Chemical and Biomolecular Engineering
Newsletter SPRING 2025

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WHAT'S NEXT.

Cullen College of Engineering
UNIVERSITY OF **HOUSTON**

THREE CULLEN PROFESSORS NAMED SENIOR MEMBERS OF THE NATIONAL ACADEMY OF INVENTORS

Cullen College of Engineering professors **Birol Dindoruk, Megan Robertson and Francisco Robles Hernandez** have joined the prestigious list of Senior Members of the National Academy of Inventors.

The University of Houston now has 39 faculty members in the NAI.

"We congratulate these three esteemed colleagues on being named NAI Senior Members," said **Ramanan Krishnamoorti**, vice president for energy and innovation at UH. "This recognition is a testament to their dedication, research excellence and pursuit of real-world impact by knowledge and technologies. Their achievements continue to elevate the University as a leader in innovation and entrepreneurship."

NAI Senior Members are active faculty, scientists and administrators from NAI member institutions who have demonstrated remarkable innovation producing technologies that have brought, or aspire to bring, real impact on the welfare of society. They also have growing success in patents, licensing and commercialization, while educating and mentoring the next generation of inventors.

Robertson, the Neal R. Amundson professor of chemical and biomolecular engineering at UH's Cullen College of Engineering, is developing new polymers and groundbreaking strategies for how we can recycle and reuse plastics. She currently has three patents and two more patent applications under consideration.

Francisco C Robles Hernández, *Professor Mechanical Engineering Technology*
Birol Dindoruk, *American Association of Drilling Engineers Endowed Professor of Petroleum Engineering & Chemical and Biomolecular Engineering*
Megan Robertson, *Neal R. Amundson Professor, Associate Chair for Faculty Development, Director, Materials Engineering Program*

CHBE'S RIMER ELECTED AICHE FELLOW

Abraham E. Dukler Endowed Professor of Chemical Engineering **Jeffrey Rimer** has been elected as a Fellow of the American Institute of Chemical Engineers (AIChE), a recognition that affirms the "high esteem with which his colleagues and peers view his distinctive professional achievements and accomplishments" according to AIChE Interim CEO & Executive Director Victor Bohnert.

To be nominated for Fellow, a candidate must have at least 10 years of AIChE membership and a substantial amount of experience in chemical engineering (typically 25 years or more), during which they have shown significant service to the profession. Rimer became involved with AIChE when he entered graduate school, taking up membership and attending annual meetings each fall.

"I've been attending for nearly 20 years now, and I've held various roles throughout the organization: being director for one of the divisions, chairing various sessions, and being a part of the editorial advisory board for their flagship journal, AIChE Journal, for a number of years," Rimer said. He described AIChE as a "focal point" for the field and profession. "AIChE annual meetings are an opportunity to network and are a great place for students to get their first experiences giving talks and poster presentations. They hold a number of different functions for the community and play a big role in keeping everyone connected not just scientifically, but socially."

Rimer's research focuses on crystal engineering with two distinct applications, which he says are linked "by trying to understand, at a fundamental level, how crystals grow and how these processes can be manipulated."

One of his areas of research is catalysis. "We design different catalysts — an example being zeolites — and identify methods to optimize their performance in commercially-relevant reactions. One of our areas of expertise is synthesis and understanding mechanisms of crystallization. Relatively few people focus on investigating aspects of zeolite nucleation and growth, which we do as part of a broader effort to create state-of-the-art materials for catalytic applications."

The other aspect of Rimer's research is "very different", concerning crystals that are implicated in human diseases.

Jeffrey Rimer
Abraham E. Dukler Professor, Director of Graduate Studies

CHBE'S WILLSON ELECTED FELLOW OF THE ROYAL SOCIETY OF CHEMISTRY

The man who turned the science of glow-in-the-dark stars into ways to detect disease, University of Houston Huffington-Woestemeyer Professor of Chemical and Biomolecular Engineering **Richard Willson**, has been elected as a fellow of the Royal Society of Chemistry, a significant honor recognizing individuals who have made substantial contributions to the chemical sciences.

Since 1841 when 77 scientists — including doctors, academics, manufacturers and entrepreneurs — formed the Chemical Society of London, with dialysis inventor Thomas Graham as their first President, the Royal Society of Chemistry has maintained its mission to advance excellence in the chemical sciences. Today the society has evolved in ways the founders likely never envisioned, with 54,000 members across the world, an internationally renowned not-for-profit publishing business and a reputation as an influential champion for the chemical sciences.

