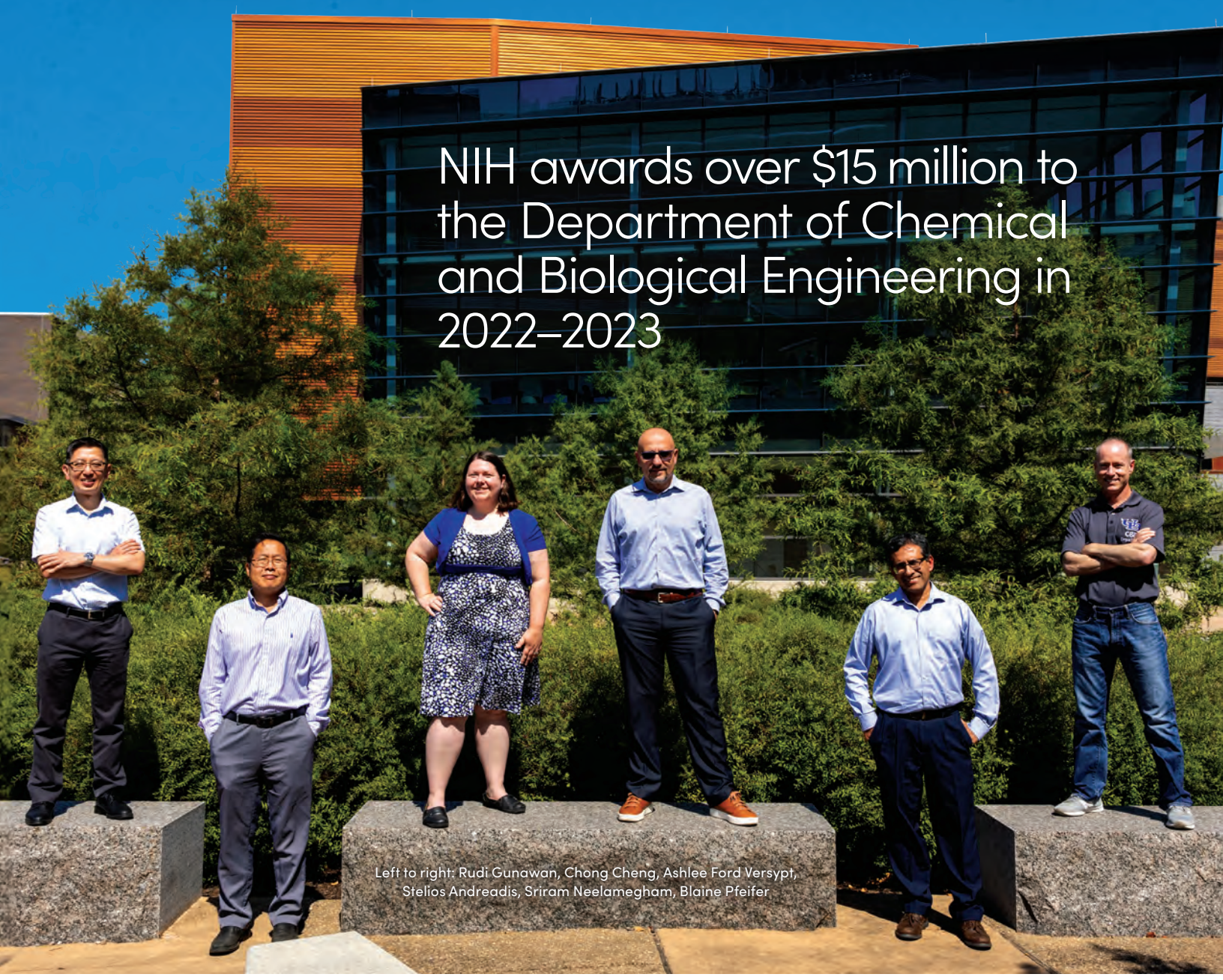
FALL 2023

CATALYST

BREAKTHROUGH COLLABORATIONS IN HEALTH, ENERGY, AND THE ENVIRONMENT

NIH awards over $15 million to the Department of Chemical and Biological Engineering in 2022–2023



Left to right: Rudi Gunawan, Chong Cheng, Ashlee Ford Versypt, Stelios Andreadis, Sriram Neelamegham, Blaine Pfeifer

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

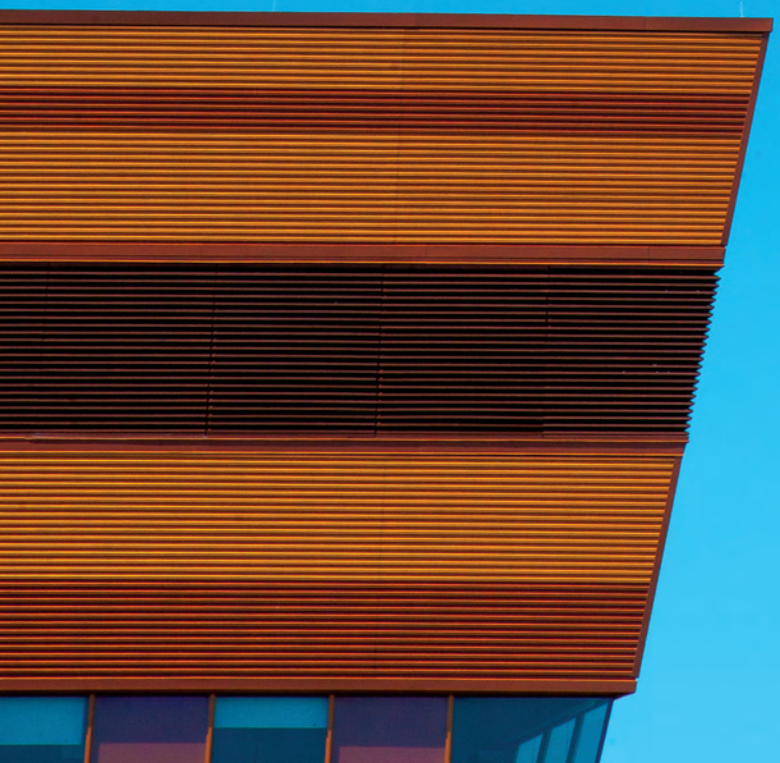
Dear CBE Community,

I am pleased to share this newsletter that highlights just a fraction of the exciting and impactful activities and accomplishments in our department.

We continue our trajectory of growth in faculty numbers, research funding, and impact as illustrated by both statistics and success stories throughout the following pages.

In the area of faculty growth, we are pleased to have Kaihang Shi and Maura Sepesy joining the department in fall 2023, and Aurora Munguia Lopez arriving in fall 2024. We have additional faculty and staff recruiting underway and hope to reach 30 faculty members by fall 2024.

Our funding from the National Institutes of Health is at an all time high, allowing us to expand our impact on the future of healthcare. Strong new funding from the Department of Energy allows us to address the most important challenges in energy and sustainability.



And our work is impacting the research community. In calendar year 2022, the average number of citations per tenured or tenure track faculty member in CBE exceeded 1000. Thus, on average, the body of work of each of our faculty members is referenced in publications about 20 times per week.

Most importantly, all these areas of growth in the department create increased opportunities for our students, enhancing the value of their experience here and preparing them to have even greater impact in their careers. This growth is also built upon a tradition of research productivity and excellence perhaps best embodied by Eli Ruckenstein, whose life and legacy we celebrated with a memorial symposium and banquet this past May. It has been 50 years since Eli joined our department, and his influence continues to be felt. I am confident he would be proud to see how the department has built upon his example.

Cheers,

Mark Swihart
SUNY Distinguished Professor
and Department Chair

$14 MILLION IN NEW GRANTS

In FY 2023 – a 17% Increase in One Year

180+

Publications Per Year Co-Authored by CBE Faculty

1000+

Citations Per Faculty Member in CY 2022

(Google Scholar)

7 SUNY

Distinguished Professors

150

Graduate Students

3 New Faculty Members

= 29 Full-Time Faculty

FACULTY AWARDS AND HONORS

GANG WU, Professor, received $3M as part of the Department of Energy's Hydrogen Shot. The project will focus on creating efficient, cheap, durable catalysts for hydrogen-powered fuel cell trucks. *See more on the Wu Lab on page 8.*

BLAINE PFEIFER, Professor, received $2.5M from the National Institutes of Health to design pneumonia vaccines tailored for older patients. *See more on the Pfeifer Lab on page 7.*

MIAO YU, Professor, received a $1.5M ARPA-Energy Grant. He is part of the largest Advanced Research Projects Agency–Energy grant ever awarded, with an additional $500k from New York State. The project will study renewable ammonia production and utilization to create hydrogen fuel for vehicles.

