CATALYST

BREAKTHROUGH COLLABORATIONS IN HEALTH, ENERGY, AND THE ENVIRONMENT

Advancing science, supporting business, and improving people's lives.

University at Buffalo
Department of Chemical and Biological Engineering
School of Engineering and Applied Sciences

DEAR CBE COMMUNITY,

After serving as CBE Department Chair for six years, this is my final newsletter.

In January 2025, I will hand over department leadership to professor Jeff Errington, who currently serves as Senior Associate Dean for Academic Affairs in the School of Engineering and Applied Sciences. I'm proud of the ways that the department has grown and thrived over the past six years and am confident that progress will only accelerate under Jeff's leadership. Our department is fortunate to have a "deep bench" of faculty members with the skills and temperament to serve in leadership roles, including department chair. This allows us to regularly rotate our leadership without a need to search beyond the department. Likewise, our former chairs (Carl Lund, Dave Kofke, and Stelios Andreadis) have remained in the department, providing continuity and immense institutional knowledge. The culture established by these department leaders has made CBE both exceptionally productive and exceptionally collegial. This culture has fostered sustainable growth and improvement over nearly three decades since Carl became chair. The end result is the many impressive contributions and achievements that you will read about in this newsletter, along with many more that cannot fit within these limited pages. I am grateful to have had the opportunity to lead the department and look forward to seeing what comes next.

Cheers,

Mark Swihart
SUNY Distinguished Professor
and Department Chair

Jeff Errington

"As an alumnus and longtime faculty member of CBE, I am thrilled and honored to serve as department chair. Prior leadership have placed the department in a strong position. It is an exciting time for CBE, with robust growth in the faculty, record research productivity, and significant student accomplishments. I look forward to collaborating with the faculty, staff, and students within CBE to act on new opportunities to increase the impact of our department and address challenges that come our way."

STELIOS ANDREADIS, SUNY Distinguished Professor, was awarded $2.9 million for new research on stem cell therapy for multiple sclerosis. His work has been featured on msn.com and *Multiple Sclerosis News Today*. Andreadis is Director of UB's Cell, Gene and Tissue Engineering Center and is a fellow of AAAS, BMES, and AIChE. Read more about the Andreadis lab on page 11.

HAIQING LIN, Professor and Director of Graduate Studies, was awarded $1.5 million for a two-year project to create clean hydrogen. Lin develops high-performance materials for carbon-capture technologies. He was selected as a 2024 Academic Leadership Development Program (ALDP) Fellow of the Mid-American Conference (MAC). He was also elected 2nd Vice-Chair of the Separation Division of AIChE, and is part of a DOE-funded team focused on training students from underrepresented backgrounds.

AMIT GOYAL, SUNY Distinguished Professor and Empire Innovation Professor, led a study on exploring semiconductor advancements for more powerful and flexible electronics, which was featured in *Scientific Reports* and *Tech Xplore*. He hosted UB's first microplastics summit as director of the New York State Initiative for Plastics Recycling Research and Innovation on June 5-7, and is co-leading the development of a barcode system for plastic recycling, as reported by *Nature News*, with SUNY Distinguished Professor and Empire Innovation Professor Thomas Thundat and PhD student Patatri Chakraborty.

SRIRAM NEELAMEGHAM, UB Distinguished Professor, was recognized by *Science Daily* in a story on overlooked COVID-19 research. Neelamegham found that glycans—complex carbohydrates found on the surface of viruses—may help the SARS-CoV-2 virus evade immune responses and enter host cells. He is a fellow of the American Institute of Medical and Biological Engineering and recipient of multiple awards including the SUNY Chancellor's Award for Excellence. He leads development of Symbol Nomenclature for Glycans at NCBI-NIH. Read more about the Neelamegham lab on page 10.

MARK SWIHART, SUNY Distinguished Professor, Empire Innovation Professor, and department chair was honored with the 2023 AIChE Shell Thomas Baron Award in Fluid-Particle Systems for "outstanding contributions and sustained innovation in the colloidal and aerosol synthesis of nanomaterials and their applications." In addition to his ongoing research in nanomaterial synthesis for energy applications, he is part of a team funded by a new three-year, $2.4 million grant from the Air Force Office of Scientific Research (AFOSR) to develop 2D materials for space applications.

Over **$10.65M** in research expenditures

Over **50%** increase in incoming undergraduates

7 SUNY Distinguished Professors

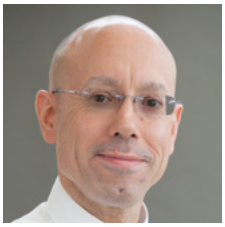
168 graduate students in 2024

FACULTY AWARDS & HONORS

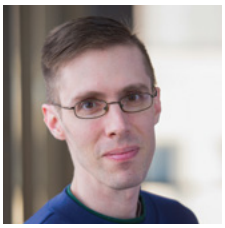
MAIO YU, Empire Innovation Professor, was featured in *Chemical and Engineering News* "2023's Top Chemistry Research, By the Numbers." His research on a heat-resistant membrane, published in *Science*, was also spotlighted by the U.S. Department of Energy, *Chemical Engineering*, and Phys.org. He also coauthored another *Science* paper on molecular recognition in covalent organic frameworks. Read more about the Yu lab on page 8.

BLAINE PFEIFER, Professor, is working with Roswell Park Cancer Institute on a five-year, $2.4 million grant from the National Cancer Institute to investigate a drug delivery system that could enable the body's cancer-fighting agents to produce stronger immune responses. He has also received the SUNY Chancellor's Award for Excellence in Research. Pfeifer was recently issued a U.S. patent entitled "Comprehensive vaccine design for commensal disease progression," together with his former student (CBE PhD graduate) Dr. Charles Jones. See more on the Pfeifer Lab on page 10.

ASHLEE FORD VERSYPT, Associate Professor, is co-investigator on a $2M NIH R01 award, "Predictive Drug Release from a Tunable Injectable Capsule," for treatment of age-related macular degeneration in the eye. She was also the Co-chair for the Bioinformatics, Computational, and Systems Biology Track of the 2023 Biomedical Engineering Society Annual Meeting.



JOHANNES NITSCHE, SUNY Distinguished Teaching Professor, organized the Howard Brenner Memorial Symposium at the National Academy of Sciences Building in Washington, DC, on May 19-21, 2024, with co-organizers Ludwig C. Nitsche, Sangtae Kim, and David A. Edwards. Brenner was a pioneer of Low Reynolds Number Hydrodynamics. The Symposium marked the 10th anniversary of his passing.



