St. Elmo Brady Academy outreach event inspires future engineers

Read more on page 16.
Letter from the Department Head

Greetings from Illinois!

With great anticipation and gratitude, we were able to return to many of our usual departmental activities this fall. We hosted an outreach activity (pages 16-17) led by three of our faculty: Damien Guiroumet, Charles Song, and Antonia Statt and 15 graduate students through the St. Elmo Brady Academy, which is named in honor of the first African-American to earn a PhD in chemistry in the U.S. here at the University of Illinois Urbana-Champaign. It is a privilege to be able to share our excitement for, and the power of, science with 60 fourth-grade students at the Booker T. Washington school. We hope to expand this program to other schools in the region by partnering with other departments.

These endeavors remind us of what we are working toward—a healthier and more sustainable future made possible through chemical and biomolecular engineering. Our graduate students showcased a myriad of scientific pursuits at our 20th annual Graduate Research Symposium (page 18), which was judged by our alumni panel: Daniel Crowl (PhD ’73), Yongji Lu (PhD ’97), Qingjun Meng (PhD ’04), and Fei Wen (PhD ’10). Later that day, we recognized the symposium awardees with our graduate student fellowship recipients (page 19) and departmental alumni award winners (page 5)—including Crowl and Wen as well as Laura Banovic Flessner, featured on pages 26-27.

This fall, we also honored our esteemed colleague, Hyunjoon ‘Joony’ Kong, who has worked tirelessly to advance bio-inspired materials and was invested as the Robert W. Schafer Professor (page 4). Read more about his research on pages 24-25. Another biomolecular engineer, graduate student Alessandra Tiffany, who works with professor Brendan Harley to revolutionize how we treat severe skull injuries, is featured on pages 22-23.

This semester culminated in one of my favorite activities: convocation (pages 14-15). This in-person celebration of our graduates, with remarks from Michelle Joycelyn, went smoothly.

"I am delighted to join the department—everyone has been extremely welcoming. We have already made great strides to better organize the department’s virtual files. I look forward to working with you all in this role."

Claire Benjamin
Associate Director of Communications

Claire Benjamin joins our department from Illinois’ Carl R. Woese Institute for Genomic Biology. She was a science writer covering the IGB’s research themes before moving on to publicize interdisciplinary, multi-institutional research projects aimed at producing more food and fuel. She has a BS in agricultural communications and MS in advertising from UIUC.

"Our department is brimming with innovators who have a vision for the future and are harnessing chemistry and molecular machinery to make it a reality. It’s a privilege to help share your inspiring stories."

Connie Knight
Graduate Program Coordinator

Connie Knight transferred from the Department of Chemistry where she has been employed in various roles since 2006. She brings experience in the administration of Chemistry’s graduate program. She will take on a central role to help with CHBE’s graduate recruiting.

"The department offered me the opportunity to become more engaged in various facets of a graduate program, including admissions and recruiting, while still being involved in the day-to-day activities of a graduate coordinator. I have already enjoyed getting to know and work with our students and faculty who have made me feel ‘at home’ here in CHBE.”

"We are grateful to our former team members, who have moved on over the past 18 months but contributed much to CHBE’s success during their tenure here."

Jenny Daly
Associate Director of Finance and Administration

Jenny Daly is now overseeing the administration of the School of Molecular and Cellular Biology at UIUC. She joined CHBE in November 2017 and worked with our faculty and staff to improve many processes to help the department run more smoothly.

Christine des Garennes
Associate Director of Communications

Christine des Garennes moved on to oversee the strategic communications of the School of Molecular and Cellular Biology at UIUC in April 2020. She joined our department in February 2015 and helped enhance CHBE’s visibility through the website, social media, and many editions of this publication.

Cindy Dodds
Graduate Program Coordinator

Cindy Dodds retired from the university in June 2021, where she worked for 30 years. She joined CHBE in November 2017 and helped us recruit and oversee several cohorts of graduate students.

Braden Shain
Associate Director of Development

Braden Shain has become the senior director of development at the University of South Carolina School of Law. He joined the department in July 2016 and helped grow our advancement efforts tremendously.

Becky Lyle
Undergraduate Program Assistant

Becky Lyle retired from the university in December 2021. She joined the department in 2005 and has assisted in all aspects of the CHBE undergraduate program as well as with the needs of several research facilities and lectures.

We plan to hire replacements for Braden Shain and Becky Lyle in 2022.

About the cover:

Outreach

Graduate student Dani Herrier works with fourth-grade students at an outreach event held at the Booker T. Washington STEM Academy in Champaign, Illinois.

Welcome to our newest administration team members

The Department of Chemical and Biomolecular Engineering has had several staffing changes over the past year or so, and we are excited to introduce some of our newest team members, who have already contributed energy and ideas to our operations.

Wendy Balthazor
Associate Director of Finance and Administration

Wendy Balthazor brings us to over 20 years of experience in business and budgeting from Wolfram, Shire Pharmaceuticals, and the University of Illinois Urbana-Champaign. Over the past eight years, she has held several roles at UIUC covering grants and contracts, finance, and administration for the College of Veterinary Medicine and University Library. She holds a BA in Japanese language and culture from UIUC as well as an MBA from Eastern Illinois University.

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Ideas in regards to fighting disease, and who has prepared students for their own professional roles.

He is a model for how faculty can contribute to the land grant mission of our institute,” said Bill Bernhard, executive vice provost for academic affairs.

At Illinois, Kong has developed various active biobody hybrid materials including self-propelling antimicrobial microbubbles, soft manipulator machinery, stimulus-response soft materials, and neuromuscular and cardiovascular organs. These materials are used for molecular and cell therapies of vascular and brain diseases and infection. Read more about Kong’s work on pages 24-25.

The event began with a warm welcome from department head Paul Kenis, the Elio Ellakim Tanika Endowed Chair, and Matthew Ando, the associate dean of the sciences in the College of Liberal Arts & Sciences.

First off, Kenis recognized the 2021 recipients of the Distinguished Alumni Achievement Award who were not able to attend the ceremony:

Monty Alger (PhD ’82) is a professor at Pennsylvania State who served as president of the American Institute of Chemical Engineers in 2000. H. Scott Fogler* (BS ’62) served on the faculty at the University of Michigan for over 50 years. “H. Scott Fogler died earlier this year; his in Memoriam” article is on page 30. Kilt Gordon (BS ’33) is known both for his semiconductor work at Quicklogic and advocacy on behalf of numerous environmental organizations. Steve McLin (BS ’68) retired from his career as an executive in the banking industry, where he was a top strategist for Bank of America.

Next, Huimin Zhao, the Steven L. Miller Chair, recognized his former graduate student Fei Wen (MS ’06, PhD ’10), an associate professor at the University of Michigan. Wen is advancing our understanding, monitoring, and modulating of T cell function, which is crucial to our ability to address cancer and diseases. Wen received an inaugural Young Alumni Achievement Award in 2019.

Zhao also recognized Joseph Glas (MS ’62, PhD ’65), who received the 2020 Alumni Achievement Award from the University of Illinois Alumni Association and the department’s 2021 Distinguished Alumni Achievement Award. Glas commended Glas for his efforts to replace chlorofluorocarbons (used in refrigeration) with safe alternatives as a vice president and general manager at DuPont. Glas has supported the department through an endowed scholarship, as a 2011 convocation speaker, and as a member of CBEE’s resource development and external advisory committees.

Professor Christopher Rao, the Morris Professorial Scholar, presented a 2021 Young Alumni Achievement Award to Jacob Bercraft (BS ’13) for launching a startup company called Strand Therapeutics that is figuring out how to use mRNA gene therapies to treat tumors. Rao also presented a 2021 Young Alumni Achievement Award to Laura Banevic Flessner (BS ’05), who founded Mindtap to provide advising, coaching, and workshops that bring together neuroscience and agile principles to fuel innovation. Read more about Flessner on pages 26-27.

Next, Kenis presented the 2021 Distinguished Alumni Achievement Award to Daniel Croll (MS ’73, PhD ’75), the former Herbert W. Dow Professor for Chemical Process Safety at Michigan Technical University, for his contributions to chemical process safety, including a landmark textbook on the topic now in its 4th edition.

Kenis recognized Robert Sankman (BS ’80) as a recipient of the 2019 Distinguished Alumni Achievement Award for his profound contributions to semiconductor and electronic packaging technologies over his 40-year career at Intel.

