FALL 2019

CATALYST

BREAKTHROUGH COLLABORATIONS IN **HEALTH, ENERGY,** & THE **ENVIRONMENT**

Multidisciplinary research creates lasting impact for science, business, and people's lives.

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

CHAIR'S **WELCOME**

Dear UB CBE community,

I am delighted to share our annual newsletter, The Catalyst, and update you on exciting developments underway in UB CBE. Our very strong research funding and scholarly productivity compare favorably with other top tier chemical engineering universities around the country, and reflect the talent and hard work of nearly 200 faculty, staff, post-doctoral researchers, and graduate students along with more than 300 undergraduates who together make up our community. As an alumnus or friend of UB CBE, I hope you will take a moment to appreciate the breadth and depth of educational and research activities that have been enabled by our growth in faculty and student numbers, research funding, and infrastructure. If you've supported these efforts by hiring or mentoring our students and recent graduates, sharing your expertise, serving on our department advisory board, or providing financial contributions, please accept our heartfelt thanks.

New developments this year include outreach to budding chemical engineers through our first annual Chemical Engineering Camp (see pg 21), and a happy hour at Big Ditch Brewery, where we met alumni spanning nearly 50 years, from the class of '70 to the class of '19. We also hosted our first annual pre-commencement brunch to honor our graduating seniors prior to the ceremony, which gave us a chance to meet many of their families, who are justifiably very proud. Finally, we announced two new undergraduate scholarships, the Professor Edward P. Furlani Scholarship, endowed by Karen Furlani and other members of Ed's family, and the Thomas and Marianne Weber Family Scholarship, endowed by Professor Emeritus Tom Weber.

Looking ahead to the 2019-20 academic year, there are new focus areas for our Master of Engineering program, with defined specializations in biotechnology; energy and sustainability; chemistry and processing of materials; and modeling, simulation, and informatics. We're also introducing a new course on the science, technology, and business of beer, wine, and spirits (craft beverages) that we hope will be of interest to undergraduate students beyond our own majors.

As we launch into a new academic year, full of energy and possibilities, we welcome your support and your ideas. Contact me anytime at swihart@buffalo.edu.

Cheers!

Mark T. Swihart
Chair, UB Distinguished Professor,
Chemical and Biological Engineering

FACULTY ACHIEVEMENTS

STELIOS ANDREADIS received the 2018-19 Excellence in Graduate Student Mentoring Award, presented by the University at Buffalo Graduate School to recognize UB faculty for their support and development of graduate students through their mentoring activities. The award is given annually to members of the graduate faculty who have demonstrated "truly outstanding and sustained support and development of graduate students from course completion through research and subsequent career placement."

Andreadis also received the 2019 AADR/IADR William J. Gies Award for Biomaterials and Bioengineering Research for the best paper published in the *Journal of Dental Research* during the preceding year. The awarded paper (*Journal of Dental Research*, 96 (7) 798-806 (2017)) demonstrated that a biomimetic material comprising fibrin hydrogels decorated with laminin peptides promoted submandibular gland (mSMG) regeneration in a mouse model. The results have significant implications for treatment of hyposalivation, which contributes to dental caries, periodontitis and microbial infections. This condition affects many patients suffering from Sjögren's syndrome, an autoimmune disease with a prevalence of 1 percent globally, and patients receiving gamma irradiation therapy for head and neck cancer treatment.

MARK SWIHART has been elected a fellow of the American Institute of Chemical Engineers (AIChE) in recognition of his contributions to chemical engineering research, including modeling and experimentation to develop a fundamental understanding of particle nucleation and growth; development of new post-processing steps to treat nanomaterials in order to make them into highly effective functional materials; and application of these materials to develop new light-harvesting technologies and new bioimaging capabilities. Several of these advances have led to commercialization and start-up companies.

Associate Professor **HAIQING LIN** was awarded a grant from U.S. DOE (NETL) to lead a $3.8 million project on rational development of novel metal-organic polyhedra-based membranes for CO_2 capture. The goal of this project is to develop transformative solubility-selective mixed matrix membranes containing metal organic polyhedra and rubbery polar polymers, achieving high CO_2 permeance, high CO_2/N_2 selectivity and high CO_2/O_2 selectivity at temperatures up to 60°C. These membranes will be fabricated into industrial modules, which will be tested using real flue gas at the National Carbon Capture Center.

GANG WU was ranked as a 2018 Highly Cited Researcher in Web of Science by Clarivate Analytics. The highly cited researcher list includes an elite group recognized for exceptional research performance demonstrated by the production of multiple highly cited papers. As an associate professor, Wu focuses on electrochemical engineering for environmental technology applications with ~200 scientific papers published. He is one of only two researchers at the University at Buffalo with this distinction and is likely one of the youngest researchers to achieve this milestone.

Gang Wu also received a $200,000 grant from the National Science Foundation for research on designing nitrogen-coordinated single atomic metal electrocatalysts for selective CO_2 reduction to CO. This project aims to create new cost-effective electrocatalysts for energy sustainability technologies.

Mark Swihart, Haiqing Lin and Carl Lund received a $360,000 grant from the National Science Foundation to study the potential of catalytic membrane reactors for low temperature methane dry reforming. Their work aims to couple catalytic reaction of natural gas and CO_2 with membrane-based separation to produce separated CO & H_2 product streams.

FACULTY ACHIEVEMENTS

JOHANNES HACHMANN has received a $700,000 grant from the National Science Foundation to lead a collaborative effort aimed at advancing a data-driven discovery and rational design paradigm in chemistry. The project aims to assert the role of big-data research in the chemical domain, i.e., to promote, enable and advance the ideas of data-driven discovery and rational design.

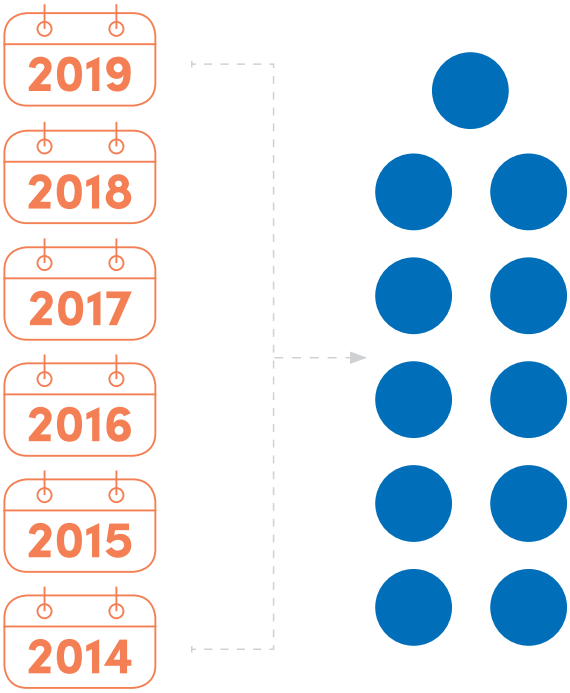
CARL LUND has been named chair of the UB Department of Engineering Education. This newly established department aims to study and implement strategies for scaling and translation of engineering education research findings into widespread classroom practice.