ANDREW SCHULTZ, Associate Professor of Research, received the 2024 Digital Accessibility Advocate Award from the UB Office of Equity, Diversity and Inclusion (EDI) for developing accessible web applications to replace paper-based processes throughout the School of Engineering and Applied Sciences (SEAS) and the university. He was also recognized as a senior member of the American Institute of Chemical Engineers (AIChE).

PASCHALIS ALEXANDRIDIS is UB Distinguished Professor and Fellow of several prestigious societies including AAAS and AIChE. Based on his career-long impact index, Alexandridis is ranked #5 among all active UB researchers. He is the recipient of numerous awards such as the ACS Schoellkopf Medal and SUNY Chancellor's Awards.

AURORA MUNGUÍA-LÓPEZ, Assistant Professor joining UB CBE in fall 2024, received the AIChE "2023 Minority Affairs Community (MAC) Janice Lumpkin Travel Award." She also received the FOCAPO/CPC 2023 Young Researcher Travel Grant Award from The Foundations of Computer-Aided Process Operations (FOCAPO) and Chemical Process Control (CPC) conferences. She coauthored a fact sheet about a novel technology for hard-to-recycle plastics to engage and inform the general public.

MAURA SEPESY, Assistant Professor of Teaching, was part of the UB New Faculty Academy cohort for Teaching and Scholarly Writing and presented "Making Learning Fun: A Student-Centered Learning Approach" during the 2024 New Faculty Academy Showcase.

MARLO ROETZER, Academic Coordinator, has been elected to the Executive Committee of the UB Professional Staff Senate, which serves as their Board of Directors. She is the chair for the PSS Adopt-A-Family Drive and is a member of the PSS Staff Development & Engagement Committee. Roetzer also serves on UB's Undergraduate Advisement Council, CBE's Undergraduate Committee, and the SEAS Scholarship Review Committee.

RHONDA PANGRAZIO, Facilities and Operations Coordinator, is the founder and president of the Wayne D. Foster Foundation Inc., an organization that awards scholarships and supports individuals encountering hardships, in memory of her father.

THOMAS W. WEBER, who served as one of the UB Department of Chemical and Biological Engineering's first faculty members, has passed away at age 94. For nearly 40 years, from 1963 until his retirement in 2000, he was a beloved mentor whose legacy lives on today in the form of several endowments made in his memory. Tom Weber taught Process Control to the inaugural classes of chemical engineers at UB, and served as department chair from 1982 to 1989. He was a pioneer of early remote learning through the UB GEMS NET system, which transmitted engineering courses from the Parker building on the south campus to remote locations within a 25-mile radius. He authored the textbook "An Introduction to Process Dynamics and Control."

Addressing Global Energy and Environmental Challenges

Boosting initiatives to reduce plastic waste

THE NYS CENTER ON PLASTICS RECYCLING RESEARCH AND INNOVATION, established in 2022 with a $4.5 million award from the New York State Department of Environmental Conservation, is directed by **AMIT GOYAL**, SUNY Distinguished Professor. The center, which includes faculty across UB, recently hosted a Microplastics Summit for leaders in microplastics research and stakeholders from across New York. Microplastics enter the environment via the breakdown of packaging and containers or are directly released from cosmetics, synthetic fibers, tires, and more. The UB Center supports research in eight task areas, each focused on different aspects of the plastics pollution problem, aiming to make a transformative impact.

Polymer recycling and education

In a $2 million National Science Foundation (NSF) funded project, **PASCHALIS ALEXANDRIDIS** and UB researchers are developing real-time sensors and machine learning techniques to sort plastics using robotic systems, with potential to significantly enhance plastic recycling. Alexandridis is also leading projects to enhance the recycling of multilayer packaging by delaminating and sorting into layers, reducing landfill waste and converting the plastics into usable materials.

AURORA DEL CARMEN MUNGUÍA-LÓPEZ, Assistant Professor, participates in the Chemical Upcycling of Waste Plastics Center funded by the U.S. Department of Energy, which is developing scalable technologies and solutions to mitigate plastic waste. Her research interests include mathematical optimization, sustainability, social justice, and process modeling.

MARINA TSIANOU, Professor, leads a 10-week research experience for undergraduates (REU) program where students are paired with a faculty mentor to conduct transformative research on plastic recycling.

THOMAS THUNDAT, SUNY Distinguished Professor and Empire Innovation Professor in UB's RENEW Institute has coauthored several recent studies on ways to identify and enhance polymers during the recycling process, one of which creates boron-doped laser-induced graphene (BLIG). The study shows promise for BLIG's use in micro supercapacitors, flexible batteries, biosensors, and gas sensors.

Thundat coauthored another study on rapid standoff spectroscopic characterization of plastic waste using a quartz tuning fork.

Clean energy sources

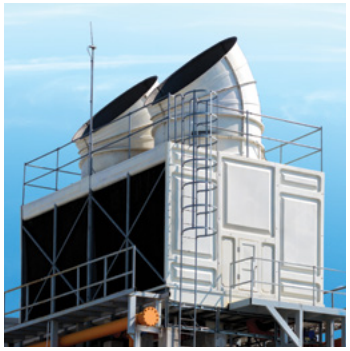
MARK SWIHART, SUNY Distinguished Professor and Empire Innovation Professor in the RENEW Institute, has developed a new general approach to producing catalysts based on high-entropy oxides and alloys that show exceptional performance in catalysis of CO_2 reactions important for CO_2 utilization and hydrogen production.

Using hydrogen as a clean energy carrier also requires sensors to detect it. Swihart, Thomas Thundat, and their research groups are exploring new ways to more effectively detect hydrogen.

CARL LUND, SUNY Distinguished Teaching Professor, is working with professors Mark Swihart and Haiqing Lin to develop membrane reactors that can produce hydrogen from gas mixtures generated by gasification of biomass.

ELENI KYRIAKIDOU, Associate Professor, is co-principal investigator on a study that aims to develop an advanced methane oxidation catalyst for lean-burn and ultra-lean burn natural gas engines. According to the U.S. Advanced Research Projects Agency-Energy (ARPA-E), this process could reduce U.S. methane emissions by 60 million tons of CO_2 equivalents per year.