Lastly, professors Mary Kraft and Hong Yang recognized the fellowships awarded over the past two years to the department’s graduate students, who were invited to stand to be recognized. The ceremony concluded with thanks to representatives from the Graduate Student Advisory Council, Richa Ghosh (Flaherty Group) and Jarom Sedarholm (Bouguet Group), who recognized the Graduate Research Symposium winners and alumni judges (page 18).

Nominations are accepted on a rolling basis with a deadline of July 13, 2022, to be considered for the 2022 Alumni Awards. Self-nominations are encouraged and all nominations are held for future consideration. For more information about the program, past recipients, or to submit your nomination, visit go.cbe.illinois.edu/AlumniAwards. Save the date for our next fall awards ceremony on Friday, October 7, 2022.
Awards & Recognition

**Diao named research co-chair at the Beckman Institute**

In June 2021, associate professor Ying Diao was named co-chair of the Molecular Science and Engineering research theme at the Beckman Institute for Advanced Science and Technology at the University of Illinois Urbana-Champaign. With expertise in nanotechnology and a desire to address grand environmental, medical, and scientific challenges, she will continue to push the boundaries of the institute’s interdisciplinary mission.

“Beckman is an inspiring model. There are no boundaries of departments or colleges. People from all disciplines come together to tackle challenges united under a shared vision,” Diao said. “I am really hoping to facilitate community building around molecular science and engineering. It’s still a relatively young discipline, and there are still barriers to overcome. It is my role to break down those barriers.”

**Diao honored with 2021 Campus Distinguished Promotion Award**

Associate professor Ying Diao received a 2021 Campus Distinguished Promotion Award from the University of Illinois in recognition of the scope, quality, and impact of her scholarship, teaching, service, and engagement efforts. The Campus Committee on Promotion and Tenure identified twelve scholars whose contributions were truly exceptional.

**Flaherty selected to be Eastman Foundation Distinguished Lecturer**

Associate professor David Flaherty was chosen to be among the Tenth Annual Eastman Foundation Distinguished Lecturers in Catalysis at the University of California, Berkeley, in 2021. His seminar was titled, “Why Does the Catalyst Need a Hole? Solvent molecules surround and interact with catalytically active sites in ways that change reaction rates and selectivities by orders of magnitude. Flaherty described the complex and previously unrecognized phenomena at solid-liquid interfaces during the direct synthesis of H2O (H2 + O2 → H2O), an environmentally benign oxidant.

**Harley elected as Biomedical Engineering Society Fellow**

Robert W. Schafer Professor Brendan Harley has been elected to the Biomedical Engineering Society (BMES) Class of 2021 Fellows. This distinction recognizes members who demonstrate exceptional achievements and experience in the field of biomedical engineering and a record of membership and participation in BMES.

Harley’s research group develops biomaterials for in vivo and in vitro tissue engineering applications within the body’s spatially patterned and heterogeneous microenvironments to promote regeneration. Recently, Harley was awarded the Clemson Award from the Society For Biomaterials that also recognized his contributions to this area of research.

**Kenis earns Energy Technology Division Research Award from the Electrochemical Society**

The Electrochemical Society presented department head Paul Kenis, the Elio Eliaian Tarika Endowed Chair, with the 2020 Energy Technology Division Research Award, which was established in 1992 to encourage excellence in energy-related research. The award recognizes outstanding and original contributions to the science and technology of energy-related research areas.

Kenis presented his talk on “Electrochemical CO2 Reduction: Path Towards a Carbon Neutral Chemical Industry?” via a live Zoom seminar. He covered a summary of the status of CO2 electrocatalysis, a techno-economic and life-cycle analysis to identify remaining hurdles, and the prospect of this technology to contribute to a sustainable chemical industry in the future.

**Kong’s teaching recognized with award from School of Chemical Sciences**

The School of Chemical Sciences at the University of Illinois presented Robert W. Schafer Professor Hyunjoong Kong with a 2020-2021 SCES Teaching Award, which recognizes the entire scope of educational efforts from course development to in-class instruction. Kong is known for his entertaining jokes and helpful lecture notes that he shares before each thermodynamics class (CHBE 321).

**Leckband receives 2021 Langmuir Lectureship Award**

Langmuir and the ACS Division of Colloid & Surface Chemistry named professors Deborah E. Leckband and Ivan I. Smalyukh from the University of Colorado Boulder as winners of the 2021 Langmuir Lectureship Award. The award recognizes individuals working in the interdisciplinary field of colloid and surface chemistry.

“Being selected as a 2021 Langmuir Lecturer is a terrific honor. Since my postdoc years with Jacob Israelachvili, I have been fascinated by the ways that surface science affects biology, from fundamental processes like cell adhesion to preventing marine fouling on ships. I have many superb colleagues in the field. Their recognition of my contributions in this way is both humbling and an honor,” Leckband said.

**Peters serves as 2021 Honoree of the Crystallization & Evaporation Area at AIChE**

William H. and Janet G. Lycan Professor Baron Peters gave an invited talk as the 2021 Honoree of the Crystallization & Evaporation Area. This award is a recognition of longstanding contributions to the field and also serves to introduce concepts that will be key going into the future.

**Shukla earns Maximizing Investigator Research Award from the National Institutes of Health**

Diwakar Shukla was among 15 Young Investigators honored by the American Chemical Society’s Polymeric Materials: Science and Engineering (PMSE) in 2020 for significant contributions to the field.

The award provides a forum for PMSE Young Investigators to share their ideas and recent advances and recognizes their accomplishments. Sing gave an invited talk as part of the PMSE Young Investigator Symposium, which was held during the ACS fall meeting.

**Su wins 2021 Elsevier Prize for Green Electrochemistry from ISE**

The International Society of Electrochemistry awarded assistant professor Xiao Su the 2021 Elsevier Prize for Green Electrochemistry in recognition of his achievements in the field of environmental electrochemistry. The annual award is given to early-career scientists under the age of 35. Su will receive the award at the 2022 Annual ISE Meeting, where he will give a lecture on redox-mediated electrochemical processes for selective separations and environmental remediation.

**Shukla named LEAP scholar for contributions in teaching and research**

Blue Waters Associate Professor Diwakar Shukla was among four professors recognized as Lincoln Excellence in Teaching Professors (LEAP) scholars by the College of Liberal Arts & Sciences. The LEAP award recognizes early-career faculty based on scholarly productivity and contributions to the mission of their departments and the College of LAS. LEAP scholars hold the title for two years.

**Sing earns 35 Under 35 Award from AIChE**

Associate professor Charles Sing received the 35 Under 35 Award from the American Institute of Chemical Engineers in 2020. The award honors engineers who have made significant contributions to AIChE and the chemical engineering profession; it was founded to recognize young chemical engineers who have achieved greatness in their fields. The winners are a group of driven, engaged, and socially active professionals, representing the breadth and diversity that chemical engineering exemplifies.

**Sing named a 2020 Young Investigator by ACS PSME**

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Research Grants

FUTURE-MINDS-QB to increase participation from underrepresented groups in biomedical data science and quantitative biology

Fisk University, a historically Black university in Nashville, and the University of Illinois Urbana-Champaign have been awarded a five-year, $1.3 million T-32 training grant from the National Institute of General Medical Sciences, a member organization of the National Institutes of Health. This grant supports the program: Fisk-UIUC Training of Under-Represented Minds in Data Science and Quantitative Biology, known as FUTURE-MINDS-QB.

FUTURE-MINDS-QB offers two tracks from a master’s degree program at Fisk to a doctoral degree program at Illinois in a field relevant to quantitative biology. Participants will receive rigorous training in the core computational and mathematical skills that are required to succeed in big-data research fields. Chemical and biomolecular engineering professors Brendan Harley, Hyunjoon Kong, Mary Kraft, and Christopher Rao are participating.

$2.4M NIH grant will develop biomaterials to repair skulls and promote regeneration

Led by Robert W. Schaefer Professor Brendan Harley, a new research project aims to develop biomaterials that are strong, malleable, and support stem cell growth to transform skull reconstruction surgeries with a $2.4 million grant over five years from the National Institute of Dental and Craniofacial Research, a branch of the U.S. National Institutes of Health.

“Craniofacial bone reconstruction is difficult and time-intensive—relying on bone grafts and illicit fitting, non-regenerative plastic implants; the result is often poor healing and high complication rates,” Harley said. “Our goal is to improve patient recovery by accelerating bone regeneration.”

Harley to lead NIH grant on microdroplet materials

Robert W. Schaefer Professor Brendan Harley is teaming up with co-investigator Andrés García, executive director of the Parker H. Petit Institute for Bioengineering and Bioscience at Georgia Tech, for a two-year effort supported by the National Institutes of Health Exploratory/Developmental Research Grant Award, which supports early and conceptual stages of project development.