new research funding **$8.0 million**

121 Publications

159 GRADUATE STUDENTS

337 UNDERGRADUATE STUDENTS



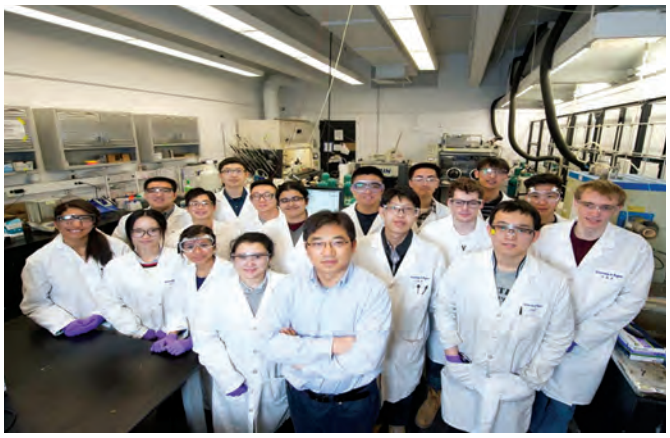
11 NEW FACULTY
IN 6 YEARS

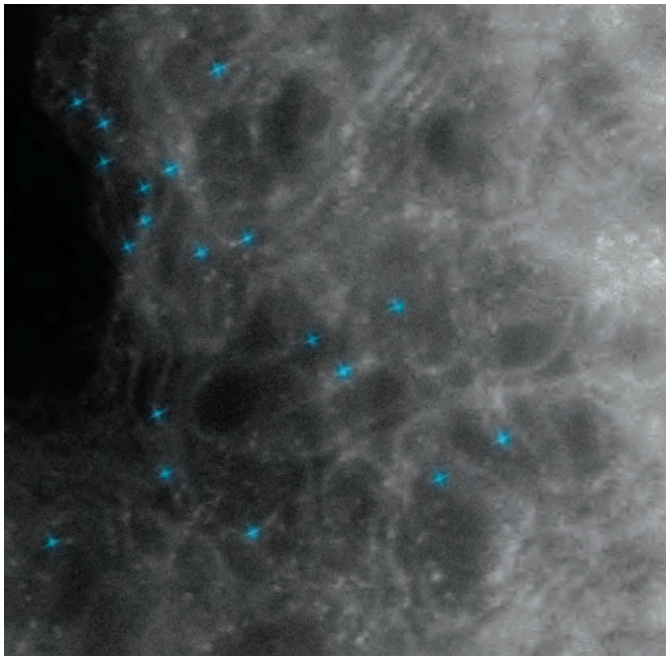
ATOMICALLY DISPERSED IRON CATALYST FOR

CLEAN-ENERGY FUEL CELL TECHNOLOGY

GANG WU

The hydrogen polymer electrolyte fuel cell (PEFC) is a clean-energy technology that converts the chemical energy of the reaction of hydrogen with oxygen into electricity, while producing water as the only product. This environmentally friendly technology is a promising high-power-density alternative to internal combustion engines for transportation applications. The application of PEFCs is currently hindered by the high cost of precious metal catalysts (i.e., platinum) that have been essential for overcoming the inherently slow kinetics of the oxygen reduction reaction (ORR). The large-scale implementation of PEFCs depends critically on the availability of low-cost ORR catalysts with high performance and excellent durability. In recent work published by the Wu research group in the journal *Energy and Environmental Science*, a platinum-free iron-nitrogen-carbon catalyst was developed with a structure that incorporates atomically-dispersed iron atoms (bright dots in the image) bonded with nitrogen atoms in the carbon matrix (bright fringes in the image) to achieve a high density of iron-nitrogen active sites that catalyze the ORR reaction in PEFCs. This iron-nitrogen-carbon catalyst is not only able to generate high performance for catalyzing the ORR, approaching that of current state-of-the-art precious metal catalysts (Pt/C), but it could significantly lower the cost of PEFCs. The successful large-scale implementation of PEFCs, enabled in part by these advances in ORR catalysis, will satisfy intense energy demands and address concerns related to environmental impacts to support a sustainable future.





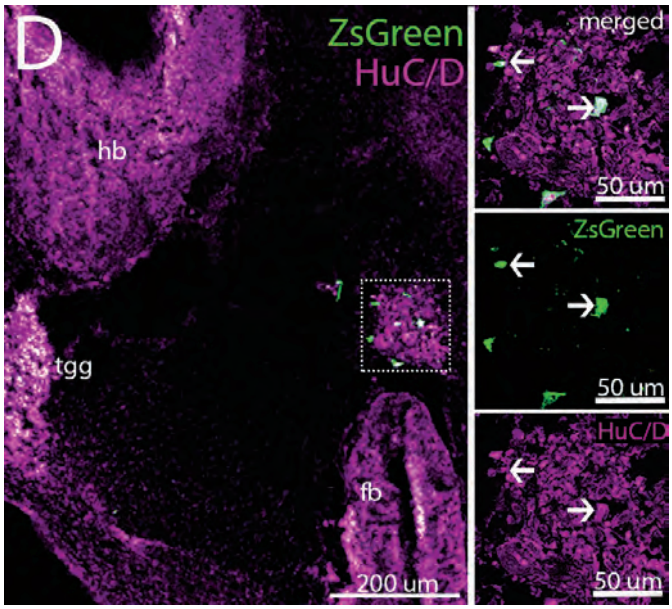
Top: The Gang Wu research team Bottom: Transmission electron microscopy (TEM) image of atomically-dispersed iron (bright dots) in a carbon matrix in iron-nitrogen-carbon catalysts

FROM OLD SKIN TO YOUNG BRAIN

STELIOS ANDREADIS

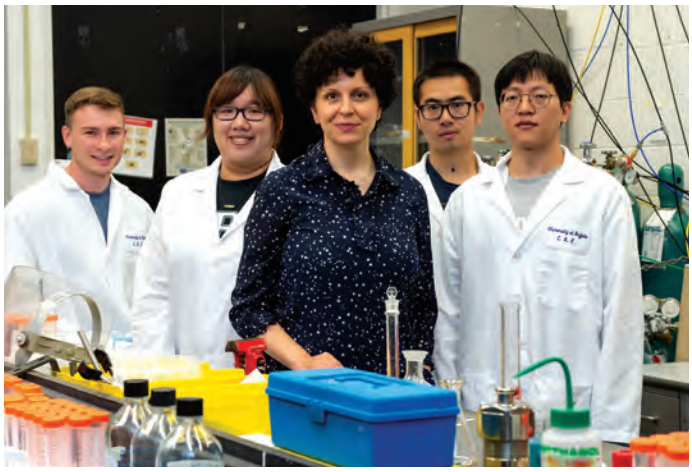
Neural crest (NC) cells are multipotent stem cells that arise from the neural tube (embryonic precursor to the brain and spinal cord) during the early stages of development and exhibit developmental potential second only to that of embryonic stem (ES) cells. Recently, the Andreadis research group showed that NC cells can be derived from neonatal epidermis—the top layer of skin—without genetic modification (Bajpai, V.K., et al., *Stem Cells*, 2017, 35, 1402-1415; Tseropoulos et al., *Bioengineering & Translational Medicine*, 2018, 3, 256-264). However, it was not clear whether multipotent and functional NC cells can be derived from the adult epidermis of aged donors who have the greatest need for cell therapies. In a follow-up study that was published this year (Moghadasi Boroujeni et al., *Scientific Reports*, 2019, 9, 9750), the team showed that functional NC cells can also be obtained from the epidermis of elderly donors, even those in their nineties. Adult NC cells proliferated more slowly compared to neonatal NC cells but showed limited signs of cellular aging, despite the advanced age of the donors, and exhibited significantly younger "biological age" (determined based on epigenetic changes of their genome) compared to the keratinocytes (KC), the cells of the epidermis from which they were derived. They also maintained their multipotency, defined as the ability to differentiate into all NC-specific lineages, including neurons (nerve cells), Schwann cells (glial cells that protect neurons), melanocytes (cells responsible for skin color) and smooth muscle cells (SMC), which are the cells of the wall of hollow organs, including blood vessels.

Most notably, implantation of these cells into chick embryos showed that keratinocyte-derived NC cells (KC-NC) from aged donors could give rise to multiple NC derivatives in the embryo, including neurons, glial cells, SMC and putative melanoblasts. Given the broad differentiation potential of KC-NC and the accessibility of human epidermis, these results suggest that KC-NC may provide an easily accessible, autologous source of stem cells for use in stem cell therapy; modeling diseases of the central or peripheral nervous system, e.g. neurocristopathies; or as a platform for drug discovery for treatment of neurodegenerative diseases.



