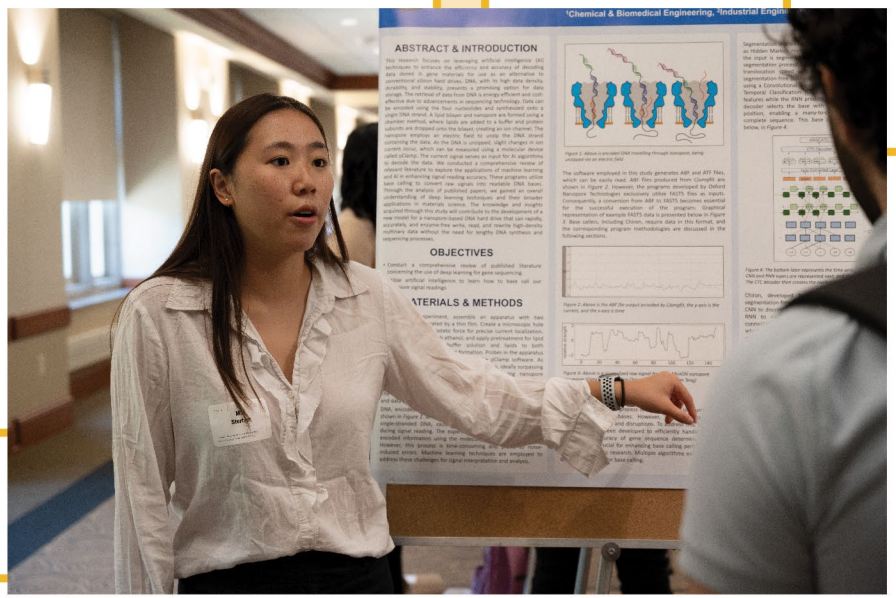
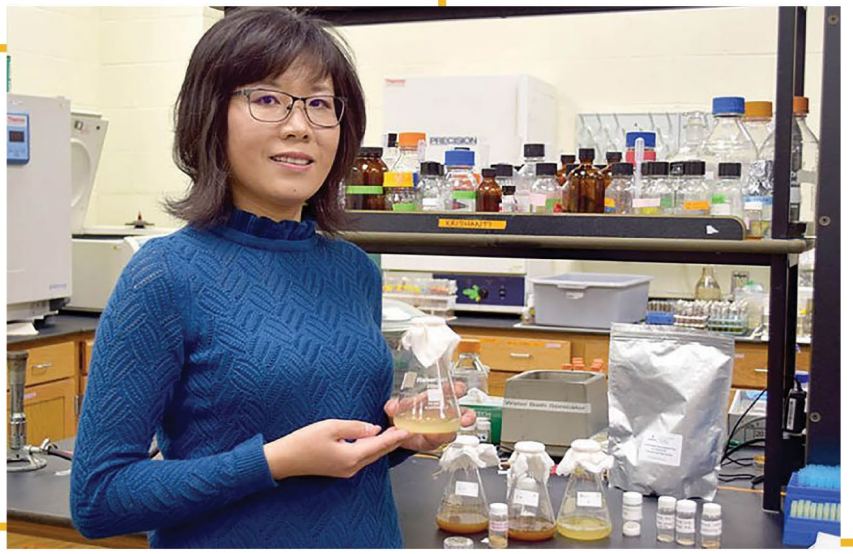
CHEMICAL & BIOMEDICAL ENGINEERING

College of Engineering
University of Missouri





MESSAGE FROM THE CHAIR

It's been an exciting year for the Department of Chemical and Biomedical Engineering at Mizzou!

This spring, we dedicated the Jost Chemical Company Chemical Engineering Unit Operations Laboratory, which ensures we have the right equipment for our students and faculty to continue to push boundaries, develop new techniques and technologies and discover new possibilities.

This past year, we also celebrated innovative research, faculty and student awards and outstanding alumni, which you can read more about in this report.

Thank you for your continued support of Chemical and Biomedical Engineering at the University of Missouri.

Kevin Gillis
Chair
Chemical & Biomedical Engineering

DEPARTMENT DEDICATES NEW LAB

The Department of Chemical and Biomedical Engineering in April dedicated a chemical engineering lab giving students and faculty access to leading-edge equipment.