Their goal is to replicate the cascade of signals necessary to control stem cell behavior, which remains a central challenge for the regenerative medicine community. The hemopoietic system, where blood cell components are formed, offers an ideal biological system. The team will use the short diffusion lengths of microdroplets to study the impact of biophysical and metabolic signals on hemopoietic stem cells.

Kong receives 2021 seed awards to support collaborative cancer research

Robert W. Schaefer Professor Hyunjoon Kong will participate in two of nine new interdisciplinary projects at the University of Illinois supported by annual seed grant awards from the Cancer Center at Illinois. The two projects are called “FORce Control of Cancer Tumor μEnvironment” and “Multi-shape 3D Hanging Drop Array for Cancer Drug-screening.” Kong will provide natural-synthetic extracellular matrices that can regulate cellular signaling and force with their biophysical and metabolic signals on hematopoietic stem cells.

C3.ai Digital Transformation Institute awards energy and climate security grant to Su and Shukla

Professors Xia Su and Diwakar Shukla received funding through a seed award from the C3.ai Digital Transformation Institute to leverage artificial intelligence (AI), machine learning, and advanced analytics for more sustainable and energy-efficient separations for water purification, resource recovery, carbon capture, and more.

“Electrification of separation processes has the potential to make a significant impact on decarbonization and environmental sustainability by providing integration with renewable energy (green electrons) and modularity,” said Su, who will lead the new project. “A significant challenge is designing selective electrodes for contaminant removal and resource recovery, and we believe data science/ artificial intelligence can play a tremendous role in accelerating materials discovery.”

Su receives seed funding to make Illinois’ water supply more sustainable

Assistant professor Xia Su joins one of eight research teams across the state awarded $229,000 in seed grants from the Illinois Innovation Network to create a more sustainable water supply system in Illinois.

Su’s project will investigate the viability of a new electrochemical wastewater-treatment system. The research team also includes Northern Illinois University professors Tomoyuki Shibata, associate professor of public health, and Kya Tae Cho, associate professor of mechanical engineering.

New U.S. and German collaboration aims to produce green hydrogen more efficiently

Through a new award program, the U.S. National Science Foundation and Deutsche Forschungsgemeinschaft (German Research Foundation, DFG) have joined forces to award the University of Illinois and Technical University of Darmstadt a three-year, $720,000 research grant to explore opportunities to more efficiently produce green hydrogen, a clean and renewable source of energy.

Led by Richard C. Akire Chair Hong Yang, the project is among the first supported by the NSF-DFG Lead Activity in Electrosynthesis and Electrocatalysis (NSF-DFG EChem), an international effort to support collaborative work between U.S. researchers and their German counterparts on engineering science projects for novel and fundamental electrochemical reactions and studies. The project assembles a multidisciplinary team, including Nicola Perry at Illinois and professor Andreas Klein at TU Darmstadt.

From left: Fisk undergraduate students Skye Fauchier, Jana Hoffman, and Lalita-Lavette Woodard who participated in summer training workshops at UIUC.

From left: professor Brendan Harley and graduate students Alecsandria Tiffany and Vasiliki (Aliki) Kollopoulos.

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Portable, affordable, accurate, fast—team invents new COVID-19 test

A new coronavirus test can get accurate results from a saliva sample in less than 30 minutes, researchers report in the journal Nature Communications. Many of the components of the hand-held device used in this technology can be 3D-printed, and the test can detect as little as one viral particle per 1-microliter drop of fluid.

“We developed a rapid, highly sensitive and accurate assay, and a portable, battery-powered device for COVID-19 testing that can be used anywhere at any time,” said Steven L. Miller Chair Huimin Zhao, who led the research. Though it is still in the prototype stage, the device is estimated to cost less than $78 and the reagents and other materials needed for testing would amount to $6–7 per test, the researchers found.

Current coronavirus testing technologies are complex, expensive, time-consuming, and require bulky equipment and expert analysts, whereas the new device can be operated by anyone with minimal training who is careful when loading samples, Zhao said.

Scientists demonstrate a better, more eco-friendly method to produce hydrogen peroxide

Led by associate professor David Flaherty, a team has demonstrated a more efficient and environmentally friendly method to produce hydrogen peroxide (H₂O₂), according to a recent study published in the journal of the American Chemical Society.

Decades ago, researchers proposed a simpler, cheaper, and “greener” one-step alternative method, where a catalyst (palladium–gold nanoparticles) drives the reaction. Flaherty’s team found that a ratio of one palladium to 220 gold atoms generates almost 100 percent hydrogen peroxide, instead of the other potential product: water.

The organization of these atoms within the catalyst matters: palladium atoms touching one another favor water formation while palladium atoms surrounded by gold favor H₂O₂ formation. Significantly, these catalysts give stable performance over many days of use and continuously achieve these remarkable selectivities to H₂O₂—and do so using clear water as a solvent, avoiding problematic and corrosive additives that are often used.

“Decades ago, researchers proposed a simpler, cheaper, and ‘greener’ one-step alternative method, where a catalyst (palladium–gold nanoparticles) drives the reaction,” Flaherty said. “Correlations between entropy changes in the water caused by the reaction, the reaction rates, and the size of the zeolite poises suggest that the changes in the structure of water clusters and chains are responsible for the improvement in catalytic rates.”

Bioengineers develop software to enhance IR-based cancer diagnosis

A team of researchers led by graduate student Kianoush Falahkheirkhah and Founder Professor of Bioengineering Rohit Bhargava, an affiliate professor of chemical and biomolecular engineering, developed new software to boost infrared imaging-based cancer diagnosis. In addition to computationally enhancing image resolution, this software will integrate data analysis and accelerate recording speeds of pathological imaging. Their research is published in Chemometrics and Intelligent Laboratory Systems.

“Most of the strategies for cancer diagnosis today are based on assessing the morphologic detail of the sample, which involves a pathologist analyzing the sample to ascertain the type and severity of the cancer. With IR imaging, we get the chemical composition of the sample, providing us with the volume of information necessary for automated tools to analyze tumors and their surrounding microenvironment,” Falahkheirkhah said.

Improving biomaterials design for bone regeneration

Bone injuries in the face and skull—known as craniomaxillofacial defects—can be caused by sports injuries, vehicle accidents, or battlefield injuries. Repairing such defects is complicated because different types of cells need to interact with each other. In a new study, led by Robert W. Schaefer Professor Brendan Harley, researchers are investigating the types of material used in reconstitution to see which one works best.

Harley’s group develops collagen scaffold biomaterials containing components that are found in bone, such as calcium and phosphate ions, and sugar compounds called glycosaminoglycans (GAGs). The researchers adapted a collagen biomaterial to include one of three different types of GAGs found in the bone tissue microenvironment: chondroitin-4-sulfate, chondroitin-6-sulfate, and heparin. They investigated how these materials influence processes important to bone regeneration, such as stem cell activation, immune cell activation, and endothelial cell activity, which is important for the formation of new blood vessels.

“Although heparin is known to directly influence blood vessel formation, to our surprise, we saw that the media generated by stem cells in chondroitin-6-sulfate scaffolds led to the greatest amount of blood vessel development compared to the other two scaffolds,” said Vasiliki “Aliki” Kallipoulou, a graduate student advised by Harley.

Less salt, more protein: Researchers address dairy processing’s environmental, sustainability issues

Researchers say the high salt content of whey—the watery part of milk left behind after cheesemaking—helps make it one of the most polluting byproducts in the food processing industry. In a new study, led by assistant professor Siao Sia and graduate student Nayeong Kim, chemists demonstrate the first electrochemical...
Unified theory explains how materials transform from solids to liquids

Years of meticulous experimentation have paid off for researchers aiming to unify the physics that defines materials that transition from solids to liquids. The researchers said a new theoretical model—a unified mathematical expression that defines how soft-yet-rigid materials transition from a solid into a liquid flow when they exceed their specific stress threshold. The findings are published in the journal Physical Review Letters.

“The behavior of yield-stress fluids has traditionally been defined by trying to combine the physics of two different types of materials: solids and liquids,” said lead author and graduate student Krunal Ramani. “But now, we have shown that these physical states—solid and liquid—can exist together in the same material, and we can explain it using one mathematical expression.”

The study, led by assistant professor Simon Rogers, unveils a unified mathematical expression that defines how soft-yet-rigid materials transition from a solid into a liquid flow when they exceed their specific stress threshold. The findings are published in the journal Physical Review Letters.