Throughout his career, Willson has developed innovative methods to purify, detect and measure substances, improving medicine production, optimizing industrial processes and advancing medical testing. And he's done it all through creative approaches rarely used by other scientists, using materials found in everyday items like reflective vests and glow sticks to develop techniques to detect viruses and other biological threats.

Richard Wilson
Professor, Department of Biology and Biochemistry

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CHBE'S ZERZE EARNS NSF CAREER AWARD TO STUDY DYNAMICS OF LIQUID-LIKE MACROMOLECULAR CONDENSED PHASES

William A. Brookshire Department of Chemical and Biomolecular Engineering assistant professor **Gül Zerze**, Ph.D., has earned a National Science Foundation (NSF) CAREER award for $500,000 for her proposal, "Unveiling the Dynamics of Liquid-like Macromolecular Condensed Phases from Nucleation to Stability."

The three states of matter are largely conceived of as separate entities, but the behaviors and boundaries between these concepts are perhaps more fluid than many might first think. Zerze's research concerns liquid solutions containing polymers, or macromolecules, and is "100 percent computational."

"I still remember, as a kid, how excited I was when I first got to see how tiny particles wiggle and jiggle. You can only see it under a microscope, but that wiggling and jiggling behavior leads to the collective behavior of matter," Zerze said.

"[Polymer solutions] are liquids, but not a pure substance like water or ethanol. These liquids — mixtures of these polymers — sometimes split into two distinct liquid phases. One would be what we call the dilute phase, which would be rich in solvent (typically water); the other would be the dense phase, which is richer in polymer but retains liquid-like properties," she said. "What I am studying in this project is the nucleation of these liquid condensed phases from solutions of macromolecules; the formation of macromolecular liquid condensed phases and how they nucleate."

Deepening our understanding of these behaviors paves the way for researchers "to control the formation of those liquid condensates" in specific applications.

Some of these innovations include nutrient encapsulation in the food industry, agricultural formulations, self-healing construction materials, and electrorheological fluids for the automotive and aerospace industries. Intracellular condensates also have implications in human disease processes. Things may occur as expected in healthy cells, but procedural errors or changes in concentration can have clinically significant impacts on the body that lead to disease.

Gül Zerze
Assistant Professor, Cancer Prevention and Research Institute of Texas Scholar

CHBE'S BOLLINI RECEIVES ISCRE 2025 RUTHERFORD ARIS AWARD TO RECOGNIZE EARLY CAREER SUCCESSES

William A. Brookshire Department of Chemical and Biomolecular Engineering Associate Professor **Praveen Bollini** has been named as the recipient of the 2025 Rutherford Aris Award of the International Symposia on Chemical Reaction Engineering (ISCRE).

This award recognizes outstanding contributions in experimental and theoretical reaction engineering research of investigators in the early stages of their career.

The award is supported by Honeywell UOP and is presented every three years at a North American ISCRE (NASCRE) meeting. It consists of a plaque, an honorarium of $3,000, and up to $2,000 in travel funds to present a lecture at the conference.

Bollini was surprised to learn of his recognition with this award.

"Looking at the list of past awardees, the winners have all been from very prestigious institutions, including MIT, Purdue, and the University of Minnesota, which has a very storied department of chemical engineering. So, I was pleasantly surprised and humbled to receive for this award," he said.

He continued, "I was reminded of the journey of learning and creating knowledge that started under the guidance of my graduate and postdoctoral mentors and continues at UH with my students and UH colleagues. My students helped me build my research lab at UH, and together we have overcome many obstacles along this path."

Bollini's research focuses on improving the ways we currently use and convert hydrocarbons pulled out from the earth into more useful products, and for capturing and converting CO_2 from the air to value-added chemicals.

Bollini cited his "fascination and obsession with molecules" and how they behave at a small scale in nanoporous materials as a primary factor in his decision to pursue this research.

