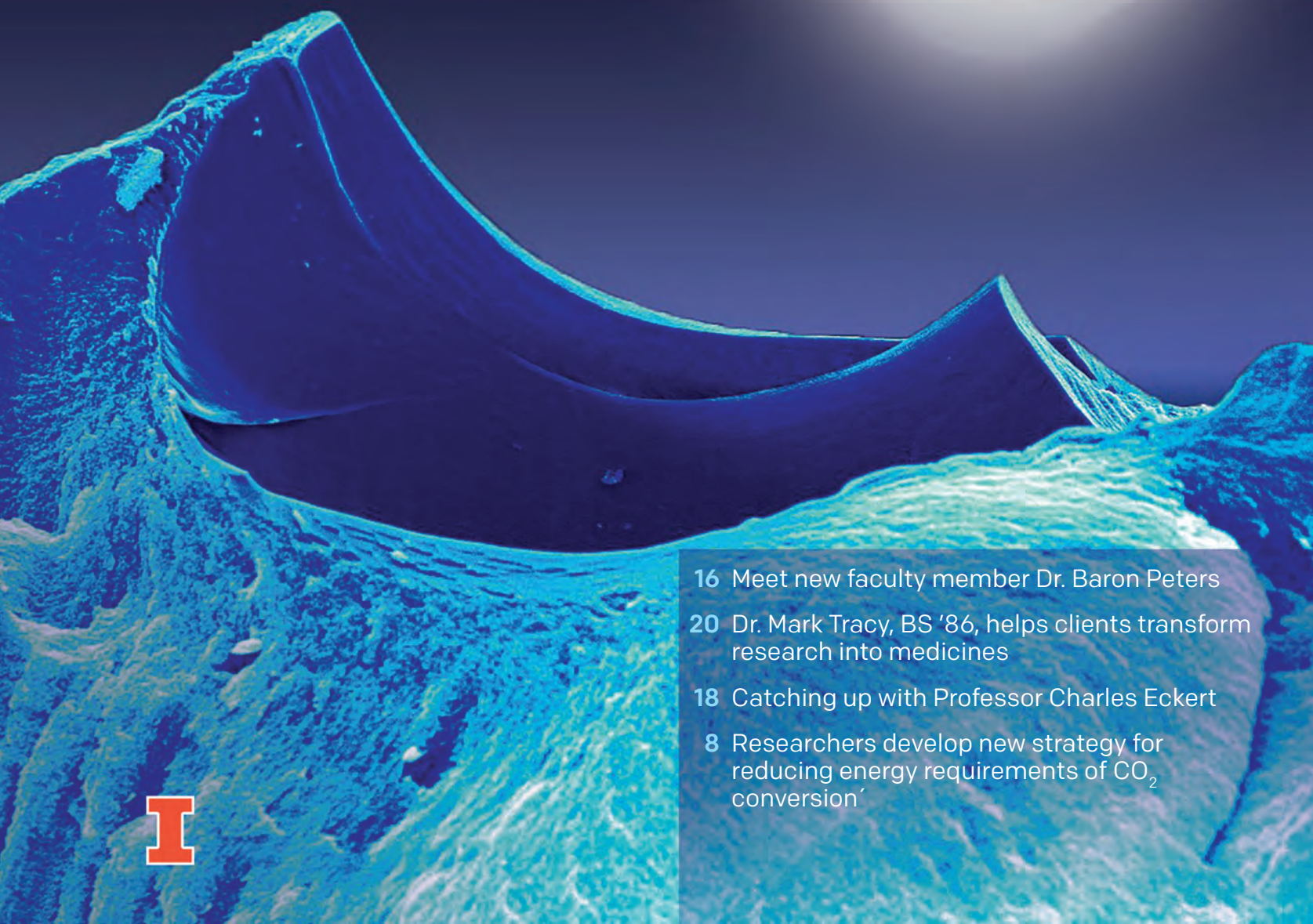
MASS Transfer

News from Chemical and Biomolecular Engineering at Illinois

Spring/Summer 2019



MASS Transfer

Department of Chemical and Biomolecular Engineering

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Contents

About cover:
"Rising Moon Above the Mountain," by ChBE graduate student Emily Chen of the Brendan Harley Group, won first place in the School of Chemical Sciences 2018 Image of Research Competition. Glioblastoma is the most common and deadly form of brain cancer, with less than 10 percent survival rate after five years. Professor Harley and members of his lab develop tissue engineering tools to investigate the influence of tumor microenvironment on tumor progression and therapeutic outcomes. The "moon" in the image is a microtumor made with several thousands of glioblastoma cells and put into the brain-memetic hydrogel biomaterial, the "mountain" in this image. This allows researchers to study processes of cancer such as invasive spreading and therapeutic resistance that lead to poor survival. The composite images were acquired using a scanning electron microscope and added with false color.

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From the Department Head's Desk

Dear alumni and friends,

Greetings from Illinois, where it's been a busy and exciting spring!

We enjoyed hosting **Dr. Ray Mentzer** (BS '74) during commencement weekend on May 11-12. Ray and his wife Beverly (also a chemical engineer) have been great supporters of Illinois and it was a pleasure listening to him share his advice and insight with this year's graduates as the ChBE convocation speaker. Ray, who also has an MS and PhD in Chemical Engineering from Purdue University, had a long, successful career with ExxonMobil. After he retired as a global safety, health, environment and security manager, he taught at Texas A&M and Purdue and is currently Executive Director of the Purdue Process Safety & Assurance Center. (See page 12 for more information and photos from the ceremony.)

Thanks also to the alumni who came back to campus in April for the Undergraduate Research Symposium. This year we had twenty-four students participate! Our judges included **Dr. Chris Burcham** (BS '92), senior engineering advisor at Eli Lilly and Company; **Ed Dvorsky** (BS '85), leader of an engineering group at Koppers Inc.; **Dr. George McConaghy** (BS '67, PhD '74), retired from Amoco and BP; and **Ron Corn** (BS '79), senior vice president of petrochemicals at Chevron Phillips Chemical. It was very rewarding to have some alumni and corporate donors with us at the April undergraduate awards ceremony, where we presented scholarships to our students. With us this year were **Ray Pasteris** (BS '75) who funds the Raymond M. Pasteris Scholarship and **Eryn Schneider** (BS '09), who represented ExxonMobil. **Ron Corn** was also on hand to present his new scholarship to a student for the first time. Thanks to all who donate to our scholarships!

We have lots of great news to share in this issue of the newsletter. You'll notice our Achievements sections for faculty and students are overflowing with news about awards. For example, **Professors Ying Diao**, **Simon Rogers**, and **Diwakar Shukla** have each won a National Science Foundation Faculty Early Career Development (CAREER) Award. In May, Professor **Bill Hammack** was recognized with the Carl Sagan Award for the Public Appreciation of Science. The award, given annually by the Council of Scientific Society Presidents, recognizes outstanding achievement in improving the public understanding and appreciation of science.

In this issue, we reconnect with former faculty member **Dr. Chuck Eckert**, who retired in recent years from Georgia Tech. We introduce you to the newest member of our faculty, **Professor Baron Peters**, who is returning to the Midwest after working as a tenured faculty member at the University of California, Santa Barbara. He studies the kinetics and mechanisms of chemical reactions using computational methods and theoretical analysis. We also feature alumnus **Dr. Mark Tracy** (BS '86) who developed several new medicines that have advanced into clinical trials and onto pharmacy shelves.

Even though the semester has ended, we are already gearing up for a busy fall. We're happy to announce a new alumni awards program for the Department of Chemical and Biomolecular Engineering. Through this program, we will recognize chemical engineering alumni who've distinguished themselves through their outstanding achievements with their professional work, leadership, service to society, or dedication and advocacy for the department. We will celebrate winners of the Distinguished Alumni Achievement Award and Young Alumni Achievement Awards at an annual event on campus in the fall. Please visit www.chbe.illinois.edu/alumni-awards for instructions on nominating a fellow alumnus or alumna.

As in previous years, we also plan to host an alumni tailgate during Homecoming weekend this fall. Please mark Saturday, Oct. 19 on your calendars!

I hope you have a wonderful summer and I am looking forward to seeing many of you on campus or on the road in the coming months.

Paul Kenis
Elio E. Tarika Chair and Department Head

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Department Head Paul Kenis invested as Elio E. Tarika Chair

Dr. Paul Kenis has been named the Elio Eliakim Tarika Endowed Chair of Chemical Engineering in a ceremony honoring his success and leadership in the field.

Kenis earned his undergraduate and graduate degrees in his native country of the Netherlands before completing a postdoctoral fellowship at Harvard University. He joined Illinois in 2000 and began researching microchemical systems with applications in energy and biology.

"Paul is a renowned scholar and his work has won him numerous accolades," said Feng Sheng Hu, the Harry E. Preble Dean of the College of LAS. "I came across his name in 2010 during my time on the selection committee for the University Scholar award. I remember that I was so impressed by Paul's productivity, innovations and discoveries. Since then, his scholarship has only grown."

The late Nancy Louise Ertle Tarika established the Elio Eliakim Tarika Endowed Chair in Chemical Engineering to honor her husband, Elio (BS '49) and to support his alma mater.

Elio Tarika was born in Cairo, Egypt and grew up on an island in Greece. He attended a private high school in Great Britain before crossing the Atlantic on the first Liberty ship, a cargo ship built in the United States, that sailed from Egypt after World War II.

Although the Tarikas have both passed away, their generosity endures, said Jonathan Sweedler, the James R. Eiszner Family Endowed Chair in Chemistry and director of the School of Chemical Sciences.

"Mr. Tarika was drawn to Illinois because of the university's reputation and the promise of receiving an excellent education here. By establishing this endowment, the Tarikas have continued to advance the Illinois legacy of excellence," Sweedler said.

"Their financial support has helped us attract and retain creative and ambitious scholars like Professor Kenis and as a result, the educational experience of our students has also been enriched. The Tarikas have made a lasting, sustainable impact on future generations of chemical engineers, and for that we are grateful."

Currently, Kenis' research focuses on the development of continuous flow reactor technology for CO_2 reduction and for the synthesis of semiconducting quantum dots and microfluidic platforms that enable either the study of the epi-endothelial junction of the lung or fast imaging of protein folding events, such as those associated with Alzheimer's disease.

"I'm very grateful for the gift and what the resulting endowment allows my group to do going forward: pursue a risky idea for which we do not have funding yet," Kenis said. "I would also like to thank my colleagues for providing an inspiring environment. This is a place that if you have good ideas and emphasize why and how you'll achieve that, we can achieve great things. It's truly an honor to get this recognition for all the work we do—we, past and present."

Kenis also thanked his partner, chemical and biomolecular engineering professor Mary Kraft, for her support.

By Samantha Jones Toal, College of LAS Communications and Marketing

From left: Jonathan Sweedler, director of the School of Chemical Sciences; Provost Andreas Cangellaris; Paul Kenis, Elio Tarika Chair of Chemical Engineering; Feng Sheng Hu, Harry E. Preble Dean of the College of Liberal Arts & Sciences

Illinois College of Engineering becomes The Grainger College of Engineering—recognizing more than $300 million in support

The University of Illinois at Urbana-Champaign's College of Engineering has become The Grainger College of Engineering, recognizing a new $100 million gift from The Grainger Foundation and more than $300 million in total support. The Grainger Foundation's total support represents the largest amount ever given to a public university to name a college of engineering, with more than $200 million provided in the last six years.

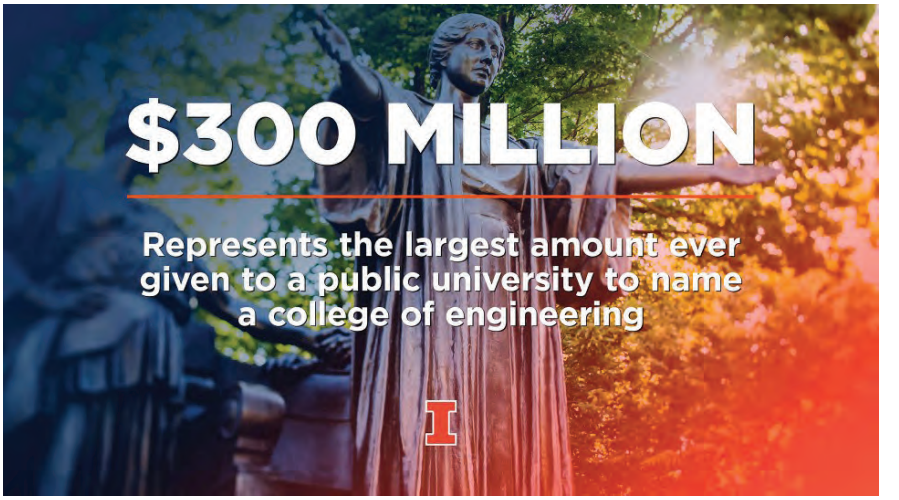
William W. Grainger graduated from the university's electrical engineering program in 1919 and founded the industrial supply company W. W. Grainger, Inc. in 1927. Grainger is an Illinois-based Fortune 500 company with more than 25,000 employees worldwide.