“Several processes, such as mudslides, avalanches, and avalanches, are published in the Chemical Engineering Journal.”

The desalination process introduced in this study uses up to 73% less energy and functions at 62% of the operating cost associated with conventional desalination systems. The findings of the study are published in the Chemical Engineering Journal.

Scientists intensify electrolysis, utilize carbon dioxide more efficiently with magnets

For decades, researchers have been working toward mitigating excess atmospheric carbon dioxide (CO2) emissions. One promising approach captures atmospheric CO2, and then, through CO2 electrolysis, converts it into value-added chemicals and intermediates—like ethanol, ethylene, and other useful chemicals. While significant research has been devoted to improving the rate and selectivity of CO2 electrolysis, reducing the energy consumption of this high-power process has been underexplored.

Led by department head Paul Kenis, the Ello E. Tarika Endowed Chair, researchers reported a new opportunity to use magnetism to reduce the energy required for CO2 electrolysis by up to 60% in a flow electrolyzer using magnetism.

Department head Paul Kenis (right) and graduate student Sahil Bhargava (left) report reducing the energy required for CO2 electrolysis by more than 60% in a flow electrolyzer using magnetism.

Kenis’s research focuses on converting biomass into useful chemicals via heterogeneous catalysis. Recent work in the Flaherty lab has uncovered classes of catalysts that demonstrate a unique ability to selectively cleave C-O bonds in esters to produce ethers that are useful as surfactants and solvents. Her work investigates the activity and selectivity of these novel catalysts for the conversion of relevant esters. By varying carbon electronegativity, carbon chain length, and steric bulk, they aim to learn more about the mechanism of selective hydrogen transfer to inform further catalyst optimization and identify opportunities to translate this technology into practice.

“Through the Clare Boothe Luce Program, I have gained valuable insight into factors that are important for longevity and success in research,” Manetsch said. “This program has introduced me to a community of fellow students and scientists who have encouraged and motivated me on my scientific journey. I am continuously inspired by my mentor, Claudia Berdugo-Díaz, and her passion for science; she has tirelessly supported and challenged me to grow as a scientist.”

Manetsch works with Project for Less and co-founded (and is now the president of) Womxn in Chemical Sciences (WiCS) to advance inclusion in the School of Chemical Sciences. She enjoys jogging, reading, and learning languages. She plans to pursue a Ph.D. in chemical engineering or materials science and aims to contribute to sustainable energy technology in a national lab or academic setting.

Clare Boothe Luce program supports two ChBE undergraduate students

Two seniors in chemical and biomolecular engineering, Melissa Manetsch and Briana Sobkecks, are represented in the 2021-2022 cohort of Clare Boothe Luce scholars. The CBL program supports eight women undergraduates who aim to study or teach science, mathematics, and/or engineering by creating a research pathway to graduate studies. CBL scholars are part of the Illinois Scholars Undergraduate Research (ISUR) program and also benefit from science communication opportunities (posters/oral presentations), monthly seminars, and interactions with faculty on topics ranging from research proposals to work-life balance.

Melissa Manetsch (left) and Claudia Berdugo-Díaz (right)

Melissa Manetsch is working with graduate student Claudia Berdugo-Díaz and associate professor David Flaherty. “Melissa is spectacular and brings enthusiasm to the research. She has helped us develop materials and processes with industrial relevance from renewable sources. It is a pleasure to have her in the lab,” Flaherty said.

Manetsch’s research focuses on converting biomass into useful chemicals via heterogeneous catalysis. Recent work in the Flaherty lab has uncovered classes of catalysts that demonstrate a unique ability to selectively cleave C-O bonds in esters to produce ethers that are useful as surfactants and solvents. Her work investigates the activity and selectivity of these novel catalysts for the conversion of relevant esters. By varying carbon electronegativity, carbon chain length, and steric bulk, they aim to learn more about the mechanism of selective hydrogen transfer to inform further catalyst optimization and identify opportunities to translate this technology into practice.

“Through the Clare Boothe Luce Program, I have gained valuable insight into factors that are important for longevity and success in research,” Manetsch said. “This program has introduced me to a community of fellow students and scientists who have encouraged and motivated me on my scientific journey. I am continuously inspired by my mentor, Claudia Berdugo-Díaz, and her passion for science; she has tirelessly supported and challenged me to grow as a scientist.”

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Briana Sobkecks (left) and Jiming Chen (right)

Briana Sobkecks is pursuing a research project with graduate student Jining Chen and Blue Waters Associate Professor Divakar Shukla. “With support from the CBL program, Briana has made tremendous progress in research along with excellence in coursework. Her work in our lab has generated new molecular insights into the mechanisms of hormone perception in plants,” Shukla said.

Sobkecks aims to improve food security by eliminating the effects of parasitic weeds like witchweed, which destroys $10 billion in food crops annually. Witchweed feeds off striglactane, a hormone secreted by host crops. Using computer models and simulations, Sobkecks investigates how witchweed metabolizes striglactanes better than crops in order to help design better proteins to ward it off. She has determined a protein that interferes with the receptor’s active site shape and the hormone’s motion, decreasing the metabolism reaction rate of striglactane in rice.

“I am grateful to Dr. Shukla, Jining, and the Clare Boothe Luce program for helping me find success in research,” Sobkecks said. “CBL has helped me grow tremendously as a researcher. I have gained confidence in my ability to describe my research with those outside my lab. The program has also given me the opportunity to connect with and learn from a variety of professors.”

Sobkecks chose Illinois for its strength in chemistry and chemical engineering. She is the vice president of the American Chemical Society student chapter. She also participates in the Campus Honors Program, student council, and sings in a church choir. After graduation, she plans to pursue a Ph.D. in chemical sciences, studying enzyme function using molecular dynamics.
To start, department head Paul Kenis, the Elio Elakim Tarika Endowed Chair, welcomed graduates to the first in-person convocation held by the department in two years. “It is wonderful to gather here today, in person, to celebrate the accomplishments of this distinguished group, who have achieved much despite the unforeseen and extraordinary circumstances caused by the pandemic,” Kenis said.

College of Liberal Arts & Sciences associate dean Matthew Ando echoed these sentiments in his welcome remarks, as did Drago.

“Each of you, the chemical engineers of the Class of 2021, has fulfilled the requirements which are challenging in normal times, but these last two years have been, and continue to be, far from normal times,” Drago said. “The COVID-19 pandemic placed a formidable obstacle in front of you, and you overcame that barrier.”

Drago described the value of pursuing, accepting, and providing opportunities.

“One day, you may find yourself as the only person in the room who understands the true risk of a proposed course of action… Your peers will see your personal and professional ethics manifest in your daily tasks long before that day,” he said. “Pursue knowledge. Pursue understanding. But more importantly, pursue wisdom. Use your knowledge and experience to arrive at appropriate and ethical decisions.”

He said accepting opportunities propelled his career first as a reactor engineer at an operating nuclear power plant and later when he was asked to perform nuclear safety assessments with the Department of Energy.

“I have also accepted opportunities to mentor colleagues,” he said. “I often heard them thank me for helping them explore solutions, but I also benefited from the relationship, for those conversations sharpened my problem solving and communication skills.”

This philosophy has led to unforeseen opportunities outside of work—being an early adopter of a home computer led to self-publishing a book.

He went on to share that “at every stage in your life, you can provide opportunities for others.”

In celebration of his 50th class reunion coming up next year, and in memory and honor of his parents, Drago established the Philip and Anne Drago Scholarship to award funds to support a chemical engineer focused on chemical process, nuclear, or bio-related safety.

“In this small way, I am providing opportunities for students I do not know, but who will undoubtedly see further than I could ever see,” said Drago, referring to a famous quote by Newton: If I have seen further, it is by standing on the shoulders of Giants.

“I challenge you to provide opportunities for others,” he said. “To the class of 2021, congratulations on your achievements, and good luck with building a magnificent and impactful career."

Today’s graduates join more than 5,000 departmental alumni who have graduated since 1901.

“ChBE returns to in-person convocation to celebrate December 2021 graduates

The Department of Chemical and Biomorphic Engineering held an in-person convocation ceremony on December 18, 2021, to celebrate nearly 50 graduates with remarks from ChBE alumnus Joseph Drago, an expert in nuclear and industrial safety.

Mass Transfer • Fall/Winter 2021
Scientists thrive on their ability to piece together the story behind their data and describe something unknown to the world. Academics also thrive in the classroom, where they help students discover knowledge and skills that were unknown to them.