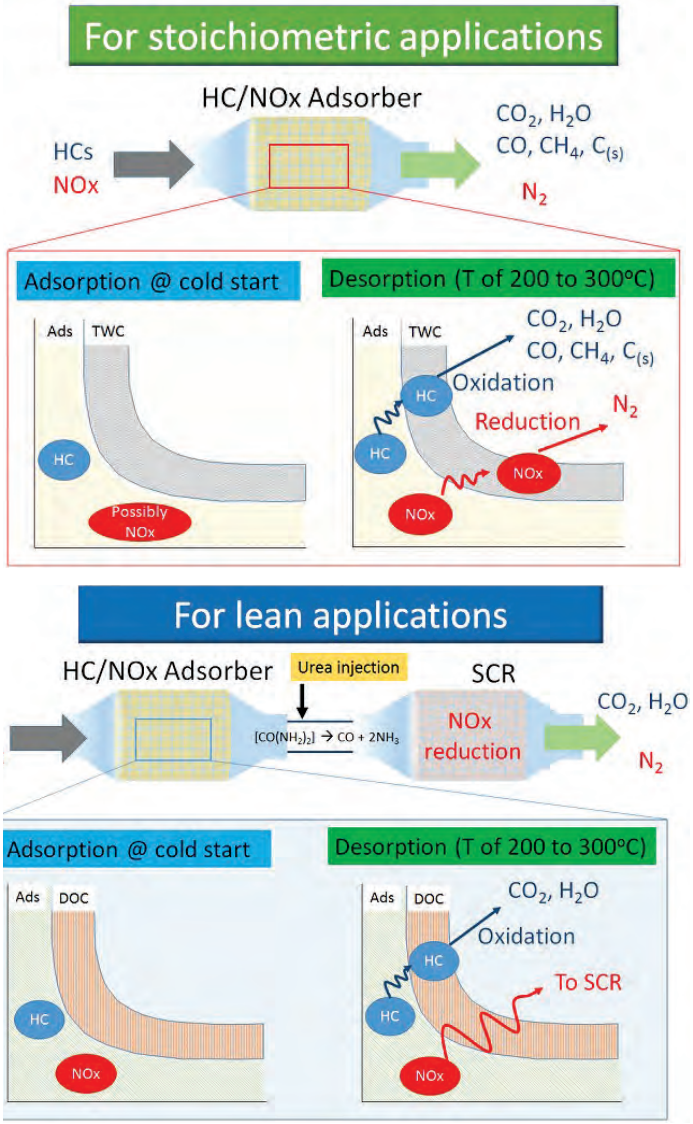
Panel D -HuC/D and ZsGreen double-positive neurons within the trigeminal ganglion (tgg); fb=forebrain; hb=hindbrain.

REMEDIATION OF
VEHICLE COLD-START EMISSIONS
ELINA KYRIAKIDOU



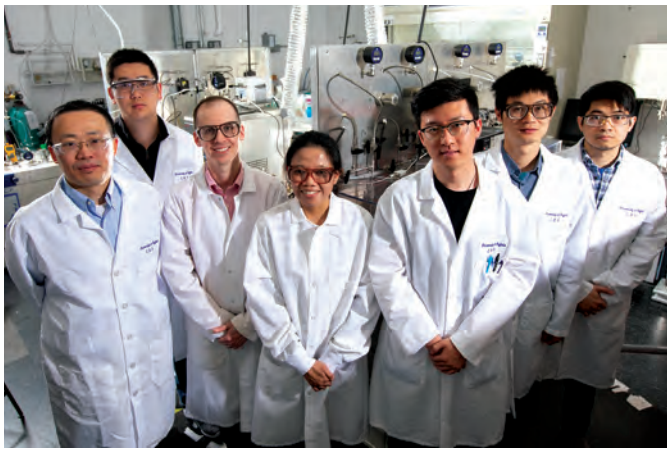
Left to Right, Timothy Buchanan, Chih Han Liu, Elina Kyriakidou, Junjie Chen, Jungkuk Lee, Photo: Onion Studio

A large fraction (up to 80 percent) of total vehicle emissions is produced during the cold-start period (i.e., the period before the catalytic converter has heated to a temperature at which the catalysts are functional). One approach to reducing the hydrocarbon (HC) and nitrogen oxide (NO_x) emissions during this cold-start period is to employ a HC trap and a passive NO_x adsorber that can adsorb the HC and NO_x emissions at low temperatures and release them at higher temperatures (see figure). The Kyriakidou research group investigates the adsorption properties of zeolitic materials via a combination of Density Functional Theory (DFT) computations and a microkinetic model validated by experiments. They seek to establish the adsorption mechanism, identify the composition and structure of the active sites, and accurately predict adsorption fractions under a variety of feed conditions. For that purpose, first-principles DFT calculations with uncertainty for SSZ-13 zeolites are performed by Caitlin Horvatits (MSc student) in collaboration with Eric Walker, PhD, at the Institute for Computational and Data Sciences at UB. The experimental portion of this research is performed by Jungkuk Lee, a PhD student in the Kyriakidou group who focuses on the controlled synthesis, characterization and evaluation of adsorbants and catalysts. SSZ-13 zeolites are chosen to allow the innovative investigation of adsorbate-adsorbate interaction, which generates macroscopic adsorption behavior that cannot be achieved with conventional materials. This combination of computations and experiments is enabling predictive design of zeolites, while tailored zeolites will reduce the amount of greenhouse gases emitted in vehicle exhaust and reduce the environmental impact of vehicles. Further information on this field of research is provided in a review paper recently authored by Lee and Kyriakidou along with Joseph Theis of Ford Motor Company (Lee et al., Applied Catalysis B: Environmental, 2019, 243, 397-414).



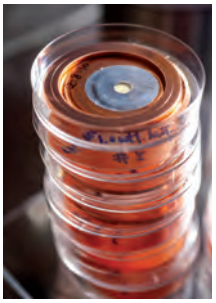
UB TEAM LEADING $3.8 MILLION PROJECT FUNDED BY THE DEPARTMENT OF ENERGY (DOE) TO DEVELOP

CARBON CAPTURE MEMBRANES



The team developing the carbon capture membrane left to right: Haiqing Lin, Leiqing Hu, Timothy Cook, Cressa Fulong; Gengyi Zhang; Liang Huang, Hien Nguyen. Photos: Douglas Levere

Associate Professor Haiqing Lin is leading a DOE-funded project to develop advanced membrane materials for CO_2/N_2 separation, which can be adapted to membrane processes for CO_2 capture from fossil fuel-fired power plants, cement plants, steel plants and other industrial facilities. Despite tremendous growth of renewable energy, fossil fuels will remain a key energy source for the next several decades; therefore, carbon capture, utilization and sequestration is a critical component of an integrated strategy to mitigate CO_2 emissions to the environment and slow the pace of climate change. As an energy efficient technology, membrane processes have attracted significant interest for this application. The major challenge to their broad implementation is the lack of membrane materials with both high CO_2 permeability and CO_2/N_2 selectivity at actual flue gas conditions.



Stack of membranes, each housed at the center of a copper and aluminum disc that helps to protect the material during experiments.

The overarching objective of this program is to rationally develop solubility-selective mixed matrix membranes (MMMs) that comprise highly polar rubbery polymers and soluble metal-organic polyhedra (MOPs) to achieve high CO_2 permeance (3000 GPU) and high CO_2/N_2 selectivity (75) at 60°C. Such membranes would outperform current leading membranes by 50 percent to 100 percent, which may enable CO_2 capture at <$30/ton CO_2 from coal-fired power plants.

The proposed MMMs are built upon three key unique approaches. First, rubbery polymers with CO_2-philicity (and N_2-phobicity) will be designed. Second, MOPs with strong CO_2 affinity will be designed and added to increase the CO_2/gas solubility selectivity. In contrast to metal-organic frameworks (MOFs), these MOPs are discrete nano-cages and are soluble in organic solvents, which facilitates preparation of thin film composite membranes with selective layers as thin as 100 nm. Third, the structure of polymers and MOPs can be independently designed in a process accelerated using computational simulation.

The endpoint of this project will be a field test of bench-scale membrane modules with raw flue gas at the National Carbon Capture Center, a DOE-sponsored research facility in Alabama.

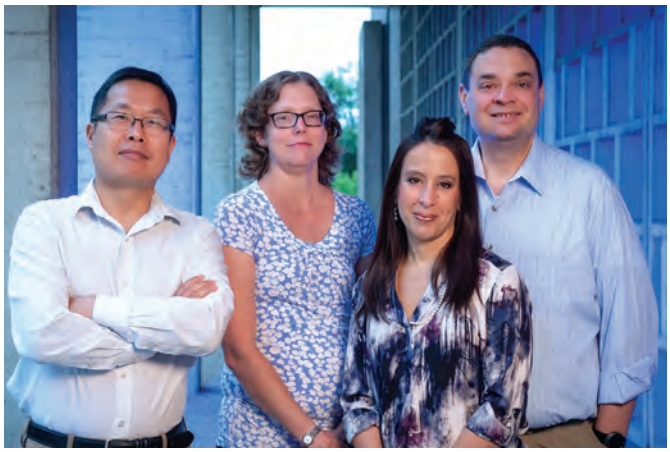
Cressa Fulong, UB chemistry PhD candidate, prepares a membrane for testing.