The Jost Chemical Company Chemical Engineering Unit Operations Laboratory has become a centerpiece of the chemical engineering program, said Kevin Gillis, chair and professor.

Yangchuan "Chad" Xing, Cramer W. LaPierre Professor and associate chair, oversees the teaching lab, where students convert classroom lessons into hands-on experience.

Specifically, students are working on techniques such as distillation, gaining a better understanding of how parameters such as temperature, pressure and composition effect separation processes. They're studying membrane separation for advances in processes such as water desalination. They're working with catalytic reactors, learning to optimize reaction conditions for maximum efficiency. Students study chemical conversion, using equipment to convert organic wastes into valuable products such as fuel, chemicals and materials. And they are studying heat transfer processes, learning conduction, convection, radiation and how to optimize heat transfer rates for maximum efficiency.

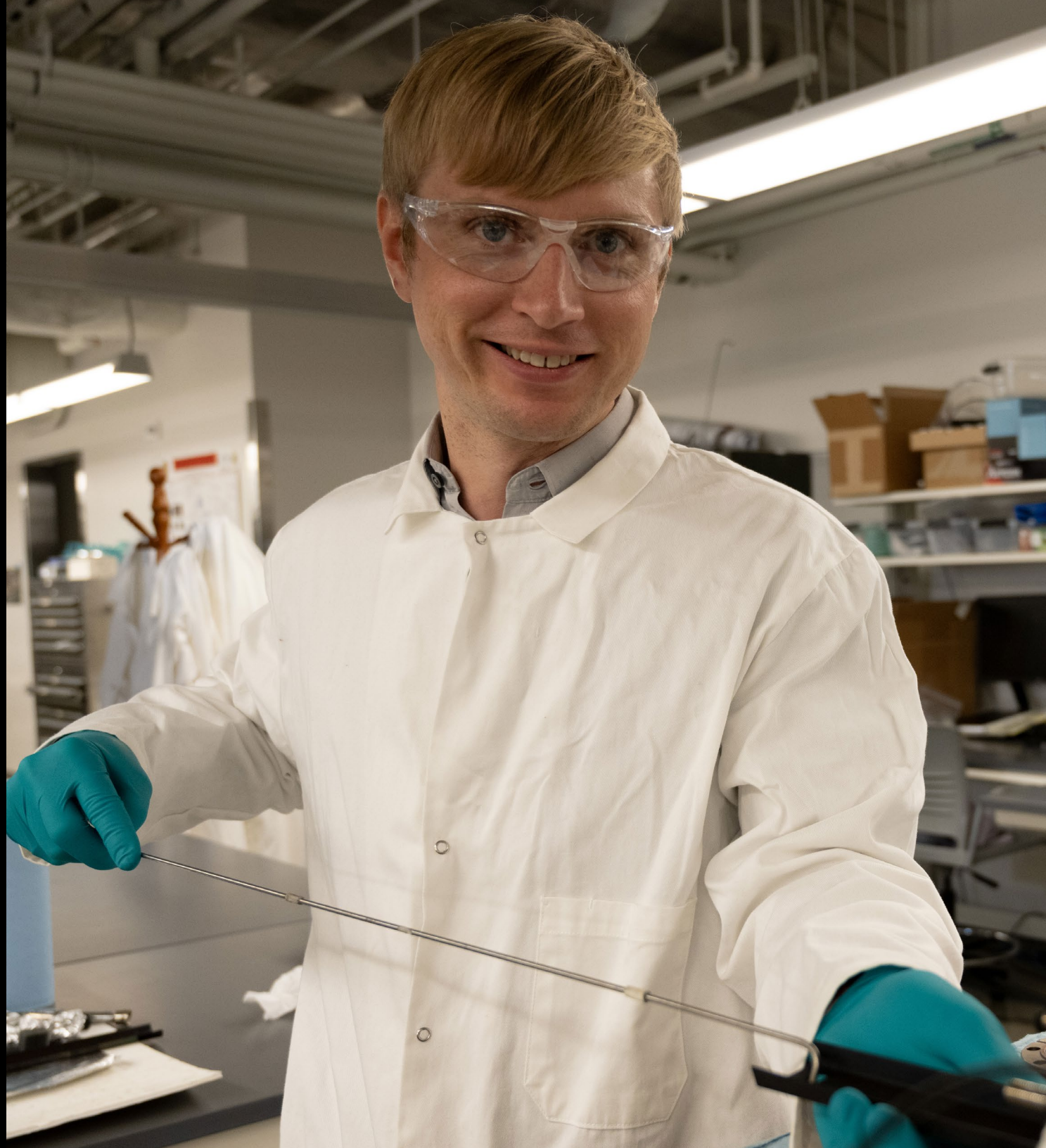
POLYMER EXPERT EARNS PRESTIGIOUS CAREER AWARD