It is those twinning motivations that make outreach events that showcase the value of our scientific endeavors while educating and inspiring future scientists so meaningful.

At a recent outreach event, more than 20 graduate students and three chemical and biomolecular engineering professors Damien Guironnet, Charles Sing, and Antonia Statt, who is also affiliated with materials science and engineering, had the opportunity to witness nearly 60 fourth graders at a local elementary school discover the short lifespan—and diminishing supply—of plastic.

They organized this activity as part of the St. Elmo Brady Academy, an outreach program that encourages middle school youth from underserved backgrounds to pursue STEM careers. The Brady Academy was founded by former CHBE lecturer Jerrod Henderson, now an assistant professor at the University of Houston; it is now managed by Valerie O’Brien at the University High School.

“We want to empower these students to make a difference each and every day by choosing to reduce, reuse, and recycle,” said graduate student Davi Harrier (Guironnet/Kenis Groups), who helped organize the event. “More than that, we want to show them the kinds of big-world problems that engineers like us—and perhaps one day them!—are tackling.”

They showcased both how difficult it is to source the raw materials required for making plastic and the diminishing returns of recycling efforts.

First, the students “mined” for coal (bolts) and oil (paperclips) amongst tubs full of rocks. Next, they pretended to ship the coal and oil (paperclips) to the power plant and used the remaining crude oil to first perform separations and then built polymers by stringing together their paper clips. Then they exchanged their paperclips for playdough to compare the processes of molding and extruding.

“By the end of the first lesson, the students could figure out how plastic items in their classroom were produced, and they got a sense of all steps involved in the production,” Statt said. “They mastered the material, but what’s more, they got excited about engineering concepts.”

“However, when the students went back to mine for more materials to make more goods, they discovered the problem with depending on limited resources like fossil fuels,” said Guironnet, who helped organize the event with his wife Sue Guironnet.

“They also learned how difficult it is to recycle plastic, as demonstrated by trying to separate different colors of playdough—a concept I’m familiar with both as a plastics expert and parent.”

“It’s easy for us to lose sight of the big picture when we are working in our sub-disciplines and constantly hustling after the next deadline,” Sing said. “These outreach efforts remind us of what we are working toward, who we are working for, and who we want to work with more in the future by making science more accessible and inclusive.”

These lesson plans are available online to be used for other outreach efforts at go.chbe.illinois.edu/SEBA.

Right: Professor Antonia Statt (center) checks in on students during the activity.

Support our outreach efforts, and the people who make them happen.

Your investment supports the best and brightest students with fellowships and scholarships; it supports world-renowned faculty and their innovative research and teaching; it funds essential upgrades to laboratories, classrooms, and technologies; and it funds outreach efforts to inspire the next generation of engineers.

You can make a gift by using the enclosed envelope, by phone at 217-244-0473, or online by scanning the QR code provided or visiting go.chbe.illinois.edu/give. In addition to outright gifts, you can support the Department of 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.

If you take the standard deduction on your taxes, the Consolidated Appropriations Act allows for an adjustment up to $600 in cash gifts to qualified charities, effectively raising your standard deduction by the amount of your gift. Visit https://go.illinois.edu/CCAnfo for more information.

We will work with you to arrange options most suitable for you. If you are interested in learning more about these or other gift options, please contact Paul Winterbotham, assistant director of development, at paulww@illinois.edu or 217-300-6222.
2021 Graduate Research Symposium

The Department of Chemical and Biomedical Engineering and the Graduate Student Advisory Council (GSAC) hosted the 20th annual Graduate Research Symposium on October 8, 2021.

The event included poster and oral presentations by the department’s graduate students on wide-ranging topics from robotic automation to coarse-grain modeling, developing organic solar cells, cell engineering factories, and speed up COVID testing.

The presentations were judged by a panel of alumni: Daniel Crowl (MS ’73, PhD ’75), who is retired from Michigan Technical University; Yongqi Lu (PhD ’97), a research University; Daniel Crowl (MS ’73, PhD ’75), and Yongqi Lu (PhD ’97). Back row from left: graduate students Destiny Collazo, Brent Buchinger, Jarom Sederholm, Kyle Timmer, Darien Raymond, Vanessa DaSilva, Howard Weatherspoon, Rui Hua Jeff Xu, and Darien Raymond.

Front row from left: Qingjun Meng (PhD ’06), Fei Wen (MS ’16, PhD ’11), Daniel Crowl (MS ’73, PhD ’75), and Yongqi Lu (PhD ’97). Back row from left: graduate students Destiny Collazo, Brent Buchinger, Jarom Sederholm, Kyle Timmer, Darien Raymond, Vanessa DaSilva, Howard Weatherspoon, Rui Hua Jeff Xu, and Darien Raymond.

For more information or to participate in future symposiums, contact the department at chbe@illinois.edu or visit their website at chbe.illinois.edu.

Poster Presentation Winners:

First place
Chengyou Shi
“Accelerating the discovery of Novel Ribosomally Synthesized and Post-translationally Modified Peptides (RiPPs) through Pathway Refactoring and Robotic Automation” (Diao Group)

Second place
Apurva Godbole
“Raman Spectroscopy and Multivariate Analysis for Noninvasive Determination of Cell Phenotype in Hydrogel Cultures” (Kraft Group)

Third place
Azarya Khabsabtar
“Tuning the Molecular Assembly Pathway for Morphology Control in Organic Solar Cells” (Diao Group)

Oral Presentation Winners:

First place
Danielle Harrier
“Biodegradable Latex: The Development of an Encapsulation Technique for the Ring-opening Polymerization of Cyclic Esters” (Guiroulet/Kenis Groups)

Second place
Whitney Sinclair
“Lung-on-a-chip Platform that Enables in situ Imaging” (Leak/Kens Groups)

Third place
Yu-Heng Deng
“Self-Locomotive, Antimicrobial Microrobot (SLAM) for Biofilm Removal through Swarm-Activating Cavitation” (Kong Group)

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Would you like to be a judge for one of our student research symposiums? The Undergraduate Research Symposium will be held on Friday, April 1, 2022, and the next Graduate Research Symposium will be held on Friday, October 7, 2022. Email the department at chbe@illinois.edu if you’re interested!

Graduate Student Fellowships

Every year, chemical and biomolecular engineering graduate students are recognized with a variety of fellowships that recognize their achievements. Congratulations to our outstanding students!

2020-2021 Fellowships

3M Corporate Fellowship
Zhang, Ning (Kraft Group)

A.T. Widiger Chemical Engineering Fellowship
Zhang, Ning (Kraft Group)

K.M. Haisch National Institute Environmental Health Science Whitney Sinclair

NSF Emergent Behaviors of Integrated Cellular Systems Summer REI
Rhee Miller

NIH Fellowship
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Get to know ChBE’s 2021 Mavis Fellows

"I wanted to become a professor of chemical engineering as an undergraduate and have pursued my career fervently ever since. Ultimately, I want to make a lasting impact in this field to benefit humankind and satisfy my intellectual curiosity. I believe the Mavis program is an excellent opportunity to help educate myself in this journey."

Jason Adams

"The Mavis program provides graduate students like me a structured chance to become proficient in faculty-related skills that we do not encounter in our everyday graduate life. This program will help me improve my proposal writing, teaching, and public speaking skills. It will also give me exposure to the very successful alumni base of previous MF3 fellows."

Soumajit Dutta

"I aspire to contribute to the global scientific community by mentoring the next generation of scientists and engineers. My ultimate career goal is to become a leader and innovator in biotechnology and translate my research findings. MF3 provides opportunities that will allow me to succeed as a faculty member and mentor."

Aleksi Kolliopoulos

"My career aspiration has always been to continue my journey in academia and become a faculty member at a research university with a strong engineering program. However, this is an extremely challenging goal. The Mavis program is extremely beneficial to my success in graduate school and helps guide me through the process of gaining the necessary skills to become a productive faculty member."

Victoria Kriuchkovskaia

"I am excited to participate in the Mavis program as I know peers in our department who completed the program and felt like the experience was beneficial. This is an opportunity for me to hone the skills that will enable me to step into a faculty role to give back to students, who like me, come from backgrounds that are underrepresented in science and who must overcome unique obstacles to succeed in this challenging field."

Chris Torres

Graduate Achievements

Chan develops protein prediction model through MolSSI fellowship

The Molecular Sciences Software Institute (MolSSI) awarded a 2021-A Seed Software Fellowship to graduate student Matthew Chan (Shakla Group) to develop a model using transfer learning that can decode the sequence, structure, and function of any protein.