As part of the naming, The Grainger Foundation will provide the additional $100 million unrestricted gift to the college's endowment, building upon its past, significant foundational support for even greater impact during the college and university's ambitious *With Illinois* campaign and beyond.

"What an anniversary! One hundred years after William W. Grainger graduated from our college, his impact is still felt. We are forever grateful," said Rashid Bashir, dean of The Grainger College of Engineering.

"Very few colleges have seen this kind of long-term, flexible support. We are proud to be one of them, and it will allow our research enterprise and educational programs to flourish. It will also allow us to recruit, reward, and retain the very best faculty with more and larger faculty chairs and professorships," Bashir said.

The name change took effect on May 16, following approval from the University of Illinois Board of Trustees.



HAMMACK, PETERS NAMED LYCAN PROFESSORS

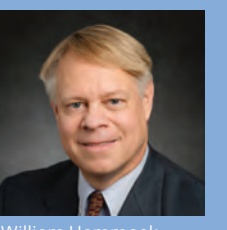
The School of Chemical Sciences announced the appointment of three new William H. and Janet G. Lycan Professors: William Hammack and Baron Peters in the Department of Chemical and Biomolecular Engineering and Liviu Mirica in the Department of Chemistry.

"Bill, Liviu, and Baron join a superlative group of dedicated colleagues that we honor with named positions, including Gregory Girolami, our other current Lycan Professor," said Dr. Jonathan Sweedler, director of the School of Chemical Sciences. The named appointments recognize the school's collective commitment to excellence in scholarly pursuits.

Professor Hammack graduated from Michigan Technological University with a BS in Chemical Engineering in 1984. He earned his MS and PhD in Chemical Engineering from the University of Illinois in 1986 and 1988. He joined the Illinois faculty in 1997. His scholarly efforts are in the areas of teaching and public outreach. He has excelled over the years, especially in the area of outreach to the general public.

Hammack continues to be one of the most listened to and most watched engineering educators in history. His YouTube channel currently has more than 800,000 subscribers. The book associated with the YouTube channel, *Eight Amazing Engineering Stories*, was a bestselling technology book on Amazon. In the classroom he has had an equally pioneering career. His course, CHBE 101: The Hidden World of Engineering, is taught to a diverse mix of students majoring in commerce, architecture, photography, history, and graphic arts.

Professor Peters graduated from the University of Missouri, Columbia, in 1999, with a BS in Mathematics and Chemical Engineering. He earned a PhD in Chemical Engineering from the University of California, Berkeley, in 2004. He completed postdoctoral research at MIT from 2004 to 2006 and was a postdoctoral fellow at Ecole Normale Supérieure from 2006 to 2007. He joined the Illinois faculty in January 2019. A feature story about Peters and his research can be found on page 16. Investitures will be held in 2019.

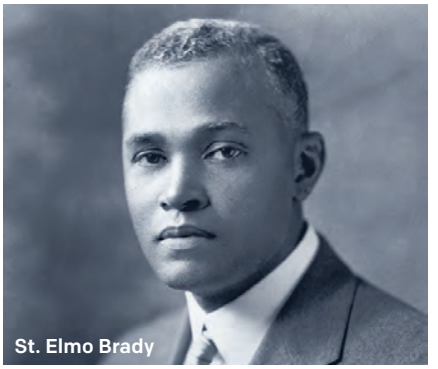

William Hammack


Baron Peters

School celebrates first African American to earn PhD in Chemistry in U.S.

The American Chemical Society honored St. Elmo Brady with a National Historic Chemical Landmark designation at an all-day event in Noyes Laboratory in February. As part of the celebration, students from several Historically Black Colleges and Universities visited the Illinois campus to learn more about graduate programs in chemistry and chemical engineering here.

St. Elmo Brady was born in Louisville, Kentucky and received a bachelor's degree from Fisk University in 1908. He began teaching at Tuskegee Normal and Industrial Institute in Alabama. In 1912, he was offered a scholarship by the U of I to pursue graduate studies, earning a master's degree in chemistry in 1914. Brady continued his studies under professor Clarence G. Derick, earning a PhD in 1916. During



St. Elmo Brady

his time at Illinois, Brady became the first African American admitted to Phi Lambda Upsilon, the chemistry honor society, in 1914, and was one of the first inducted into Sigma Xi, the science honorary society, in 1915.

Dr. Jonathan Sweedler, the director of the School of Chemical Sciences, said Brady's most enduring legacy involves his efforts to enhance and create undergraduate curricula, graduate programs and fundraising efforts at Fisk University, Tuskegee University, Howard University and Tougaloo College. Each of those campuses will host a celebration of Brady's achievements and display a plaque in his honor.

Several relatives and family friends of Dr. Brady were able to attend the event in Urbana. Also in attendance were representatives and students from Fisk, Tuskegee, Howard, and Tougaloo. The event began with opening comments from Dr. Sweedler and continued with tours of the Departments of Chemistry and Chemical and Bimolecular Engineering and school facilities. The Illinois chapter of NOBCChE (National Organization for the Professional Advancement of Black Chemists and Chemical Engineers) held a luncheon and poster session, and other workshops were held for faculty and students throughout the day.

At the dedication ceremony, Dr. Peter Dorhout (BS Chemistry, '85), immediate past president of ACS, presented the university with a bronze plaque that can be viewed outside of 100 Noyes Laboratory.

From left: School of Chemical Sciences Director Jonathan Sweedler, LAS Dean Feng Sheng Hu, Dr. George Armstrong from Tougaloo College, Dr. Charles Hosten from Howard University, UI Provost Andreas Cangellaris, and Dr. Natalie Arnett from Fisk University.

From left: W. Clay Fonvielle, Brady's great-grandson; ChBE Department Head Paul Kenis; Carol Brady Fonvielle, Brady's granddaughter; Jerrod Henderson (PhD '10) and Rick Greer, co-founders of the St. Elmo Brady STEM Academy.

SCHOOL ADVISOR HONORED

The College of Liberal Arts & Sciences recognized Todd Spinner, academic advisor for the School of Chemical Sciences, with a 2018-19 LAS Award for Excellence in Academic Advising.

Spinner has served the school as an adviser since 2010 and is the most senior adviser in longevity and responsibility. He has implemented several services and programs, including a program that tracks students who are struggling in major core classes and a redesign of major course sheets so students could more accurately track their course progression. Colleagues said Spinner is committed to being available to his students, and students know him for his friendly and engaging demeanor, and his knowledge of how he can assist their studies.

Faculty Achievements

Three faculty receive NSF CAREER Awards

Congratulations to **Drs. Ying Diao**, **Simon Rogers**, and **Diwakar Shukla**. The three assistant professors recently won National Science Foundation Faculty Early Career Development (CAREER) Awards.

CAREER Awards are prestigious and competitive awards given to junior faculty who exemplify the role of teacher-scholar through outstanding research, excellent education, and the integration of education and research within the context of the mission of their respective organizations.


Simon Rogers

Dr. Rogers won the award for his work on understanding the ways soft materials transition from acting as solids to acting as liquids. The title of his proposal is "Time-dependent Structures of Soft Materials under Flow: A Rheo-Scattering Approach to the Study of Thixotropic Yield Stress Fluids."

Yield-stress materials can be utilized in a variety of ways—in 3D printing applications, pharmaceuticals, photovoltaics, food, and more. No matter their application, yield-stress materials need to retain a desired shape under certain conditions but also be able to flow on demand. For instance, in some types of 3D printing, it's important to use inks that can flow out of a nozzle but then turn into solids once printed, allowing for a variety of structures to be formed, he said.

"We seek to understand these behaviors at a molecular level, so we can design and engineer smart responsive materials for a variety of applications," Rogers said.

Rogers and members of his lab will develop experimental methods that link the mechanical changes we observe on human length scales to what happens at a molecular level. This will enable the design of new materials as well as more efficient industrial processes.

Dr. Shukla will receive support for his lab's efforts in developing new algorithms and their applications to the field of computational biology.


Diwakar Shukla

Shukla's project, "Reinforcement Learning of the Free Energy Landscapes of Proteins," addresses the challenge of sampling large-scale conformational dynamics in molecular simulations and develops a computational approach likely to have broad impact on understanding the dynamics underlying protein function.

"The research effort aims to apply the proposed methodologies to investigate proteins that play a critical role in the environment (sugar transport in plants) and human health (neurotransmitter transport in human brain), but in which limited structural or dynamic information is available. Therefore, this project will provide new information critical for regulating their activity," Shukla said.


Ying Diao

Dr. Diao's proposal, "Multiscale Assembly of Conjugated Polymers at Dynamic Reconfigurable Interfaces," aims to develop dynamic, reconfigurable interfaces to direct the assembly of semiconducting polymers into highly ordered structures across length scales. Controlled assembly of electrically active materials has been a cornerstone of the electronics and energy industries. In recent years there has been an increase in semiconducting polymers which could be applied in everything from flexible electronics to imperceptible medical devices. But there remains a challenge in controlling the assembly of semiconducting polymers from the molecular to the device scale.

"The award will enable us to explore new concepts and to uncover unknown mechanisms of directed assembly of semiconducting polymers, a new area I ventured into since joining Illinois," Diao said. Ultimately the goal of such work is to enable high-performance and low-cost printed electronic, energy and biomedical devices which interact seamlessly with the human body and the living environment.

All three CAREER Awards include support for a number of public engagement activities for school-age children and mentorship for undergraduate and graduate students.

Hammack receives Sagan Award


Bill Hammack

Professor **Bill Hammack** was recognized with the Carl Sagan Award for the Public Appreciation of Science. The award, given annually by the Council of Scientific Society Presidents, recognizes outstanding achievement in improving the public understanding and appreciation of science. Previous recipients include Steven Pinker, Thomas Friedman, and Bill Nye. The first recipient was astronomer and science communicator Carl Sagan.

The Council of Scientific Society Presidents (CSSP) represents the breadth of science and engineering research disciplines through its member societies and federations.

Bill Hammack is a William H. and Janet G. Lycan Professor at the University of Illinois. As an engineer, his mission over the last 20 years has been to inform the public about engineering and science. His media work explaining fundamental science and its application through engineering—from his work in public radio to his use of internet-delivered video—has been listened to or viewed over 50 million times. In clear, accessible, but technically accurate language, he has excited the next generation of engineers and scientists, and aided the public in appreciating the impact of science and engineering in our society and economy.

He earned a BS in Chemical Engineering at Michigan Technological University and an MS and PhD in Chemical Engineering from the University of Illinois. He taught at Carnegie Mellon for a decade before returning, in 1997, to Illinois.

Shukla wins Sloan Fellowship

Blue Waters Assistant Professor **Diwakar Shukla** was among 126 recipients of the Sloan Research Fellowships from the Alfred P. Sloan Foundation for 2019. The awards honor early career scholars whose achievements mark them as among the most promising researchers in their fields.

Shukla uses physics-based models and techniques to understand complex biological processes such as the regulation of protein structure and function, with applications in food security and human health. He joined the Illinois faculty in 2015 and is an affiliate of the department of plant biology, the Center for Biophysics and Quantitative Biology, and the National Center for Supercomputing Applications. He is a graduate of the Indian Institute of Technology in Mumbai and received a PhD from MIT.

Harley inducted into AIMBE College of Fellows

The American Institute for Medical and Biological Engineering (AIMBE) elected Professor **Brendan Harley** to its College of Fellows at its annual meeting this March.


Brendan Harley

Dr. Harley was chosen for his "innovative and translational contributions to instructive and spatially graded biomaterials for regenerative medicine and for engineering dynamic cell-material interactions."

Election to the AIMBE College of Fellows is among the highest professional distinctions accorded to a medical and biological engineer. It is comprised of the top two percent of medical and biological engineers. Membership honors those who have made outstanding contributions to engineering and medicine research, practice, or education and to the pioneering of new and developing fields of technology, making major advancements in traditional fields of medical and biological engineering, or developing/implementing innovative approaches to bioengineering education.

He joined the Illinois faculty in 2008 and is a Professor and Robert W. Schaefer Faculty Scholar. He is also leader of the Regenerative Biology and Tissue Engineering research theme at the Carl R. Woese Institute for Genomic Biology. He received his SB from Harvard University in 2000 and SM/ScD from MIT in 2002 and 2006.

At Illinois, Dr. Harley has focused his efforts on developing biomaterials that replicate the dynamic, spatially-patterned, and heterogeneous microenvironment found in the tissues and organs of our body. He and members of his lab use this approach to generate insight regarding the design of biomaterials for craniomaxillofacial and musculoskeletal tissue regeneration, hematopoietic stem cell engineering, as 3D models of the glioblastoma tumor microenvironment in the brain, and to replicate dynamic tissues such as the endometrium.