STELIOS ANDREADIS, SUNY Distinguished Professor, has been elected fellow of the American Association for the Advancement of Science (AAAS), the world's largest general scientific society and publisher of the *Science* family of journals. Andreadis was also elected to the AIChE Class of Fellows in 2022. He is an internationally recognized leader in the field of stem cell engineering, especially cardiovascular tissue engineering.

ASHLEE FORD VERSYPT, Associate Professor, has received the William H. Corcoran Award. She was recognized for the most outstanding article published in *Chemical Engineering Education,* by the American Society for Engineering Education (ASEE) Chemical Engineering Division, 2023. The article was entitled Supporting Faculty during the COVID-19 Pandemic.

AMIT GOYAL, SUNY Empire Innovation Professor and SUNY Distinguished Professor, is among 15 scientists from across the world shortlisted for the 2023 Global Energy Prize. The award honors exceptional contributions to scientific and technological research and development in the energy sector. Goyal was nominated in the New Ways of Energy Application category for his contribution to high-temperature superconductivity and inventions to fabricate long lengths of high-performance superconducting wire for large-scale energy-related applications of high-temperature superconductors.

PASCHALIS ALEXANDRIDIS, UB Distinguished Professor, has been elected a Fellow of the International Association of Advanced Materials. He has also been appointed to the Governing Board of the Technical University of Crete in Greece and named Editor-in-Chief of the *Journal of Dispersion Science and Technology.* Based on his career-long impact index, Alexandridis is ranked #247 worldwide in "Chemical Physics," and #5 among all active UB researchers.

VIVANA MONJE-GALVAN, Assistant Professor, received the SoBLA "Outstanding Service and Volunteer Award." The Society for Latin American Biophysicists (SoBLA) presented her with the award during the national meeting of the Biophysical Society (BPS). SoBLA's mission is to catalyze interactions among Latin American Biophysicists worldwide, providing young scientists with opportunities to reach biophysicists in Latin America and abroad to establish collaborations and/or internships, to promote the development of biophysics.

THOMAS THUNDAT has been named a SUNY Distinguished Professor, the highest rank in the SUNY system. Thundat, SUNY Empire Innovation Professor in the Department of Chemical and Biological Engineering and the UB RENEW Institute, is an internationally renowned scholar known for developing micro- and nanomechanical chemical and biological sensors.

MARINA TSIANOU has been promoted to Full Professor. She also received the UB SEAS JEDI Faculty Award. This award recognizes faculty members who are outstanding advocates for Justice, Equity, Diversity, and Inclusion. Tsianou was recognized for her sustained commitment, exemplary contributions, and leadership at the department, SEAS, university, SUNY-wide, and professional society levels promoting inclusion and increasing engagement of female and underrepresented students.

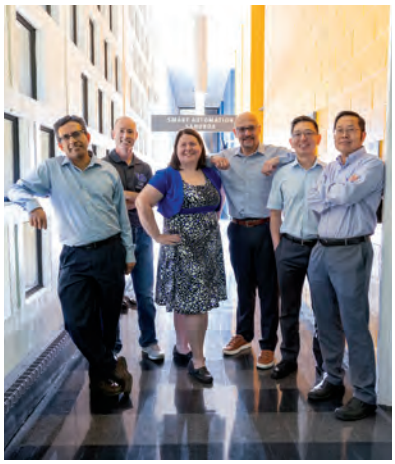
ELENI KYRIAKIDOU has been promoted to Associate Professor with tenure. She also received UB's Exceptional Scholar: Young Investigator Award in August 2022. Kyriakidou's research program focuses on catalysis of carbon-hydrogen bond activation and related emissions reduction technologies with both fundamental scientific impact and important practical implications for controlling vehicle emissions.

CHONG CHENG, Professor, provides service to disadvantaged communities through his humanitarian activities. He recently translated a classic biography of Henry Dunant, the founder of the Red Cross, from English to Chinese, and the 300-page Chinese translation was published in traditional Chinese this past April. Cheng also serves as a member of the Amherst, New York Committee on Disabilities, and writes opinion pieces for *The Buffalo News.*

MARLO ROETZER, Academic Coordinator, is serving as a senator for the UB Professional Staff Senate (PSS). In this role, she is a liaison for staff members, participates in university shared governance, promotes professional development, and encourages collegiality and support of the UB community. Roetzer is also a member of UB's Undergraduate Advisement Council, the department's Undergraduate Committee, and the SEAS Scholarship Review Committee.

EMA SCOLLO, Academic Coordinator, received the UB SEAS Rising Star award. The award recognizes her work as UB CBE's Graduate Academic Coordinator. In this role, she has added substantial value to the department's graduate student services, and in doing so has supported many of the points of the SEAS Strategic Plan and UB's Top 25 goals.

NIH Awards over $15 Million to the Department of Chemical and Biological Engineering in 2022-2023



Seven Chemical and Biological Engineering faculty members have secured $24 million in funding from the National Institutes of Health (NIH) over the last seven years. The NIH comprises 27 institutes and centers that aim to develop fundamental knowledge about living systems and apply that knowledge to enhance health, lengthen life, and reduce illness and disability.

"Our researchers broadly advance health and healthcare," says Mark Swihart, SUNY Distinguished Professor and chair of the Department of Chemical and Biological Engineering. "Robust NIH support is essential to achieving this global impact." NIH is supporting University at Buffalo chemical and biological engineers seeking to regenerate cells, fight cancer, deliver medication more effectively, and much more. Six faculty members lead 16 projects that could impact millions.

STELIOS ANDREADIS

Stelios Andreadis, SUNY Distinguished Professor, has secured four grants from NIH as principal investigator (PI) and one as a co-investigator and mentor. Andreadis' most recent project, in collaboration with Fraser Sim from the UB Department of Pharmacology, and supported by a $2.9 million grant, develops programmable hydrogels for delivery of neural stem cell derived oligodendrocytes to lessen the effects of demyelinating disease, a condition that deteriorates the protective coating around neuronal axons. Oligodendrocytes are cells of the central nervous system that play a key role in maintaining the health of neurons.

Andreadis' group will use a $2.4 million grant to investigate the role of the innate immune system in successful implantation of tissue engineered vascular grafts, developed in Andreadis' laboratory.

The group is investigating the body's inflammatory response to endothelialization, patency, and long-term remodeling of vascular grafts, toward use of these off-the-shelf arterial replacement grafts to treat cardiovascular disease.

A $2 million grant is funding Andreadis' investigation into reversing skeletal muscle aging. Using the transcription factor NANOG, their studies of its effects on metabolic and epigenetic rewiring of senescent cells led to discovery of novel druggable targets to reverse aging and ameliorate the effects of age-related diseases.

Andreadis and Olga Baker, professor of otolaryngology at the University of Missouri, are PIs on a $1.9 million project investigating strategies to promote regeneration of salivary glands impacted by radiation therapy during cancer treatment. Andreadis is also co-investigator and mentor on a T32 training grant titled Advanced Training in Oral Biology.

CHONG CHENG

Professor Chong Cheng is the PI on a $2.4 million grant to study an alternative polymer to carry cancer medications into the body. Polyethylene glycol (PEG)-based carriers are widely used in drug delivery. However, because PEG is used in a range of foods, cosmetics, and pharmaceuticals, people can develop antibodies against it, leading to allergic responses and reduced efficacy. Cheng's zwitterionic polymers provide a promising alternative. "The major advantage of zwitterionic polymers is immune response. Unlike PEG, there are currently no antibodies for zwitterionic polymers," Cheng says. The team is testing whether zwitterionic polymer-drug conjugates (ZPDCs) can serve as a novel drug delivery system for medications treating pancreatic cancer.