Transfer learning is a machine learning method that can extrapolate information from known data and apply it to understand similar but unknown data. Chan’s machine learning model aims to understand how a protein’s specific amino acid sequence affects its structure and function. The applications are limitless, but one timely example is the ability to predict how mutations affect the viability of the coronavirus.

As a MolSSI fellow, Chan attended a week-long training camp. He also received six months of financial support coupled with weekly guidance, training, and mentorship from two of MolSSI’s software scientists: Doaa Altarawy and Sina Mostafanejad. "I greatly benefited from having these scientists, who have real experience in machine learning, to advise me and plan out the next steps in this project," Chan said.

MF3 Fellows mentor a less experienced assistantship.

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MF3 Fellows mentor a less experienced assistantship.
Alezandria Tiffany’s quest for knowledge knows no bounds

An academic journey from Los Angeles to Urbana-Champaign and abroad to Sydney, Australia

While she may not have foreseen her career trajectory, both in terms of discipline and location, each destination has brought her new opportunities to pursue her intellectual curiosity.

Like many scientists, innate inquisitiveness is the foundation upon which she has built her career. As a young girl, Tiffany would ask her parents “loads of questions” about the world around her that they couldn’t answer, so they equipped her with books to find the answers for herself.

Tiffany has been seeing answers ever since.

“I would read books about animals in the ocean and animals in the Amazon,” she said. “I just became obsessed with learning new things.”

With each new topic came a potential career: marine biologist, botanist, forensic scientist, and geologist all made her list at some point. “Every time that I thought a subject was cool, I wanted to be that type of scientist,” she said.

It was her high school science teacher who encouraged her to become an engineer; she chose chemical engineering based on her aptitude for chemistry.

Over time, her questions, and the tools that she employs, have grown in complexity.

At the University of Southern California, where she completed her bachelor’s degree, Tiffany decided to participate in a work-study program that would look great on her resume and help her afford to live in LA.

In the lab of professor Richard Robers, she worked with a postdoctoral scholar to use mRNA display—a technique used for in vitro protein evolution—to design new peptides that selectively bound AGP4, a protein overexpressed in cancer.

It was this opportunity where she rediscovered her love to explore the unknown and her passion for biology.

“I found that I really like being in the lab because it was fun and exciting to be discovering something new,” she said. “I asked, ‘How can I do this all the time?’”

The graduate student in her undergraduate lab encouraged her to attend graduate school. She applied to several of the top chemical and biomolecular engineering programs across the country with the goal to attend the best school possible—several of which happened to be in the Midwest.

“When I was visiting the schools, I felt that Illinois had the realest people,” she said. “I felt like they were honest with me, and they were willing to answer all of my questions. I felt like the students were comfortable around the professors, which I have found to still be mostly true.”

At Illinois, with its broad expertise in both chemical and biomolecular engineering, Tiffany has been able to pivot from the industrial focus of her undergraduate program to her blossoming interest in biomedicine.

Before she began her PhD program, Tiffany took part in the Summer Predoctoral Institute (SPI), which provides an opportunity for incoming graduate students from underrepresented populations to start their graduate work at Illinois while creating a cohort of colleagues to grow with in academia.

Through SPI, she found her research project and graduate advisor, Robert W. Schaefer Professor Brendan Harley.

“I got a jumpstart in the group by getting acclimated and trained that summer, which was really nice,” said Tiffany, who now works on improving biomaterials for bone repair.

“I’m specifically interested in large-scale injuries caused by trauma, such as explosions to the face experienced by soldiers,” she said. “I have been changing the composition of our materials in order to improve specific cellular outputs, including cell migration, vessel infiltration, and mineral deposition. We are increasing the speed at which these large-scale injuries—that normally wouldn’t heal by themselves, are able to heal.”

That goal is not too far off, she says. They are already testing these materials in animal models to refine the materials before pursuing human trials.

Not surprisingly, her intellectual curiosity has encouraged her to branch out from her research program to her blossoming interest in biomedicine.

“Now, I’m thinking: How can we use our materials to study disease more in-depth?” she said. “How can we repurpose our existing materials to study bone cancer or osteoporosis in vitro?”

It was this line of thinking—and, admittedly, a desire to avoid Illinois winters—that led Tiffany to Sydney, Australia, to work with Scientia associate professor Kris Kilian at the University of New South Wales. Kilian’s lab is interested in how the chemistry of materials influences the behavior of mammalian cells.

“When I was last in her lab, I was determined that I would continue to work in her lab,” she said. “Collaboration is critical for my work in biomaterials development.”

While her next step in academia (or otherwise) remains to be seen, one thing is for certain: she won’t be settling for anything less than the best opportunity to tackle big questions alongside like-minded scientists. For her, collaboration is key to both career success and satisfaction.

“I feel very lost when I’m reading complex biology papers, but I know that information would be beneficial to my work in biomaterials development. “

“Even now, as a graduate student, I’m the same as I was when I was little. I read a paper about bone cancer or a paper on breast cancer, and I’m like, ‘Oh, I want to do that. I want to do that. I want to do that!’—I still am very interested in all these different topics. I’m doing exactly what I wanted to do back when I was an undergraduate: I’m working in a lab and learning something new all the time.”

“Yet, they study cells in a variety of different 3D architectures to see how they behave and how to better study their biology.” Tiffany said. “I worked on developing hydrogel models to mimic bone and the lung because when a type of bone cancer—called osteosarcoma—metastasizes to the lung, survivability decreases.”

Through her work with Kilian, Tiffany learned about new materials, different cell types, 3D printing, and evaluation techniques like confocal microscopy. She mastered the process to culture endothelial cells, fibroblasts, and bone cancer cells.

When she wasn’t working in the lab, she was exploring the Land Down Under with her husband, Kaelin. They visited Brisbane, Melbourne, and hopped over to New Zealand.

However, the year-long adventure was cut short by the pandemic; they returned to Illinois three months early in August 2020. Despite these unforeseen circumstances, Tiffany has no regrets.

This opportunity was made possible by her gumption, love to travel, and a grant from the National Science Foundation called Graduate Research Opportunities Worldwide, or GROW.

“One of my favorite things about science and math is that it is a global enterprise,” she said. “You can really do it anywhere.”

The grant was awarded based on Tiffany’s research proposal, which she said was “honestly quite fun to put together”—contrary to popular belief.

“Even now, as a graduate student, I’m the same as I was when I was little,” she said. “I read a paper about bone cancer or a paper on breast cancer, and I’m like, ‘Oh, I want to do that. I want to do that. I want to do that!’—I still am very interested in all these different topics. I’m doing exactly what I wanted to do back when I was an undergraduate: I’m working in a lab and learning something new all the time.”

Currently, she is applying for postdoctoral research positions in cell biology and disease modeling.

“I have my PhD expertise in materials development and characterization, but I’d like to learn more complex cell biology techniques,” she said. “I feel very lost when I don’t like doing things by myself; I love collaborating with people in and out of my lab,” she said. “Collaboration is critical for science to advance, and diverse teams ask questions to push the boundaries of science. Someday, I want to create a cohesive research program that combines materials development with cell biology to create truly fruitful collaborations.”
Today’s scholars construct stories onto towering buildings begun by their predecessors—and thanks to these multi-generational scientific collaborations, we can see further than ever before. In the metropolis of chemical and biomedical engineering research, Robert W. Schaefer Professor Hyunjoon Kong has laid the foundation for a new area of study at the University of Illinois Urbana-Champaign.

At his recitation investiture (read more on page 4), Kong shared that his uncle, who was an English professor, first came to UIUC on sabbatical and returned to describe the “large university campus, educational environment, and lifestyle” that so differed from their native country of South Korea.

Perhaps it was this experience, Kong suggests, that inspired his dream to study in the U.S.—yet he never would have imagined that his career would bring him to the U.S.—yet he never would have imagined that inspired his dream to study in America at a large university brimming with colleagues, tools, and inspiration. Certainly, it is the culmination of his curiosity that was piqued in the unlikeliest of places, back in his graduate school bathroom.

Top left: graduate student Lauren Endress; bottom right: graduate student Ryan Miller

Hyunjoon Kong:
An inspired biochemical engineer

“If I have seen further it is by standing on the shoulders of giants,” said Sir Isaac Newton, famously.

Today, he is designing synthetic machines—called antibacterial micro-bots—that can tackle those biofilms, or tissue made by microorganisms, which it turns out, are ubiquitous.