Assistant Professor Matthias Young received a National Science Foundation (NSF) Faculty Early Career Development Program, or CAREER award.

The award allows him to continue to explore how to make polymers (plastics) that conduct electricity and can charge and discharge to make metal-free batteries. The polymers are made by linking small molecules or monomers together into long chains, but how they are usually made is random and messy and doesn't provide good control over how the molecules link together.

"My research group has been working over the last five years to grow our understanding and incubate impactful research ideas in the polymer science area, and this award is especially meaningful because it gives us encouragement that the polymer community values the ideas we have been working on," he said.

Young's research could help develop improved materials for applications such as water treatment, chemical sensors and battery technologies.



NOVEL BIOMARKERS TO TRACK SECRETION

A Mizzou research team is devising a new tool to find what happens at the molecular level during adrenaline rushes.

Department Chair Kevin Gillis is working with Professor Tim Glass from the Department of Chemistry on the research, which is funded with a grant from the National Science Foundation.

Specifically, they're developing a method to follow biological activity using fluorescent molecules. These specialized molecules are similar to green fluorescent proteins in that they serve as biomarkers, however they're advantageous in that they are smaller and less intrusive than proteins.

Glass, an organic chemist, makes the molecules in his lab. Gillis then uses them to study secretion from cells of adrenal glands.

WEARABLE TECHNOLOGIES

Associate Professor Zheng Yan and his team have created an ultrasoft, breathable material that can be used for on-skin, wearable bioelectronic devices capable of tracking vital signs such as blood pressure, heart activity and skin hydration.

"Our overall goal is to help improve the long-term biocompatibility and the long-lasting accuracy of wearable bioelectronics through the innovation of this fundamental porous material which has many novel properties," Yan said, noting that the material is made from a liquid-metal elastomer composite. "It is ultrasoft and ultra-stretchable, so when the device is worn on the human body, it will be mechanically imperceptible to the user."

Its integrated antibacterial and antiviral properties can also help prevent harmful pathogens from forming on the surface of the skin underneath the device during extended use.

The work builds on the team's existing proof of concept, as demonstrated by their previous work including a heart monitor currently under development. In the future, Yan hopes the biological data gathered by the device could be wirelessly transmitted to smartphone or similar electronics for future sharing with medical professionals.

PROVIDING GREATER ACCURACY FOR MEDICAL BIOSENSORS

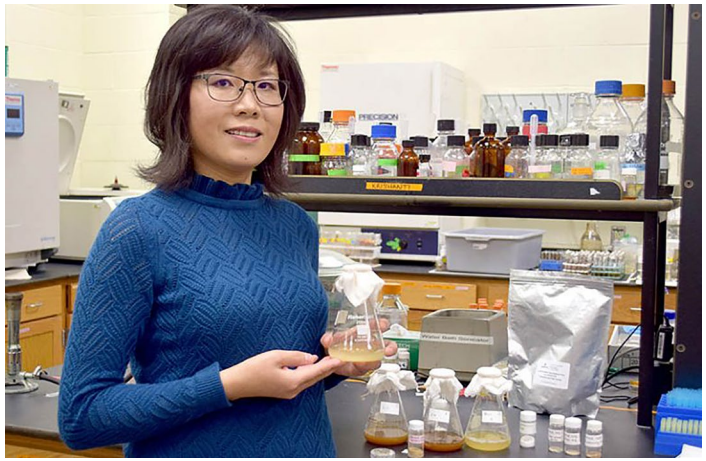
Professor Li-Qun "Andrew" Gu and a team of researchers have developed a new method using nanopores to help scientists advance their discoveries in neuroscience and other medical applications.