Providing energy needs for our future



SUNY Empire Innovation Professor **MIAO YU** is working on nearly $40 million in DOE-funded projects aimed at meeting future energy needs while mitigating climate change. Yu is a co-principal investigator on REFUEL + IT, which develops sustainable and scalable technologies for converting renewable electricity into liquid fuels that can be easily stored and transported. He is also leading a project that will develop a catalytic membrane reactor to produce ammonia more efficiently at moderate temperatures and pressures, resources required for fertilizer production.

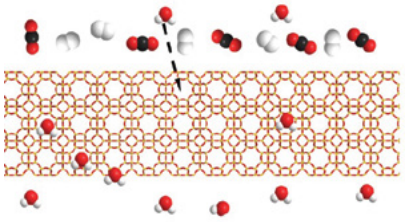
Yu is also a co-principal investigator on a project to reduce CO_2 emissions from power plants. His team is developing a new type of membrane incorporating ionic liquids, which could capture nearly all the CO_2 from natural gas combined cycle flue gas. Yu is also leading a project that could mitigate climate change by capturing CO_2 directly from the air, contributing to carbon neutrality goals.

Assistant Professor **KAIHANG SHI** is using two-dimensional energy histograms as a novel feature for machine learning to predict gas adsorption in metal-organic frameworks, enabling more accurate predictions. Shi's work could help discover and design new advanced nanoporous materials capable of separating and storing gases.

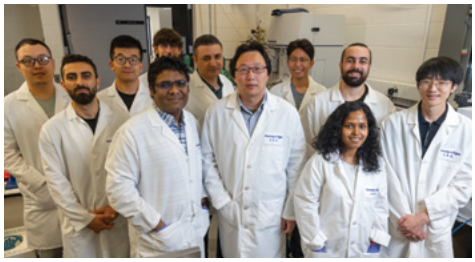
HAIQING LIN, Professor, is coauthor on several studies creating new materials or methods for separating hydrogen from CO_2. "Phenyl-Incorporated Polyorganosilica Membranes with Enhanced Hydrothermal Stability for H_2/CO_2 Separation," describes how to create an ultrathin silica membrane with improved performance in the presence of water vapor.

Lin's team also created mixed matrix materials (MMM) for gas separation membranes and demonstrated superior gas separation, significantly outperforming current commercial membranes. They also developed thin-film composite membranes to capture CO_2 from post-combustion gases, which could be produced using existing industrial manufacturing processes and have a higher permeability than thicker films.

Nanoporous Membranes for Precise Molecular Separation



Molecular sieving membranes for energy and environmental applications

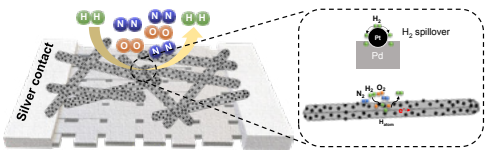


The Miao Yu group is focused on nanoporous materials and advanced nanoporous structures for energy and environment-related applications. From 2023 to 2024, they've made significant breakthroughs on developing nanoporous materials and separation membranes. In a recent publication in *Science* (384, 1441-1447 [2024]), the group, in collaboration with colleagues from the University of Colorado-Boulder, synthesized a new type of covalent organic framework (COF), with pores that can be precisely adjusted from 0.3 to 0.4 nm by heating from 30 to 100°C. This new material may have important applications for separating difficult-to-separate mixtures, such as O_2/N_2 and N_2/CH_4 for air separation and natural gas purification.

In another paper published *Science* (381, 1098-1104 [2023]), Yu and coauthors reported a new type of nanoporous membrane, carbon-doped titanium oxide (CDTO), used for precise organic molecule separation under harsh industrial conditions. These revolutionary membranes can overcome the limitations of current membranes and could be applied for large-scale applications in the pharmaceutical, chemical, and petroleum industries.

Miao Yu has also launched a startup company, E2H2NANO, LLC, which is built upon Yu's Na^+-gated nanochannel membrane technology. The company has received a DOE (Department of Energy) award to demonstrate carbon-neutral methanol synthesis using their revolutionary membrane. This Phase 1 project may lead to $8 million in DOE funds in Phase 2.

Palladium Nanostructures for Hydrogen Sensing and Safety



Schematic illustration of the hydrogen sensor based upon platinum-decorated palladium nanowires

In recent years, momentum has been building around the use of hydrogen as an energy carrier, with major investments in hydrogen infrastructure around the world. Making widespread use of hydrogen a reality will require many advances. One that is easily overlooked is the need for low-cost, widely deployable, fast, and sensitive sensors for hydrogen. Because hydrogen is colorless, odorless, and has exceptionally wide flammability limits, undetected hydrogen leaks are a substantial hazard. Mark Swihart's research group, in collaboration with Thomas Thundat's group has developed a series of low-cost hydrogen sensors based upon novel palladium nanostructures, including both nanowires and nanosheets.

Their most recent publication, which appeared in *Advanced Sensor Research*, showed that decorating palladium nanowires with tiny particles of platinum reduced the sensor response time substantially. They also showed that these sensors could be fabricated on paper substrates using only a few micrograms of palladium and platinum. The lead author on this study and others, Abhishek Kumar, PhD 2022, continues to conduct research on clean energy at Pacific Northwest National Laboratory. Meanwhile, Sadaf Mohsenifard, a current PhD student and coauthor on this paper, is developing new nanostructures that will provide even faster and more sensitive responses to low concentrations of hydrogen gas.

26TH ANNUAL GRADUATE SYMPOSIUM

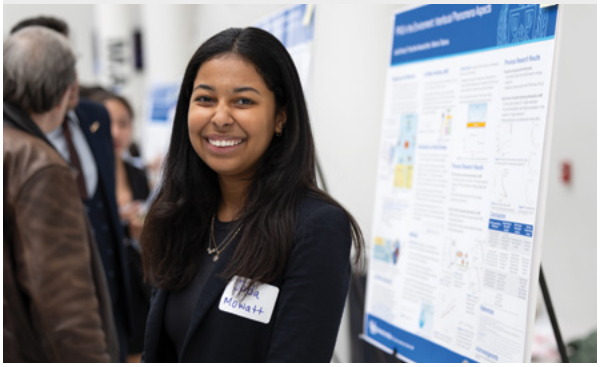
Hemant Dandekar

Over 200 people participated in the UB CBE Graduate Research Symposium held on Friday, October 20, 2023. The event featured over 60 posters, two lectures from senior graduate students, and a keynote lecture from Hemant Dandekar, PhD 1991, Global Commercial Director of Automotive Advanced Interlayers at Eastman Chemical Company. A video of his lecture, "*My Journey from a Technologist to a Global General Manager - Adventures and Lessons Learned Along the Way,*" can be found on the department's YouTube Channel. PhD students Bratin Sengupta (Miao Yu Research Group) and Ronel Zachary Samuel (Stelios Andreadis Research Group) provided opening lectures. The poster contest and reception were held in the Center for the Arts Atrium.