“Biofilms are everywhere,” he said. “I don’t want to scare you.”

That yellow stuff that forms within an infected wound is a biofilm that is difficult to remove with antibiotics. Your bad morning breath can also be caused by biofilms. And the black stuff growing between your shower tiles? That’s a biofilm, Kong says. In fact, he discovered biofilms after he came to the U.S. and was responsible for cleaning his bathroom for the first time. Truly, inspiration can strike anywhere.

Current cleaning options on the market only work on the surface of three-dimensional biofilms. His biomaterials use bubbles to penetrate biofilms and destroy them from the inside out. He is in talks to scale up the manufacturing of this product.

“I am quite confident that we are the first to demonstrate how to produce particles that can swim in the water and create bubbles to clear away biofilms,” Kong said.

Now that Kong’s team has laid the foundation, other research groups are investigating how to combat biofilms in various tissues, biomedical devices, and places with biomaterials.

Synthetic Engineering

Kong is also teaming up with colleagues to understand how cells cooperate and compete with each other, specifically in regards to the development of healthy or diseased tissues. The goal is to control the interaction between cells in order to mimic/accelerate disease progression outside of the body to enable clinical prediction and treatment studies.

Kong’s team is interested in applying this knowledge to develop organs that reproduce the patient-specific physiological function and biotransport of a beating heart and muscles activated by innervated neurons.

Kong is also developing microfluidic chips to study how the sleep cycle influences the interactions between blood vessels and the brain with Martha Gillette, Alumni Professor of Cell and Developmental Biology at UIUC and Bumsoo Han, Professor of Mechanical Engineering at Purdue.

“Sleep is very important to our body,” Kong said. “During daily activities, our brain generates waste, but during the nighttime, our bodies must flush out the metabolic waste. We are studying a certain change in the permeability of the blood vessel during this process. My chemical engineering students are stunned to learn that this is basically a fluid dynamics problem.”

Kong says, thanks to this line of research, he always encourages his students to sleep rather than cram before an exam. (He teaches thermodynamics and bio-transport courses, for which he was recently recognized with a teaching award from the School of Chemical Sciences.)

Building Collaborations

“I kind of always try to think out of the box—that has helped me to start something new,” Kong said, adding that he shares this ambition with many of his collaborators.

Now, Kong is leading a group of like-minded scientists in a new research theme called “Multi-Cellular Engineered Living Systems” (M-CELS) at the Carl R. Woese Institute for Genomic Biology, an interdisciplinary life sciences research institute at UIUC.

“We can utilize M-CELS to assemble various transformative engineering systems, such as a biohybrid robot, a neuro computer, and energy generation device, as well as other new and unforeseen possibilities,” Kong said in a 2020 announcement. “These systems may also encompass implantable ‘hyper-organ’s that sense a biological signal, and in response, synthesize, secrete, and deliver a biologic product via diffusion or pumping.”

“Currently, theme members are working to engineer neuron-innervated muscle-based biohybrid robots that perform autonomous functions in response to external stimuli,” Kong said. “These core technologies will provide enabling technologies and computational methods for the advancement of M-CELS, along with evolutionary insights and ethical considerations.”

The new theme is an opportunity to build more collaborations, to see further together, which is the premise of the IGB. Perhaps, it is also the epitome of Kong’s dream to study in America at a large university brimming with colleagues, tools, and inspiration. Certainly, it is the culmination of his curiosity that was piqued in the unlikeliest of places, back in his graduate school bathroom.

For Kong, this postdoctoral position was an opportunity to expand his research, but also to work on a variety of systems from which he could draw inspiration.

Kong joined UIUC in 2007 and established an independent research program at the interface of biology and materials.

Engineering Micro-Bots

Building upon his work with Mooney, Kong developed biomaterials to promote wound healing—but he soon witnessed challenges that must be overcome before these therapeutic products could be implemented.

“If there is an infection, it will neutralize all our efforts,” he said. “What I found was that microorganisms are making their own tissue within our host tissue, called a biofilm, that acts as a physical barrier for our great drug delivery system or tissue engineering products.”

Kong was inspired to learn how to control molecular and cellular transportation within our complex biological system to overcome these biochemical and biophysical barriers.
Laura Banovic Flessner is a recipient of the 2021 Young Alumni Achievement Award (read more page 5) in recognition of her accomplishments since she graduated with a BS in chemical engineering in 2005. In a field where success is often measured by tangible metrics, Flessner is distinguished by the intangible: her character.

Yes, she has a resume chock-full of tangible achievements. She began her engineering career at Procter & Gamble where she helped design and test the packaging for PUR Flavor Options, which won the 2009 Consumers’ Choice Product of the Year. Next, she would spearhead upstream product development, new consumer modeling, and new business models as a senior products research engineer at P&G.

She moved on to work in products research within R&D at Pfizer—where she drove over 70 technical consumer-led decisions over five years. As director of R&D Product Design and Neuroscience, she helped design and test the packaging for PUR Flavor Options, which won the 2009 Consumers’ Choice Product of the Year. She was interviewed at Pfizer by the same connection who first helped hire her to work with the brand PUR within P&G. At Pfizer, she helped to build a new R&D function called the Greenhouse.

Flessner aims to democratize and catalyze innovation by empowering and equipping young professionals with a suite of proven tools and techniques—like Agile, Lean, design thinking, and neuroscience—coupled with the leadership piece of being able to connect with others to make their ideas happen.

“We are more aware of diversity, but awareness doesn’t fix the bias in our brains,” she said in her speech. “I want to urge those of you who have ideas not to wait—to find the people who support you, because they are out there... Those who have ideas, step up, and those of you who hear ideas and see ideas from others, ask them: How can I support you?”

Early on in her career, Flessner asked for more responsibility, but opportunities were not given to her.

“Here I am, a woman, Asian, quiet, sweet, and nice, and I get along with everybody,” she said. “But that isn’t the image that you get when you think ‘leader.’”

So she took matters into her own hands.

“Networking is important,” she said in her speech. “We hear about that, but when you experience it—it’s powerful learning experience on how to bring people onto your side—helping others to see the vision that you have and being able to network through the organization to gain sponsorship.”

It was a powerful learning experience on how to bring people onto your side. Helping others to see the vision that you have and being able to network through the organization to gain sponsorship.

“...I want to bring innovation to people who wouldn’t normally call themselves innovators; but they are if they’re solving problems creatively—that’s innovation.”

Laura Flessner aims to democratize and catalyze innovation by empowering and equipping young professionals with a suite of proven tools and techniques—like Agile, Lean, design thinking, and neuroscience—coupled with the leadership piece of being able to connect with others to make their ideas happen.

Now, she is helping others bring their innovative ideas to life through Mindtap.

Throughout her career, Flessner has sought out opportunities that combine her passion for technology and people—which according to her speech—she inherited from her father and mother, respectively.

Her latest business venture connects all the dots.
George T. Allen (BS '79) passed away peacefully on Aug. 7, 2021, at the age of 64. He was born in Decatur, Illinois, the eldest of three siblings. While at the University of Illinois, he was an active member of the Kappa Sigma Fraternity and met the love of his life, Carol Ann Allen (Dow). They had two children and moved from Illinois to Georgia to California to Wisconsin, before settling in Greenville, South Carolina, for many years. He was a gifted and successful engineer and manager—his career spanned all aspects of his field and eventually brought him to Vistia, where he lived since 2003. Wherever and whatever his job, he was an active member in a local church and Rotary; he was also on Tulare County’s Mental Health Board and member of the Suicide Prevention Foundation. He retired in 2019. All along, he enjoyed spending time with his family, helping others, traveling, and walking the family dogs.

Wayne Edwin Gargrave (BS '65) passed away on Oct. 16, 2021, following a long bout with an auto-immune disorder. He was born on June 18, 1942, in Platteville, Wisconsin. He attended Joliet Junior College before the University of Illinois and went on to earn an MS in chemical engineering from the University of California, Berkeley. Following graduation, he began his career at Standard Oil as an engineer in the research department at the Whiting, Indiana, refinery, where he met his wife, Janice. He retired from the company, then known as BP, in 1999 at age 57. He was known for his love of figuring stuff out and making things work, teaching his boys how to do stuff, and giving gifts to his children and grandchildren. He is survived by his wife of 51 years, Janice Patricia Gargrave.