Praveen Bollini
Associate Professor

RESEARCH ADVANCEMENTS

THE UNIVERSITY OF HOUSTON TEAM

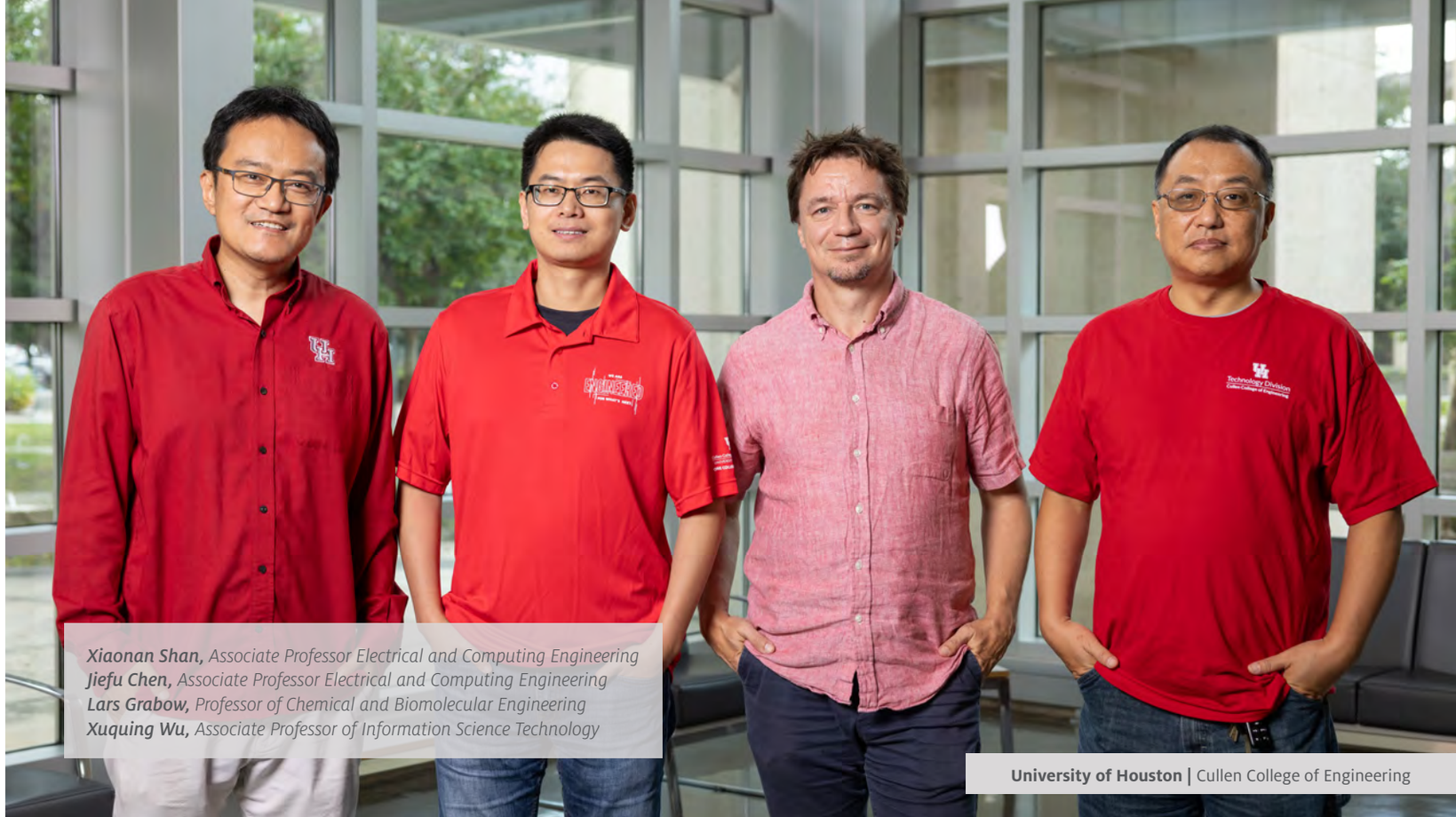
BOOSTING CLEAN ENERGY WITH AI-POWERED CATALYSTS AND MICROWAVE PLASMA TECHNOLOGIES

As the world races to combat environmental degradation and climate challenges, transitioning to renewable energy has become a top priority. However, the inconsistent nature of wind, solar and other renewable sources poses a significant challenge to maintaining a stable energy supply, which has slowed the transition.

An interdisciplinary team of scientists is collaborating to find a workable solution by harnessing the power of artificial intelligence and microwave plasma, and blending knowledge from chemistry, materials science and engineering.

The National Science Foundation awarded a $1 million grant to this project, titled "Multidisciplinary High-Performance Computing and Artificial Intelligence Enabled Catalyst Design for Micro-Plasma Technologies in Clean Energy Transition."

