - Strategies for Working with Mentors and Having Productive Relationships
    - Abstract
        - Dr. Rebecca Dunning from the College of Agriculture and Life Sciences will present a workshop on leading as a mentee in a mentoring relationship. She is an expert on mentoring relationships and strategies to optimize personal and professional development. Pizza will be served.
    - Bio
        - Rebecca Dunning, Ph.D., leads FFAR Fellows, a national leadership program for cohorts of 30 doctoral students studying food and agricultural sciences in universities throughout the United States and Canada. She provides individual mentorship and cohort training and development to fellows, in-person and virtually, and to NC State student and faculty groups as requested. Dunning offers mentorship workshops to NC State faculty and leads the CALS Graduate Peer Mentor Program. She holds a master's degree in agricultural economics from Auburn University, a doctoral degree in sociology from Duke University, and she continues to learn everyday from the inspiring graduate students that she serves. Her areas of expertise include leadership, professional development, mentoring, and graduate student success.
- Xinhua Liang (WashU St.Louis)(11/20/23)
    - Title: Catalyst Design and Synthesis via Atomic Layer Deposition
    - Abstract
        - Heterogeneous catalysts enable many chemical transformations of fossil resources (natural gas, methane, liquid petroleum, coal, etc.) into useful products. Normally, heterogeneous catalysts consist of small metal particles dispersed on a high surface area porous oxide support. Atomic layer deposition (ALD) is a thin film growth technique based on sequential, self-limiting surface chemical reactions, and has focused principally on the formation of oxide thin films with precise atomic layer control. Due to the unique nucleation process during the first few cycles of ALD, ALD can also be used to prepare highly dispersed metal nanoparticles or even metal single atoms. In this presentation, I will introduce ALD chemistry, metal and bimetallic nanoparticles prepared by ALD, and ALD thin film modified catalysts for various catalytic reactions.
    - Bio
        - Dr. Xinhua Liang is a professor in the Department of Energy, Environmental, and Chemical Engineering at Washington University in St. Louis. He joined WashU in August 2022 from Missouri University of Science and Technology, where he

was the Linda and Bipin Doshi Associate Professor of Chemical and Biochemical Engineering and had been a member of the faculty since 2012. He attended the Chemical Engineering program at Tianjin University, earning bachelor's degree in 2001 and master's degree in 2003. He received Ph.D. in Chemical Engineering from the University of Colorado Boulder in 2008 and had three years of postdoctoral training there. Dr. Liang's research interests are in nanostructured materials synthesis and functionalization by atomic/molecular layer deposition and applying this technology in a broad range of energy and environmental applications including catalysis, storage batteries, and gas and liquid separation.

- Martin Seifrid (NCSU)(11/27/23)
    - Title: Evolving Materials Design Toward the Lab of the Future
    - Abstract
        - To address pressing challenges in energy and healthcare, we must accelerate the pace of scientific discovery through digital technology, data-driven science, and automation. In this talk, I will discuss how I have combined experimental and computational tools to design organic semiconducting materials using both conventional and self-driving laboratory methods. I will provide an overview of how a self-driving lab works from both digital and experimental perspectives, with examples from the lab's achievements in designing organic semiconductor laser materials. Finally, I will provide a glimpse into my lab's current research directions.
    - Bio
        - Prof. Martin Seifrid is an assistant professor in the Department of Materials Science and Engineering at North Carolina State University. His group develops self-driving laboratories – automated experiments guided by machine learning – and leverages them to design precisely controlled organic mixed ionic-electronic conducting materials with applications in sensing, energy storage, healthcare, and neuromorphic computing.
        - Prof. Seifrid received his Ph.D. in Chemistry from the University of California, Santa Barbara in 2019. He worked in the Center for Polymers and Organic Solids from 2014 to 2019 under the supervision of Professor Guillermo C. Bazan. In October 2019, he joined the group of Prof. Alán Aspuru-Guzik at the University of Toronto for a postdoctoral fellowship. There, he worked on self-driving laboratories, autonomous molecular design, automated synthesis and characterization, and organic lasing materials.
- Johanna Schröder (Stanford)(12/4/23)
    - Title: Uncovering the Dynamics of Oxygen Reaction Electrocatalysts from Synthesis to Application Using In-Situ/Operando Techniques to Improve Catalyst Designs
    - Abstract
        - Water electrolyzers and hydrogen fuel cells are key technologies for storing and converting renewable energy sources.1For expending the use of both devices enhanced oxygen evolution and oxygen reduction reaction (OER, ORR) catalysts are demanded due to the slow kinetics of both oxygen reactions. Current state-of-the-art catalysts primarily comprise costly metals (iridium, platinum).