"Potential applications include studying the structures of DNA- and RNA-based diseases and disorders, such as COVID-19, HIV and certain types of cancers, to see how drug therapies work," said Gu, who is also an investigator in the Dalton Cardiovascular Research Center. "Or we could potentially discover new small-molecule drug compounds that can be used in future drug discoveries. Also, the tool could help in the development of sensors for neurotransmitters for studies in neurochemistry and neurodegenerative disease diagnostics."

The technique involves aptamers, or single strands of DNA or RNA molecules that selectively bind to a specific target. This allows researchers to know exactly what they are detecting with the nanopores and study how individual molecules are interacting with each other, said Department Chair Kevin Gillis, a co-corresponding author on the study.

"This approach contributes to a growing area of research called synthetic biology which is intended to reproduce the most important features in life by replicating the most basic biological functions in synthetic form," Gillis said. "This makes it one of the most powerful approaches to understand the basic principles of life."

TURNING FOOD WASTES INTO BIODEGRADABLE PLASTICS



Associate Professor Caixia “Ellen” Wan is helping researchers at Virginia Tech develop a process to convert food wastes into biodegradable plastics.

Wan is part of a team that received a $2.4 million grant from the U.S. Department of Agriculture (USDA) to upscale bioplastic production with the goal of replacing petroleum-based plastics while also keeping leftovers out of landfills.

The first-of-its kind project aims to solve two significant problems. Because bioplastics are made from plant and animal products that naturally degrade, they can replace traditional plastics that have harmful effects on the environment, especially marine life. On the other end, diverting food scraps from landfills can significantly reduce greenhouse gas emissions.

Wan will convert different categories of food wastes, such as vegetables, bread and meat, using microorganisms that can process various substrates into polyester biopolymers for plastic materials.

ENGINEERING A ZERO HUNGER WORLD

Assistant Professor Kiruba Krishnaswamy participated in the AAAS Emerging Researchers National Conference in Science, Technology, Engineering and Mathematics in January.

The event brought more than 2,000 undergraduate and graduate students from around the world together in Washington, D.C.

Krishnaswamy joined LaKisha Greenwade, founder and president of Wearable Tech Ventures, to lead a workshop about design thinking and innovation. Krishnaswamy specifically discussed multipronged approaches for a Zero Hunger World, one of 17 Sustainable Development Goals set forth by the United Nations.

The conference was hosted by the American Association for the Advancement of Science, Diversity, Equity and Inclusion Programs and the National Science Foundation Division of Human Resource Development.

ROGERS RECEIVES AICHE AWARD FOR EXCELLENCE IN CHEMICAL ENGINEERING TEACHING PRACTICE

Associate Professor Reginald Rogers received the inaugural Award for Excellence in Chemical Engineering Teaching Practice at the American Institute of Chemical Engineers Annual Meeting this fall. The award was presented for innovative, caring and supportive approaches to inclusive excellence in teaching and mentoring.

It's not the first time Rogers has been recognized for his commitment to students. In 2021, he was honored with The National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) Dr. Tyrone L. Mitchell Mentor on the Map Award.

"These awards mean a lot because they're a cumulation of everything I do, whether it's working with students in the classroom or in the research lab or office, where they come to see me when they need advice," said Rogers, who is also Director of Graduate Studies.

BORGELT NAMED MIZZOU ADVISOR OF THE YEAR

Associate Professor Emeritus Steve Borgelt was honored this past semester with the University of Missouri's Advisor of the Year Award for his more than decade of service as advisor of the Engineers' Club and St. Patrick's Board at Mizzou Engineering.

"I was surprised," he said. "It means a lot. It's hard to explain how much it means."

In his nomination, students praised him for his commitment to mentorship and stressed that he's been the cornerstone of Engineers' Week at Mizzou for the past 14 years.