Lin is leading the research, with Timothy Cook, PhD, assistant professor of chemistry, serving as co-principal investigator. The two have worked on a number of interdisciplinary projects together, and preliminary results have been published in Dalton Transactions and Joule. The team also includes scientists from Rensselaer Polytechnic Institute, the California Institute of Technology, Membrane Technology and Research, Inc. and the Trimeric Corporation, with the total funding for all collaborators totaling $3.8 million.

DEVELOPMENT OF LONG-LASTING ANTIBACTERIAL PROPERTIES

NOVEL DENTAL RESINS

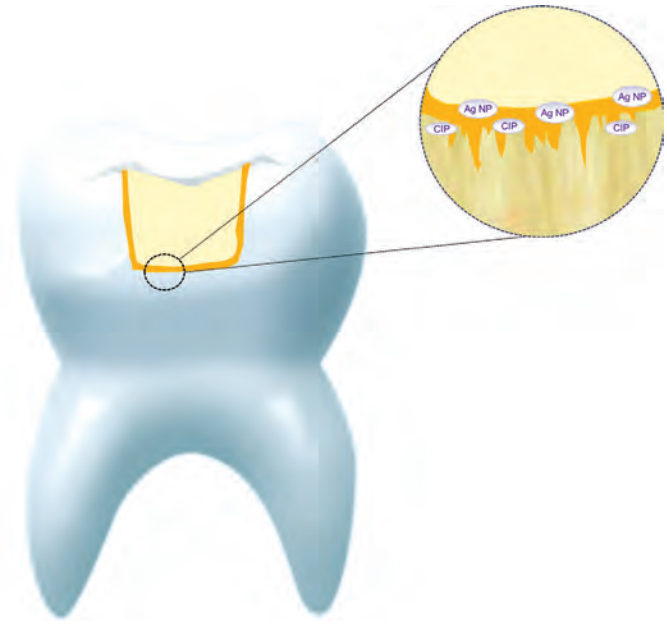
CHONG CHENG & MARK SWIHART



Left to Right, Chong Cheng, Michelle Visser, Camila Sabatini, Mark Swihart
Photo: Onion Studio

Replacement of dental restorations is a major public healthcare burden (>$5 billion annual cost in the U.S. alone). Over 50 percent of these replacement restorations are the direct result of recurrent caries caused by bacterial activity. Therefore, the development of long-lasting antibacterial dental biomaterials has emerged as a critically important research theme related to public dental health. To address this need, Chong Cheng and Mark Swihart from Chemical and Biological Engineering have collaborated with Camila Sabatini and Michelle Visser from UB's School of Dental Medicine to investigate new designs of antibacterial resins with long-term antibacterial efficacy. They have demonstrated that integrating antibiotics into dental adhesives using polymer-antibiotic conjugates (PACs) as novel antibacterial additives is a promising approach to achieving new types of antibacterial dental resins. In their proof-of-concept study, a model PAC-containing dental resin was prepared by first synthesizing a PAC containing ciprofloxacin (an antibiotic) via polymerization of the corresponding monomer-antibiotic conjugate (MAC), followed by mixing the PAC with a commercial dental resin and curing the mixture (Fig. 1). With a very slow and sustained release of ciprofloxacin, the PAC-containing dental resin showed significant killing effectiveness against Streptococcus mutans, one of the main cariogenic bacteria (Zhang et al., *Biomaterials Science*, 2019, *7*, 287-295). Recently, the research team was awarded an NIH R21 grant from the National Institute of Dental and Craniofacial Research (NIDCR) to perform further systematic studies to test and optimize this approach. In this R21 project, a library of PAC-containing dental resins will be prepared, and their antibacterial behavior and other biomedically relevant properties, such as antibiotic release profile, biocompatibility, mechanical properties, color stability and risk of inducing antibiotic resistance, will be studied.

In a complementary approach, the team has prepared silver nanoparticle-loaded amorphous calcium phosphate (ACP) microspheres, incorporated them into a commercial dental resin and tested their release of silver and calcium ions (Keskar et al., *Nanoscale Advances*, 2019, 1, 627-635). The silver ions confer antibacterial activity, while calcium ions can promote remineralization of dentin at the tooth-restoration interface. A second NIH R21 grant for research in this direction is pending. Future research directions for growing this productive transdisciplinary collaboration range from tissue engineering of dentin to fundamental studies of remineralization and, ultimately, to clinical studies and commercial implementation of improved materials that will significantly extend the lifespan of dental restorations.



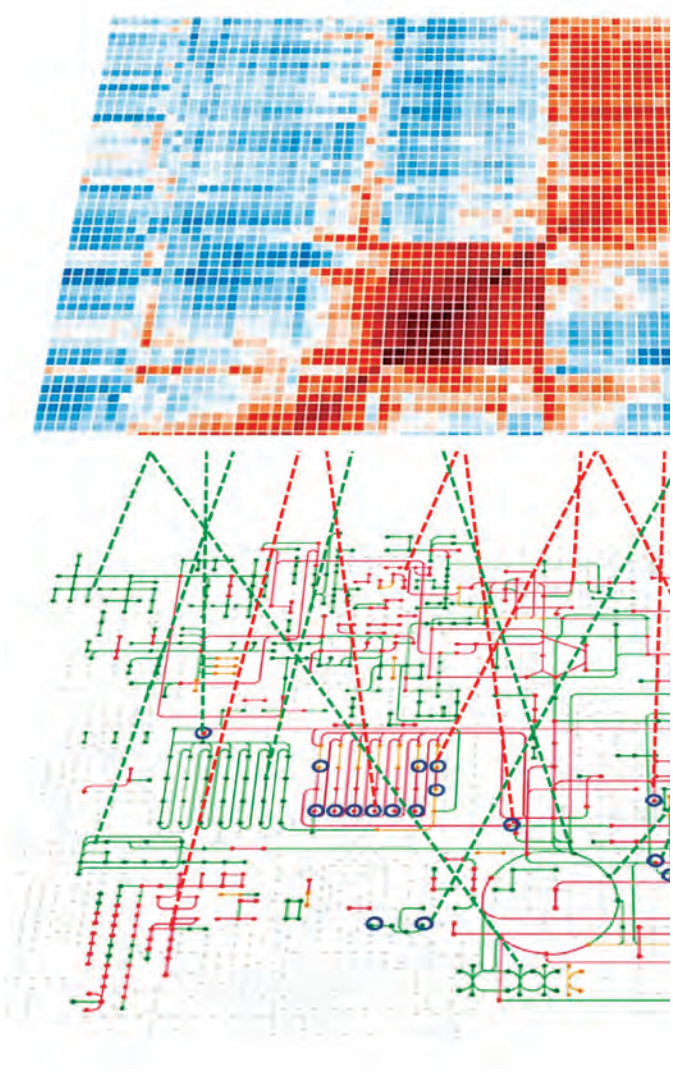
Tooth-filling bonded interface with controlled-release of therapeutic agents

SYSTEMS BIOLOGY OF AGING

RUDI GUNAWAN

Human life expectancy has been increasing steadily over the last two centuries. However, this increase has not come with an equal gain in healthspan—the length of healthy life. As a result, age-related illnesses such as cardiovascular and Alzheimer's disease have become the leading causes of death throughout the developed world, including in the U.S. Understanding the biology of aging is key for compressing the period of morbidity and improving the quality of life in old age, not to mention reducing the socioeconomic impact of an aging population. Biogerontological research over the past decades has provided substantial insight into the hallmarks of aging. Still, formulating treatments that delay aging will require a holistic view of the human body, a task that is complicated further by the heterogeneity of aging—people age differently.

The Gunawan group has been harnessing the data revolution in biology and medicine to gain system-level insights on aging-associated alterations in cells, organs and organisms, with the ultimate goal of slowing aging and its consequences through personalized treatments. Their team develops bioinformatics tools and mathematical models for integrative analysis of molecular data of cells and tissues (transcripts, proteins, metabolites) and applies these tools and models to understand the aging process in humans and model organisms. The group's past work established the cellular processes behind mitochondrial DNA mutations and their accumulation in aged tissues that cause energetic dysfunctions in organs such as the brain and heart. Presently, the group's aging research centers on metabolism in aging—how aging affects metabolism and how metabolic perturbations such as dietary restriction modulate lifespan (see illustration)—and cellular pathways that contribute to the heterogeneity of lifespan.