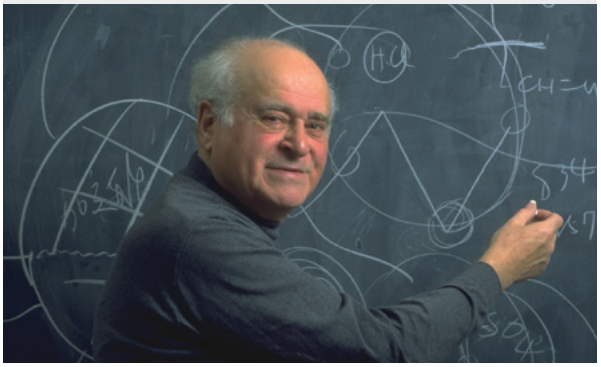
ELI RUCKENSTEIN MEMORIAL LECTURE

John L. Anderson

On Friday, April 12, 2024, UB CBE was honored to host National Academy of Engineering president, John L. Anderson, who presented the annual Eli Ruckenstein Memorial Lecture. Dr. Anderson spoke on "*Engineering the Energy Transition to Net Zero Carbon*." The Ruckenstein Lecture, held each spring, honors the late Eli Ruckenstein, a prolific researcher who made contributions in almost every subfield of chemical engineering. Each year, the series brings a distinguished scholar in chemical engineering to our campus to speak about research activities in their laboratory, trends in the field, and larger problems in society that chemical engineers can address. The series is supported by the Ruckenstein Endowment Fund, which has been funded by generous alumni and faculty donors.



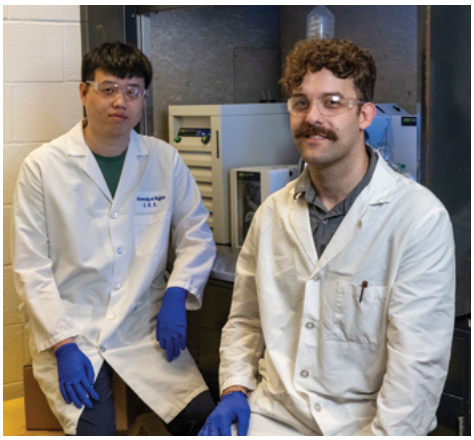
UB CBE PhD student Jada Mowett



Eli Ruckenstein

Pfeifer Group Uses Teamwork to Advance NIH Project Awards

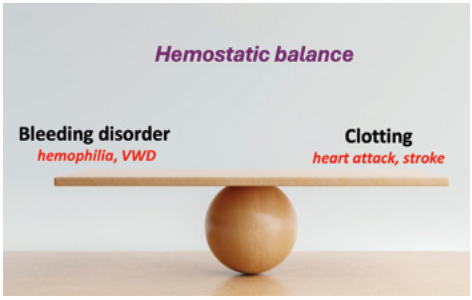
In addition to receiving the SUNY Chancellor's Award for Excellence in Research in 2024, UB CBE professor **BLAINE PFEIFER'S** research group is supported by two NIH R01 awards. These awards are supporting research of students Yihui Chen and Gavin Twoey. Chen is working on a collaborative project with the Bou Ghanem laboratory in the UB Microbiology and Immunology Department that focuses on pneumococcal disease in elderly subjects. Twoey is working in collaboration with the Muhitch team at Roswell Park on bio-delivery systems capable of prompting a more potent immunotherapy response to cancer. Also in the Pfeifer group, Justin Bassett is working with the Bou Ghanem team on pneumococcal disease vaccine formulations, including a project leveraging cutting-edge microscopy core instrumentation centers offered between UB and the Hauptman-Woodward Institute. This includes the use of cryo-EM (Electron Microscopy) to better visualize antigen delivery devices designed for enhanced immunity. A recently-concluded project in collaboration with professors Mark Swihart and Paras Prasad at UB and Dr. José Pérez Donoso (Universidad Andres Bello, Chile), funded by DARPA (Defense Advanced Research Projects Agency), produced substantial data generated by, among others, Mr. Bassett and visiting students Juan José Gutiérrez and Nia Oetiker, now being reported in multiple publications.



PhD students Yihui Chen and Justin Bassett

How Sugars Control Bleeding

UB Distinguished Professor **SRIRAM NEELAMEGHAM**, in collaboration with professor Jun Qu, UB Department of Pharmaceutical Sciences, and Beverly Schaefer, clinical associate professor in UB Pediatrics, are exploring the role of glycans in regulating thrombosis and hemostasis. All blood proteins involved in maintaining hemostatic balance are extensively glycosylated. Yet, the role of glycans in regulating thrombosis and hemostasis is not well characterized. The focus of the project is primarily on von Willebrand Factor (VWF) and other coagulation factors, as each of these is extensively glycosylated. The project goal is to determine the role of these complex carbohydrates in regulating bleeding and determine new ways to modulate hemostasis. Western New York Blood Care (WNYBC) awarded the initiative $450,000 over a three-year period. Neelamegham also holds appointments in the UB Department of Biomedical Engineering and Jacobs School of Medicine and Biomedical Sciences.