ASHLEE FORD VERSYPT

Associate Professor Ashlee Ford Versypt is a co-PI with researchers at Ohio State University on a $2.1 million project integrating computational models and experimental data. The project uses models and data to optimize a drug delivery capsule's release rates. The work advances treatment for wet age-related macular degeneration in the eye.

In her project, Mathematic Modeling of Prebiotic Dietary Intervention on Immunomodulation During Estrogen Deficiency, Ford Versypt's team aims to develop treatments for osteoporosis.

"We study the dendritic cell-mediated bone and T cell responses to estrogen deficiency and B-galactooligosaccharides prebiotic dietary intervention in the periphery (bone and blood) and locally (gut) using a combination of *in silico* mathematical models and *in vivo* animal models."

Ford Versypt is also the PI on the $1.9 million project Quantitative Systems Biomedicine and Pharmacology for Multiscale Tissue Damage. The goals for this project are to accelerate and facilitate construction and reuse of multiscale models and create multiscale models to improve physiological understanding of how immune stimulants affect damage in inflammation and immunotherapy.

SRIRAM NEELAMEGHAM

UB Distinguished Professor Sriram Neelamegham is the PI or co-PI on five NIH-funded projects. Neelamegham's most recent project will develop SARS-CoV-2 virus-like particles and analyze the immune response against these particles using mouse and pig models.

Neelamegham is also leading two projects associated with cellular glycosylation. The first is developing mathematical modeling methods and experiments to study cellular glycosylation reaction networks, to understand how glycosylation is regulated in human blood cells and its impact on inflammatory diseases. The second is a supplemental grant to support machine learning algorithms used to analyze the glycoscience data collected in the first initiative.

Neelamegham and associate professor Sheldon J. Park recently completed a grant to test the hypothesis that glycosyltransferases can be engineered using rational molecular design to yield glycan binding proteins.

Neelamegham is co-PI on another NIH grant through the University of Nebraska Medical Center that supports mass spectrometry and CRISPR-Cas9 workflows.

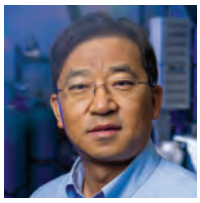
BLAINE PFEIFER

Professor Blaine Pfeifer is collaborating with scientists at the Roswell Park Comprehensive Cancer Center on a $2.4 million grant to address limitations of dendritic cells. Dendritic cells patrol skin and soft tissue and alert the immune system when hostile microbes invade. Dendritic cells often do not warn of cancer's arrival. Because cancer forms within the body, immune system cells do not view it as hostile. Pfeifer and others aim to overcome this limitation by training dendritic cells to consume pieces of genetic information – key proteins found on patients' cancer cells – enabling them to alert the immune system so it can fight the cancer.

Pfeifer and Elsa Bou Ghanem, assistant professor in UB's Jacobs School of Medicine and Biomedical Sciences, are developing a pneumococcal disease vaccine designed for aged subjects. Elderly patients are more prone to pneumococcal disease and pneumonia. This work is supported by a $2.4 million grant.

Additionally, Rudiyanto Gunawan, associate professor, is a co-PI on a project titled Leveraging Pathogen-Host Networks to Identify Virus-specific and Estradiol-regulated Mechanisms During Respiratory Infection.

Professor Gang Wu Has Received $3 Million as Part of the Department of Energy's Hydrogen Shot



University at Buffalo researcher Gang Wu became interested in solving the problem of air pollution when he was a graduate student in the 1990s. On May 22, the U.S. Department of Energy (DOE) awarded his lab $3 million to continue his work doing just that.

The award is part of Hydrogen Shot, a DOE initiative to tap hydrogen as an efficient, affordable fuel, and achieve net-zero carbon emissions by 2050.

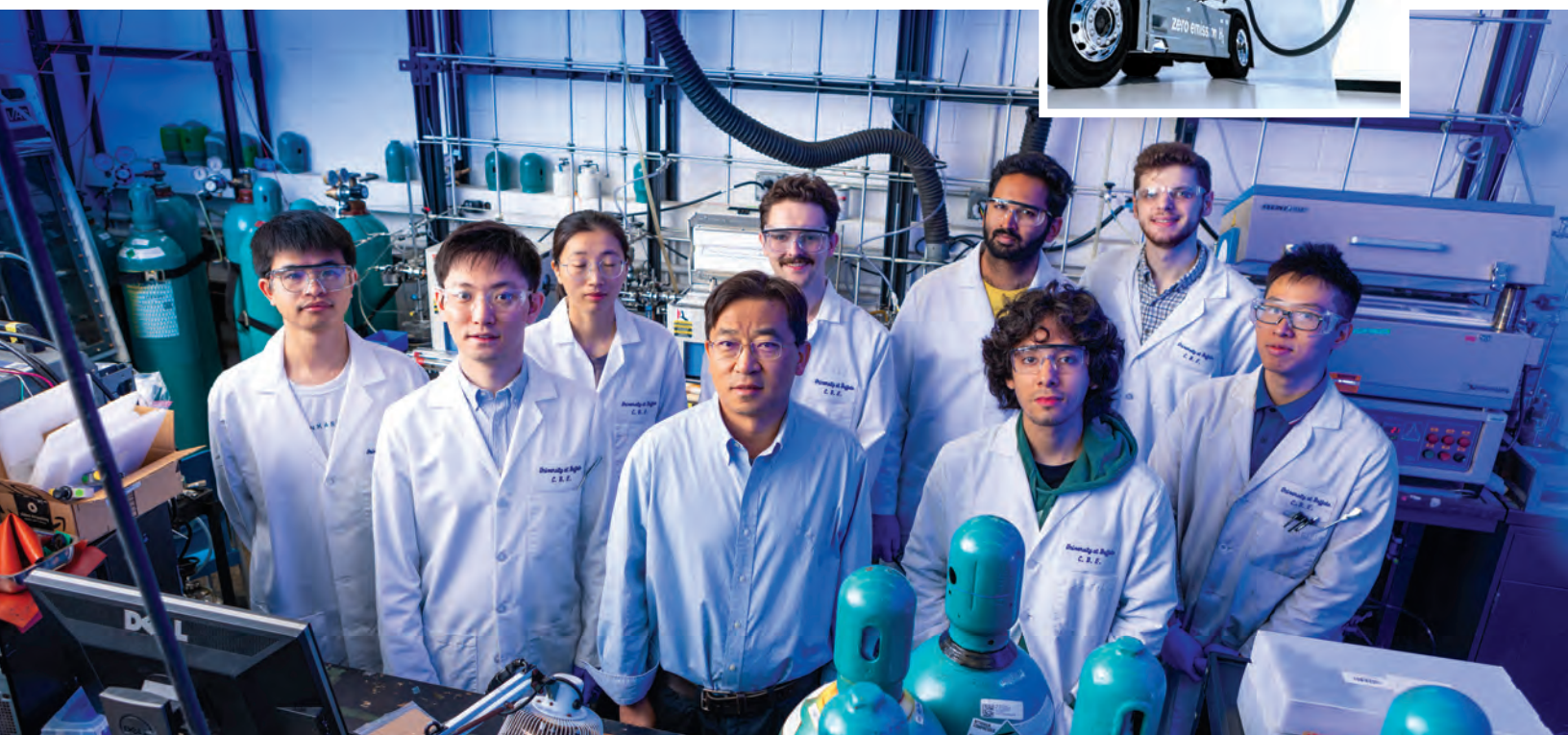
"This is a national consortium of scientists working together," says Wu. "Developing clean energy is the most important thing we can do for the future of human civilization."

That promise of clean energy is what makes hydrogen so attractive as a fuel. A hydrogen fuel cell emits only water vapor as a product, without the carbon dioxide released by gas- and diesel-powered vehicles.