Mapping gene activity to a metabolic network

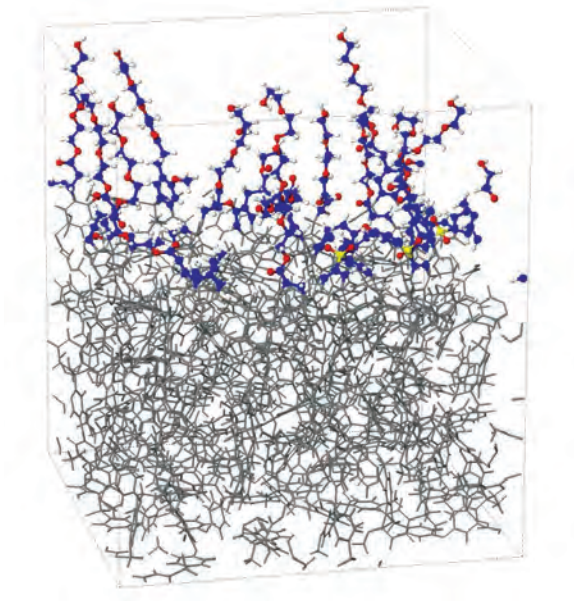
MOLECULAR MODELING

OF POLYMER MEMBRANES FOR WASTEWATER CLEANUP

JEFF ERRINGTON

There is broad interest in developing membrane systems for handling wastewater from a diverse array of sources (e.g., household wastewater, drainfields). The ideal membrane permits pure water to permeate through and rejects contaminants. The permeated water is then reused, reducing the impact of the wastewater on the environment.

The Lin group is pursuing a promising class of polymeric membranes that consist of a polymer brush tethered to a base polymer structure (see image). Key design questions for these materials involve the types of polymers to use and how to tether them to the surface (e.g., grafting density, polymer length). Fundamental questions about the molecular-level organization of water and contaminants in the vicinity of the polymer brush must be addressed to fully understand the origins of membrane performance. The Errington group is now collaborating with the Lin group to address these questions via molecular simulation. The work is led by Yiqi Chen, a chemical engineering PhD student. The team has developed a framework for estimating interfacial properties (e.g., water contact angle) and has established metrics for characterizing how water organizes near the surface of these materials. Moving forward, the aim is to use the recently-developed computational tools to accelerate the design and discovery of improved polymeric membranes for water treatment.



Simulation snapshot (configuration) of a hydrated membrane consisting of a polysulfone base (colored gray) and a poly(ethylene glycol) diacrylate brush (blue, red, and white spheres). Water molecules have been removed to improve clarity.

MAKE A CHARITABLE CONTRIBUTION

Your support is vital to UB CBE's success, providing the difference between funding what is necessary and what is possible. Donors to our annual fund allow bright, hardworking students to fulfill their dreams and complete their degrees through scholarships and fellowships. They advance the profession by funding groundbreaking research, and they provide resources to furnish facilities and purchase the latest technologies for faculty and students. A gift from you in any amount helps UB CBE make critical investments and recruit and retain the best students and faculty.

To make a gift, simply go online to cbe.buffalo.edu/donate or call us at 716.645.1174.

THANK YOU!

UB CBE GRADUATE PROGRAM UPDATE

SHELDON PARK, DIRECTOR OF GRADUATE STUDIES

The landscape of higher education continues to shift due to changing scientific, societal, financial and even political factors, which create new challenges that require a timely and appropriate response. Many departments in SEAS and chemical engineering at other institutions have reported difficulties in sustaining enrollment in their graduate programs. We have been aggressive in meeting our enrollment goal through several strategic moves, including streamlining existing master's programs, creating new topical concentrations and reaching out to previously untapped pools of applicants. UB CBE currently offers four alternative tracks for pursuing a master's degree (three under master of science and one under master of engineering)—each with a distinct educational objective and target audience. For example, MS: Course-based (MS Track 3) offers a fast-track option to completing a master's degree (within 12 months) so that the students who are less interested in gaining research experience can complete their studies quickly and move on to apply what they've learned to advance their careers. This past year, we graduated five students in MS Track 3, with four more poised to graduate this summer. We have also introduced four different flavors of master of engineering, in addition to the flexible ME program, to address the desire of potential applicants to develop a specialized set of skills. These course focus areas are: biotechnology; energy and sustainability; chemistry and processing of materials; and modeling, simulation and informatics. These topic areas reflect the diverse research portfolio and expertise of the CBE faculty, and sustained growth of both the department size and external research funding. The success of these programs remains to be seen, but we will continue to gather input from current and potential students to optimize our offerings and attract new students who can benefit from studies in CBE. Together, these efforts to date have yielded positive results, allowing us to meet our enrollment goals for the coming year. Thus, our graduate program remains strong despite a somewhat challenging climate. Most importantly, solid enrollments allow us to continue our scientific journey and break new ground in research and innovation. Happy trails!

GRADUATE STUDENT SPOTLIGHT

GABRIELLE PAWLOWSKI

Gabrielle Pawlowski is a second-year PhD candidate in the Neelamegham research group. She holds a BS from Clarkson University and an MS from the University of Notre Dame, both in chemical engineering. Originally from the Buffalo area, Pawlowski chose UB due to the department's world-class research and close-knit community.

Her current work focuses on developing computational tools and algorithms for the high-throughput analysis of mass spectrometry-based glycomics data. These programs can be used in many applications, such as to discover novel glycan biomarkers that are prognostic indicators of disease. They may also lead to the democratization of the field of glycoscience by making user-friendly software more freely available to the research community.

On campus, Pawlowski is a Schomburg Fellow and secretary for the UB CBE Gradute Student Association, and she is involved with CIRTL@UB, the Center for the Integration of Research, Teaching and Learning. CIRTL@UB is a network that aims to advance STEM teaching practices. She has also participated in the NAVIGATE project, an innovative training program that teaches women in STEM the skills needed to succeed in their fields.

In the future, she hopes to apply the knowledge she's gained with her different research projects in the field of patent law. Outside of the lab, Pawlowski's hobbies include playing clarinet, snare drumming and Polish folk dancing.

2019 GRADUATE PROGRAM EVENTS

GRADUATE SYMPOSIUM

Top, Douglas Lauffenburger, Bottom, Andrew Kroetsch and Right, Junyi Liu Photos: Onion Studio

UB CBE's annual Graduate Research Symposium took place on October 12, 2018 in the UB Center for the Arts, and featured over 60 posters from CBE graduate students. The keynote speaker was Dr. Douglas A. Lauffenburger from the Department of Biological Engineering at Massachusetts Institute of Technology. Dr. Lauffenburger spoke on "Humanizing Therapeutics Discovery & Development". Two PhD candidate speakers also presented, Andrew Kroetsch from the Sheldon Park group spoke on "A Platform Engineering Approach

for the Design of Recycling Therapeutic Antibodies", and Junyi Liu of the Haiqing Lin Group discussed "Highly Polar Polymers with Superior Membrane CO_2/N_2 Separation Properties for Carbon Capture". Following the lectures, all graduate students in their second year and beyond were invited to present their research, which was evaluated by a large panel of judges including faculty, alumni, and advisory board members from CBE, and a wine, beer, and hors d'oeuvres reception was enjoyed by all. This fall's seminar is scheduled for Friday, October 25, 2019 and will feature an alumnus from private industry, Durgesh Vaidya of OFS Optics, who will talk about how students can transition into corporate citizens once they graduate; or "Phase Equilibria of Corporate Life". For more information or to volunteer to be a poster judge, visit us online at cbe.buffalo.edu.

GRADUATE STUDENTS TALK

CAREERS IN CHEME

On May 6, alumnus Demetrius Sarigiannis (PhD 2001) visited UB CBE graduate students for a beer and pizza hour during which they talked about his career path from Micron to GE to Praxair, and about some of the work he was involved in at each company. He presented a few of the research problems he encountered in industry, and the lessons he learned while solving them. Demetrius felt that the students were genuinely curious and most interested in getting his perspective on navigating career options. The session went so well that Dr. Sarigiannis came back and helped some students by critiquing their technical presentations on a one to one basis. If you would like to visit our students at any level and talk to them about a career in chemical engineering, please visit www.cbe.buffalo/alumni, and thank you.