E-Week began at Mizzou in 1903 when engineering students "discovered" St. Patrick was an engineer. Today, under Borgelt's guidance, students plan numerous activities throughout the week, including a lighting ceremony and lab exhibits.

"It's about tradition," he said. "But it also teaches students life skills and helps them become better professionals,"

AICHE STUDENT CONFERENCE SETS RECORD AT MIZZOU

Mizzou Chemical Engineering students broke a regional record and earned honors at the 2023 American Institute of Chemical Engineers (AIChE) Regional Student Conference.

The conference is an annual event that brings in top chemical engineering students from colleges and universities across the central United States for competitions, including the Chem-E-Car Competition® poster and oral presentation competitions, Chem-E Jeopardy competition, networking and special events. Mizzou hosted the event for the first time since 2009.

This year's conference attracted 281 students, faculty and industry representatives, setting an attendance record for the Mid-America Region. Mizzou Chemical Engineering senior Katrina Brathwaite placed third in the Student Poster Competition, and Mizzou's Chem-E-Car Team placed second in the Chem-E-Car Poster Competition.

KUEHNEL RECEIVES NSF GRADUATE RESEARCH FELLOWSHIP

Lucas Kuehnel, B.S. ChE ’23, received a 2023 National Science Foundation (NSF) Graduate Research Fellowship.

He used funding from the prestigious Fellowship to transition into a Ph.D. program at Mizzou, where he is conducting research under the mentorship of Professor Patrick Pinhero. The award covers three years of a graduate program, during which he’ll study terahertz energy using photonic crystals.

“Dr. Pinhero is doing a unique subset of research around terahertz energy harvesting,” he said. “There are few in the country who have worked so extensively in the area, and he’s one of them.”

MCDOUGAL NAMED GOLDWATER SCHOLAR

Emma McDougal was named a 2023 Goldwater Scholar. McDougal is a member of the Biomodulatory Materials Engineering Laboratory, led by Associate Professor Bret Ulery. Specifically, she is part of a project focused on targeted peptide delivery. The group is creating biomodulatory materials capable of therapeutically targeting the immune response to prevent or treat infectious diseases and cancer.

“What I love about research is that is allows me to take what I learn in the classroom and apply it to real-life problems,” she said. “Finding those connections between my classes and my projects is neat and very rewarding. It’s motivating, too.”

NSF REU FOCUSES ON MATERIALS SCIENCE

Students participating in a materials science-focused summer program spent nine weeks at Mizzou Engineering getting hands-on research experience.

It's part of a Research Experiences for Undergraduates Site funded by the National Science Foundation and co-led by Associate Professors Reginald Rogers and Matt Maschmann.

"My hope is to get students to see research as more than just standing in a lab," Rogers said. "It's developing an idea and using creativity to solve problems. I want to sow a seed and introduce them to research and industry opportunities so they can make well-informed decisions to do whatever is right for them after graduation."

The overall theme of the REU focused on materials, however that has broad-reaching, interdisciplinary applications. Students worked with cell cultures and biomaterials, carbon nanotubes and polymers. The REU also included weekly seminars focused on creativity, idea generation and collaboration. Rogers emphasized that working with materials requires creativity, which benefits from diverse experiences and backgrounds.

"Life experience generates new ideas," he said. "That's where creativity comes from. And then using that creativity to solve problems, and translating that into research."

JOST RECEIVES MISSOURI HONOR AWARD

Jerry L. Jost, B.S. ChE ’70, was recognized with a 2023 Missouri Honor Award for his contributions to the profession and to the College. The award is the highest honor bestowed by Mizzou Engineering.

“This award represents the cumulative benefit I have received from all of the great people I have learned from and worked with over my 50-plus year career,” he said. “I thank the College of Engineering as well as all those whose shoulders I have stood on.”

Jost is the Founder and President of Jost Chemical Company, a manufacturer of high purity chemicals used in pharmaceuticals, nutritional food and other specialty markets around the world. He started the business in 1985 after several years in industry.

Jost has served on the Chemical Engineering Industrial Advisory Board for more than a decade and in 2021 established the Jerry L. Jost Endowed Chair in Chemical Engineering.