This project aims to leverage machine learning for catalyst discovery and develop new characterization methods for studying chemical reactions under extreme conditions such as plasma, one of the four states of matter, which is an ionized state consisting of positively charged ions and negatively charged electrons. The goal is to improve the efficiency of catalysts in hydrogen generation, carbon capture and energy storage.



Xiaonan Shan, *Associate Professor Electrical and Computing Engineering*
Jiefu Chen, *Associate Professor Electrical and Computing Engineering*
Lars Grabow, *Professor of Chemical and Biomolecular Engineering*
Xuquing Wu, *Associate Professor of Information Science Technology*

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CHBE FACULTY SEEK TO SUPPORT TALENTED LOW-INCOME STUDENTS, BUILD INTERCOLLEGIATE CONSORTIUM WITH NSF GRANT

Two faculty from the William A. Brookshire Department of Chemical and Biomolecular Engineering — assistant professor **Jerrod A. Henderson**, Ph.D., and lecturer **Hasan Zerze**, Ph.D. — have been awarded a share of a $100,000 planning grant from the National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics program (S-STEM). The collaborative project, "Building a Chemical Engineering Inter-Institutional Consortium to Support Talented, Low-income Students," runs through 2025 and will also involve the University of Kentucky and Prairie View A&M University.

S-STEM "supports institutions of higher education to fund scholarships for academically talented low-income students and to study and implement a program of activities that support their recruitment, retention and graduation in STEM" to "enable low-income students with academic ability, talent or potential to pursue successful careers in promising STEM fields."

"Our aim is to build a consortium among the University of Houston, Prairie View A&M, and the University of Kentucky in an effort to support engineering students who face financial barriers and challenges pertaining to engineering identity development," said Zerze. "Our aim to mitigate the impact of financial stress on students' academic success and overall well-being is driven by the recognition that financial difficulties can significantly hinder educational outcomes.

"Data shows that financial stress is closely linked to decreased academic performance and mental health challenges. By addressing these issues, the consortium can play a pivotal role in empowering academically promising students who might otherwise be discouraged by financial burden."

Henderson connected with University of Kentucky PI Sarah Wilson, Ph.D., and Prairie View A&M PI Keisha Antoine, Ph.D., at the American Institute of Chemical Engineers' Chemical Engineering Faculty Summer School held at the Colorado School of Mines in 2022. Henderson describes the chemical engineering community as "tight-knit", connected by "strong support for student success, belonging, and wellness."

Jerrod A. Henderson
Assistant Professor

Hasan Zerze
Lecturer

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CHBE'S BHOWMICK AWARDED BY INTERNATIONAL RUBBER CONFERENCE ORGANISATION

Research professor **Anil K. Bhowmick**, Ph.D., in the William A. Brookshire Department of Chemical and Biomolecular Engineering has been awarded the International Rubber Conference Organisation's (IRCO) Gold Medal for his contributions to research, education, and industry in the field of rubber science and engineering.

"This is the overall recognition for my lifetime work. I have been working in the area of elastomers for the last 40 years, and this is a recognition of that, but I am especially honored because I am from an academic institute – a university – and generally this award is given to people working in the industry. So I feel great about this. I'm glad that my work [as an academic] is useful to the industry and has been recognized," said Bhowmick, who currently holds 23 relevant patents.

"Many of my ideas, mostly published in the form of papers and publications in international journals, are used extensively in the industry," he added.

First awarded in 1994, the IRCO notes that the medal should recognize "a personality of exceptional merit in the rubber community" and "have made distinguished contributions to IRCO conferences as an organizer, as chairman of conferences or symposia or as a presenter." Bhowmick is the fifth US-based recipient to be recognized with the award since its inception.

Anil K. Bhowmick
Research Professor, Rubber Science and Technology

AI DRIVES DEVELOPMENT OF CANCER FIGHTING SOFTWARE $2.5 MILLION FAST-TRACK GRANT TO DEVELOP ANALYSIS OF SINGLE CELLS

University of Houston researchers and their students are developing a new software technology, based on artificial intelligence, for advancing cell-based immunotherapy to treat cancer and other diseases.