PhD student Shreya Mukherjee and Demetrius Sarigiannis Photo: Onion Studio

UB CBE'S WEDNESDAY LECTURE SERIES

Each semester the department hosts a weekly research seminar series for faculty, students, alumni, and chemical engineering professionals. We invite interesting speakers—people at the top of their fields—who are conducting creative research in chemical and biological engineering. Our goal is to provide access to the latest ideas in the field, and the experts who are developing them, while also acquainting the larger chemical engineering community with the research advances being made at UB. During each seminar, speakers give a 50-minute presentation, immediately followed by a question and answer period. All interested members of the UB and Western New York communities are encouraged to attend, and no registration is necessary. Unless otherwise noted, seminars are held at 11:00 a.m. in 206 Furnas Hall, UB North Campus.

THIS FALL'S LINEUP INCLUDES...

Mercouri Kanatzidis
Northwestern University

Alexander Revzin
The Mayo Clinic

Jaehong Kim
Yale University

Michael S. Wong
Rice University

Eugene X.Y. Chen
Colorado State University

Geoffrey Geise
University of Virginia

Andre Palmer
Ohio State University

Cameron Abrams
Drexel University

Christopher Bowman
University of Colorado

Arthi Mayaraman
University of Delaware

Subramanian Ramakrishnan
Florida State University

A full schedule can be found on our website at cbe.buffalo.edu/seminars

RUCKENSTEIN LECTURE

Chad Mirkin
Photo: Onion Studio

The annual spring Ruckenstein Lecture honoring Eli Ruckenstein, a prolific researcher who has made (and continues to make) contributions in almost every subfield of chemical engineering, took place on Thursday, April 18, and featured Chad Mirkin, Director of the International Institute for Nanotechnology and the George B. Rathmann Prof. of Chemistry, Chemical and Biological Engineering, Biomedical Engineering, Materials Science & Engineering, and Medicine at Northwestern University. Mirkin spoke on "Rational Vaccinology: In Pursuit of the Perfect Vaccine" to a standing room only audience in UB's Student Union.

LORI DUVALL-JACKSON

RECEIVES SUNY CHANCELLOR'S AWARD FOR EXCELLENCE IN CLASSIFIED SERVICE

Lori DuVall-Jackson at Hluhluwe-Imfolozi Park, South Africa

Lori DuVall-Jackson has been named a recipient of the 2019 SUNY Chancellor's Award for Excellence in Classified Service, in recognition of consistently demonstrated superlative performance within and beyond her position. DuVall-Jackson places a strong emphasis on ensuring that UB CBE provides excellent service to its graduate student community and that its initiatives, systems and services improve their overall experience.

In her day-to-day job duties, DuVall-Jackson assists with graduate student applications, inquiries, appointments, tuition, personnel files and general customer service. While performing these tasks, she advocates for students from abroad who have not yet found their voice, helps them navigate the university system, ensures they're well and productive, and continually checks in. UB CBE's students rely on her to ensure their success on a daily basis.

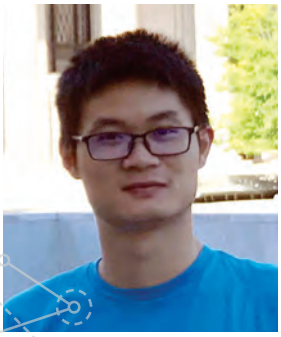
DuVall-Jackson is a strong advocate for animal rights, particularly the preservation and protection of the world's wild elephant population, and volunteers regularly in Zululand, South Africa. At home she volunteers for The Elephant Sanctuary in Tennessee, which provides a permanent home for retired zoo and circus elephants.

"Lori is both a creative problem solver for our students, and a valued advisor and counselor to them. She looks after their academic and financial well-being as she processes their appointments and various academic forms, and also takes time to talk with them, significantly enhancing the student experience. I believe this was captured very well in the following statement from the 'Acknowledgements' section of the M.S. thesis of Mr. Runsheng Zhang (a 2018 M.S. graduate of our department):"

"I would also like to offer my special thanks to the secretary of the Chemical and Biological Department, Mrs. Lori Duvall-Jackson. She's been not only a staff of the department who took care of pretty much every single academic issue I've had but a great mentor and friend who shares both amazing adventures that enlighten my days and bitter moments, which get me through those hard times."

—Mark Swihart, UB distinguished professor and chair

STUDENT AWARDS & HONORS



LIANG HUANG SELECTED FOR YOUNG MEMBRANE SCIENTIST AWARD

The NAMS Young Membrane Scientist Award was created by the North American Membrane Society, the leading professional society in North America that promotes all aspects of membrane science and technology. As a postdoctoral associate working in the Haiqing Lin research lab, Liang Huang's focus is on developing polymers and 2D materials for membrane applications. He has published 28 research articles on graphene and polymers for membrane gas separation and water purification.

OGECHI OGOKE WINS PANASCI COMPETITION

Ogechi Ogoke took first place on April 10 in UB's Henry A. Panasci Jr. Technology Entrepreneurship Competition (Panasci TEC) for a patient-specific cell therapy that can be used as an alternative to a liver transplant. A doctoral student in the Parashurama research group, Ogoke is also one of UB's 2018-19 Western New York Prosperity Fellows. He will receive $25,000 in start-up capital, and in-kind services valued at $27,000 to support commercialization of his research. A provisional patent has been filed by UB for a process that uses a patient's own stem cells to repair and regenerate specific types of liver damage. In addition to eliminating the need for a liver donor, the therapy is projected to cost about $50,000—a fraction of the $800,000 a transplant would cost. It would also take far less time. The technology also has the potential to provide faster recovery times for patients with chronic liver damage.

XIAOYI CHEN AWARDED ELIAS KLEIN FOUNDERS' TRAVEL SUPPLEMENT TO ATTEND THE 2019 NAMS CONFERENCE

As a PhD candidate in the Lin research group, Xiaoyi Chen's research focuses on the development of reduced holey graphene oxide (GO) membranes for nano filtration applications. She presented her work at the May 2019 NAMS meeting in Pittsburgh.

AREF SHAHINI NAMED FINALIST IN THE UB GRADUATE SCHOOL'S 2019 3 MINUTE THESIS COMPETITION

Aref Shahini's presentation was titled The Fountain of Youth from Embryonic Life. His research in the Andreadis group explores how genes from the embryonic development stage can be used to reverse age-associated syndromes. Shahini is motivated to combat muscle loss and improve strength among the senior citizen population through gene therapy. Outside of the lab, he enjoys nature, adventure, going to the gym, snowboarding, baking and playing guitar. He is planning a career as a research scientist.

YANGHUA HE PUBLISHED IN ENERGY AND ENVIRONMENTAL SCIENCE JOURNAL

PhD candidate Yanghua He of the Wu research group was recently published in *Energy and Environmental Science*, a prominent journal with an impact factor of over 30. She has developed a cobalt catalyst for electrochemical energy technology that solves environmental concerns. Her research interests focus on exploring advanced electrocatalyst designs and synthesis strategies using earth-abundant elements for energy conversion applications such as metal-air batteries and fuel cells.

AIChE STUDENT CHAPTER LEADERSHIP BROADENS CLUB IMPACT

The UB CBE AIChE Student Chapter elected an all-female executive board to lead the club in the 2019-20 academic year, and with that came a new vision and ideas for reaching beyond traditional activities and department service.

Newly elected AIChE Student Chapter President Manraj Barn and Vice President Jadwiga Varga have a broad vision for this year's activities, aiming to create an even more inclusive environment. One way they'll do that is by increasing participation of first- and second-year students. To welcome them to the club, the e-board is creating study groups where they can interact with peers, meet students who are further along in the major, and advance in their academic studies.

The e-board also plans to increase membership by engaging students from other majors to join AIChE and participate in the ChemE car project. At the regional conference earlier this year, other clubs had mechanical and electrical engineers on their ChemE car teams, which both reflects the interdisciplinary teamwork of engineering practice and helps produce a more reliable car. Colleagues in other disciplines at UB are an untapped resource who may be glad to join in the project.

The club also hopes to promote inclusivity by opening up their alumni speaker series to students from across the School of Engineering and Applied Sciences. They hope that doing so will promote interdisciplinary cooperation and also educate other engineering majors about the importance of chemical engineering in all fields. If you are interested in speaking about your professional experience, please contact Barn and Varga via our web page at cbe.buffalo.edu/aiche.