Diao recognized for research excellence

Assistant Professor **Ying Diao** has been named a winner of The Grainger College of Engineering **Dean's Award for Excellence in Research**. The award is given annually to a handful of engineering faculty in recognition of their research. She was honored at the college's faculty awards ceremony in April.

The Diao Group focuses on developing fundamental understanding of and innovative methodologies for directed assembly of functional materials and their applications in electronics, renewable energy and healthcare. Diao, a Dow Chemical Company Faculty Scholar, joined the Illinois faculty in 2015. She received her PhD degree in Chemical Engineering from MIT in 2012 and completed her postdoctoral studies at Stanford University.

She was also recently selected as an Emerging Investigator in Crystal Growth & Design by the American Chemical Society's Axial blog. The March 13 issue of the virtual journal featured work by the Diao Group.

Also this spring, Diao was chosen to receive the 2019 American Vacuum Society's Prairie Chapter Early Career Award. She will receive the award at the chapter symposium this September at the University of Illinois at Urbana-Champaign campus. She will deliver an award lecture at the symposium.

She was cited for her "original contributions bridging molecular assembly with surface science to reveal unconventional mechanisms of surface-induced nucleation, and innovative, scalable, printing methods for nanomaterials manufacturing."

Flaherty joins ACS Catalysis board

Assistant Professor **David Flaherty**, who will become an associate professor in August, was appointed to the American Chemical Society's *Catalysis* Early Career Advisory Board in April.

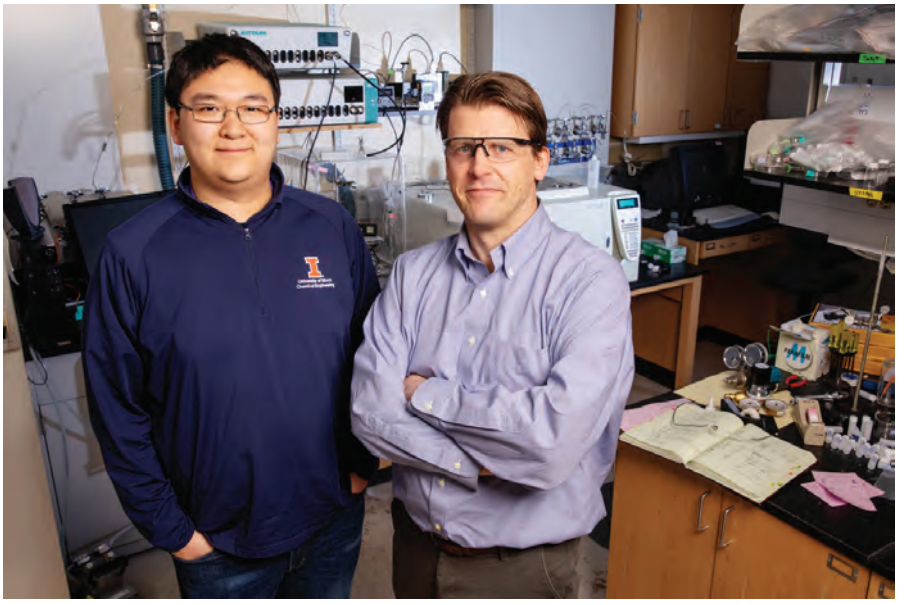
The researchers were chosen on the basis of their nominations by the journal's editors, editorial advisory board members, and from the suggestions of the membership of the global catalysis community. The board's expertise represents the broad distribution of topics published in the journal—heterogeneous, homogeneous, and biological catalysis—giving editors insight into the current or emerging opportunities in each subcommunity.


David Flaherty

Research in the Flaherty Lab focuses on the overlapping topics of catalysis, surface science, and materials synthesis. Dr. Flaherty has received a number of notable awards in recent years, including and NSF CAREER Award and the New Investigator Award from the American Chemical Society. He earned his BS from the University of California, Berkeley in 2004 and his PhD from the University of Texas at Austin in 2010.

Study: Reducing energy required to convert CO_2 waste into valuable resources

Surplus industrial carbon dioxide creates an opportunity to convert waste into a valuable commodity. Excess CO_2 can be a feedstock for chemicals typically derived from fossil fuels, but the process is energy-intensive and expensive.



Research Assistant Shawn Lu (left) and Paul Kenis, Elio E. Tarika Chair and Head of Chemical and Biomolecular Engineering. Photo by L. Brian Stauffer, U of I News Bureau.

University of Illinois chemical engineers have assessed the technical and economic feasibility of a new electrolysis technology that uses a cheap biofuel byproduct to reduce the energy consumption of the waste-to-value process by 53 percent. The new findings are published in the journal *Nature Energy*.

Conversion of CO_2 to chemicals like ethylene for plastics is possible through a process called electrochemical reduction. Typically, a stream of CO_2 gas and a fluid electrolyte move through an electrolysis cell that breaks the CO_2 down into molecules like ethylene on the cathode, but it also produces oxygen from water on the anode, the researchers said.

"About 90 percent of the energy required in conventional CO_2 reduction is used up by the oxygen-producing, anode side of an electrolysis cell," said co-author Paul Kenis, Elio Tarika Chair and Department Head. "But there is no big market for the excess oxygen, so 90 percent of the energy is wasted."

Finding a feed material that reduces the energy to drive the anode reaction could be a strategy for radically reducing the energy requirements of CO_2 conversion, according to a recent National Academies Report of which Kenis was a co-author.

The new study proposes glycerol–an organic byproduct of sugar cane biofuel production that requires less energy to oxidize–as an alternative to the energy-intensive oxygen-producing step.

To test if the new electrolysis technique has the potential to push the full CO_2 conversion process to a carbon neutral or negative budget, the researchers examined the cost and energy consumption for the production cycle of the waste-to-value process. The four-step cycle includes the capture of industrial CO_2 waste gas, the input of electricity, the new electrolysis reaction, and the separation and processing of the final chemical products.

"Our model uses the current electrical grid setup as the source of electricity to make the scenario more realistic," Kenis said. "Being able to drive CO_2 conversion with already-in-place infrastructure–and not relying on the hope of the future grid being powered by 100 percent renewables–while achieving carbon neutrality or negativity could be a holy grail scenario."

The analysis includes best- and worst-case CO_2 emissions and energy consumption scenarios and concludes that the prospects of CO_2 reduction, in terms of CO_2 emissions and economics, can drastically improve by looking beyond conventional anode reactions.

"The glycerol-based electrolysis reaction shows a lot of promise. However, we will continue to explore other organic waste materials because even when production rises in the wake of increased biofuel production, it still will not be enough to support the need," he said. "The good news is the chemistry involved is flexible and there are a lot of organic waste products that can do the job."

Sumit Verma

Many researchers focus on improving the selectivity and activity of chemical catalysts for CO_2 reduction reactions, and that work needs to continue, said Sumit Verma, (PhD '18, Kenis) study co-author. "Looking beyond oxygen evolution at the anode seems like a win-win situation, as we not only reduce the processes' energy consumption but also produce a second valuable product stream," he said.

The International Institute for Carbon Neutral Energy Research; Japanese Ministry of Education, Culture, Sports, Science and Technology; Dow Chemical Company; and the Glenn E. and Barbara R. Ullyot graduate fellowship supported this research.

By Lois Yoksoulian, U of I News Bureau

Researchers gain control over soft-molecule synthesis

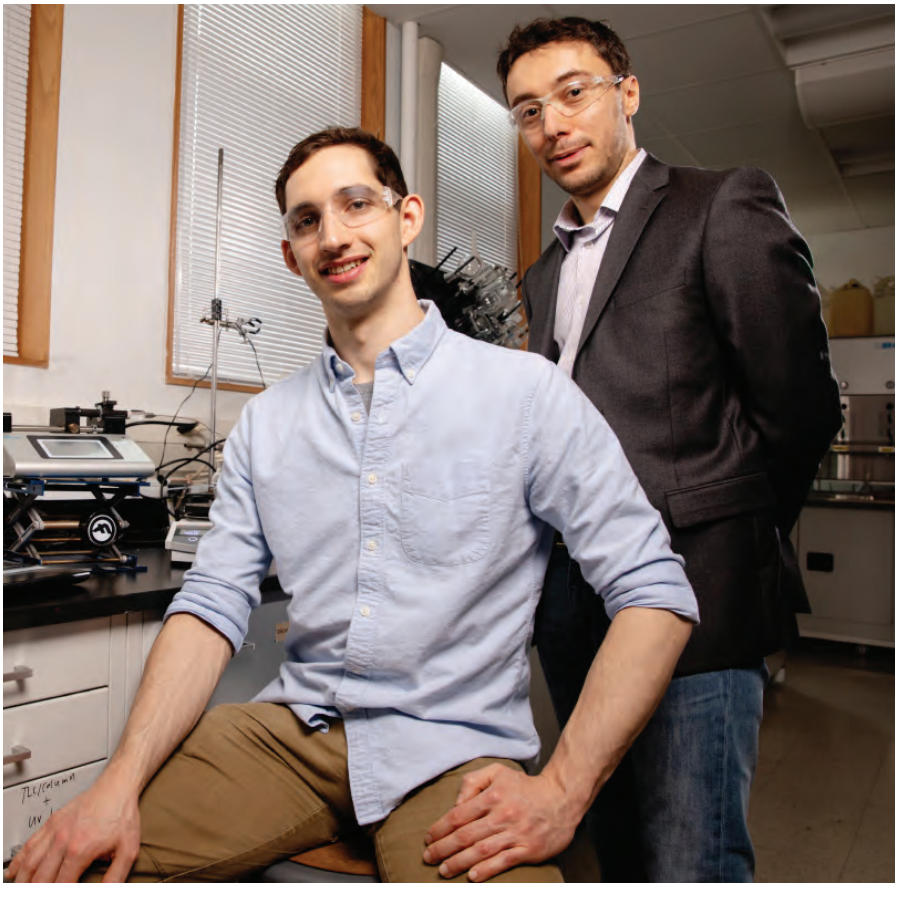
By gaining control over shape, size and composition during synthetic molecule assembly, researchers can begin to probe how these factors influence the function of soft materials. Finding these answers could help advance virology, drug delivery development and the creation of new materials.

"We approached this new research concept not by trying to fix a problem, but by asking what is possible when it comes to soft-molecule synthesis," said Assistant Professor of Chemical and Biomolecular Engineering **Damien Guironnet**, the lead author of a new study. "What if we can gain control over things like shape, size and composition during molecular synthesis – what does that mean?"

The findings were reported in the *Proceedings of the National Academy of Science* earlier this year.

For years, scientists have struggled to clarify how nanoparticle shape and size influence their behavior within living tissue, the researchers said. "The size of the synthetic molecules we are creating correspond to the size of viruses," said **Dylan Walsh**, a ChBE graduate student and study co-author. "Observations made from controlling these factors will allow researchers to probe these types of questions."

The team combined classic chemical synthesis techniques and basic chemical engineering principles. They introduced precise control over the polymer formation sequence via the flow rate of the building blocks used. By altering flow rate, the new process can yield soft matter with unique architectures, the researchers said.



Prof. Damien Guironnet, right, and graduate student Dylan Walsh developed a new technique that allows them to program the size, shape and composition of soft materials. Photo by L. Brian Stauffer.

"We use mathematical modeling to predict the shape, size and composition of molecules we create and use computer-guided synthesis in the lab to adjust the flow rate of the mixtures that control the architecture of the polymer," Guironnet said.

The researchers felt it was not enough to simply state that they can do this – they needed to prove it.

"Our mathematical modeling does not include any assumptions so there is really nothing else that can be formed other than what we model, but math is not something you can see," Guironnet said. "Shape is something we can see, and we were able to verify with microscopic imaging that we formed polymers consistent with what we predicted."

The team achieved this with synthetic molecules that are soluble in organic solvents, but the next step will be to move onto water-soluble molecules. "If we truly want to better understand our immune response and improve drug-delivery specificity, we need these to be water-soluble so that they can work in our bodies," he said.

"Shape is something we can see, and we were able to verify with microscopic imaging that we formed polymers consistent with what we predicted."

Damien Guironnet

"We have access to new building blocks, and now we can work on figuring out how we can use these blocks to assemble new materials at the molecular level," Walsh said. "We think of it as playing with Legos to see how the shape of the individual building blocks influences the final product."

The National Science Foundation supported this study.

By Lois Yoksoulian, U of I News Bureau

2019 Undergraduate Research Symposium

Congratulations to the winners!

The annual symposium was held on Friday, April 12, 2019, and sponsored by Omega Chi Epsilon and the Department of Chemical and Biomolecular Engineering. This year, 24 students participated.