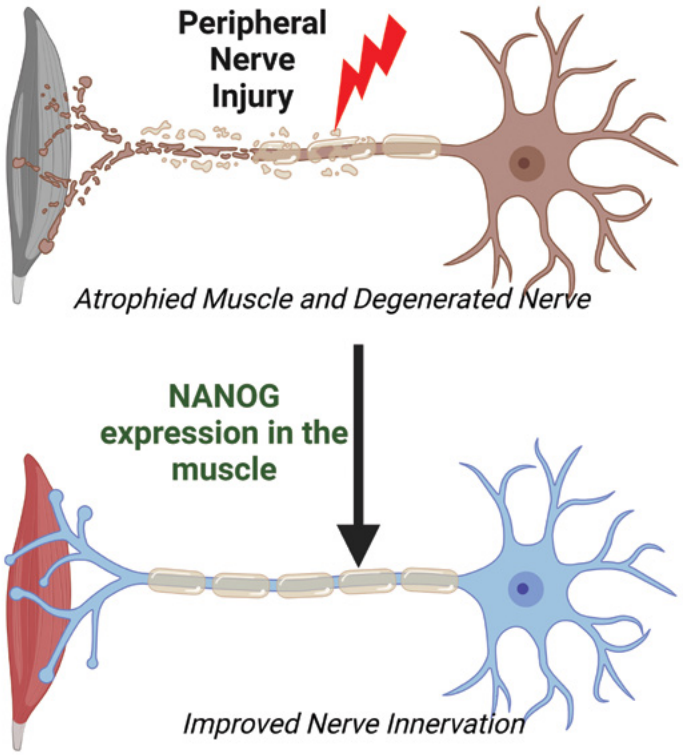
The art of balancing bleeding

Reprogramming Old Skeletal Muscle to a Youthful State

In a project funded by the National Institute on Aging (NIA), the **STELIOS ANDREADIS** group is pursuing experiments to reverse aging by partial reprogramming of senescent stem cells into a "younger" epigenetic state. Using transcription factor NANOG they were able to reverse skeletal muscle aging both *in vitro* and *in vivo* in mouse models of premature and natural aging. NANOG ameliorated the hallmarks of senescence and restored the number of stem cells (Pax7+) in part by metabolic reprogramming that involved suppressing metabolism of amino acids glutamine and methionine, while promoting proline metabolism. The findings were reported in *Nature Communications* and *Cell Reports*. The work demonstrated that reprogramming metabolic and epigenetic pathways could potentially be directed to reverse aging and mitigate the effects of age-related diseases.

More recently, in collaboration with Kirkwood Personius, clinical associate professor of the UB School of Public Health and Health Professions and UB Cell, Gene and Tissue Engineering (CGTE), they employed NANOG-mediated reprogramming of skeletal muscle to an embryonic-like state that is conducive to innervation. This study demonstrated that partial reprogramming enabled skeletal muscle re-innervation, reduced atrophy, and improved functional outcomes following peripheral nerve injury.

NANOG expression reprograms muscle tissue into a state that makes it receptive to innervation, ultimately enhancing functional recovery following nerve injury.



GRADUATE STUDENT ACCOMPLISHMENTS & RESEARCH

EDUARDO A. CHACIN RUIZ (Ford Versypt lab) earned 2nd Place in the Minority Affairs Committee Eminent Engineers Poster Competition for his presentation "Mathematical Modeling of Drug Release from Bi-Layered Drug Delivery Systems in the Eye." He also participated in the AIChE's Three Minute Thesis Competition. He was recognized with the 2023 AIChE IDEAL Star Award for leadership in LatinXinChE community (AIChE) and is part of the leadership team in the LatAm GSA club (UB).

ERDA DENG (PhD 2024, Lin lab) received a 2024 American Institute of Chemical Engineers (AIChE) Separations Division Graduate Student Research Award, recognizing his outstanding achievements in the area of membrane-based separation.

NICHOLAS GLOVER (Ford Versypt lab) received the AIChE CAST (Computing & Systems Technology Division) Directors' Award for his outstanding achievement at the 2023 Annual Meeting. Glover was recognized for his poster, "Simulating Solute Transport Through the Kidney Glomerulus Using FEBio," in the Computing & Systems category.

ARIEL LIGHTY (Ford Versypt lab) has received a National Science Foundation Graduate Research Fellowship. Her PhD research focuses on understanding the effects of aging and diet on gut health using mathematical models, and she hopes to continue advancing biomedical sciences through data-driven and mechanistic models after graduating.

EMMANUEL M. NSENGIYUMVA (PhD 2023), received a prestigious NSF Ascend fellowship to conduct research and outreach on "forever chemicals" in the Chong Cheng and Haiqing Lin labs. Nsengiyumva also served as a guest speaker for the Buffalo Educational Opportunity Center (EOC) during its International Fest event in April 2024, and as a Community Speaker for the #Oneworld Community Concert & Exhibit on April 27, organized by Bridges from Borders, a local nonprofit organization focused on improving mental health in immigrant communities.

AMEYA TANDEL (PhD 2024, Lin lab) was the reserve champion in the UB Three Minute Thesis (3MT) competition. Held on March 1, the competition celebrated PhD students' exciting research by cultivating their academic, presentation, and research communication skills. Participants were judged on their ability to effectively convey the essence and importance of their research to a non-specialist audience in just three minutes, with one PowerPoint slide. Tandel's presentation was titled "*Turning Murky to Clear: Unveiling Pure Water with Membrane Magic!*"

Noteworthy service: A team including PhD students Haryana Thomas, Oluwatoyin Campbell, Nicholas Glover, and Emmanual Nsengiyumva, in partnership with students from the Department of Chemistry, recently established a chapter of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) at UB. The mission of NOBCChE is to advance and support Black chemists and chemical engineers through professional development, academic support, and community engagement.

Congratulations to UB CBE's Best Dissertation Award winners Debanik Choudhury, Yaoli Zhao, and Gengyi Zhang. Their selection was based on the novelty and potential impact of their PhD research. The award is made possible by a generous endowment established by UB CBE Alumnus Ranjit (PhD 1973) and Sunanda Chakravorti.

PATATRI CHAKRABORTY
AMIT GOYAL AND THOMAS THUNDAT LABS

TTB: An Advanced High Speed Plastic Sorting Technique By Molecular Contrast Infrared Imaging

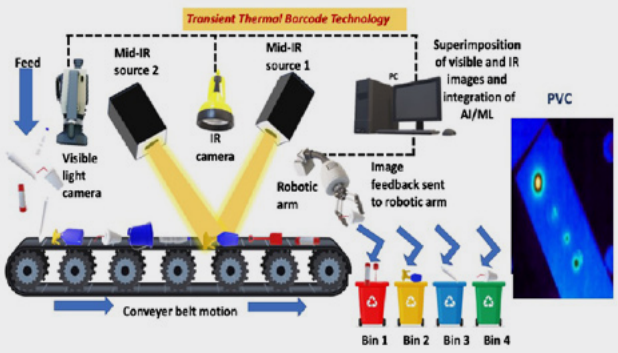
PhD student Patatri Chakraborty is developing a new high speed, high throughput way to sort plastic called Transient Thermal Barcode (TTB). TTB technique is based on imaging localized heat generated by absorption of mid-IR light (photothermal effect), which produces a localized heating pattern (absorbance spectrum), unique to each of the 6 types of recyclable plastic. Her coauthored papers on plastic sorting have been published in *Sensors and Actuators B: Chemical*, *Journal of the Electrochemical Society*, and *ECS (Electrochemical Society) Sensors Plus*. She is the Vice President of UB's ECS student chapter. She and her team represented UB at the Keysight Innovation Challenge 2022 and were awarded the first runner up trophy.