Finally, as the club increases its alumni network of graduate students and industry professionals, they see potential benefit to undergraduates of organizing a panel involving CBE graduate students. During the panel discussions, club members will be given the opportunity to discuss the application process for graduate schools, as well as ask questions about graduate student life and research projects. Although the event will mostly cater to seniors in the CBE department, all will be welcome and encouraged to attend. For more information on the UB CBE AIChE Student Chapter and all student clubs, visit us at cbe.buffalo.edu/about.

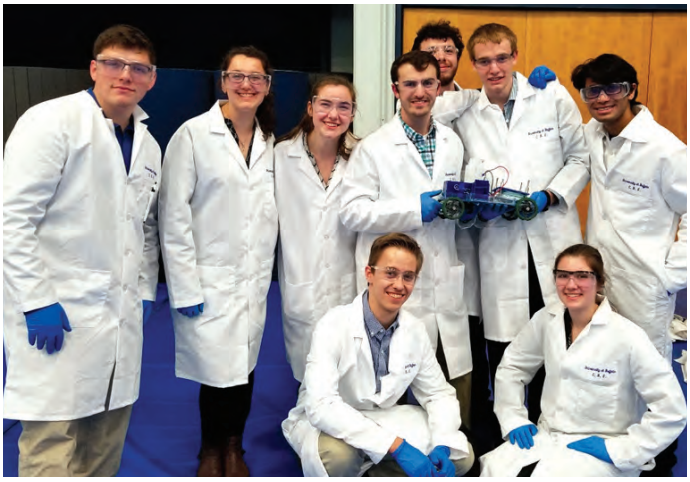
—Submitted by Manraj Barn and Jadwiga Varga

AIChE Club Members on apple picking field trip with "Cider" the dog. From L->R Kimberly Vaeth, Darius Rub, Leonardo Gobatto, Manraj Barn, Emma Herman, Joe Kulczyk, Nathan Dean, Shatoni Ross, Chidubem Okorozo, Gabrielle Santoro, Jessica Paskie, and Cider

2019 CBE CHEME CAR COMPETITION

ALEXANDER RUSCH, BS 2019

For the first time in several years, the 2019 University at Buffalo Student Chapter of the American Institute of Chemical Engineers (AIChE) participated in the annual ChemE Car Competition during the AIChE Regional Conference in April. The goal of the competition is to design, build and operate what is essentially a miniature power plant on wheels. The driving mechanism of the design must be capable of being controlled and eventually stopped with some form of a chemical reaction. The competition is judged based on the ability of the team to control the chosen chemical reaction(s) and meet a distance requirement disclosed on the day of the conference. UB was able to send nine club members (pictured) to compete at this year's conference and is happy to announce that its team placed in the top 10 of well over 20 teams that participated. The club is looking forward to this year's competition and is coached by Gang Wu, associate professor.



From the Penn State-Hosted AIChE Regional Conference. Pictured left to right: Daniel MacIntosh, Julia Caserto, Kimberly Vaeth, Bill Erdman, Alex Rusch, Jack Burke, Adam Ramsey, Melanie Ragonese, Darius Rub

UNDERGRAD SPOTLIGHT

OLUWATOYIN CAMPBELL

Oluwatoyin Campbell is currently a rising senior studying chemical engineering at the University at Buffalo. She is an international student from Nigeria who decided to come to UB not only due to UB's outstanding reputation for chemical engineering education, but also because she has family residing in the Buffalo area. After graduation, Campbell is open to either immediately starting a career in industry or pursuing further graduate studies in her field. Her ultimate ambition is to work in the research and development branch of a food or pharmaceutical company and to be able to actively come up with solutions that will influence lives in a positive manner. When she has free time, she enjoys reading novels and watching movies with friends and family.

"I am very grateful to be able to attend UB, especially in the Department of Chemical and Biological Engineering. In my third year, I got involved with undergraduate research by joining Prof. Chong Cheng's group and participating in a project on synthesis of functional polylactides for drug/gene delivery. In the laboratory, I am learning important concepts related to the research being done. I also follow and assist the graduate students working in the laboratory with their assigned projects, all the while gaining beneficial knowledge and skills related to their work."

—Oluwatoyin Campbell

BUFFALO'S ENGINEERS WITHOUT BORDERS

DEVELOP WATER SUPPLY SOLUTION FOR VILLAGE IN NICARAGUA

Johannes Hachmann, UB CBE assistant professor, is the founding faculty advisor for the UB student chapter of Engineers Without Borders (EWB-UB), which is part of the national EWB-USA organization. The latter consists of 13,800 volunteer members and seeks to build a better world through engineering projects that empower communities to meet their basic human needs.

EWB-UB's inaugural project is to develop and implement a water supply solution for La Laguna, a community in the central highlands of the Department of Matagalpa in Nicaragua, which is located 22 miles from the nearest municipal infrastructure. EWB-UB formed a five-year partnership with the community to work together toward providing clean drinking water to La Laguna.

In January 2018, five of the club's members—CSEE students Carlos Abreu, Aaron Chaney and Evan Supple, as well as MAE students Gavin Amos and Scott Scheers—together with UB alumna Rosaleen Nogle (MS 2007, BS 2005, Civil Engineering, and BA Anthropology 2005), an assistant principal engineer with the Buffalo Sewer Authority, traveled to La Laguna to visit their partner community for the first time and evaluate the situation on-site, as well as survey the region for possible implementations of water infrastructure.

Surveying the topology and project environment in La Laguna, Nicaragua

"The team observed that there were about 50 homes. They were not clustered together in a typical village, but rather spread over almost nine square miles of rainforest, mountains and quicksand connected only by dirt walking paths. The village had over 250 residents, and over two-thirds of the children were sickened annually by contaminated drinking water," Nogle said.

The EWB-UB team is currently developing a long-term solution for the community, which includes the installation of a pipeline and central basin system that provides filtration, chlorination and home distribution, sourced from a year-round flowing mountain stream that is dammed approximately half a mile from the center of La Laguna on an adjacent mountain. Provided sufficient political stability, the goal is to implement this design in the early months of 2020, supported by Nicaraguan engineers and inspectors.

The EWB-UB project team on site in La Laguna

Current hilltop water supply source for La Laguna

CE408 **PLANT DESIGN**

One our favorite undergraduate course offerings is the senior plant design class, the capstone to the CBE undergraduate curriculum. The senior design project brings together the chemical engineering concepts that students have studied during their time in the department, such as mass and energy balances, fluid mechanics and heat transfer, thermodynamics, reaction kinetics, and chemical separations. The course also covers new material on project economics, cost estimation and finance. UB CBE faculty use a concept known as spiral learning, whereby the earlier classes introduce content that specifically applies to the actual design project the students will undertake in their final semester.

In recent years, the department has added industrial advisors to the course. During the semester, as the students produce progress reports, each advisor reviews several of the reports and then meets with the student design groups to discuss the various choices the group has made in their design and offer advice on directions they might pursue for the next phase of the project. The advisors bring in their years of manufacturing experience to make students aware of practical concerns in the design, such as logistics, staffing levels, plant layout and process safety management issues. The advisors also offer input to the course instructor regarding potential improvements to the project scope and specification for future classes.

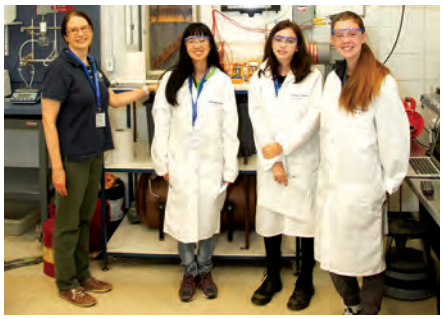
The advisors' generous offering of time and knowledge has made an invaluable contribution to the course by providing a "real world" perspective to the students' experience. Special thanks to this year's industrial advisors: Paul Ameis, general manager, VanDeMark Chemical Inc.; Mahesh Biradar, technology development lead, energy & chemical applications; John Peck, development associate, and William Scharmach, senior development specialist, Linde; and Rich Fickelscherer, manager, Falconeer Technologies.