Wu's project will focus on a long-sought goal: to develop a catalyst for a hydrogen fuel cell that is efficient, cheap, and durable. Wu has been seeking this catalyst for more than 18 years; his ongoing efforts have been recorded in more than 300 papers appearing in scientific journals including *Science, Nature Catalysis,* and *Nature Energy.*

"The concept of a hydrogen fuel cell is simple. Developing a catalyst that meets the goal — efficient, cheap and durable — is the challenge," says Wu, who also is directing a $600,000 subaward from General Motors on a different project with a similar focus. In that project, UB will explore innovative approaches to the design and synthesis of functional carbon materials with remarkable support effects, aiming to boost traditional platinum/cobalt catalysts.

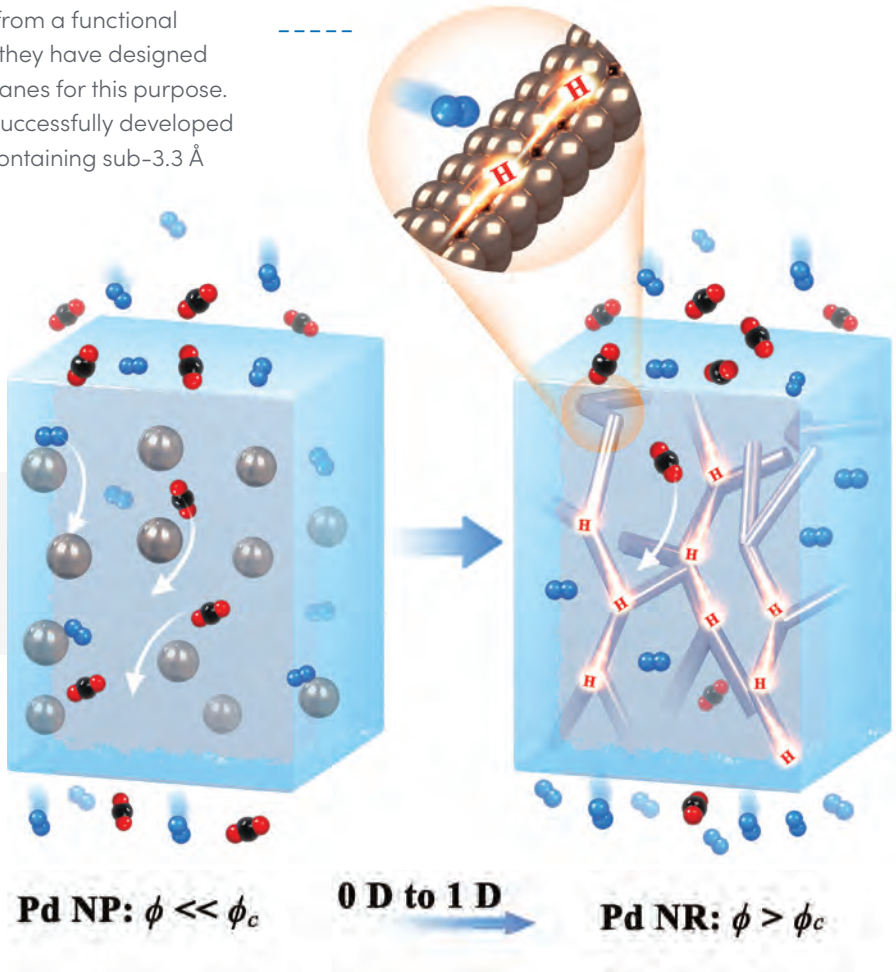
Information sourced from reporting by Mary Durlak. "UB engineer Gang Wu receives $3 million as part of the Department of Energy's Hydrogen Shot" UB Now, July 5, 2023



Holistic Approaches to Purify Hydrogen for the Hydrogen Economy

Dr. Leiqing Hu, a research scientist pursuing advanced membranes for hydrogen (H_2) purification, has been selected as one of the global winners of the 2023 IChemE & CCST Young Investigator (YI) Award. He plans to pursue an academic career in carbon capture and clean energy production.

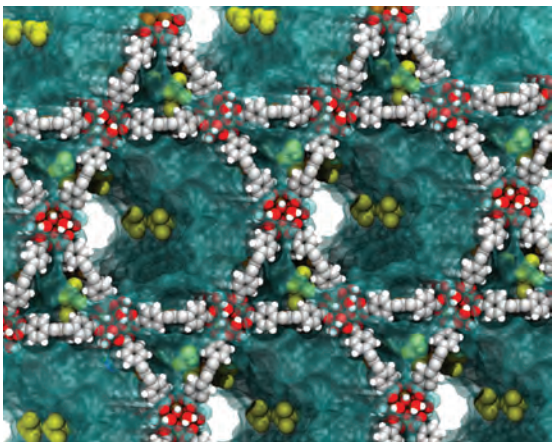
Hydrogen has been touted as a clean energy carrier to decarbonize various industries for a carbon-neutral society. However currently, more than 90% of H_2 is produced from fossil fuels, with CO_2 as a byproduct. H_2 purification and CO_2 capture during H_2 production are critical steps to minimize carbon emissions. Working with UB Professor Haiqing Lin, Leiqing is developing high-performance membrane materials to realize energy-saving and environmentally friendly H_2 purification processes. Starting from a functional polymer, polybenzimidazole (PBI), they have designed several series of advanced membranes for this purpose. Particularly, for the first time, they successfully developed nanoporous carbon membranes containing sub-3.3 Å ultramicropores that can precisely sieve H_2 from other larger gases such as CO_2, methane, and nitrogen. Additionally, they designed palladium (Pd)-percolated networks using a low-loading of Pd nanorods. The Pd nanorods have a high affinity towards H_2 and facilitate H_2 transport, thus achieving superior H_2/CO_2 separation performance. These studies were reported in prestigious journals, such as Science Advances, Advanced Materials, and Small.



Membranes based on Pd-percolated networks for H_2 purification

UB CBE Continues to Build Faculty Strength through New Hires in Clean Energy

A successful transition to a sustainable, carbon-neutral society of the future requires unprecedented collaboration across multiple disciplines. Recognizing this, the School of Engineering and Applied Sciences at the University at Buffalo sought applicants for a multi-departmental faculty cluster that will tackle key challenges in the broad area of clean energy. The cluster will emphasize multidisciplinary collaboration, both among faculty within this group and with existing colleagues across SEAS and UB. Continuing through 2024 and 2025, UB CBE will focus additional resources on recruiting faculty and growing research in clean energy.



Assistant Professor KAIHANG SHI joined UB CBE this fall as the department's 2023 Clean Energy faculty hire. His postdoctoral research was performed with Professor Randall Snurr at Northwestern University.

While there, he developed a physically inspired way to better represent nanoporous materials for machine learning using energy-based descriptors. Their team generated over 3 million simulated adsorption data points for a first-of-its-kind online adsorption database, MOFX-DB, which has been accessed by over 4,500 users from 75 countries (including leading companies such as Microsoft and IBM) since January 2020.

The database is facilitating data mining for high-performing materials to address global challenges. In close collaboration with experimental groups led by Professors Joseph Hupp and Omar Farha of Northwestern University, and Jörg Kärger, from Leipzig University, Shi also developed novel computational and mathematical tools that allow for the safe and efficient remediation of chemical warfare agents.

At UB CBE, Shi will launch his own research group in the area of computational engineering of nanoporous materials for energy, healthcare, and sustainability. His team will apply both physico-chemically-based models and sophisticated molecular simulations with machine learning approaches to accelerate the development of new nanoporous materials that can address key technological challenges.

AURORA MUNGUIA-LOPEZ, who will join the department in fall 2024, is currently a post-doctoral fellow in the Department of Chemical and Biological Engineering at the University of Wisconsin – Madison.

Her research focuses on Systems Engineering, Optimization, Sustainability, and Environmental Justice, integrating optimization, process modeling, and techno-economic and life cycle analysis into a computational framework to assess plastic upcycling technologies (e.g., solvent-based recycling and pyrolysis). Her approach has enabled quantification of economic and environmental benefits and helped guide both process and product design by identifying key bottlenecks (e.g., solvent selection, precipitation methods, and polymers with reduced environmental impact). She has already published 15 journal manuscripts, with seven more either under review or being prepared.

Upon joining, she will be able to take advantage of immediate opportunities to collaborate with RENEW, ISE, CSEE, faculty in the College of Arts and Sciences, the Law School, the School of Management, and faculty being hired in UB's new Sustainability & Clean Energy cluster.