First place was awarded to Faisal Aldukhi from the Shukla Group with his presentation, "Elucidating Binding Pathway of Brassinolide and Castasterone to BRI1."

Two students tied for second place: Ty'Nya Larry from the Kenis Group with "Lung-on-a-chip Enables Dynamic Imaging of Pulmonary Lung Tissue in Response to Aerisiolized Nanoparticles" and Kevin Wade of the Gewirth Group with "The Effect of Organosilane Cathode Coatings on Lithium-Ion Battery Performance."

Third place went to Noah Hopkins of the Schroeder Group who presented "Non-Equilibrium Dynamics of Vesicles Using a Stokes Trap and Precision Microfluidics."

Thank you to the four alumni judges who volunteered their time: Dr. Chris Burcham (BS '92), Ed Dvorsky (BS '85), Dr. George McConaghy (BS '67, PhD '74), and Ron Corn (BS '79).

Dr. George McConaghy worked for Amoco and BP in Naperville, IL as Manager of Chemicals R&D, retiring in 2005 after 33 years of service. After retirement, he was a part-time visiting lecturer for the University of Illinois Department of Chemical and Biomolecular Engineering until 2011. In addition to his bachelor and doctoral degrees from Illinois (he studied turbulent transport in polymer solutions with the late Professor Thomas Hanratty), he has an MS in Chemical Engineering from the University of Washington.

After graduating with his bachelor's degree from Illinois, **Ed Dvorsky** joined the Bendix Corporation (now part of Honeywell), working on research projects for advanced semiconductor technologies. New opportunities led him to positions in the microelectronics/supercomputer industry in the Midwest, including stints with Cypress Semiconductor and Cray Research. His final foray in microelectronics was with a start-up company that developed MRAM memory chips. The new millennium brought him back to Illinois and a new focus in specialty chemicals with Koppers.

At Chevron Phillips Chemical, **Ron Corn** is responsible for the olefins, NGL, and aromatics product lines and accountable for the company's Saudi joint ventures. Previously he served as senior vice president in specialties, aromatics, and styrenics, vice president in corporate planning and development, vice president in olefins and NGL and general manager in Asia, where he oversaw all Chevron Phillips Chemical activities in the region.

Dr. Chris Burcham is the lead engineer responsible for the commercialization of a late phase development project at Eli Lilly. In addition to his Illinois degree, he earned a PhD in Chemical Engineering from Princeton University in 1998.

Top photo: Department Head Dr. Paul Kenis with OXE President Pierce Blazina and winners Noah Hopkins, Ty'Nya Larry, Kevin Wade and Faisal Aldukhi.

Bottom photo: Judges Dr. Chris Burcham and Ed Dvorsky, OXE president Pierce Blazina, judges Dr. George McConaghy and Ron Corn.

Would you like to be a judge for one of our student research symposiums? The 2019 Graduate Research Symposium will be on Friday, Oct. 18, and the next Undergraduate Research Symposium will be on Friday, April 3, 2020. Please email the department at chemeng@illinois.edu if you're interested.

Jugovich Selected for Grainger College of Engineering Award

Congratulations to ChBE student Nicole Jugovich, who was chosen for the Lisle Abbott Rose Award from the University of Illinois Grainger College of Engineering. The award is given to a student who most nearly approaches the ideal of technical excellence combined with cultural breadth, depth, and sensitivity.

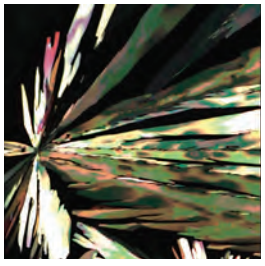
Through the Illinois Scholars Undergraduate Research program, Jugovich has been a part of two research teams. As a sophomore, she worked with Assistant Professor Ying Diao's group and this year with Professor Brendan Harley's lab. In Dr. Diao's lab, she worked on optimizing a dropwise fabrication process for synthesizing organic semiconductor crystals. In Dr. Harley's lab, she has investigated hydrogel systems which will be used to create a complex, 3D cell-laden model to study brain cancer cells.

The undergraduate from Western Springs, IL said her interest in engineering grew out of an "Introduce a Girl to Engineering" day at Argonne National Laboratory in seventh grade. At that event she met a nuclear engineer who spoke about her experience as a woman in engineering and the potential applications of clean energy.

She continued to challenge herself with advanced math and science coursework throughout high school at Benet Academy in Lisle and sought out more STEM-related opportunities, including a summer engineering camp at the U of I.

At Illinois she is a member of the Society of Women Engineers, where she serves as the special events coordinator. She also was the secretary of the organization's information and marketing committee. She also is a group leader for the Engineering Ambassador Program, which involves organizing and presenting science topics to students in grades three to 12 to spark their interest in engineering Jugovich has a passion for bringing together diverse groups of people to solve problems. This summer she is traveling to China as part of the Hoeft Technology & Management Program, a partnership between the Grainger College of Engineering and the Gies College of Business. Jugovich plans to work in industry at the intersection of business and engineering.

"Not only does the Hoeft program challenge students with rigorous coursework, but it also offers professional development workshops to build critical skills outside of the classroom. The unique lessons in mentorship, professional branding, and women in management have been especially helpful in my development as a rising professional," she said.



Pictured are cross-polarized microscope images of organic semiconductor crystals, which precipitated from solution. Organic crystal research can advance organic electronics, since organic semiconductor crystals can be produced at 1/20th of silicon's cost.

2018-2019
Department Scholarship Recipients

Thanks to generous donors, the Department of Chemical and Biomolecular Engineering was able to reward 31 outstanding undergraduate students with scholarships this year. Congratulations to all the winners!

John Martin Ankenbauer Memorial Scholarship
Lucas Kreidl

Franklin A. Boyle Scholarship
William Spreadbury

Corn Family Scholarship
Hui Du

Donald E. Eisele Memorial Award
Eric Cai

ExxonMobil Scholarship
Robert Schneider

Robert S. Frye Scholarship
Kevin Wade

Clarence G. Gerhold Memorial Scholarship
William Lyon

Dr. Joseph and Donna Glas Scholarship in Memory of Professor James Westwater
Christian Monte

James K. Grant Scholarship
Vivek Vermani

Chester W. Hannum Scholarship
Linzixuan Zhang
Thomas Johnston

Dr. Edmund D. and Sara J. Heerdt Scholarship
Marko Ivancevic
Jing Zhao

Donald B. Keyes Award in Chemical Engineering
Andrew Gugulski

John W. Latchum Jr. Scholarship
Joseph Cangialosi

Dr. Ray A. Mentzer Scholarship
Anthony Salazar

Kirk Nass and Michael Gillespie Scholarship
Michelle Brown

Raymond M. Pasteris Scholarship
Ty'Nya Larry
Quyen Nguyen

Phillips 66 Scholarship
Sophia Belvedere
Nicole Jugovich
Victoria Wisniewski

Worth Huff Rodebush Scholarship
Madeleine Chalifoux

Rohm and Haas Scholarship
Chea Yean Chee

Rebekah Schiff-Berger Memorial Scholarship
Beth Born

Thomas R. and Yolanda S. Stein Scholarship
Yiling Loh
Sanjna Shah

Glenn E. and Barbara R. Ullyot Scholarship
Faisal Aldukhi
Natalia Markiewicz

R. J. Van Mynen Chemical Engineering Scholarship
Zhitao Chen

Bruno H. Wojcik Scholarship
Alishba Rehman

2019 Chemical and Biomolecular Engineering Convocation

Congratulations to the Class of 2019!

On Sunday, May 12, 2019, the Department of Chemical and Biomolecular Engineering celebrated students receiving bachelor's and doctoral degrees at a ceremony that took place in the Tryon Festival Theatre in the Krannert Center for the Performing Arts. A reception was held after the ceremony on Centennial Plaza between Noyes Lab and the Chemistry Annex.

This year's convocation speaker was **Dr. Ray Mentzer**, who received his BS in Chemical Engineering from Illinois in 1974, followed by his master's and doctoral degrees in chemical engineering from Purdue University. He enjoyed a career of 28-plus years with ExxonMobil, working around the world with 14 assignments in a variety of areas, including oil and gas facility design and operation, research, financial management, safety, health & environment, and public affairs. His last position with the company was as Global Safety, Health, Environment and Security Manager.

Upon his retirement from ExxonMobil, Dr. Mentzer joined the Mary Kay O'Connor Process Safety Center in the Department of Chemical Engineering at Texas A&M University where he taught the senior-level chemical process safety and oil & gas processing courses for eight years. He oversaw ten graduate students with research focusing on process safety management and metrics, risk assessment, safety culture and resilience, downhole drilling safety, and liquefied natural gas (LNG) safety. Dr. Mentzer is currently a visiting professor in chemical engineering at Purdue University, teaching the senior and graduate student level process safety course and he is Executive Director of the Purdue Process Safety & Assurance Center. The center is supported by numerous major corporations and focused on the prevention of major industrial incidents such as Bhopal and Deepwater Horizon.

Married for 34 years, he met his wife Beverly, also a chemical engineer, at ExxonMobil. They have two children who hold degrees in mechanical engineering and economics. Dr. Mentzer enjoys reading, golf, and international travel.

In his remarks to students, Mentzer said that within a week of graduation, their GPA will have little significance and no one will ask about it. Instead, graduates should expect their future managers and supervisors to ask, "What have you done for me lately?"

"The key question is where do you go from here. What will you do with the analytic and engineering problem-solving skills that you have acquired here at U of I?"

Mentzer outlined five suggestions:

First: Demonstrate your technical competency and what you have learned.

Second: Be a life-long learner and focus on your career development.

Third: Take to heart the following 'habit' from Steven Covey's book, 7 Habits of Highly Effective People:" Seek first to understand and then to be understood.

Fourth: You likely won't like all of your work assignments or jobs equally, but hard work and a strong work ethic will be a major factor in the opportunities you will be given and your accomplishments.

Fifth: Strive to balance your work life, family life, community and relationships, and personal life.

Department Head Paul Kenis told graduates that he and his Chemical and Biomolecular Engineering colleagues were very proud of their accomplishments.

"We hope we have provided you with the education that will help you become successful and we wish you best of luck in your professional and personal lives," he said.

Left photo: Dr. Ray Mentzer (BS '74) addresses graduates. Top right: PhD candidates line up to be 'hooded'. Bottom right: Faculty participate in the ceremony.

Congratulations to the Illinois AIChE ChemE car team, which won second place for "Innovation from Energy by Chevron" during the Spring 2019 Engineering Open House.

Thank you to LyondellBasell and ChBE alumnus Blake Stevens (BS '11) for a fantastic tour this spring of the olefin unit in Morris, IL. Students in CHBE 121 had a great time!

Graduate Student Achievements

Mavis Future Faculty Fellows


Gavin Donley


Dinesh Kumar


Evan Lloyd

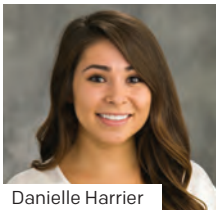

Ajit Vikram


Hao Yu

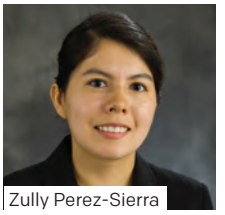
Five graduate students from Chemical and Biomolecular Engineering were chosen for the Mavis Future Faculty Fellows Academy, a Grainger College of Engineering program designed to facilitate training for the next generation of great engineering professors. The students include Gavin Donley (Rogers Group), Dinesh Kumar (Schroeder Group), Evan Lloyd (Moore Group), Ajit Vikram (Kenis Group), and Hao Yu (Schroeder/Moore Groups).

There are three main components to the training: teaching, research, and service. All fellows will become proficient in these core areas through various activities and events. The activities in each area will be designed to enhance the graduate students' experiences in their departments. In addition, the fellows will complete a capstone experience that will enhance their professional development in a self-directed area.

Grad College recognizes students for excellence


Danielle Harrier

The University of Illinois Graduate College honored ChBE graduate students Danielle Harrier and Zully Perez-Sierra for their academic excellence this spring. The college's "Celebrating Diversity, Recognizing Excellence" reception recognized graduate students from populations underrepresented in graduate education (African American, American Indian, Pacific Islander, Latina/Latino) for excellence in research, teaching or service. Harrier is a member of Assistant Professor Damien Guironnet's lab. Her research surrounds utilizing microfluidics to perform advanced encapsulation of catalytic material. Perez-Sierra is a member of Reid T. Milner Professor Deborah Leckband's lab. Her research focuses on identifying material properties that stabilize or shut down protein functions by quantifying folding dynamics from micro-temp jumps and single molecule fluorescence.


Zully Perez-Sierra

Walsh wins at POLY symposium


Dylan Walsh

ChBE PhD student Dylan Walsh was selected to present at the Excellence in Graduate Polymer Research Symposium this spring. The symposium, organized annually by the POLY division of the American Chemical Society, is intended to recognize outstanding graduate students in polymer science and engineering, foster networking and exposure, and help develop the careers of future leaders in the field of polymers. Walsh received the Best Oral Presentation Award.