CellChorus Inc., a spin off from the University of Houston, is commercializing the UH-developed Time-lapse Imaging Microscopy In Nanowell Grids™ platform for dynamic single-cell analysis with label-free analysis. Now they've received a $2.5 million grant from the National Center for Advancing Translational Sciences of the National Institutes of Health to fast-track the development of an advanced "label-free" version of this technology in partnership with the University of Houston.

Badri Roysam, Hugh Roy and Lillie Cranz Cullen University Professor of Electrical and Computer Engineering at the University of Houston, is collaborating with **Navin Varadarajan** on the project. Varadarajan is an M.D. Anderson Professor, Chemical and Biomolecular Engineering also at UH and co-founder of CellChorus.

"This is an opportunity to leverage artificial intelligence methods for advancing the life sciences," Roysam said. "We are especially excited about its applications to advancing cell-based immunotherapy to treat cancer and other diseases."

TIMING™ is a specialized tool for studying single cells over time. Because it is a video-array-based technology, it observes cell interactions and produces tens of thousands of videos. Analyzing these massive video arrays requires automated computer vision systems.

"By combining AI, microscale manufacturing, and advanced microscopy, the label-free TIMING platform will yield deep insight into cellular behaviors that directly impact human disease and new classes of therapeutics," said Rebecca Berdeaux, chief scientific officer at CellChorus and co-Principal Investigator on the grant. "The generous support of NCATS enables our development of computational tools that will ultimately integrate single-cell dynamic functional analysis of cell behavior with intracellular signaling events.

Badri Roysam
Hugh Roy and Lillie Cranz Cullen University Professor

Navin Varadarajan
M.D. Anderson Professor

CHBE'S HENDERSON EARNS TEACHING AWARD FROM EDIIE

Jerrod A. Henderson, Ph.D., Assistant Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, is the 2024 winner of the Inclusive Excellence in Teaching Award from Excellence in Diversity & Inclusion in International Education (EDIIE).

EDIIE is part of Diversity Abroad, an organization focused on international education toward inclusive excellence. Diversity Abroad describes itself as the first organization solely dedicated to advancing diversity and inclusion practices and policies in international education, with work that aligns to and advances higher education's inclusive excellence and comprehensive internationalization goals.

Henderson received the award during the Global Inclusion 2024, Diversity Abroad's 12th annual conference, which was held in late October in Washington, D.C.

"I am honored to be recognized for doing what I love – teaching and providing diverse experiences to diverse learners in diverse parts of the world," he said. "This award will further illustrate the importance of understanding engineering on a global scale and approaching the world with global competence and humility."

Since 2019, Henderson has developed programs in non-traditional locations such as Salvador in Brazil (2019 and 2024), Colombia (2023) and Ghana (2022), where people of color are solving the world's most challenging problems, such as providing access to clean water, improving medicines and the just energy transition.

Henderson added, "I am also grateful to have been nominated for this award by my institution's director of global engagement, Maggie Mahoney. Her support has been invaluable in advancing internationalization efforts on our campus and beyond."

He also thanks every collaborator, including Rick Greer, Vincent Carales, David Horton, Jr., Le Shorn Benjamin, Chrisdolyn Dawson and Minerva Carter. Each one has supported the execution of these learning abroad experiences and the 47 students who have participated in these learning abroad experiences since 2019.