Also joining in fall 2023 is Assistant Professor of Teaching MAURA SEPESY. She will serve as an instructor for undergraduate courses, and contribute to essential departmental undergraduate activities such as preparation for ABET accreditation, advisement, ensuring student award success, diversity enhancement, and external educational grant support.

She is an essential addition to the UB CBE undergraduate education team as she will also develop and facilitate interactions with industry employers, government laboratories, and other academic institutions in support of student internships, co-op placements, and research experiences. She is a recent graduate of Case Western Reserve University, with a PhD in Chemical and Biomolecular Engineering.

50TH ANNIVERSARY

Eli Ruckenstein

MEMORIAL SYMPOSIUM

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

On May 22, 2023, the Department of Chemical and Biological Engineering presented a day-long symposium celebrating the life and work of renowned chemical engineer and scientist Eli Ruckenstein.

Former colleagues and students, along with esteemed scientists from all over the USA attended to share scientific talks, tributes, and memories. University at Buffalo President Satish Tripathi opened the symposium, and featured technical talks were given by:

- Clayton J. Radke
  UC Berkeley
- Keith Johnston
  University of Texas at Austin
- Mark Barteau
  Texas A&M University
- Matthew Tirrell
  University of Chicago
- Rakesh Jain
  Harvard Medical School
- Yannis G. Kevrekidis
  John Hopkins University
- Yun Hang Hu
  Michigan Technological University

Ruckenstein Memorial Keynote Speakers, Andrei Ruckenstein, President Satish Tripathi, and Velina Ruckenstein with Clayton Radke.

In addition, memories and tributes were shared by more than a dozen of Eli's students, collaborators, and colleagues. The event also featured a display of Eli's most notable medals and awards, donated to the UB Archives by the Ruckenstein family.

The day concluded with a banquet at The Buffalo History Museum, attended by the Ruckenstein family, featured speakers, and the CBE faculty.

For more than 45 years, Eli Ruckenstein played a major role in the growth and development of what is now the Department of Chemical and Biological Engineering at UB. He brought national attention to the department, mentored dozens of students, researchers, and young faculty members, and provided advice to generations of department chairs. During his five decades in the U.S., Ruckenstein received countless honors for his groundbreaking contributions across many fields of research, most notably the National Medal of Science, which he received in a White House ceremony in 1999. Ruckenstein was elected to the National Academy of Engineering in 1990 and received the Founders Award from the Academy in 2004, an honor bestowed on a single engineer each year across all disciplines. In 2012, Ruckenstein was elected to the American Academy of Arts and Sciences. Ruckenstein was also known among colleagues and friends for being an extraordinarily driven yet compassionate human being. While intensely focused on his research and dedicated to the success of his students and colleagues, he was deeply concerned with broader issues, including world history and philosophy. He is survived by his wife, Velina, his son Andrei and daughter Lelia, their respective spouses, Shelagh Leahy and James O'Malley, and two grandchildren, Olivia and Leo Ruckenstein.

The annual Ruckenstein Lecture series was established in 2009. Both the memorial symposium and this annual event are made possible in part by generous donors to the Eli Ruckenstein Endowment Fund. Donations to the Fund can be made at www.cbe.buffalo.edu/ruckenstein, where you can also view the symposium photo album.

GRADUATE RESEARCH

With well over 100 graduate students conducting research in the department at any given time, the scope and diversity of research projects is extraordinary. The following pages provide just a few examples of the exciting research being conducted by CBE graduate students. To see much more, please join us for our annual Graduate Research Symposium in the UB Center for the Arts. Each year, more than 80 students present posters on their ongoing research – more fully conveying the breadth and depth of departmental research excellence.

OLUWATOYIN CAMPBELL

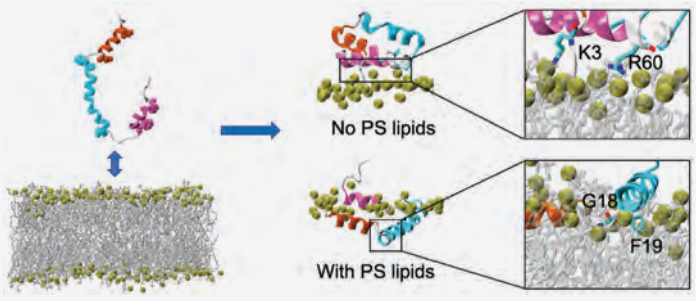
Identifying Key Lipid Species That Affect Lipid-Modulated Protein Dynamics

PhD Student Oluwatoyin Campbell (Monje-Galvan lab) uses molecular dynamics to understand bio-interactions at the cell membrane interface. Using realistic membrane models for the endoplasmic reticulum (ER), she aims to determine the role of lipid species in the binding and insertion of p7, a protein channel for the hepatitis C virus. The channel affects lipid homeostasis as it assembles close to lipid droplets, the fat storage sites for the cell. Her work on p7-membrane interactions has been published in Biophysical Journal and The Journal of Structural Biology. She is involved in activities with the GradSWE (Society of Women Engineers) at UB and mentoring undergraduates. Her most recent effort is a publication on a protocol for membrane simulations with two undergraduates in the Journal of Visual Experiments (JoVE).

DEBANIK CHOUDHURY

Inhibition of Glutaminolysis Restores Age-Associated Loss of Mitochondrial Function

Mitochondrial dysfunction is a key factor in aging and age-related diseases. PhD student Debanik Choudhury (Andreadis lab) spearheaded a study, published in Cell Reports, that explored the link between amino acid metabolism and mitochondrial function during cellular aging. Aging cells rely on the amino acid glutamine for bioenergetics. However, this leads to accumulation of a toxic byproduct, urea, which is detrimental to mitochondrial function and DNA integrity. In an exciting development, using the anti-cancer drug CB-839, a glutaminase inhibitor, Choudhury and coworkers restored mitochondrial function and alleviated aging hallmarks in progeria mice. This novel translational approach highlights CB-839's potential in targeting age-related manifestations, offering promising prospects for therapeutic interventions.



Phosphatidylserine (PS) lipids prompt interactions and result in deeper protein insertion

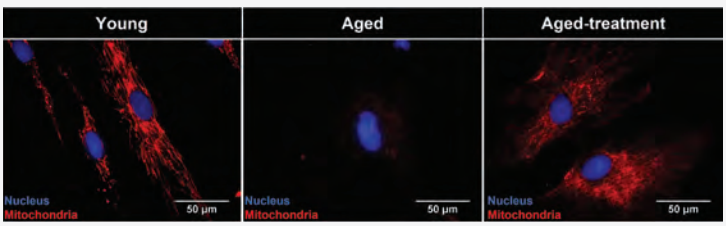


Image showing restored mitochondria with treatment in aged cells

CHRISTIAN FERGER

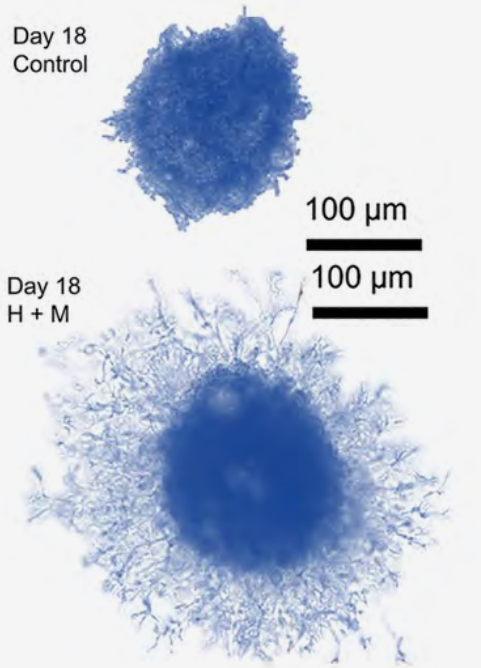
Molecular Recycling of Plastics for a Sustainable Future

Christian Ferger recently earned his PhD under the advisement of Professors Marina Tsianou and Paschalis Alexandridis. He is currently employed as a Remote Operating Center Engineer at Linde. Ferger's PhD research, funded by an NSF Emerging Frontiers in Research and Innovation (EFRI) award, addresses the plastic pollution problem. Most plastic materials produced today are discarded to landfills where they may remain for hundreds of years. Ferger investigated the use of environmentally responsible solvents in dissolution/precipitation and solvent-based delamination as methods of molecular recycling to recover polyolefins. His work contributes to the design and implementation of sustainable methods of upcycling plastic waste, which are superior to thermochemical methods of recycling in terms of energy consumption and greenhouse gas emissions.