Shape, size, and composition are crucial to material design. In his presentation, Walsh showed a scalable methodology to produce large, well-defined macromolecules with programmable shape, size, and chemistry, by combining reactor engineering principles and controlled polymerizations. This approach allows construction of these axisymmetric shapes, such as cone, sphere, hourglass, football and bowtie shapes.

Catalysis Society awards Kuhn


Andrew Kuhn

ChBE graduate student Andrew Kuhn, a member of Richard C. Alkire Chair Hong Yang's research group, won the Kokes Award from the North American Catalysis Society (NACS). The award provides financial support for Kuhn to attend the 26th annual NACS meeting this June.

Kuhn's research focuses on developing non-precious metal catalysts for the thermal reduction of oxygen. Special interest is placed on identifying physical, chemical, and structural properties that affect oxygen conversion and the selectivity to specific products. His current work applies to CO_2 capture from flue gas and projects related to sustainability.

Poster prize for Adams

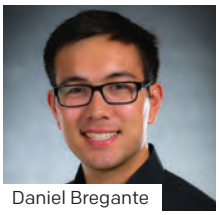

Jason Adams

Jason Adams, a PhD student in Assistant Professor David Flaherty's Lab, won the best poster prize at the Catalysis Club of Chicago's Annual Symposium. His presentation was entitled, "Solvents Facilitate Proton-Electron Transfer in Direct Synthesis of H_2O_2." For this work, the group studied the role of solvents in the direct synthesis of H_2O_2 from H_2 and O_2 on Pd.

"We found that methanol and water both facilitate a type of proton-electron transfer mechanism to reduce O_2, but they differ due to the formation of organic coproducts in methanol. In this case, these residues open up new co-catalytic reactions, force the Pd nanoparticles into a PdH phase, and significantly alter product reaction barriers when compared to the water solvent," he said.

Bregante wins a PhD Completion Award

Congratulations to PhD student Daniel Bregante, who won a PhD Completion Award from the Graduate College at the University of Illinois.


Daniel Bregante

Bregante's dissertation will be on "Unraveling Inner- and Outer-Sphere Interactions that Impact Catalysis at the Liquid-Solid Interface." He is a member of the Flaherty Lab.

Many consumer products used today (e.g., plastics, cosmetics, pharmaceuticals) rely on catalysis within liquid solvents (e.g., within methanol, water). However, there is a dearth of understanding for how specific solvents, surfaces, and intermediates interact and influence rates and selectivities, where small improvements can greatly reduce emissions and energy use. Within microporous materials (e.g., zeolite catalysts with less than 1 nm pores), the complexity of the system increases further because the solvent must arrange itself into specific structures to accommodate the small pores surrounding it.

"The central thesis of is that within zeolite catalysts, the confluence of interactions between confined solvents, surface intermediates, and (a)polar surfaces can be broken down into discrete energetics (electronic, confinement, H-bonding, ...) that collectively describe the system," he said.

The Graduate College's Dissertation Completion Fellowships help outstanding Illinois graduate students complete the doctoral degree by providing a one-year stipend along with tuition and fee waivers. The criteria used in making the awards include the significance of the research, as reflected in the nominee's proposal and the letters of support, the student's productivity and efficient progress toward the degree and the likelihood that the student will defend and deposit the dissertation by August 2020.

Beckman fellowship for Lloyd

Congratulations to ChBE PhD student Evan Lloyd, who was been awarded a Beckman Institute Graduate Fellowship. The program offers Illinois graduate students the opportunity to pursue interdisciplinary research at the institute. For his research project, "Morphogenic Manufacturing of Engineering Materials," Lloyd seeks to develop a synthetic mimic to biological morphogenesis to generate complex patterns, forms, and functions autonomously in engineering materials.

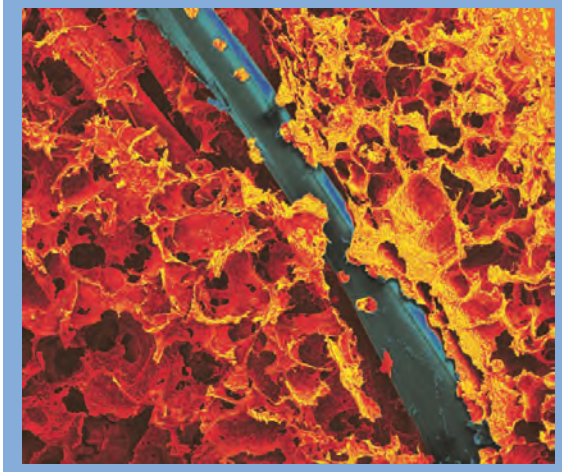
The study will employ a coupled reaction and thermal diffusion system to support feasible manufacturing times (< 1 day) with synthetic morphogenesis. More specifically, he will use frontal ring-opening metathesis polymerization of dicyclopentadiene as the foundation. He will work with Philippe Geubelle from the Department of Aerospace Engineering, Jeff Moore with the Department of Chemistry, and Nancy Sottos from Materials Science & Engineering.

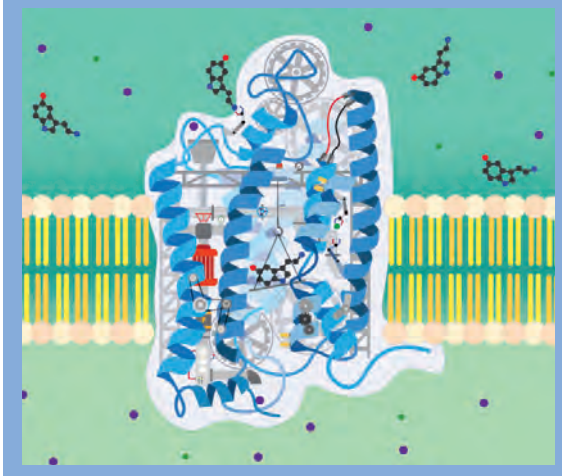
Polymer Physics Award

Tyler Lytle, a member of Assistant Professor Charles Sing's lab, was a finalist for the Padden Award for the Division of Polymer Physics at the American Physical Society. The award recognizes a graduate student for Excellence in Polymer Physics Research. Lytle is a PhD student in the Department of Chemistry and earned his BS in Professional Chemistry and Physics from the University of Evansville in 2014.

DOE selects Kwok

Justin Kwok, a member of Assistant Professor Ying Diao's lab, has received a Department of Energy Graduate Student Research Award. Kwok is a PhD student in Materials Science & Engineering and his research is about understanding how flow can be used to direct the alignment and crystallization of conjugated polymers.





The department had a strong showing at the 2018 School of Chemical Sciences Science Image Challenge. Graduate student Jee-Wei Emily Chen (Harley Group) won first place for her "Rising Moon Above Mountain," featured on the cover of this issue of Mass Transfer. In addition to Chen's image, the following images were finalists: "Fire and Ice" by Marley Dewey (Harley Lab) (top image); "Feathers of the Ocean," by Prapti Kafle (Diao Lab) (middle image); "Molecular Machinery," by Matthew Chan (Shukla Lab) (botttom image).

Baron Peters: Catalysis, Nucleation, and Reaction Rate Theory

New faculty member joined department in January

For the past 11 years, Dr. Baron Peters has worked at the University of California, Santa Barbara as a Professor of Chemical Engineering and Chemistry. His work there was recognized by a National Science Foundation CAREER award in 2010 and a Camille Dreyfus Teacher-Scholar Award in 2013. Alumni from his group have become assistant professors at the University of Michigan and the Indian Institute of Technology Kanpur, staff engineers at three national laboratories, and research and development engineers in industry.

Peters studies the kinetics and mechanisms of chemical reactions using computational methods and theoretical analysis.

"In our work we are particularly interested in reaction rates, mechanistic hypothesis tests, and using natural time and length scale separations to construct multiscale models. These seem like niche topics, but they have several applications: catalysis, polymerization kinetics, nucleation and growth, and reactions in complex environments," Peters said.

"We use a very broad tool set, which includes electronic structure calculations, molecular dynamics simulations, Monte Carlo, and population balance models. The common thread running through all of our work is the theory of rare events, fleeting transitions separated by long random waiting times."

Missouri roots

Peters grew up in Moberly, a small town in Missouri. Although his current work involves a lot of math and computation,

those interests didn't blossom until he was older. As a child, he was interested in art, fishing, and sports and his first exposure to computers didn't occur until his senior year of high school. He credits high school teachers for sparking an interest in math and science and inspiring him to apply to college. Peters started at the University of Missouri on a full scholarship in 1994.

Peters went on to major in chemical engineering and math. He continued his studies and earned a PhD in Chemical Engineering at UC-Berkeley, studying with Professors **Arup Chakraborty** and **Alex Bell**.

"I chose Berkeley because I had read some of Chakraborty's fascinating papers as an undergraduate, and I was tempted by the mountains and trout streams of California," Peters said. "In the Pitzer Center, I was surrounded by brilliant scientists who worked in reaction dynamics, quantum chemistry, and statistical mechanics. It was an enriching environment where students were constantly exposed to research outside of what their advisers did. My own PhD work ultimately did not like look like what my advisers focused on."

As a postdoc with Professor **Bernhardt Trout** at MIT, Peters studied protein degradation mechanisms, activated gas diffusion in methane hydrates, solid-solid nucleation, and he developed path sampling-based mechanistic hypothesis testing tools that remain state-of-the-art.

Peters left Santa Barbara to join the Department of Chemical and Biomolecular Engineering at the University of Illinois in January 2019. To Peters' great relief, all the members of his research lab decided to move with him to Illinois.

"At Santa Barbara, I had two great collaborations with **Susannah Scott** (in catalysis) and **Mike Doherty** (in crystallization). Modern funding models favor large teams with shared goals, and the smaller campus at Santa Barbara provided few opportunities to expand beyond those two collaborations," explained Peters. "I chose the University of Illinois because they made me a great offer and because it has many excellent programs that overlap with my interests. I have met many faculty members within the Departments of Chemical and Biomolecular Engineering and Chemistry whose interests overlap with mine."

Future directions

The Peters Lab has developed state-of-the-art models and simulation methods for nucleation in systems with multiple components. Their work on crystal nucleation and growth, which is funded by Eli Lilly, is focused on developing drugs with the correct crystal structures. The lab also has National Science Foundation and Department of Energy-funded projects on ethylene polymerization and amorphous catalysts.

"The Phillips ethylene polymerization catalyst makes about half the world's polyethylene. However, it is still unclear

how it works," explained Peters. "It is an amorphous catalyst, so all of the sites are a little bit different, which makes it difficult to investigate them experimentally and theoretically."

Several other catalysts also are made from amorphous materials. By building reliable computational tools for this family of catalysts, Peters hopes to understand how they work so that their properties can be systematically improved.

Teaching interests

Peters is teaching a new graduate course on kinetics and reaction engineering.

"For decades, this course has been taught with a focus on catalysis, but I'm working to make it a graduate-level kinetics course for every branch of chemical engineering. Everyone in the chemical sciences encounters kinetics, whether you're growing crystals, making polymers, synthesizing nanoparticles, growing cells, or doing catalysis. Understanding the rate processes involved, formulating models that can predict changes in time and position is important. There are a lot of opportunities, applications, and challenges in those areas," he said.

> "In our work we are particularly interested in reaction rates, mechanistic hypothesis tests, and using natural time and length scale separations to construct multiscale models. These seem like niche topics, but they have several applications: catalysis, polymerization kinetics, nucleation and growth, and reactions in complex environments."
>
> **Baron Peters**

While working in the disparate areas of catalysis, nucleation, and reaction rate theory, Peters noted some oddly persistent gaps between the chemistry, physics, and engineering perspectives on kinetics.

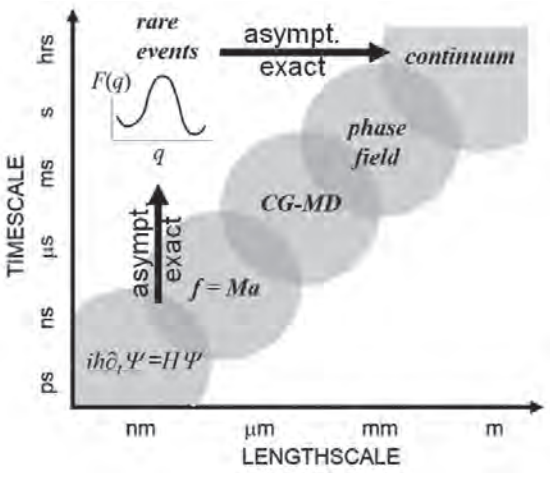
"Chemistry, chemical engineering, and chemical physics books cover almost mutually exclusive branches of kinetics, and advances from the last 40 years are all confined to the original literature, making them incomprehensible to most of the new PhD students. The key to progress in many areas is recognizing which theories are appropriate for which process, which tools can do the required calculations, and knowing how to stitch theories at different scales together into internally consistent models," he explained.