FIVE INDUCTED INTO CHEMICAL ENGINEERING ACADEMY OF DISTINGUISHED ALUMNI

Five alumni were inducted into the Chemical Engineering Academy of Distinguished Alumni in October.

Now in its 10th year, the Academy recognizes the program's most prominent alumni and friends.

"Members of this esteemed alumni academy exemplify the best in engineering, philanthropy and service," said Kevin Gillis, chair of the Department of Chemical and Biomedical Engineering. "They motivate and inspire students, partnering with the department and college to help future generations of chemical engineers."

The 2023 inductees are:

- **Teresa Crockett**, B.S. ChE '91, M.S. '92, Senior Vice President, Separation Management Office, 3M
- **Baolin Deng**, William Andrew Davidson Professor of Civil and Environmental Engineering and founder of the Chemical Engineering Academy at Mizzou Engineering
- **Kerri Crain Hailey**, B.S. ChE, Math '96, Vice President of Baby Care Research and Development, Procter & Gamble
- **Jeremy Lowe**, B.S. ChE '96, First-Chair Trial Lawyer, Shareholder, Leydig, Voit & Mayer, Ltd.
- **Chris Roach**, B.S., ChE '93, CEO, Monarch, President of Renewables Division of Roeslein & Associates

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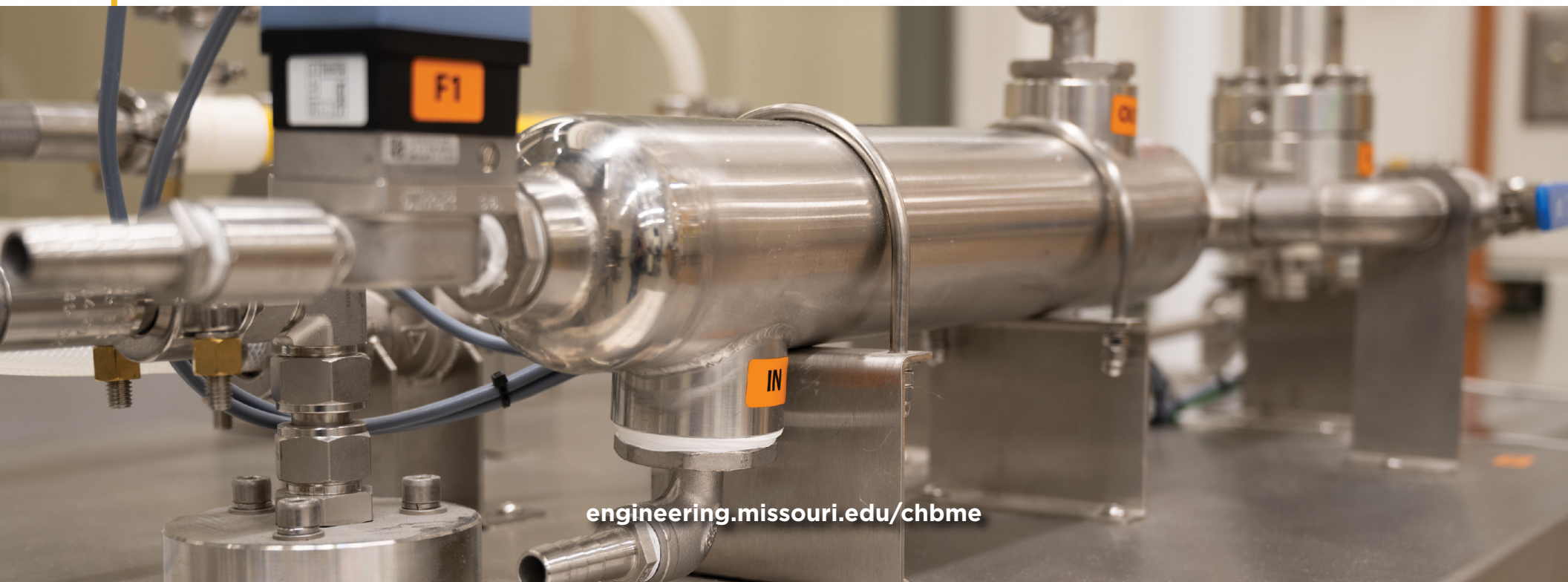

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