One approach to reducing device costs is maximizing the utility and durability of iridium and platinum, while another is substituting them with non-platinum-group metals. Understanding the synthesis mechanism and the dynamic catalyst behavior during electrochemical application play key roles in developing improved catalysts for both strategies. To understand utility and stability limitations of catalysts, an ideal synthesis method allows independent control of various material properties. This requirement is fulfilled by the polyol process.2 Understanding the synthesis mechanism is an important step toward expending the nanoparticle size control during the polyol process.3 For optimized catalyst designs, ensuring a decent electrochemical stability is crucial, hence identifying the catalyst dynamics and degradation is a key. Four expected catalyst degradation routes are dissolution, followed by redeposition through Ostwald ripening, particle agglomeration or coalescence, and particle detachment.4 To reduce the stability testing time and accelerate catalyst degradation, accelerated stress test (AST) protocols are applied mimicking device conditions. The gas diffusion electrode (GDE) setup facilitates these protocols under realistic device-like conditions, combining the advantages of fundamental and application device testing.5 To identify catalyst dynamics and degradation mechanisms especially the utilization of in-situ/operando X-ray techniques such as small- and wide-angle X-ray scattering (SAXS, WAXS)6 or X-ray absorption near-edge spectroscopy (XANES)7 is necessary to track changes in nanoparticle size, phase fraction, and oxidation state, respectively. Overall, in-situ/operando methods enable the monitoring of catalyst changes from preparation to application. Understanding parameter effects and catalyst limitations presenting great opportunities for enhancing catalyst designs.

    - Bio
        - Johanna Schröder received her B.Sc. in Chemistry and Masters of Science in Chemistry from the University of Bremen. She earned her Ph.D. in Physical Chemistry from the University of Bern and has been working as a Postdoctoral Researcher at Stanford University as a Mobility Fellow of the Swiss National Science Foundation. Johanna works in the SUNCAT Center for Interface Science and Catalysis at Stanford University's Department of Chemical Engineering and the SLAC National Accelerator Laboratory.
- Aisulu Aitbekova (Caltech)(12/6/23)
    - Title: Towards Affordable Solar Fuels and Chemicals for Everyone
    - Abstract
        - Generating solar fuels for difficult-to-electrify areas (such as long-distance transportation) necessitates the development of technologies optimized at multiple levels. On a molecular level, we need to create catalytic materials that stably convert CO2 with high conversion rates and selectivity to desired products. On a system level, we need to engineer reactors that efficiently convert solar energy into heat required to run chemical reactions. This stringent requirement explains a lack of studies reporting the formation of liquid fuels. In this talk, I will present our work to develop a tandem

photoelectrochemical-photothermal system that converts CO2, water, and sunlight into multicarbon products.

- Bio
  - Aisulu Aitbekova is a Kavli Nanoscience Institute Postdoctoral Fellow in the Harry Atwater Group at the California Institute of Technology. Prior to this appointment, she earned her Ph.D. in Chemical Engineering working with Matteo Cargnello at Stanford University. Aisulu received her M.S. in Chemical Engineering Practice from the Massachusetts Institute of Technology and B.S. in Chemical Engineering from Nazarbayev University in Kazakhstan. Her PhD work focused on developing novel catalytic materials. By synthesizing catalysts with well-defined properties (size, shape, and composition) and tracking their dynamic nature using X-ray absorption spectroscopy, she studied how a property of a catalyst affects its performance then used this knowledge to develop more efficient materials for thermocatalytic CO_2conversion and automotive exhaust emission control. Now, as a postdoctoral member of the Liquid Sunlight Alliance DOE Energy Hub, Aisulu develops solar-driven processes (photoelectrochemical CO_2 reduction, photothermal ethylene oligomerization, and tandem photoelectrochemical/photothermal CO2 conversion into liquid fuels) through catalyst synthesis, device fabrication, and reactor engineering.