To address these gaps in the literature, Peters published the first comprehensive kinetics textbook, *Reaction Rate Theory and Rare Events*, in 2017. The book is being used in graduate kinetics and reaction engineering courses in several chemical engineering departments.

In his spare time, Peters dabbles in pottery and likes backpacking and hiking.

"I have taken my wife and kids, and sometimes my PhD students, on backpacking trips. Now that the kids and I are both getting older, I'm excited to let them carry my stuff for a change," he said.

Written by Ananya Sen



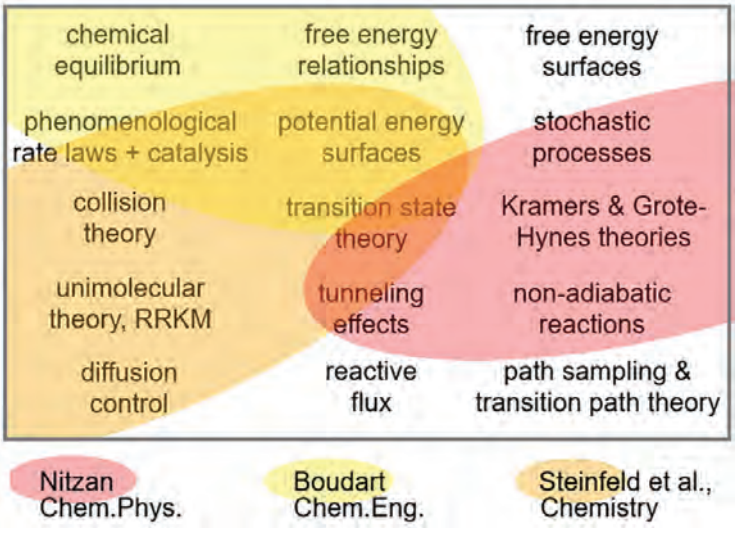


Figure on left: Most multiscale modeling strategies climb the diagonal and lose accuracy at every scale. The rare events approach exploits natural length and time scale separations to make predictions that retain the full accuracy of ab initio or atomistic level calculations.

Figure on right: Gaps between the kinetics literature in different fields, now addressed by Peters' uniquely comprehensive book *Reaction Rate Theory and Rare Events.*

Catching up with...
PROFESSOR CHARLES ECKERT

A native of St. Louis, Dr. Charles Eckert knew early in his life that he wanted to be an educator. He studied at the Massachusetts Institute of Technology, earning his bachelor's and master's degrees in Chemical Engineering in 1960 and 1961. He then received his PhD in Chemical Engineering from the University of California at Berkeley. Dr. Eckert joined the Illinois chemical engineering faculty in 1965 and served as department head from 1980 to 1986. In 1989, he moved to the Georgia Institute of Technology, where he was the J. Erskine Love Jr. Institute Professor in the School of Chemical & Biomolecular Engineering and founder and director of the Specialty Separations Center. He retired in 2015. During his 50 years in academia, he advised 108 PhD students, 43 at the University of Illinois.

We caught up with Dr. Eckert to ask about his time here at Illinois and at Georgia Tech, how he's spending his retirement, and his reflections on chemical engineering education and research advances.

What brought you to the University of Illinois in 1965? What was the department like?

After my PhD, I wanted to spend a year abroad. I took a postdoc position in France. At the time, it was unusual for ChemEs to do postdoctoral work. Because my research is at the interface between chemistry and chemical engineering, I needed to interact with chemistry faculty; Illinois had a strong chemistry department. The chemical engineering department was combined with chemistry. [In 1969 chemical engineering became a stand-alone department within the School of Chemical Sciences.] The head was Jim Westwater and the star was Harry Drickamer. Other faculty members were Tom Hanratty, John Quinn, Roger Schmitz, Jack Hudson, and Bob Sani. I got a corner of someone else's lab and

had a heavy teaching load. I didn't work with graduate students right away. I did start some research with undergraduates and as the department progressed, I began to get graduate students, including some very good ones, and I built my research program.

When I was at Illinois, Stan Smith from Chemistry was very heavy into PLATO, the first computer-based education system in the world. He wrote PLATO programs for chemistry while I wrote them for chemical engineering. The language was complex but we could anticipate most of the wrong answers and lead students down the path until they found out how to come to the right answer. A typical lab experiment could take six to eight hours. On the computer, they could do an experiment in one hour and if they made a bad mistake, the computer would flash and make noise emulating an experiment blowing up. PLATO became a powerful teaching tool.

You are known for your dedication and enthusiasm for teaching. Tell us about your approach to working with students.

One of the things I started at Illinois was a course in communications. Students were taking a writing course from the English department, but it wasn't useful for engineers. I worked with an in-house team from Dow Chemical Co. on a new writing course and taught it as an elective. When I went to Georgia Tech, I continued to develop it. Very quickly it became clear the class ought to become part of the curriculum. It became a required course within 10 years.

When I got to Georgia Tech, I was pleased to find out that undergraduate research and teaching were important there. One of the things that attracted me to Georgia Tech was they taught in small sections, so professors could talk and interact with students. You can't do that with a larger class. The kind of teaching I like to do is interacting individually with students. While there, I won Georgia Tech's Best Faculty Teaching award in 1999 and I was selected for the inaugural State of Georgia Regents' Research in Undergraduate Education Award in 2000.

I really loved working with young people, seeing them light up when they had an idea or solved a problem. One advantage of teaching chemical engineering classes is all the students are majors and they want to be there. We have highly motivated students, which made teaching a lot of fun.

It's all a question of mentoring, and teaching graduate students to become mentors. At Georgia Tech, when I met with my first graduate student, Barbara Knutson, I told her in the first year that I would tell her what to do. By the second year, she was telling me what to do, and she was correct. She's now a professor at Kentucky and has been for 25 years. I got so excited about seeing the growth in self-confidence and creativity and letting students know they could have ideas and try out their ideas.

Tell us about your research.

My research was at the interface of chemistry and chemical engineering. I was a physical chemist in a chemical engineering department. A lot of what I did, starting at Illinois, was on using

novel solvents to achieve various goals, from catalysis to recycling CO_2 from the atmosphere and various other types of applications, such as how could we modify solvents to run a reaction or force a separation. What ChemEs do is go from the milligram to tonnage level, but we also figure out how to do that in an energy efficient and economical way.

From the beginning you engaged with industrial partners.

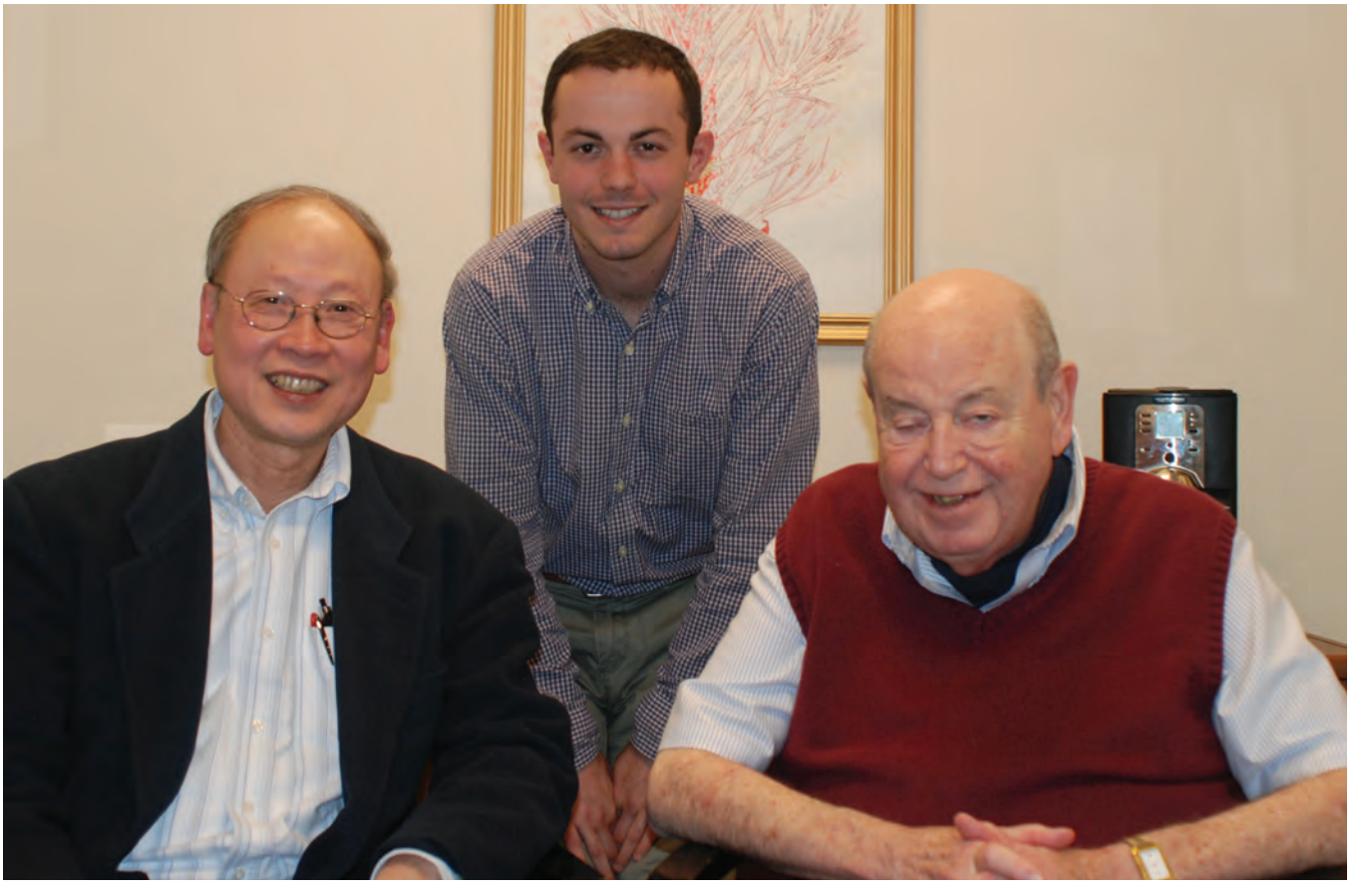
I had a lot of interaction with companies—DuPont, Dow, and others. Much of our research was sponsored by these companies. My first industrial collaboration was at Illinois. I was a consultant to Phillips Petroleum, commuting between Bartlesville, Oklahoma, and Illinois. It was helpful to interact with people in industry and look at industrial problems. They'd listen to my issues, and I'd hear about their issues. It was helpful to have the interaction between academia and industry. Of the doctoral students I had, probably two-thirds went into industry and one third went into academia. Many of them did both. Many who went into industry moved from technical positions into corporate leadership.

What excites you about chemical engineering research today?

One exciting area is big data and how researchers can extract information from big data sets. Another is biological applications, largely pharmaceutical applications, but not exclusively. I don't have a background in biology, but there is a lot of excitement in that area. Of course a major problem is global warning. It's quite clear to most people that global warming is occurring and engineering is required to minimize emissions. Moreover, to take CO_2 out of the atmosphere and sequester it is even more challenging, incredible because it's so dilute. We would have to do it on an enormous scale, and it's going to be expensive. These are partly chemical engineering problems and partly management problems.

Since retiring, you and your wife Susan moved to Florida. How are you doing?

I have some health issues but I'm improving. I do a lot of reading. The retirement community where I live offers a lot of opportunities. I'm delighted to get visitors. What I miss is the one-on-one interaction with students. Over the years I've had a number of students who were of incomparable creativity, and I still keep in touch with many of them. It's a delight to hear from them. Many are retired. A few years ago I had a visit in Atlanta from my first PhD, **Kin Wong** (1970) and got a picture of him with my 100th PhD, **Jackson Switzer** (2013. now a Senior Process Development Engineer at Albemarle Chemical Co.). Recently we had a visit from **Joan Brennecke** (PhD, 1989) and her husband **Mark Stadtherr** (Illinois faculty member 1976-95). Both are on the faculty of the University of Texas.



Eckert with his first PhD student Kin Wong (PhD '70, Illinois) and his 100th, Jackson Switzer (PhD '13, Georgia Tech).

Alumnus **Mark Tracy**, a leader in drug delivery and RNA therapeutics, reflects on his career and offers insights on biotech opportunities for ChemEs

Dr. Mark A. Tracy, BS '86, has developed more than 10 new medicines that have advanced into clinical trials and onto pharmacy shelves, including a first-in-class therapeutic using the gene silencing technology RNA interference (RNAi). Now a consultant who works with biotechnology and pharmaceutical companies around the world, he is optimistic and enthusiastic about advances in RNA therapeutics, cell and gene therapies, and gene editing. He also is excited about the many roles chemical engineers can play in developing, scaling up, and manufacturing new medicines.