Alfred “Al” G. Luebbers (BS '74) died on Aug. 5, 2021, from complications of heart failure at the age of 69. He was born on Nov. 15, 1951, in Pavia, Illinois, the eldest of five brothers. After graduating from the University of Illinois, he moved to Minnesota with his wife, Pat, and began a 39-year career at 3M. As a manager at 3M, he strove to mentor and support the people he worked with. He had a special affinity for supporting talented women to rise to their potentials in an era when that was not common. Adaptive sailing brought him a freedom that he could only experience elsewhere. He loved music, especially jazz, and his guitars. He lived a life that modeled kindness and courage. He did this with steadfast determination and unwavering fortitude, which were hallmarks of his daily living.

Robert “Bob” Earl Schlisson (BS '50) died on Nov. 7, 2021, at the age of 94. He was born in Keokuk, Iowa, and grew up on the family farm near Carthage. He learned the importance of hard work, skipping third grade, and eventually going on to study at Carthage College on a scholarship. He left school to join the Navy during WWII, and after being honorably discharged, received his BS with honors from the University of Illinois. He moved to Richland, Washington, to work at the Hanford Nuclear Plant and met his wife of 69 years, Millie (Harina). He went on to earn his PhD in chemical engineering. He was the director for research for Marathon Oil in Littleton, Colorado, and served on the Executive Committee of the Colorado Environmental Commission. Bob and Millie retired early and joined the Peace Corps in 1987; they were stationed in Sierra Leone for two years. An avid hobbyist, he was an expert in woodworking, a master photographer, a creative home movie maker, an early computer wiz, a home improvement genious, a championship bowler and fast pitch softball pitcher, a licensed airline pilot, a devoted genealogy detective, a world traveler, and a lifelong learner. His passion for excellence showed in everything he did.

William “Bill” P. Schultz (BS '53) passed away on June 21, 2021, at the age of 81. He received his BS in chemical engineering from the University of Illinois and his MBA from the University of Chicago. He worked in a variety of roles for UOP in Des Plaines for over 30 years. He was the loving father of his three children. He was a devoted grandfather, spending much of his time as a spectator at their sporting events. He had a passion for hunting and fishing, developing some lifelong friendships in the process. He was known for his sense of humor, love of life, and pride in the relationships he had both with family and friends. He is survived by his spouse of over 50 years, Mary Ellen.

Richard “Rich” D. Varjian (MS '73, PhD '76) died on July 5, 2021, in Lake Forest, Illinois. He earned his BS in chemical engineering from Rutgers University, where he was active in the oldest engineering honor society Tau Beta Pi and Pi Lambda Upsilon, the national chemistry honorary society. Advised by professor Richard Alkire, he went on to earn his PhD from the University of Illinois. His career in electrochemical engineering began at Dow, and continued with other technical corporations for the rest of his life. His wife of 45 years, Phyllis, survives.

H. Scott Fogler was known to the chemical engineering world as a researcher, scholar, author, and, most importantly, a skilled and accomplished educator. He was passionate about teaching, and worked tirelessly to teach his students the tools and creative skills they would use throughout their careers to make a difference in the world. Fogler earned a BS in chemical engineering from the University of Illinois Urbana-Champaign—where he was honored as a distinguished alumnus posthumously this fall (page 5). He went on to earn an MS and PhD from the University of Colorado, which named him a distinguished alumnus in 1987. He joined UN Chemical Engineering in 1965 as an assistant professor, spending over 50 years enriching the education of his students, his department, and the field of chemical engineering.

Well known for his work on the application of fundamental chemical reaction engineering principles to the petroleum industry, he published 240+ research articles with his students—more than 49 master’s students and 45 doctoral students—in areas such as acidization of petroleum wells, upstream engineering gelation kinetics, wax deposition in subssea pipelines, and asphaltene flocculation and deposition kinetics. Over the last 20 years, Fogler focused his research on problems in upstream research with particular focus on asphaltene and paraffin deposition. He also authored or co-authored 12 textbooks, including “Elements of Chemical Reaction Engineering” and “Essentials of Chemical Reaction Engineering.”

Fogler’s most notable service was to AIChE, where he served as President in 2009, and, among other achievements, created the long-running and much lauded Chem-E-Car Competition. He was a member of the renamed “Scott Fogler AIChE Chem-E-Car Competition” and, most importantly, a skilled and accomplished mentor—his career spanned all aspects of his field and eventually brought him to Vistia, where he lived since 2003. Wherever and whatever his job, he was an active member in a local church and Rotary; he was also on Tulare County’s Mental Health Board and member of the Suicide Prevention Foundation. He retired in 2019. All along, he enjoyed spending time with his family, helping others, traveling, and walking the family dogs.

Larry Anderson (MS ’73) passed away on Aug. 22, 2021, at the age of 59. He was born in Tuscola, Illinois, and received his BS in chemical engineering from the University of Illinois. He also served in the U.S. Army Corps of Engineers. He worked as a chemical engineer, devoting his career to designing and managing the construction of LNG terminals and chemical plants across the U.S. and internationally. He loved spending time with his family. His hobbies included golf and fishing. He served as the tournament chairman for the “Fun Times” bass club. He was a boat captain for the Marshall County High School bass club. He was a member of First Christian Church of Putschar where he served as an elder and chairman of the Ministry Table. He is survived by his wife of 59 years, Beatrice (Roe) Anderson.
REMEMBER WHEN...

Remember when department head Paul Kenis, the Eli Elixalim Tai Ka Endowed Chair, took polaroid photos at the beginning of the semester to help him memorize his students’ names? You may spot a few familiar faces here, including Alumni Award winner Laura Flessner with her now husband, Ryan.

Mass Transfer: Fall/Winter 2021

The Department of Chemical and Biomolecular Engineering at Illinois hosted many friends, alumni, and colleagues at a reception held at the 2021 Annual Meeting of the American Institute of Chemical Engineers in November. Thank you to all who helped us recognize two years of awards and recognition that have been bestowed upon our distinguished faculty members. We hope very much to see you at our reception next meeting in Phoenix. In the meantime, please keep in touch and send us your accomplishments to feature in our next issue of Mass Transfer. Let us know what you’ve been up to at chbe@illinois.edu.

Class Notes

Rommie Amaro (BS ’99), a professor and endowed chair at the University of California, San Diego, led a team of 50 scientists to create a fascinating atomic simulation of the coronavirus in an airborne droplet of water, as seen in the New York Times at https://nyti.ms/30fA909.

John L. Anderson (PhD ‘71) was among four transformative leaders named as 2021 Commencement honorees at Rensselaer Polytechnic Institute; the others included Dr. Anthony Fauci, Sir Paul Nurse, and the Honorable Ash Carter. Anderson has served as president of the National Academy of Engineering (NAE) since 2019.

Jacob Becraft (BS ‘13) was among MIT Technology Review’s 2021 list of Innovators Under 35. He is the founder and CEO of Strand Therapeutics, a company that’s figuring out other applications for mRNA beyond COVID-19 vaccines. (Becraft is an Alumni Award winner on page 5.)

Cory Berkland (MS ‘01, PhD ‘04), the Solon E. Summerfield Distinguished Professor at the University of Kansas, has co-founded Bond Biosciences, a biopharmaceutical company focused on the discovery and development of first-in-class non-absorbed oral therapeutics that bind excess ions locally in the gastrointestinal (GI) tract to treat or prevent human disease. The company has completed $5 million Series A financing to enable Phase 1b studies for lead candidate BBI-001 in patients with hereditary hemochromatosis.

Evan Lloyd (PhD ‘21) received the Arthur K. Doolittle Award from the Division of Polymeric Materials: Science and Engineering (PMSE), a division of the American Chemical Society (ACS). The award recognizes an outstanding talk presented during the PMSE symposium at the ACS National Meetings. Lloyd presented “Rapid, energy-efficient synthesis and recycling of degradable thermosets” at the Spring 2021 ACS meeting.

Jillian Ryan (BS ’12), an engineering manager at the Henkel Corporation, was named a STEP Ahead Award Honoree and Emerging Leader by the Manufacturing Institute. Now in its ninth year, STEP showcases trailblazing women who are changing the manufacturing landscape for the better.

“I enjoy solving complex problems to create a tangible benefit. Manufacturing is the perfect environment to do so. Every day I can see how my efforts make a positive impact such as improving our product, gaining efficiencies in our process, and making our operators’ experiences at work better.”

Jillian Ryan

Professor Huimin Zhao gathered with colleagues and graduate students past and present at AIChE.
Let's stay in touch.

Share your news or update your contact information at go.chbe.illinois.edu/AlumniUpdates or by filling out the attached form. Stay up-to-date on department news online!

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