DANIEL GUIGGEY

Linking Collective Migration/Growth to Differentiation Boosts Global Transcriptional Maturity in Human Stem Cell-Derived Liver Organoids

The transition from migration/growth to differentiation is a central process in organ growth and cancer. Thus, elucidating the underlying transcriptional complexity can advance human pluripotent stem cell (hPSC) differentiation. Using liver as a model, Daniel and other members of the Parashurama group performed transcriptomic analysis for the differentiation of migrating hepatoblasts (MHBs) into hepatocytes (HEPs) in development and regeneration. This included identifying changes in the gene regulatory network, transcriptional maturation, and cell signaling pathways. Based on their hPSC-HEP protocol that mimics this transition, they are currently developing bioinformatic and modeling approaches that both predict the MHB to HEP transition and provide the option to bypass intermediate states.



DARPA Project Brings Chilean Researchers to UB

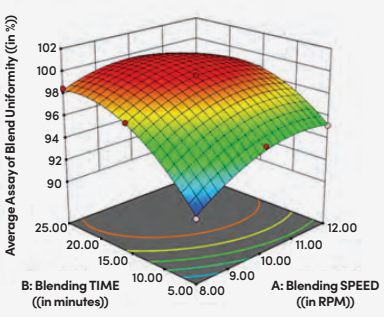
In conjunction with colleagues from UB Chemistry (Paras Prasad) and the Universidad Andrés Bello in Chile, Mark Swihart and Blaine Pfeifer secured funding from the Defense Advanced Research Projects Agency (DARPA) to pursue development of bioengineered nanoparticles, in particular, inorganic Rare Earth Element (REE) Nanoparticles (NPs) from bacterial biosynthesis. Nia Oetiker, PhD, and Juan José Leon, a graduate student, are visiting from the Universidad Andrés Bello, Chile, to work alongside Prasad, Swihart, Pfeifer, and CBE PhD students Kaiwen Chen and Justin Bassett. The idea behind the project is to use an environmentally friendly bioengineering approach toward REE NPs with unique optical properties. The project has implications across an array of applications that include bio-imaging for various diagnostic and treatment purposes as well as materials used in advanced energy conversion.

Nia Oetiker and Juan José Leon

REGINALD JACQUES

Blend and Content Uniformity: Important Concepts at the Core of Tablet Scoring

Emmanuel Reginald Jacques, known as Reggie, obtained his PhD from the Alexandridis research group. Reggie has over 15 years of experience in the pharmaceutical industry, developing many drug product formulations that are currently approved for use in the market. Reggie's doctoral research focused on formulating tablets that can be partitioned in two portions with equal amounts of active ingredient. Reggie addressed the drug particle size and excipient ratio influences on content uniformity. He also investigated different tableting conditions and performed various characterizations and *in vitro* tests to determine processing conditions that would produce scored (partitioned) tablets with suitable physical and chemical characteristics. Reggie's findings inform tablet scoring formulation development and processing strategies.



Average Assay of Blend Uniformity=
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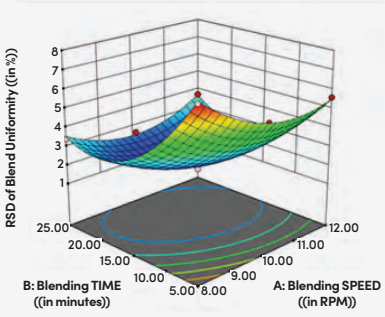
-0.9500AB-1.52A^2-2.22B^2



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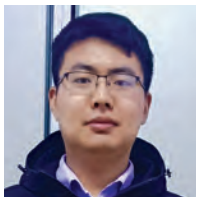


JINHUI LI

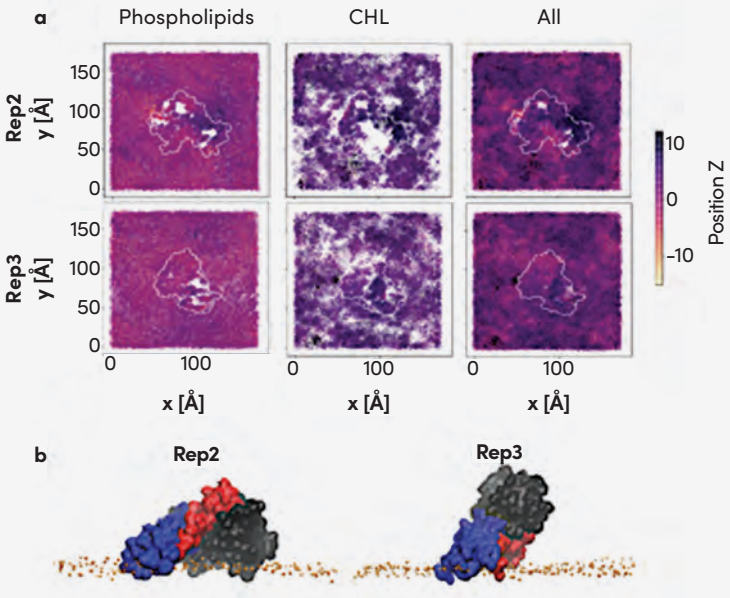
Interaction of Lipid Bilayers With Small Molecules for Medicinal Applications

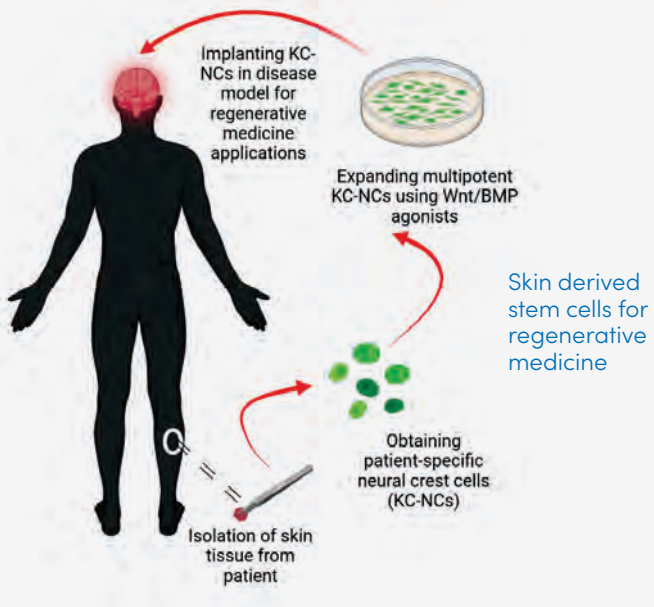
Jinhui Li (Monje-Galvan lab) is characterizing the effect of chemical diversity on the interaction of saponins with cell membranes, given their potential applications as antibacterial, anti-inflammatory, and anti-cancer therapeutics. His publication in ACS Applied Biomaterials has opened up communication with a team of researchers at the University of Copenhagen (Professor Soren Bak) that studies the same chemical compounds in the context of biopesticides and plant biochemistry. Li's work has also enabled a collaboration with another research team (Francisco Javier Sierra-Valdez) at the Tecnológico de Monterrey, Mexico. Li and these collaborators are currently preparing a publication that summarizes their findings on how local anesthetic drugs modulate the physical and mechanical properties of lipid bilayers in the context of anti-inflammatory treatments.

PIHU MEHROTRA

Skin Derived Neural Crest Stem Cells and Metabolic Requirements for Multipotency

Neural crest-like stem cells (KC-NCs) can be derived from adult human tissues such as the skin. However, these cells lose their multipotency or "stemness" rapidly in culture, limiting their clinical utility. In Mehrotra's work recently published in Stem Cells, she showed that the multipotency of KC-NCs can be preserved by treating them with Wnt and BMP signaling agonists. This treatment led to upregulation of key neural crest-specific genes and was accompanied by metabolic rewiring of cells to a highly glycolytic state. This study reveals that an interplay between gene transcription and carbon metabolism is crucial in governing stem cell identity. Given the accessibility of the skin and ease of obtaining these cells without genetic modification, the results have significant implications for regenerative medicine as well as for studying human disease.





