



William A. Brookshire
Department of Chemical
and Biomolecular Engineering
Cullen College of Engineering

TRANSPORT CHEMICAL & BIOMOLECULAR ENGINEERING

The background of the slide features a laboratory setting with various pieces of glassware. On the right, a large Erlenmeyer flask is tilted, with a purple liquid being poured from it. A graduated cylinder is positioned above the flask, with a single drop of purple liquid falling into it. In the foreground, there is a beaker containing a clear liquid and a glass rod. The entire scene is overlaid with a semi-transparent red and blue gradient, and the text is centered over this background.

OPENING DOORS TO SMARTER DEVICES AND SAFER DRUGS, CHBE'S RIMER CONTROLS CRYSTAL FORMATION

Bending and Twisting Crystals at The Welch Center for Advanced Bioactive Materials Crystallization

From creating flexible gadgets to better medicines, the art of bending crystals is reshaping technology and health, and at the University of Houston a crystals expert makes it look almost like a magic trick.

Jeffrey Rimer, Abraham E. Dukler Professor of Chemical Energy, has shown how to bend and twist crystals without physical force — no touching, poking or prodding and no heat or radiation, conditions typically required to achieve reshaping.

Instead, he is using a molecule called a tautomer, which is doing all the work, inducing bending and twisting of biogenic crystals.

In the world of crystals, tautomers are shifty characters — molecules with the ability to shift their atoms around. All at once a hydrogen atom might be in one place, then hop to another, while other atoms slip around.

One of the pharmaceutical applications where this will be of potential importance is in drug delivery, where approximately 30 of the top 200 drugs are tautomers.

“Here, we present a unique case of natural bending without the application of external forces,” reports Rimer in the journal PNAS. ⚙️



Jeffrey Rimer

Abraham E. Dukler Professor, Director of Graduate Studies

KARIM ASSISTS IN DESIGNING ROBOTIC HANDS FOR USE IN HEALTH, AGRICULTURE, MANUFACTURING

Dexterous Robots Move from Labs to Industry with NSF Support

In the rapidly evolving robotics industry, today's robots that might appear humanlike and dexterous still can't do what people do, lacking the ability to perform fine manipulation tasks required in factories, homes, hospitals and farms. And with labor shortages expected to jeopardize more than \$450 billion of the U.S. GDP by 2028, improving automation seems an intelligent solution.

In addition, advanced robotic hands and upper limb prosthetics are urgently needed to improve the quality of life for over 400,000 Americans living with upper limb loss and for more than 20 million people struggle with daily activities due to limited mobility. Yet they face the highest rates of abandonment of any assistive device.

That's where Altus Dexterity comes in. It's a collaborative team of researchers from Carnegie Mellon University, the University of Illinois Urbana-Champaign and the University of Houston, creating skill-augmented hands, drawing from years of study on how people use their hands, to bridge

this gap and bring functional dexterity to real-world applications. Altus Dexterity is part of the 2023 cohort of the NSF Bio-Inspired Design Innovations track, part of the Directorate for Technology, Innovation and Partnerships and aligned to the National Science Foundation Convergence Accelerator program.

The NSF is now providing additional support to Altus Dexterity, up to \$5 million to continue working on its robotic hand designs and test its products in real-world pilot projects.

"Our solution is a bio-inspired robotic hand that combines softness with strength, and all over sensing with dexterity," said Nancy Pollard, a member of Altus Dexterity and a professor in the Robotics Institute and Computer Science Department at CMU. Pollard is leading the effort.

The robotic hand has a rigid skeleton inside with elastic material covering it. There are 12 electrodes in each finger to sense any contact force within this skin. ⚙️

Alamgir Karim

Dow Chair and Welch Foundation Professor

Director, International Polymer & Soft Matter Center (IPSMC)