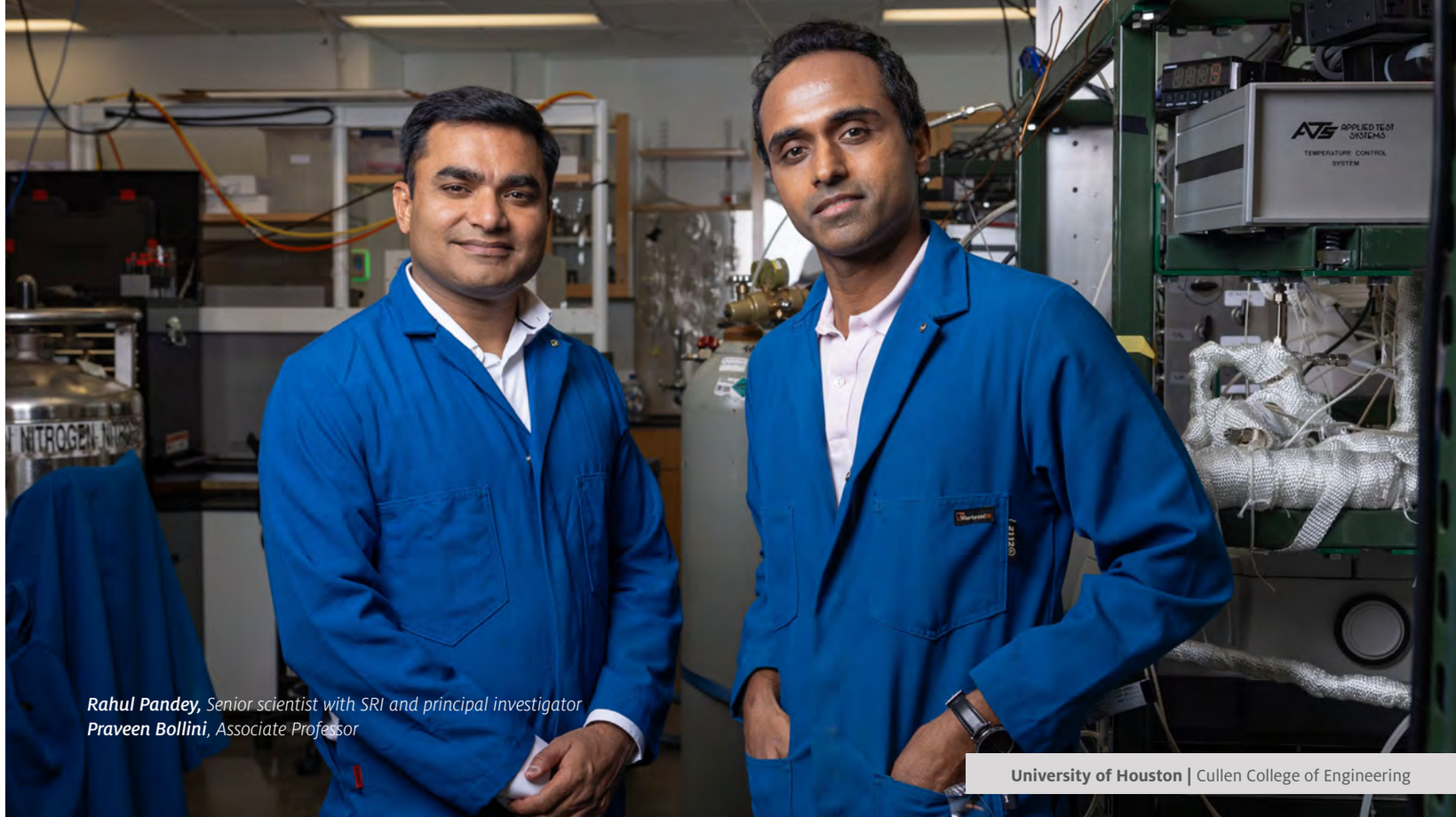
Jerrod A. Henderson
Assistant Professor

CULLEN PROFESSORS, ALUM REVOLUTIONIZING TECH TO PRODUCE SUSTAINABLE FUEL

A University of Houston-affiliated project that has the potential to transform sustainable fuel production was selected to receive $3.6 million from the U.S. Department of Energy's Advanced Research Projects Agency-Energy.

Led by leading nonprofit research institute SRI, "Printed Microreactor for Renewable Energy Enabled Fuel Production" (PRIME-Fuel) aims to develop a modular microreactor technology that converts carbon dioxide into methanol using renewable energy sources. UH, a Carnegie-designated Tier One public research institution, is contributing essential research needed for the project.

This is part of ARPA-E's $41 million Grid-free Renewable Energy Enabling New Ways to Economical Liquids and Long-term Storage program, otherwise known as the GREENWELLS program, which includes 14 projects to develop technologies that use renewable energy sources like wind and solar to produce sustainable liquid fuels or chemicals, which can be transported and stored similarly to gasoline or oil. Selected teams will develop systems that use electricity, carbon dioxide and water at renewable energy sites to produce renewable liquid renewable fuels that offer a clean alternative for sectors like transportation.



Rahul Pandey, *Senior scientist with SRI and principal investigator*
Praveen Bollini*, Associate Professor*

CULLEN COLLEGE

The University of Houston
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The University of Houston Cullen College of Engineering addresses key challenges in energy, healthcare, infrastructure, and the environment by conducting cutting-edge research and graduating hundreds of world class engineers each year. With research expenditures topping $40 million and increasing each year, we continue to follow our tradition of excellence in spearheading research that has a real, direct impact in the Houston region and beyond.

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