THOMAS & MARIANNE WEBER FAMILY SCHOLARSHIP

UB CBE Professor Emeritus Tom Weber has recently established a generous endowment gift to be used for the purpose of undergraduate student scholarships in the Department of Chemical and Biological Engineering. The first scholarship from the fund will be awarded to a deserving undergraduate student in 2020.

HIGH SCHOOL **CHEME CAMP**

For one week in July, UB CBE hosted its first annual cheme camp, designed for high school juniors and seniors with an interest in and aptitude for chemistry, physics and/or mathematics. The camp aimed to provide a memorable and exciting experience through hands-on and digitally simulated activities, and it provided an opportunity for these students to discover a passion for chemical engineering while considering college majors. Twenty high school students from the Buffalo Niagara community spent the week learning not only what chemical engineers do, but participating in experiments in membrane separation, nanoparticle synthesis and molecular simulation in the UB CBE labs. They were also introduced to unit operations through both laboratory activities and process simulation experience. Two and a half days were spent visiting local companies, including Linde, ThermoFisher, Dupont and Rich Products, to expose students to chemical engineering practice and possible career trajectories. Engineers from VanDeMark and Peroxychem came to UB to participate in activities with the students and consider some industrial case studies. Many thanks for the support from CBE faculty, staff, local industry partners and UB student and alumni chaperones Callie Bailey-Wickins, Sykhere Brown, Isaac Rezey and Leonardo Gobbato. Student reactions were quite positive:



"My perception of chemical engineering has been widely expanded during this week. At first, I had a vague idea of chemical engineering as working with substances in a lab. I now understand it as a very versatile field with applications in many different and interesting areas."

"After a week of camp, my interest in chemical engineering has grown substantially as I now know how broad it is and how many applications there are for a degree in it, especially in this area."

"Before I did the camp I thought that chemical engineers just sat in a lab mixing chemicals together. Now I learned that chemical engineering is a lot more diverse than that."

While the students came away from the experience enthused and impressed with the profession, we are also optimistic that they are considering pursuing chemical engineering as part of their collegiate experience.

Below: Campers learning about combustion research at Linde

ALUMNI NEWS AND OUTREACH

ASHUTOSH SHARMA, SECRETARY OF THE DEPARTMENT OF SCIENCE AND TECHNOLOGY, GOVERNMENT OF INDIA, RETURNS TO UB CBE

Ashutosh Sharma, PhD 1988, is among the most distinguished scientists in his country. He has conducted groundbreaking interdisciplinary research that has changed our understanding of thin film instabilities and self-organized micro- and nano-patterning. His work has broadly impacted fundamental and applied science and engineering, particularly in the area of nanoscience. An institute chair professor of chemical engineering at the Indian Institute of Technology Kanpur, Sharma has returned to Buffalo to lecture at UB on several occasions. Under his leadership, the Department of Science and Technology launched a new doctoral fellowship program for Indian students abroad, in which UB has been a participant. In appreciation of his association with, and his impact on, our university, and in recognition of his distinguished career achievements, the University at Buffalo conferred upon him a 2019 State University of New York honorary doctorate in science this May. On this occasion he also delivered a School of Engineering and Applied Sciences distinguished lecture at UB. While visiting, he made time to gather with three fellow alumni of his era and his PhD advisor, Eli Ruckenstein.

"I have a vivid memory of driving down to a secretary's home in the outer suburbs of Buffalo in the blizzard of 1985 close to Christmas Eve to get a research paper typed, and I also fondly recall many beers with Eli at his home while working on a manuscript on a sunny afternoon! Summers in Buffalo were exceptional, with many cheers brought on by driving around the Niagara frontier and camping trips in the Adirondacks."

TELL **UB CBE STUDENTS** ABOUT CAREERS IN CHEMICAL ENGINEERING

Our students like to learn from alumni working as chemical engineers in the field. Please tell them what you do on a typical workday and what they can expect. Your advice is always appreciated. Share your story at cbe.buffalo.edu/careers.

THE PROFESSOR

EDWARD P. FURLANI SCHOLARSHIP

Karen Furlani, in tribute to her late husband and former UB School of Engineering and Applied Sciences professor, Edward P. Furlani (PhD 1982, MA 1980, BS 1977), has pledged $100,000 to create an endowed fund to be used for the purpose of providing two annual scholarships to deserving undergraduate students, one from CBE and one from electrical engineering, who plan to go on to graduate school to pursue a career in research. This year's CBE inaugural recipient was Joshua P. Hazelnis, who was honored at the CBE Undergraduate Awards ceremony on May 8.

ALUMNI HAPPY HOUR AT BIG DITCH BREWING COMPANY

On June 19, local UB CBE alumni gathered at Big Ditch Brewing Company in downtown Buffalo for our first-ever alumni happy hour. While enjoying beer and snacks courtesy of Big Ditch, guests received a personal tour of brewery operations from alumnus Matt Kahn, BS 1998. Around 50 alumni and guests attended the gathering, which was such a success that we're already planning next year's event!

Alumnus Matt Kahn leads brewery tour

COMPUTING IN THE CHEME INDUSTRY

Attention UB CBE alumni, you can help CACHE (Computer Aids for Chemical Engineering) Corporation assess computing practices of chemical engineers in industry today and guide changes in the curriculum for students of tomorrow. The last CACHE survey was conducted in 2003, and of course since that time, the field of information technology has changed substantially. To participate, go to https://www.surveymonkey.com/r/CBEsurvey. Thank you for helping CACHE (and the educators it represents) to understand current computing practices in industry.

ALUMNI PROFILE

PHIL MAFFETTONE

PHD (BS 2014)

Phillip M. Maffettone, PhD (BS 2014) began his research career in Professor Mark Swihart's lab as an undergraduate student studying silicon nanoparticle synthesis and applications. During his time at UB, Maffettone earned the prestigious Barry M. Goldwater Scholarship. He then received a Marshall Scholarship for graduate studies in the United Kingdom. The scholarship is awarded to, at most, 40 American students a year. Maffettone was the first UB student to receive the prestigious award since 1988. While attending the University of Oxford, he completed his DPhil in inorganic chemistry with a thesis titled Informed modelling of disorder: From spaghettis to meatballs. His work focused on simulating disorder in diffraction where Bragg's law breaks down; spanning perovskites to proteins, it promoted a healthy disregard for disciplinary boundaries.

Currently he is a research associate in the Department of Chemistry at the University of Liverpool and is focused on developing the laboratory of the future, using artificial intelligence to combine simulation and autonomous experimentation. Maffettone came back to Buffalo this summer to present a seminar on his latest work aimed at intelligent automation of materials discovery. A student athlete while attending UB, he played on the UB rugby team all four years, mentored high school students through UB's Interdisciplinary Science and Engineering Partnership, and organized an annual volunteer trip to the Dominican Republic to teach children English. He also plays trombone, bass and guitar, and he still plays rugby.

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

308 Furnas Hall, University at Buffalo
The State University of New York
Buffalo, NY 14260-4200

UB CBE ALUMNI SPOTLIGHT

JENNIFER KULJU BARNES

Jennifer Kulju Barnes participated in the 3 + 2 engineering program, graduating in 1995 with a BA in Chemistry from SUNY Geneseo and BS in Chemical Engineering from UB. Since graduation, Barnes has worked at VanDeMark Chemical Inc. in Lockport, New York. After starting out in R&D as a process development engineer, she transitioned to R&D lab/pilot lab manager, guiding product development from lab to pilot to plant scale. Barnes then moved on to the phosgene derivatives plant as a process engineer, operations superintendent, and ultimately master planner / senior process engineer. Over her career, Barnes had the opportunity to apply her engineering skills in R&D, process optimization & troubleshooting, environment, health, safety, and quality (EHSQ), and production scheduling & planning.

"**UB CBE** prepared me for many different roles in my career, and gave me the foundation to succeed in my professional life. I am thankful for my education at UB and that's why I support UB CBE with my annual donation. To students, take every opportunity available. Internships are very valuable. Keep an open mind on your career possibilities because there are many different paths, including design, process development, research, sales, planning, environmental, safety, and quality. Work hard but also enjoy time doing things you love."

Outside of work Barnes spends time with Ben, her husband of 21 years. They have two children, Emily (16) and Andrew (14), and a dog, Finn. The family loves watching UB Bulls football and basketball, and is actively involved with school, church and sports. They enjoy taking family vacations and especially love cruising. They have seen glaciers in Alaska, Mayan ruins and snorkeled in the Caribbean Sea.