ALI GHASEMI
MARINA TSIANOU AND PASCHALIS ALEXANDRIDIS LABS

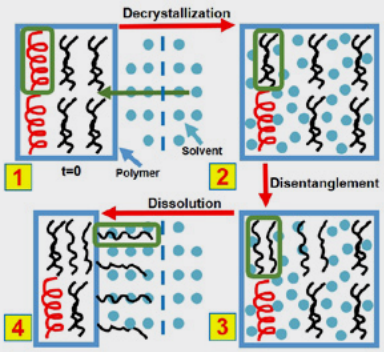
Dissolution Mechanism of Polyolefins Informs the Dissolution/Precipitation Recycling Process

Polyolefins constitute half of the 1 trillion pounds of annual global plastics production, but less than 10% is recycled, and the rest is landfilled or incinerated. Dissolution/precipitation is a method that can increase polyolefin recycling. However, published information on polyolefin dissolution kinetics is lacking. Ghasemi investigates the dissolution of semicrystalline polyolefins through joint experiments and modeling. His findings will help optimize solvent systems and processing conditions for "molecular" recycling of polyolefins from mixed plastic waste. His work has been published in *Technology Innovation for the Circular Economy*. He has also mentored several undergraduate students during the summer 2023 and 2024 breaks.

Transient Thermal Barcode (TTB): A high-speed high-throughput plastic sorting technique using molecular contrast infrared imaging



Molecular mechanism of semicrystalline polyolefin dissolution



ASHIS KUMAR PODDER AND MOHAMED ALAA MOHAMED
STELIOS ANDREADIS LAB

Injectable Shear-Thinning Hydrogels Promote Oligodendrocyte Progenitor Cell Survival and Remyelination in the Central Nervous System

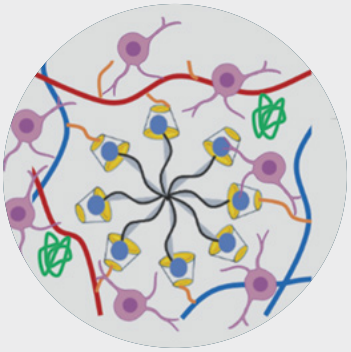
PhD student Ashis Kumar Podder and Postdoctoral Fellow Mohamed Alaa Mohamed developed innovative shear-thinning hydrogels to promote remyelination in the central nervous system. Utilizing a rationally designed injectable hydrogel system with immobilized pro-survival signals, they delivered human oligodendrocyte progenitors, the myelin forming cells, into hypomyelinated mouse brain. These cells exhibited high viability and partially restored the compact myelin sheath in the brain's corpus callosum 12 weeks post-transplantation. Their research, recently published in *Science Advances*, shows significant promise to improve cell therapies for devastating neurological disorders. This work was a collaborative effort between the laboratories of Stelios Andreadis (CBE) and Fraser Sim (UB Neuroscience Program).

JACOB LICHT
PASCHALIS ALEXANDRIDIS AND MARINA TSIANOU LABS

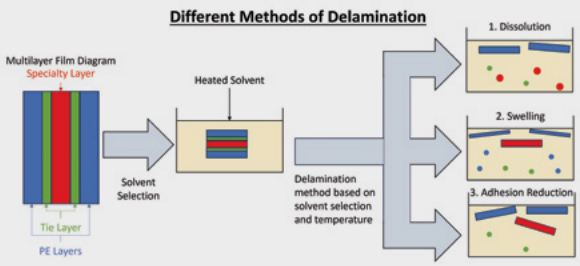
Solvent-Based Delamination of Multilayer Films for Plastics Recycling Applications

PhD student Jacob Licht develops solvent-based processes to reclaim polyethylene from multilayer plastic films. 15 billion pounds of multilayer plastic films are used annually to protect food and pharmaceuticals. Despite their recyclable components, multilayer films are currently discarded and landfilled due to challenges of separating bound polymers. Solvent-based delamination is a new method for recycling multilayer films. By selectively dissolving binding layers in a multilayer plastic film, valuable polymers like polyethylene are freed from the film, and are then recovered and recycled. Licht's research has been presented at AIChE meetings and REMADE Circular Economy conferences. He has also mentored several undergraduate researchers interested in plastic recycling.

Dynamic shear-thinning hydrogel (STH) with conjugated pro-survival signals to deliver myelin-forming cells (human oligodendrocyte progenitors) into mouse brain



Methods of inducing solvent-based delamination in multilayer plastic films



BRATIN SENGUPTA
MIAO YU LAB

Carbon-Doped Metal Oxide Nanofilms for Ultrafast and Precise Separation of Molecules

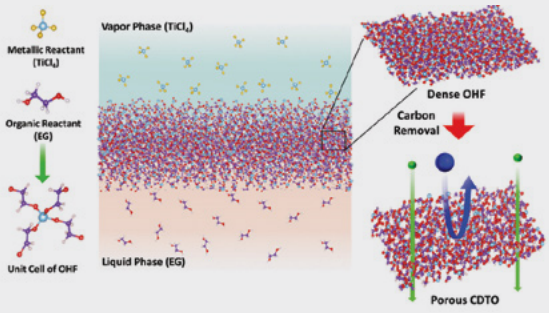
Bratin Sengupta, PhD Summer 2024, uses interfacial reactions to fabricate inorganic nanoporous membranes for precise molecular separations. Sengupta and his co-workers developed interfacial reactions to create thermally and chemically stable carbon-doped metal oxide films that are analogous to polyamide desalination membranes, extending membrane application to harsher environments. Owing to high pore density, these membranes offer high flux, even though they are relatively thick. His work on carbon-doped metal oxide nanofilms has been published in *Science* in September 2023. In his free time, he loves reading books, visiting art museums and watching movies. Bratin writes for *The Telegraph*, an Indian national newspaper's science and policy column.