Tracy has held a lifelong curiosity about the world and a passion for building and making things, from model ships and cakes as a child to new therapeutics and biopharmaceutical companies as an adult. It was at the University of Illinois where he was inspired by great faculty to pursue a career in science and where he was first introduced to and developed a passion for research in chemistry and engineering.

Inspired by research

Tracy grew up in the Chicago suburbs. As a child he and his family often stopped at the U of I campus on their way to visit relatives in southern Illinois. (His father was a graduate of the College of Commerce, now Gies College of Business). In high school he developed an initial interest in chemistry and gravitated toward subjects that supported his interest in building and making things. A chemistry class with Professor **Steve Zumdahl** during his first year at Illinois cemented his interest and future in chemical sciences. Zumdahl provided Tracy and many other students with their first experience of working in an academic research lab.

As he advanced in the chemical engineering curriculum, Tracy became interested in polymers after taking a class with Professor **Tony McHugh**, whose research is in polymer science and engineering.

Tracy decided to complete a senior thesis with new professor **Charles "Chip" Zukoski** entitled "The Synthesis, Characterization, and Sizing of Monodisperse Silica Dispersions." This work resulted in his first published paper in a peer-reviewed scientific journal. Professor Zukoski's enthusiasm for the field was infectious.

"It was exciting and inspiring to be working for him. I was hooked on research!"

At Illinois, Tracy was a member of the AIChE student chapter and was a recipient of its Achievement Award. He also was president of the Phi Lambda Upsilon Chemical Science Honor Society and a member of Tau Beta Pi. He was an active member of the Illini Union Board, helping to organize events that brought in speakers such as Rosalyn Yalow, a Nobel Prize-winning medical physicist and Illinois alumnus. He

It was at the University of Illinois where he was inspired by great faculty to pursue a career in science and where he was first introduced to and developed a passion for research in chemistry and engineering.

also volunteered as an usher at the Krannert Center for the Performing Arts and enjoyed attending football and basketball games, including the most memorable games during the year in which the football and men's basketball teams won Big Ten Championships.

Industry boot camp

After earning his bachelor's degree, Tracy headed to Stanford University where he pursued a master's degree in chemical engineering and a PhD in chemistry. At Stanford, his mentor was chemistry Professor **Robert Pecora**, who used light scattering techniques to study polymers and colloidal solutions. Tracy found himself using much of what he learned at Illinois, such as physical chemistry, mass transfer, fluids, and polymer science. As the Pecora lab engaged with people in industry and worked on industrial problems, Tracy realized he wanted to go that route after graduation.

He joined a biotechnology start-up Enzytech, Inc, co-founded by MIT Professors **Alex Klibanov** and **Robert Langer**. Langer is considered a pioneer in the fields of drug delivery and tissue engineering and founded more than 25 medical science-based companies. At Cambridge, MA-based Enzytech, which later merged with another biotech firm, Alkermes, Inc., Tracy helped to develop the first sustained release protein product approved by the FDA and several other commercialized products based on novel drug delivery science. These include Vivitrol® for treatment of alcohol and opiate dependence and Bydureon® for Type II diabetes. While there he gained experience in formulation science, proteins, peptides, and small molecules, manufacturing of complex injectable products, clinical and nonclinical studies, and much more.

"I call it my biopharmaceutical development boot camp. I learned what it took to build on academic research to develop and commercialize a new medicine," he said.

Opposite page: Mark Tracy in Amsterdam and on this page, hiking with his wife and two children.

In 2006, Tracy left Alkermes to join the biopharmaceutical company Alnylam, Inc. to apply his drug delivery science and product development experience in the new and emerging field of RNA therapeutics.

RNA Therapeutics

RNA acts as a messenger within the body's cells, carrying instructions from DNA for controlling the synthesis of proteins. RNA interference is a process that occurs naturally within our cells to block how certain genes are expressed. The new class of drugs being developed at Alnylam, called siRNAs, works by silencing a portion of RNA involved in causing disease. Unlike most small molecule or protein drugs, siRNA needs to be delivered within specific cells to silence the target gene, he said.

"This was an exciting time. The Nobel Prize was awarded that year to (Andrew) Fire and (Craig) Mello for the discovery of RNA interference. The promise was high—to alter genetic drivers of disease for new and better medicines. Drug delivery was the main road block to advancing this new discovery to the clinic. My job at Alnylam was to solve delivery challenges and develop products," he said.

Ultimately Tracy and his team zeroed in on two potential delivery solutions. The first was a lipid nanoparticle-based (LNP) formulation which involved wrapping the siRNA in special lipids which can be taken up in the desired cell. The second was to chemically attach a cell targeting ligand directly to the siRNA.

"Both worked but the path to the clinic was faster for the LNP approach at the time. Fast forward to today, the company has built a pipeline of new medicines using both delivery platforms," Tracy said.

Of all the products and projects Tracy has been involved with over the years, he is most proud of the role he played in developing Onpattro®, the first RNA interference-based therapeutic approved by the FDA. Onpattro uses the LNP delivery system. It is also the first FDA-approved treatment for patients with polyneuropathy caused by hereditary transthyretin-mediated amyloidosis (hATTR), a rare, debilitating and often fatal genetic disease characterized by the

buildup of abnormal amyloid protein in peripheral nerves, the heart, and other organs.

"It was rewarding to help develop a treatment for patients with this rare and devastating condition, one that shows the potential to slow or even halt disease progression in patients. It doesn't get much better than that in my experience," he said.

Since he became involved in developing RNA therapeutics, Tracy said he has been amazed by the progress made in understanding the genome and the role of nucleic acids in impacting disease. Those new understandings have translated to the development of emerging products, such as the new RNAi therapeutic for treatment of TTR amyloidosis. In the future, Tracy hopes they could also translate to new treatments for cancers and more common diseases like infectious, neurodegenerative, and cardiovascular diseases. He is particularly excited about research utilizing mRNAs, or messenger RNAs, to express antigens in a way that will enable more rapid development of vaccines for pandemics. He expects continued rapid advances in gene therapy and gene editing.

"The challenge is these new therapies currently are costly and often very difficult to manufacture. But these are problems chemical engineers are well-equipped to solve," he said.

Sharing his knowledge

In 2012 he established Tracy BioConsulting, LLC. He works with a variety of clients, from single-person start-ups to large multi-national firms, to share the knowledge and experience he's gained from his years in drug delivery and biopharmaceutical product development. Tracy assists clients to plan, build, and navigate a successful path from research through the clinic for new therapeutic platforms and drug programs. He also helps clients to create business opportunities and sits on several corporate and university advisory boards.

"I thought I could enable organizations small and large to come up with effective drug development plans to move a product past the research setting. That's the primary focus of my consulting—supporting that translational gap and exploiting new business opportunities that emerge ultimately to get novel, safe, and effective drugs to patients."

About a decade ago, he connected with staff at the University of Illinois Carl R. Woese Institute for Genomic Biology, which was established in 2000.

"I was blown away by what they accomplished in such a short time. I wanted to be a part of it in a small way and help support their efforts in human health research by providing students with exposure to drug development and biotech entrepreneurship beyond the academic research setting."

The National Institutes of Health calls the process of translating basic drug research into a viable medical product the "Valley of Death." This is the period of transition when a technology is seen as promising, but is too new to validate its commercial potential. Effectively navigating through this period, he believes, requires an understanding of the perspectives of industry and foundations to ultimately attract the necessary funding and support in order to reach the clinical stage.

"I always felt that to solve the biggest problems we face, including those in human health, you need to bring people together from across the traditional academic, industry, and other societal boundaries," he said. "By facilitating biotech industry or entrepreneurship-related experiences for students, we're providing them with a broader perspective ultimately necessary to transform a discovery into an approved drug."

Tracy's advice to students, especially those interested in entrepreneurship, biotechnology, or biopharmaceutical development is to take in as many different experiences. Students interested in developing novel therapies need to understand the business and medical sides, as well as the physical and biological sciences, he said.

"Expect some failures along the way. In biotech, you can't be at the edge of a discipline or technology without experiencing setbacks. Setbacks are often opportunities. If you can see an opportunity in a setback, at least over time, sometimes that puts you in better position."

Tracy said he received an excellent technical and scientific education at Illinois.

"It was hard work for sure but my experiences at Illinois set me up for my career. That foundation provided me with the skills and confidence to launch a career I find very rewarding. I am grateful to the university and all my professors and mentors. I am proud to be an Illini," Tracy said.

MARK TRACY

Education

BS Chemical Engineering, 1986, University of Illinois

MS Chemical Engineering, 1987, Stanford University

PhD Chemistry, 1992, Stanford University

Greater Boston Executive Program, 2003, MIT Sloan School of Management

Career

Founder and President, Tracy BioConsulting

Dr. Tracy also teaches and lectures on topics related to drug delivery and development, entrepreneurship, and RNA therapeutics and is an adjunct professor at Brown University.

Selected Awards

Fellow, American Institute for Medical and Biological Engineering

Past President and Fellow, Distinguished Service Award, Controlled Release Society

Family

Home base: Massachusetts. In his free time, Dr. Tracy sings in a chorus and he and his wife Wendy and their two children, ages 12 and 14, enjoy spending time outdoors, hiking throughout New England, travelling, and attending concerts and museums.

Class Notes

Deligianni elected to NAE

Congratulations to Hariklia "Lili" Deligianni, PhD '88 (Alkire), who was elected to the National Academy of Engineering.

As a research scientist at IBM, Deligianni played a leading role in solving a number of technical challenges in the electronics industry. She and her colleagues introduced electrochemical processes in solder bump technology, now a standard practice for joining silicon chips to packages. She also co-invented the copper electrodeposition process for on-chip interconnects, which has revolutionized the capability of computer chips, allowing computers to run faster. Deligianni retired from IBM at the end of 2017.

Deligianni was one of 86 new members and 18 foreign members announced by the NAE earlier this year. She was elected for her work in "electrochemical processes used by major microelectronic chip producers worldwide."

Election to the NAE is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature" and to "the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

Carnegie Mellon ChemE hires Robinson

Anne Skaja Robinson, PhD '94 (Wittrup), has joined Carnegie Mellon University as head of its Department of Chemical Engineering. Robinson was most recently at Tulane University, where she served as chair of the Department of Chemical and Biomolecular Engineering since 2012.

Robinson's research focuses on understanding the disease mechanisms behind neurodegenerative disease such as Alzheimer's and Parkinson's and improving the production of biopharmaceuticals on an industrial scale. She has received a number of national awards, including the National Science Foundation Presidential Early Career Award for Science and Engineering (PECASE), the American Chemical Society's BIOT Perlman Award, and the AIChE SBE Biotechnology Progress Award for Excellence in Biological Engineering Publication. She also is an AIChE Fellow.

Ford Versypt wins NSF CAREER Award

Congratulations to Ashlee Ford Versypt, PhD '12 (Braatz), whose research on multiscale modeling of diabetic kidney disease has received funding from the National Science Foundation. This spring she received an NSF CAREER Award for her project, "Multiscale Modeling of a Virtual Kidney during the Onset and Progression of Diabetic Kidney Disease." Ford Versypt is an assistant professor of chemical engineering at Oklahoma State University.

Her project will develop a new approach for studying diabetic kidney disease through a virtual kidney to detect and monitor damage to the glomeruli (where most damage occurs) during the onset and progression of diabetic complications in the kidney. The tool will aid in understanding how diabetic kidney damage begins and changes over time. In the long term, results from this project will help predict the impact of many factors on kidney health during diabetes management. The project also will involve educational activities.

Perry receives 3M Award

Sarah L. Perry, PhD '10 (Kenis), assistant professor of chemical engineering at the University of Massachusetts Amherst, has received the 3M Non-Tenured Faculty Award for 2019. The awards are given to young faculty members who are conducting promising research but have not yet received tenure.

Perry said the award will allow her to expand the research efforts into the development of complex coacervate-based materials as an environmentally friendly platform to enable the encapsulation of active materials for sensing and delivery. "In particular, we are looking to encapsulate enzymes and therapeutic proteins for use in smart bandages," she said in a UMass Amherst press release.

Share your news with us!

Email chemeng@illinois.edu, fill out the online form at go.illinois.edu/chbe_alumni_form or mail the enclosed card found at the back of this magazine.

The Chemical and Biomolecular Engineering Partners Fund

Thanks to our loyal donors, the Department of Chemical and Biomolecular Engineering at the University of Illinois is facing the world's challenges head on. In this issue of the newsletter we'd like to provide alumni and friends with additional information about The Partners Fund, one of several funds the department maintains. The Partners Fund is where unrestricted donations are held. It also contains donations made by companies matching alumni gifts, doubling and tripling impact. Here are some examples of how gifts to The Partners Fund have made a difference in recent years.