EMMANUEL NSENGIYUMVA

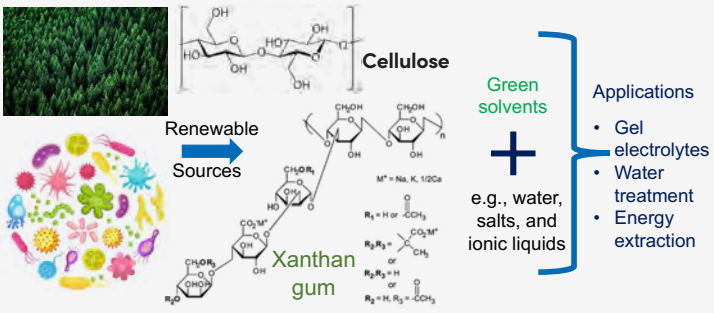
Xanthan Gum Polysaccharide Aqueous Structure and Properties Modulated by Additives

Emmanuel Nsengiyumva just completed his PhD under Professor Paschalis Alexandridis. He is interested in environment-friendly materials such as polysaccharide biopolymers. Polysaccharides find diverse applications in the food industry, pharmaceutics, cosmetics, and petroleum extraction. Xanthan gum polysaccharide is widely used as a thickening agent, for which polymer chain conformation and associations are critical. Nsengiyumva researched how polymer structure in aqueous solution is affected by salts that are ubiquitous in applications, and how structuring can be modulated by special additives such as ionic liquids that combine electrostatic and hydrophobic interactions. Understanding these complex interaction mechanisms will facilitate the design of eco-friendly conductive hydrogels and gel electrolytes for various applications.

ZIWEN ZHANG

Self-Reinforced and Self-Healing Polymers: A New Strategy to Address Mechanical Property Deterioration of Polymer Materials

Self-healable and reprocessable polymeric materials with dynamic bonds have been widely studied. However, polymer self-reinforcement via conversion between multiple types of covalent bonds has not been reported. Ziwen Zhang's (Cheng lab) research reports dynamic covalent polymer networks (DCPNs) with catalyst-free shifting multi-dynamic bonding features. His work demonstrated that a free thiol could exhibit dynamic exchange with a metastable hindered urea group, resulting in a more stable thiol-urethane and hindered urea dual-functional dynamic system. Such a system maintains its self-healing properties while enhancing its original mechanical properties. Incorporating the dual-functional dynamic exchange chemistry could potentially broaden the scope of self-healing materials.



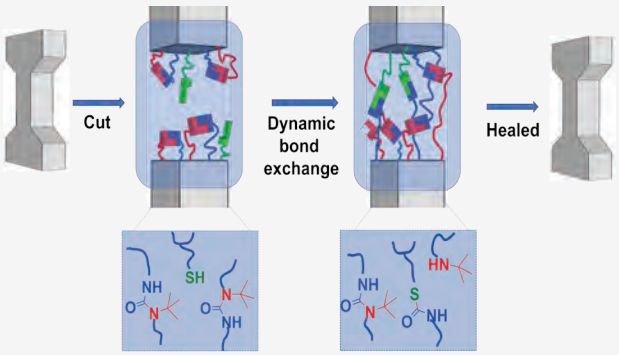


Illustration of the self-healing mechanism

UB CBE Congratulates Lili Rassouli, Who Was Chosen for a Prestigious Department of Energy Research Program

Rassouli, who is pursuing her doctorate in chemical engineering in the Michel Dupuis research group, intends to further her work at the Pacific Northwest National Laboratory this fall.

GENGYI ZHANG

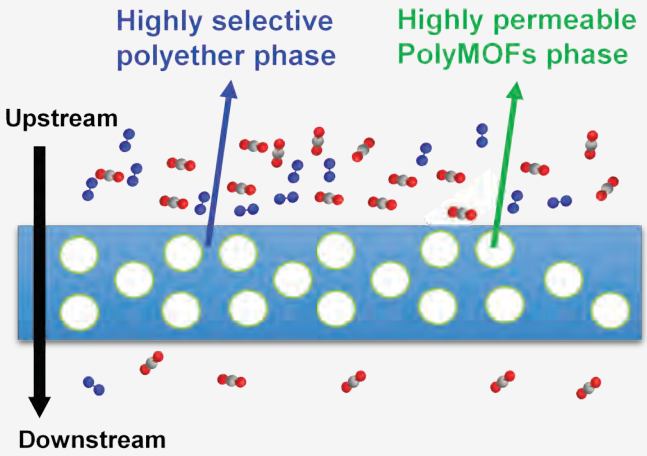
CO_2-philic Block Copolymers with Intrinsic Microporosity for Post-Combustion CO_2 Capture

Reducing CO_2 emissions from coal-fueled power plants is widely viewed as a key element in mitigating global warming. Gengyi Zhang (Lin lab) is developing a novel, step-change membrane that can significantly reduce CO_2 capture cost. Their approach was to develop new and scalable membrane materials based on block copolymers (BCPIMs) of rubbery poly(ethylene oxide) (PEO) and polymerizable metal-organic frameworks with superior CO_2/N_2 separation properties. Techno-economic analysis suggests that the capture cost based on the membrane developed in this project may be as low as $20-22/ton, which is well below the U.S. Department of Energy's nominal target of $30-40/ton.

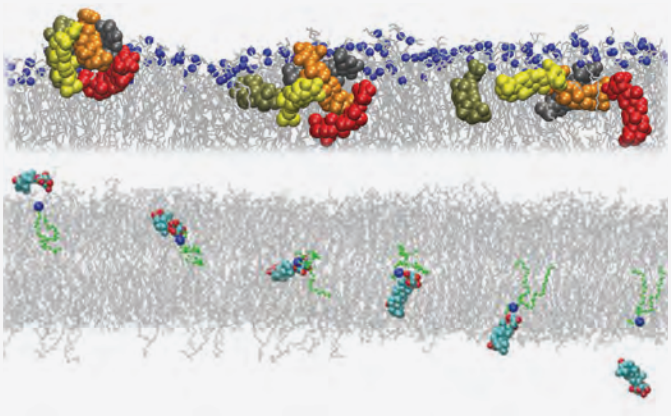
RICARDO RAMIREZ

Modeling the Fingerprint of Protein-Lipid Interactions at the Membrane Interface

Ricardo Ramirez (Monje-Galvan lab) is conducting simulation studies on molecular mechanisms of cell death; particularly the effect of peripheral membrane proteins on membrane lipid sorting, and membrane remodeling and disruption in the context of necroptosis. Molecular understanding of these topics will contribute to the development of novel treatments for neurodegenerative and cancer diseases. The Monje-Galvan group's recent publication in Frontiers in Chemistry was done in collaboration with the research group of G. Ekin Atilla Gokcumen in UB Chemistry. They are continuing studies for an upcoming follow-up manuscript.



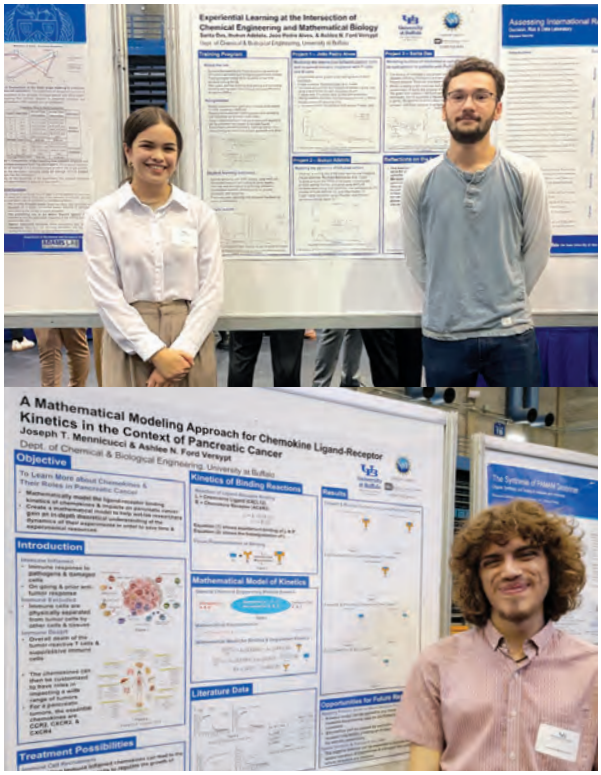
Schematic of BCP-MOF membranes comprising continuous polyether phase and discontinuous MOFs phase



Permeation of small molecules

UB CBE Faculty Mentor Undergraduate Students

Undergraduate students in chemical and biological engineering gain research experience by participating in inquiry-based learning opportunities to engage as active learners in a research setting.