BINGZHANG ZHANG
GANG WU LAB

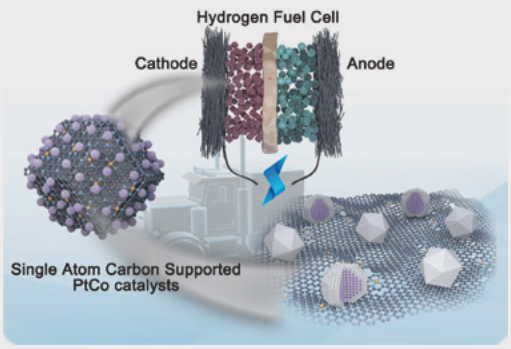
Highly Active and Durable Intermetallic Pt_3Co Catalysts for Heavy-Duty Proton-Exchange Membrane Fuel Cells (PEMFCs)

PhD Student Bingzhang Zhang integrates highly durable carbon support and stable Pt_3Co catalysts via an advanced chemical vapor deposition (CVD) method. The enhanced ordered $L1_2$ Pt_3Co catalysts further boosted membrane electrode assembly (MEA) performance and durability, relative to the state of the art. They achieved an initial performance of 1.62 Acm^{-2} at 0.7V and only lost 12% of their activity after 150K durability testing cycles. This gives fuel cell technology a bright future in heavy-duty truck applications. His work on oxygen reduction reaction (ORR) catalysts and carbon support for fuel cells has been published in *ACS Catalysis*. He was a key member of professor Gang Wu's group as a research assistant in the Million Mile Fuel Cell Truck (M2FCT) consortium funded by DOE.

Nanoporous carbon-doped metal oxide nanofilms allow for precise molecular separation



Schematic illustration of the Pt_3Co Nanoparticles Based on Single Atom Carbon Support for Fuel Cell Application



GENGYI ZHANG
HAIQING LIN LAB

Ultrathin Nanocomposite Membranes for Carbon Capture

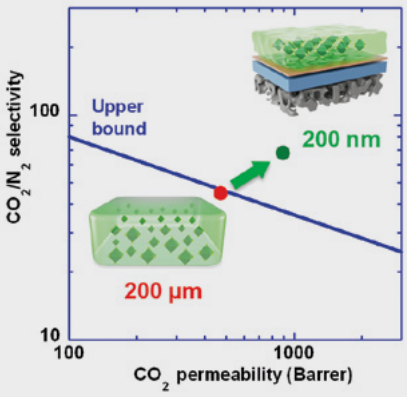
Gengyi Zhang, PhD fall 2023, developed a novel membrane that can significantly reduce the cost of post-combustion CO_2 capture. He designed ultrathin (100 nm) and scalable membranes based on a block copolymer of rubbery poly(ethylene oxide) and metal-organic framework with superior separation performance under real flue gas conditions. This research suggests that the CO_2 capture cost may be as low as $20-22/ton. His research has been published in *Journal of Membrane Science*, *ACS Applied Materials & Interface*, *Advanced Functional Materials*, and *Green Energy & Environment*. In addition to his lab work, he has mentored both graduate and undergraduate students by assisting them in developing research plans and training them in polymer characterization. He enjoys skiing in the winter and tennis each summer.

TALA MON
ELENI KYRIAKIDOU LAB

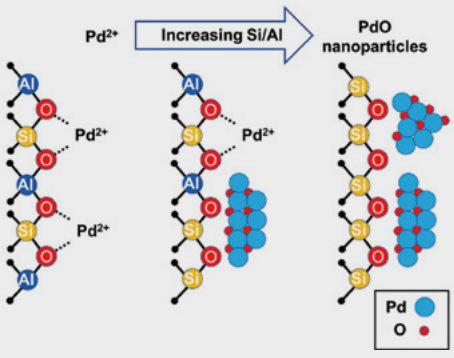
Hydrothermally Stable and Sulfur Resistant High Silica Pd/CHA for Low Temperature CH_4 Oxidation

Tala Mon develops hydrothermally stable and sulfur-tolerant Pd/zeolite catalysts for remediating methane emissions from natural gas engines. By synthesizing high-silica zeolites, he seeks to produce a hydrophobic support for active PdO nanoparticles to oxidize methane to CO_2 and water at low temperatures (<400°C). His work is funded by the Advanced Research Projects Agency-Energy (ARPA-E), Reducing Emissions of Methane Every Day of the Year (REMEDY) program and the Alliance for Sustainable Energy, LLC, managing and operating contractor for the National Renewable Energy Laboratory for the U.S. Department of Energy. Mon's work is the basis of a patent application in conjunction with Syracuse University entitled: "High-silica Pd-based small pore zeolite catalysts for low temperature CH_4 oxidation". Mon is also involved in mentoring undergraduates and high school students in the lab, along with serving as a judge for the Terra Rochester Finger Lakes Science & Engineering Fair.

Schematic of mixed matrix membranes



Development of high-silica zeolite supports to enhance active PdO nanoparticle formation in oxidizing methane

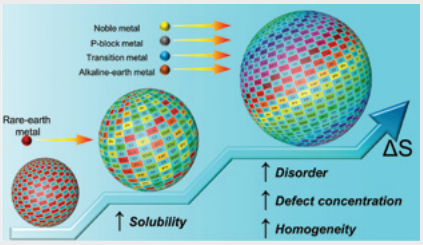


SHUO LIU
MARK SWIHART LAB

Non-Equilibrium Flame Aerosol Process to High-Entropy Nanomaterials

Shuo Liu, PhD 2024, uses a flame aerosol process to fabricate metastable and high-entropy nanomaterials. This technology can overcome thermodynamic limitations and mix immiscible elements in a single-phase to prepare various metastable solid solutions, high-entropy nanoceramics, high-entropy alloy nanoparticles, and high-entropy Metal Organic Frameworks (MOFs). These novel materials demonstrate promising applications in diverse fields, including catalysis, electrochemistry, sensors, and thermal management. His most recent studies were published in *Nature Communications* and *Matter*. Shuo Liu also collaborates with Drs. Chaochao Dun, and Jeffrey J. Urban from the Lawrence Berkeley National Lab.