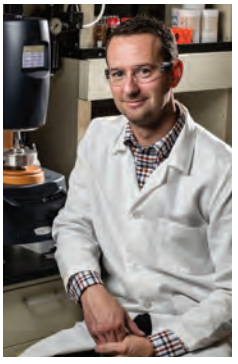
Recruiting and retaining faculty

As our student population grows, the department continues to add faculty. We have turned to The Partners Fund to help recruit new faculty hires and retain some of our star faculty. The fund has helped pay for graduate student stipends, salaries for postdoctoral fellows, and laboratory equipment.

Developing student leaders

The Partners Fund supports ChBE student organizations and student leaders. For example, the department provided financial assistance to several ChBE students attending the annual meeting of the Society of Women Engineers, the world's largest conference for women engineers.

Simon Rogers



Dr. Simon Rogers is establishing Illinois as a world leader in soft matter research. His group uses a variety of experimental and computational tools to understand and model advanced colloidal, polymeric, and self-assembled materials for biomedical, energy, and environmental applications.

"The start-up package provided by The Partners Fund has allowed me to purchase state-of-the-art rheological equipment that has led to breakthroughs in colloid and polymer rheology."

Dr. Simon Rogers, Assistant Professor

David Flaherty

Dr. David Flaherty tackles some of the toughest challenges in the chemicals industry. With the help of The Partners Fund, his lab recently purchased a volumetric adsorption device. The instrument allows him and his students to probe chemical interactions at the surface of catalysts that are being considered for applications in fuel cells and production of environmentally friendly monomers used in consumer goods.

"The instrument brings new capabilities to campus and increases student and faculty productivity. It also contributes to the education of graduate students by providing them with hands-on experience with critical tools used for material characterization."

Dr. David Flaherty, Assistant Professor

Jackie Letzter

Illinois native and ChBE student Jackie Letzter has served on the SWE Illinois officer board for several years, most recently as its recruitment chair. As an Engineering Learning Assistant for Engineering 100, she is a mentor, instructor and resource for new students. She also has worked as a teaching associate and advisor for the Summer Scholars program of Illinois Engineering First Year Experience for incoming freshmen.

"The SWE conference was an absolute privilege to attend! As a SWE Illinois section, we received several awards, namely the first place prize for the Boeing Team Tech design competition and a number of student scholarships. Financial help from the department made my attendance possible."

Jackie Letzter, senior, Chemical and Biomolecular Engineering

New ChBE Alumni Awards Program

The Department of Chemical and Biomolecular Engineering Alumni Awards Program recognizes graduates who have distinguished themselves through their outstanding professional achievements, their dedication and advocacy for the department, or their service or contributions to society.

Honors include:

Distinguished Alumni Achievement Award

Honors ChBE graduates for their professional/technical achievements, dedication and advocacy for the department, or service/contributions to society.

Young Alumni Achievement Award

Honors ChBE alumni who have graduated within the previous fifteen years of the recognition event and have established themselves through professional/technical achievements, dedication and advocacy for the department, or service/contributions to society.

Nomination process

Nominations for these awards are solicited annually. The deadline for submitting a nomination is AUGUST 1, 2019. Nominations can be submitted online or by downloading a form from www.chbe.illinois.edu/alumni-awards and mailing it to the department.

Awards reception

Alumni awards will be presented at the Fall Awards Reception on OCTOBER 11, 2019 on campus.

More information

Please contact the department at chemeng@illinois.edu, 217-244-9214, or visit www.chbe.illinois.edu/alumni-awards

Giving to Chemical and Biomolecular Engineering

Alumni and friends play a vital role in the success of the University of Illinois Department of Chemical and Biomolecular Engineering

Your investment supports the best and brightest students with fellowships and scholarships, it supports world-renowned faculty and their innovative research and teaching, and it funds essential upgrades to laboratories, classrooms, and technologies.

You can make a gift online, by phone, or by using the enclosed envelope in this magazine.

In addition to outright gifts, you can support Chemical and Biomolecular Engineering as part of your overall financial, tax, and estate planning with deferred gifts such as bequests, charitable trusts and annuities, pooled income funds, retained life estates, retirement accounts, and life insurance.

We will work with you to arrange options most suitable to you. If you are interested in learning more about these or other gift options, please contact:

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In Memoriam

Robert Canfield, BS '58, of Alvin, TX, died on April 3, 2019. Born in Springfield, IL, he served in the Army and was stationed in Europe during the Korean War. After returning from the service he enrolled at Illinois, got married and earned his BS in Chemical Engineering in 1958. He joined Monsanto in Sauget, IL and he and his wife Agnes ("Aggie") lived in Belleville. In 1962, the family moved to Texas when Bob worked on the company's Chocolate Bayou plant. After retiring from Monsanto, he became vice president at Partec Resources, a chemical technology licensing firm. He enjoyed traveling with his wife and granddaughter, visiting places such as Brazil, Australia, and Finland. Mr. Canfield enjoyed umpiring baseball games and he was also an accomplished woodworker.

Joseph Chirtel, BS '48, of Osprey, FL, died on Jan. 11, 2019. Born in Brooklyn, NY, he grew up in Detroit and Chicago. After graduating high school, he completed one year of his studies in chemical engineering at the University of Illinois before leaving to serve in the Army. After he was honorably discharged in 1946, he returned to Illinois and earned his BS in Chemical Engineering, followed by an MS in Chemical Engineering from the University of Delaware. In 1983 he retired from Stauffer Chemical as director of manufacturing. After retiring, he continued to work as a part-time consultant to various government agencies involved in the chemical weapons treaty ban.

Robert Griffiths, BS '68, died on Dec. 15, 2018. Born in Fort Lewis, WA, he grew up in Charleston, IL, and attended Culver Military Academy in Indiana. He earned his BS in Chemical Engineering from Illinois in 1968, followed by his PhD in ChemE from the University of Michigan. Dr. Griffiths worked for many years at the General Motors Research Laboratory. Following his retirement, he was a tax preparer for H & R Block. He enjoyed playing golf and traveling with his wife, Kathleen.

Ray Hauser, BS '50, died March 31, 2019, in Boulder, CO. Dr. Hauser was a prolific inventor with 31 patents in the fields of polymeric materials and medical/cosmetic products. Early in his career, he worked for the Connecticut Hard Rubber Company and for Martin Marietta. He helped to create several companies, including Hauser Laboratories, Hauser Chemical Research and SatisPHARMA. The first of these was a partnership with his wife, Connie, a civil engineer, in 1961. Dr. Hauser studied chemical engineering at the University of Illinois, graduating with a bachelor's degree in 1950. He also obtained a master's degree from Yale University in 1952 and a PhD from the University of Colorado in 1957, both in chemical engineering. He was drafted twice into the Armed Services and the GI bill twice helped pay for schooling. He was a Fellow of the American Society for the Advancement of Science, the Society of Plastic Engineers, and the Society for Materials and Process Engineering and he received recognition as a University of Colorado Outstanding Engineering Alumnus. He was active in St. Andrew Presbyterian and in First Presbyterian Churches in Boulder. He was quick to lend a hand and to mentor others. Music was his favorite avocation and gardening was his second. He enjoyed board and card games and taught his kids to play bridge at an early age.

John Kraska, PhD '69, died on Jan. 26, 2019, in Michigan. Born in Minneapolis, Dr. Kraska received a bachelor's degree from the University of Minnesota and went on to earn his PhD in Chemical Engineering from the University of Illinois in 1969. He met his wife Joanne while they were students at the U of I. Dr. Kraska worked as a chemical engineer at the Upjohn Company for 30 years.

James R. Laible, BS '54, died March 13, 2019, in Terra Linda, CA. Born in Henry, IL, he grew up in Normal and graduated from University High School. He was active in the Boy Scouts and attained the rank of Eagle Scout. He enrolled in the University of Illinois and joined Alpha Chi Sigma fraternity, but his studies were interrupted by the Korean War. After serving in the Army and attaining the rank of master sergeant, he returned to Illinois and graduated in 1954. In 1959, he earned his PhD in Chemical Engineering from the University of Wisconsin. He and his wife, Elizabeth McCanse, moved to Marin County in 1959 when Dr. Laible went to work for what is now Chevron Corporation. For over 30 years, he participated in the design and construction of projects in California, Washington, and the Southeast U.S. Following retirement in 1990, Dr. Laible joined the Chevron Retirees Association and served on its board of directors in Marin County. He enjoyed traveling, word puzzles, electronics projects, horseback riding, opera, and country music.

Andy Maverick, MS '51, died on May 27, 2018. Born in Los Angeles, he served as a medical corpsman with the Marines from 1944 to 1946 and was stationed in Guam. He graduated from UCLA with a BS in Chemistry, followed by an MS in Chemical Engineering from Illinois. After working at Standard Oil in California, he entered a joint venture with his brother-in-law and taught engineering and electronics for over 30 years at Los Angeles City College. He held a lifelong love of languages, travel, and skiing. He grew up attending Episcopal churches in California and loved the music. He was known for his good cheer, quick wit, successes with winemaking and barbecuing, joy in bodysurfing, and enthusiasm for science.

Alfred Thompson, BS '54, of Upper St. Clair, PA, died on Nov. 9, 2018. Born in Oak Park, IL, Mr. Thompson graduated from Illinois with a BS in Chemical Engineering in 1954 and obtained an MS in International Affairs from the University of Pittsburgh in 1986. He enjoyed a successful career at PPG Industries that spanned more than 33 years. Upon his retirement, he became chairman of the SCORE chapter of Pittsburgh, helping entrepreneurs grow their businesses. He enjoyed golfing with his family and celebrated his 70th birthday with a hole-in-one. He held positions of elder and deacon at Westminster Presbyterian Church and volunteered as receptionist for many years.

Rachel Wicklund, BS '04, formerly of Belvidere, IL, died on Dec. 24, 2018. Born and raised in the Rockford area, she graduated at the top of her class from Belvidere High School in 2000. In 2004, she graduated summa cum laude with a BS in Chemical Engineering from Illinois. She continued her education and earned her master's and doctoral degrees in food science. Ms. Wicklund worked for Tate & Lyle as Technical Manager for Global Ingredient Technology Food and Beverage Solutions. She enjoyed traveling and spending time with her family, especially her nephews, and her dogs.

Remember When

RIGHT IMAGE:
While searching through the archives for photos of Professor Eckert (see Catching Up with Chuck Eckert on p. 18), we found lots of pictures of his graduate students engaged in research. In this photo, taken in 1978, **Ken Cox** (PhD '79) uses a mass spectrometer to measure the solution thermodynamics of liquid metal mixtures. Cox, a former research engineer with Shell, is now a chemical engineering professor at Rice University. He tells us that for this experiment, the heating was done with an electromagnetic induction furnace, using a graphite block to contain the sample cells. The sample cells were made of boron nitride and graphite. Each cell had a finely drilled hole to allow measurement of partial pressures by a Knudsen diffusion method. He completed the machine shop work to fabricate the block and cells. The entire experiment was conducted under high vacuum, which created an additional challenge for Cox since at the time the labs were not air conditioned. Because one drop of perspiration would have defeated the vacuum, Cox said he worked late at night when the labs were cooler.

BOTTOM IMAGE:
In this undated photo, Professor Eckert teaches a chemical engineering course.

Department of Chemical and Biomolecular Engineering
University of Illinois at Urbana-Champaign
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New Alumni Awards Program

The Department of Chemical and Biomolecular Engineering has created a new program to recognize alumni for their outstanding professional achievements, their dedication and advocacy for the department, or service to society. We will celebrate winners of the **Distinguished Alumni Achievement Award** and **Young Alumni Achievement Award** at an event on campus on Oct. 11, 2019. For information on how to nominate a graduate of our department, please visit: chbe.illinois.edu/alumni-awards

Nominations are due Aug. 1.

Save the date! Homecoming tailgate

Saturday, Oct. 19, 2019

As part of Homecoming weekend, the department will host an alumni tailgate prior to the football game on Saturday, Oct. 19. The Fighting Illini will take on the Wisconsin Badgers.

We will be sending postcards and email invitations soon and more information will be forthcoming on chbe.illinois.edu.

Stay in touch, share your news

Stay up-to-date on events and news about ChBE alumni, faculty, and students. Visit our website: chbe.illinois.edu

Facebook.com/chemicalengineering.illinois

Twitter: @ChBE_Illinois

Join the department's networking group on LinkedIn: https://www.linkedin.com/groups/8680060/

We love to hear from alumni. Share your news by emailing us at chemeng@illinois.edu, filling out the online form at go.illinois.edu/chbe_alumni_form, or by mailing the card attached to this newsletter.

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You can also submit your gift in the enclosed envelope. Thank you!

Students and family celebrate Spring 2019 Convocation.