This past year, Associate Professor Ashlee Ford Versypt mentored four undergraduate students in her Systems Biomedicine and Pharmaceutics lab, and in 2022, ten more, including two from Howard University and Case Western Reserve University. **SARITA DAS, IBUKUNOLUWAPO ADETOLA,** and **JOEY MENNICUCCI** each presented at the UB Celebration of Academic Excellence Poster session on April 26. The showcase featured student research and creative projects completed under the mentorship of UB faculty and was coordinated by the UB Experiential Learning Network (ELN).

In the Spring 2023 semester, **TEAGAN ALLART** worked in SUNY Distinguished Teaching Professor Carl Lund's lab comparing the minimized volumes of water-gas shift catalyst beds in several different reactor configurations. Water-gas shift is an important step in the purification of hydrogen produced by the gasification of biomass. Teagan developed mathematical models for single packed bed reactors, two packed bed reactors in series, and a packed bed membrane reactor. Her modeling utilized catalyst properties and reaction rates for two classes of water-gas shift catalyst (high-temperature and low-temperature catalysts). To date, she has minimized reactor volume for all of the packed bed reactor configurations and is working on minimizing the volume of packed-bed membrane reactors. Allart is also active in UB Women in Science and Engineering (WISE) and is the incoming AIChE student chapter president.

In Assistant Professor Viviana Monje-Galvan's lab, **ANGELA AGUIRRE** and **SETH THOMSON** worked with PhD student Jinhui Li in the spring 2023 semester running cell membrane-only simulations with complex mixtures. They each simulated a membrane with six lipid species (complex for simulations) to quantify the effect of membrane size on its physical properties using molecular dynamics simulations. They will both complete analysis of their systems under Monje-Galvan and Li's supervision during the fall semester to ultimately submit the conclusions from their study for publication. In addition, Aguirre and Van Le, an undergraduate from the Math Department at UB, worked with PhD student Toyin Campbell during the spring 2023 semester on a manuscript describing the protocol to build, simulate, and analyze realistic membrane models, which has been published in The Journal of Visualized Experiments (JoVE), along with a short professionally recorded video highlighting the steps in their protocol.

For more information on undergraduate research opportunities at UB CBE, see Experiential Learning Opportunities on our website.

CE 408 Plant Design Evolves and Continues to Put a Capstone on CBE Students' UB Journey

Chemical Engineering Plant Design (CE 408), is taught by Teaching Associate Professor Dave Courtemanche and serves as UB CBE senior students' capstone course.

Students are tasked with putting together the various elements of chemical engineering that they have learned over their academic career at UB to design and analyze the potential profitability of a new chemical plant.

Students use the knowledge gained from their many CBE classes, with specific emphasis on the Material and Energy Balances, Fluid Dynamics, Heat and Mass Transfer, Reactor Design, and Separations courses. Students learn to use the UniSim Process Simulation software. New subject matter relating to financial analysis and heat exchanger networks is introduced. In recent years, CBE has been collaborating with the Department of Engineering Education to provide students with insights into effective teamwork. Lectures on engineering ethics and working across global cultures have also been added. Feedback from recent graduates is that this course has been a useful aid in getting off to a good start on their first assignments in the workplace.

Community volunteers for CE 408 include Jennifer Barnes, VanDeMark Chemicals; Paul Ameis, Waste Technology Services; Larry Coleman, Independent Consultant; John Peck, Linde Corporation; and Rich Fickelscherer, Falconeer Technology.

Congratulations to UB CBE's Undergraduate Academic Excellence Awardees

The faculty and staff of the department are proud of all our students for what they learn and achieve in their studies with us. It gives us particular pleasure to recognize those who excel in academics or service among this already outstanding group of students. We do this at the end of each academic year at our awards ceremony. Here is a summary of those receiving special recognition.

- **Professor Thomas W. Weber Undergraduate Excellence Award**
  Bryson Shunk
- **Professor Edward P. Furlani Scholarship**
  Ruth Bello
- **CBE Award for Student Achievement in Sexual Violence Prevention**
  Holly Quagliato and Marieross Navarro
- **Thomas and Marianne Weber Family Scholarship**
  Shane Varner, Chintan Jayesh Shah, Sarah Hamdan, and Sarah Clements
- **AIChE WNY Local Section Outstanding Senior Award**
  Anish Avasthi
- **AIChE WNY Local Section Outstanding Junior Award**
  Teagan Allart
- **WNY – ACS Distinguished Student Award**
  Sydney Steward
- **CBE Senior Academic Excellence Award**
  Scott Coia, Jordana Mazer, Mitchell McGarrity, Joel Mercado, Aidan O'Sullivan, and Luke Stockdale
- **CBE Junior Academic Excellence Award**
  Max Barletta, Lamon Friday, Quinn Gruppe, Aurora Occhino, Sam Sigler, and Kirsten McGraw
- **John R. Dervay II, Memorial Scholarship**
  Daniel Byrnes
- **Barbara and Jack Davis Engineering Education Endowment Fund**
  Parker Catalano and Claire Farry
- **Bauer Foundation WiSE Experiential Learning Fund**
  Anna Belyablya
- **Lester Gerhardt Experiential Learning Fund**
  Sarah Hamdan

If there's a particular skill, achievement, or personal quality that you think is important and want to promote among our students, you or your company may want to consider sponsoring a new award to recognize them. Even a small annual award can have impact. Please contact us if you'd like to explore options.

David Kofke

David A. Kofke
SUNY Distinguished Professor
Director of Undergraduate Studies

UB CBE Congratulates Undergraduate Sydney Swedick

Sydney has been awarded the prestigious Goldwater Scholarship.

She plans to pursue a PhD in neuroscience and hopes to conduct research on peripheral nerve injuries and spinal cord injuries using tissue engineering and regenerative medicine.

UB CBE Hit the Goal on Giving Day

The UB Department of Chemical and Biological Engineering extends a huge thank you to our advisory board members and over 50 alumni and friends who helped make this year's Giving Day a huge success.

UB Giving Day is a 24-hour, community-driven fundraising challenge to support critical needs and deliver big opportunities that make the UB experience everything it is and everything it can be. Gifts made on this day have double the impact through the power of matches and challenges.

The department's Advisory Board Members created a challenge to our alumni and friends to make a donation of any amount, with the condition that if we reached the magical number of 50 donors, they would add $5,000 to the total.

As you may have guessed, CBE made their 50 donor Giving Day Challenge goal with time to spare! If you were one of those who helped push us over the top, please accept our heartfelt thanks for your support.

The CBE Advisory Board is very excited about the results of our 2023 UB Giving Day Challenge. The opportunity to support the students, faculty, and the Chemical Engineering Department's immediate needs is an honor for the board members and our esteemed colleagues in the chemical engineering network.

I would personally like to thank all those who donated to the Giving Day Challenge and championed the CBE Department. All your contributions are greatly appreciated, and I look forward to breaking another record with all of you next year!

Anna Knight
Project Business Lead
Linde
UB CBE Advisory Board Chair

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

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We Couldn't Have Done It Without You

We are deeply grateful to everyone who made our CBE Giving Day Challenge a success, including our Department Advisory Board members who put up the funds for the challenge, and all of our alumni and friends who pitched in. The department and our students will benefit greatly from everyone's generosity!

Mark Swihart
SUNY Distinguished Professor
and Department Chair

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