Schematic illustration of the incorporation of increasing number and diversity of cations to create high-entropy ceramic nanoparticles

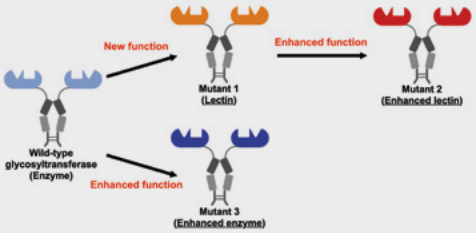


RYOMA HOMBU
SRIRAM NEELAMEGHAM LAB

Biomolecular Engineering to Develop New Lectins and Glycosylating Enzymes

PhD student Ryoma Hombu uses protein engineering to create novel proteins with boosted function. He engineered mammalian glycan-processing enzymes, called glycosyltransferases, to generate novel lectins (glycan-binding proteins) that recognize carbohydrate epitopes undetectable using traditional reagents. A similar engineering strategy was also applied to enhance enzymatic activity. He is interested in using his biotechnological and chemical perspectives to solve problems in glycobiology, an attractive research field related to biological phenomena like cancer progression and viral infection.

Rational design- and library-based protein engineering enabled mammalian glycosyltransferases to have enhanced or new functions

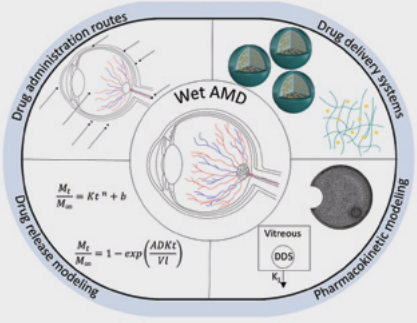


EDUARDO ANDRES CHACIN RUIZ
ASHLEE FORD VERSYPT LAB

Experimental and mathematical approaches for drug delivery in the eye

PhD Student Eduardo Chacin Ruiz leverages mathematical models to predict drug release from drug delivery systems in the eye. Using mechanistic models that incorporate polymer and drug properties, he aims to predict both drug release and concentration in the eye to improve wet AMD treatment. His paper, "Experimental and Mathematical Approaches for Drug Delivery for the Treatment of Wet Age-Related Macular Degeneration," was published in *Journal of Controlled Release*.

Wet AMD drug administration routes, drug delivery systems, drug release modeling, and pharmacokinetic modeling



Collaborative Success: Undergraduates Thrive with PhD Mentorship in the Monje Lab

Seth Thomson joined the Monje lab in spring 2023 and has since been working with PhD student Jinhui Li. Lipids constitute the basic skeleton of cell membranes and play active roles in signaling processes. Organisms differ in lipid species content and ratio, but these differences are challenging to mimic using molecular modeling techniques. Most simulations of lipid membranes use one to three lipid species to approximate the membrane environment. Thomson simulated and analyzed lipid membrane models using at least six lipid species and varied the size of the membrane patch. He and Li are preparing a manuscript summarizing their findings on the effect of membrane patch size on the physical and mechanical properties predicted by this more realistic membrane modeling. **Their benchmarks provide relevant insights for the setup of membrane-protein and membrane-small drug molecular dynamics studies.**

Dina Dahhan joined the Monje Lab in January 2024 to work under the mentorship of PhD student Toyin Campbell. Campbell received the Graduate Women in Science (GWIS) Fellowship, which sponsored Dahhan's participation in the study of the p7 protein channel from Hepatitis C. Dahhan simulated models of biological membranes to characterize the influence of membrane lipids in protein-protein interactions of p7 monomers prior to the formation of the channel. This protein is relevant for viral assembly and is known to affect lipid production, storage, and usage. **Dahhan continues to work on the project as research for credit and will explore the role of specific lipid species in protein-protein and protein-lipid interactions.**

CBE RECOGNIZES OUTSTANDING UNDERGRADUATE ACADEMIC ACHIEVEMENTS

- **Professor Thomas W. Weber Undergraduate Excellence Award**
  Ryan Sheehan
- **Professor Edward P. Furlani Scholarship**
  Anna Belyablya
- **AIChE WNY Local Section Outstanding Senior Award**
  Joseph Mennicucci
- **CBE Senior Academic Excellence Award**
  Max Barletta, Kyle Dempsey, Ryan Knavel, Aurora Occhino, Shane Varner

Celebration of a Successful School Year

The student chapter of the American Institute of Chemical Engineers (AIChE) – Chemical and Biological Engineering – University at Buffalo hosted a banquet to celebrate their graduating seniors.

During the 2023-2024 academic year, the club was run by students Teagan Allart (President), Joey Mennicucci (Vice President), Michael Pawlowski (Treasurer), Anna Belyablya (Secretary), Kyle Dempsy (Industrial Relations), Elise Dougherty (Social Chair), and Victoria Czech (Technical Director).

They organized plant tours in the Buffalo region at companies including Linde, National Fuel, and Avion, along with a variety of events ranging from social gatherings for ice cream and game nights to professional development workshops. These included resume writing with industry professionals, research panels, and interview speed dating sessions. The club also collaborated with other STEM clubs such as WiSE and Chem Club for outreach efforts at local schools.

- **CBE Senior Leadership Award**
  Teagan Allart & Michael Pawlowski
- **CBE Junior Academic Excellence Award**
  Joao Pedro Alves, Christina Bishop, Andrew Cancilla, Sarita Das, Marialis Kwak, Evan Preston, Robert Rappold
- **Nicholas Chopey Scholarship**
  Aurora Occhino
- **Thomas and Marianne Weber Family Scholarship**
  Angela Aguirre, Kirsten McGraw, Samantha Sigler
- **John R. Dervay II, Memorial Scholarship**
  Sophie Sharma
- **Barbara and Jack Davis Engineering Education Endowment Fund**
  Emily Petrinec
- **Bauer Foundation WiSE Experiential Learning Fund**
  Sarita Das
- **Chuang Family Scholarship**
  Naqiya Shabbir Arsiwala
- **David M. Benenson Memorial Scholarship**
  Kirsten McGraw

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School of Engineering and Applied Sciences

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ALUMNI SPOTLIGHT

Kristen, Megan, Kelly, and Dave Ford

DAVE FORD, BS 1991, ADVISORY BOARD MEMBER AND SUPPORTER

Dave earned his BS ChE degree from UB in 1991. He had a transformational undergraduate research experience in professor Dave Kofke's group, learning the relatively new (then) technique of molecular simulation, which set him on a path to graduate school and a career in academia. He is currently Dean of the College of Science and Engineering at Central Michigan University.

> "As a longtime member of the academic engineering community, it has been fun to keep in touch with the professors who taught me and to see the amazing growth in the prestige of UB and CBE in particular. I'm grateful for the opportunity to give back to the department that prepared me so well and guided me in exactly the right direction." –Dave Ford

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University at Buffalo
Department of Chemical and Biological Engineering
School of Engineering and Applied Sciences