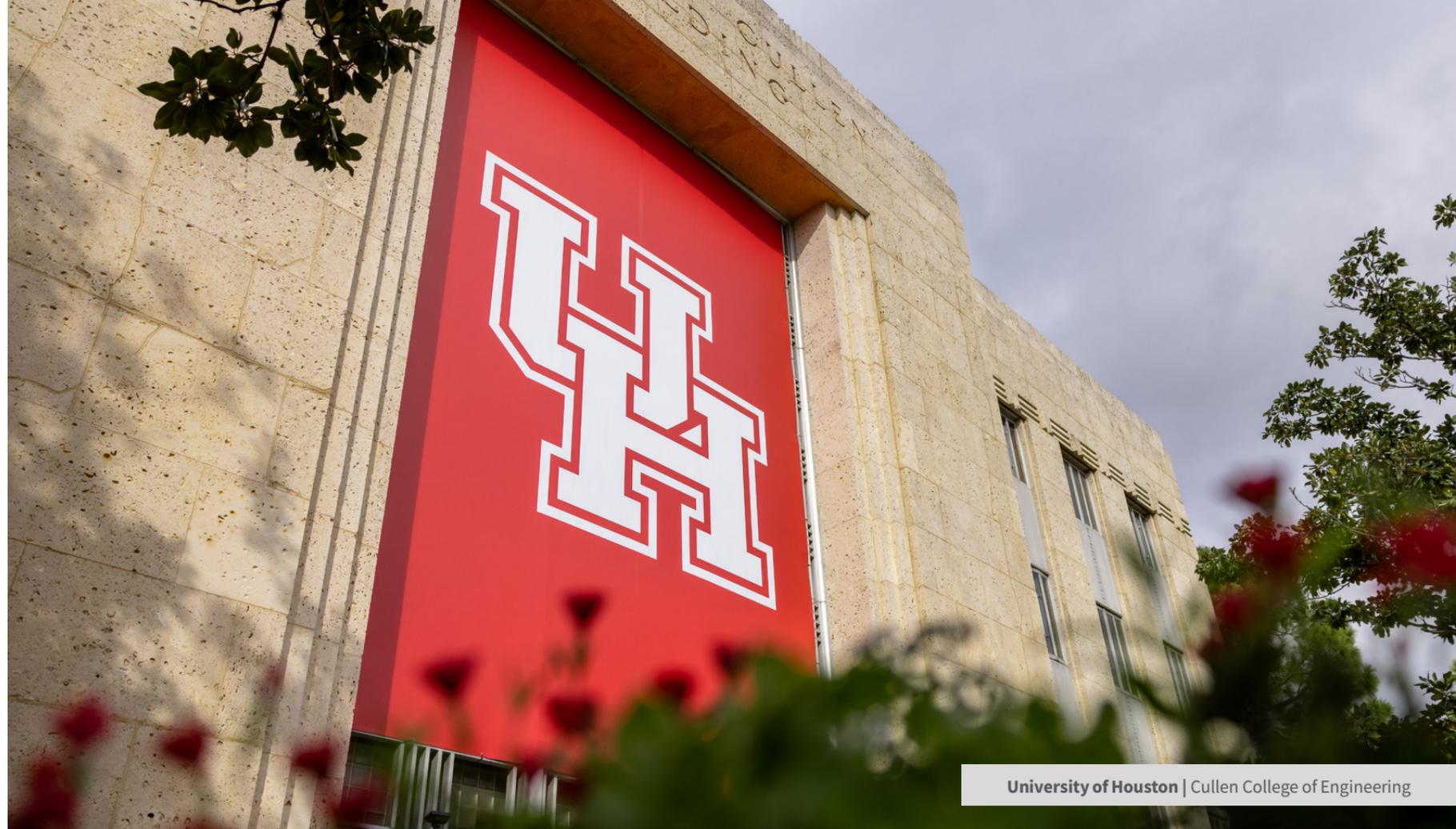
HENDERSON'S \$1.2M ENGINEERING EDUCATOR TRAINING PROGRAM WELCOMES CO-PIS AND 3 NEW POSTDOCS

“Authentic Community-Engaged Scholarship in STEM Education Postdoc Training Program,” a project led by principal investigator and William A. Brookshire Department of Chemical and Biomolecular Engineering assistant professor **Jerrod A. Henderson** along with three UH Co-PIs and funded by the National Science Foundation with a grant of \$1,227,108, has onboarded three elite postdoctoral researchers in pursuit of producing highly-skilled, community-engaged engineering educators to benefit the Houston area and beyond.

“I’m so excited for this work,” said Henderson.

The program will support “the development of three independent STEM education researchers equipped with distinctive skills in building community-engaged research-practice partnerships and leading community-embedded research.”

“Our partnerships with schools, community organizations, and informal learning spaces will expand access to engineering pathways, particularly for the communities surrounding the University of Houston (e.g., Third and Second Wards), and educators impacted by our research and practice will gain tools to implement student-centered, research-based practices, directly improving classroom experiences for thousands of students,” he said. ⚙️



CONRAD AND PALMER RECEIVE \$250,000 FOR POLYELECTROLYTE BRUSH INVESTIGATION

Frank M Tiller Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering **Jacinta Conrad**, PI, has received \$259,749 in NSF funding for her proposal, Collaborative Research: Effect of Polymer Chemistry on Penetrant Transport in Weak Polyelectrolyte Brushes, with Co-PI and Ernest J and Barbara M Henley Professor **Jeremy Palmer**. This project is a collaboration with Rice University's Amanda Marciel, who received a further \$290,251 for her part of the project.

They're interested in studying what are called polymer brushes: polymer chains, or long repeating units tethered to one end of a surface, which can modify the properties of a given surface. For example, these chains might make a surface softer or change its charge. Conrad and Palmer are particularly interested in brushes whose properties change in response to environmental conditions.

Many applications in filtration and membrane separation involve surfaces through which fluids, ions, or small particles must be able to move. Better understanding how these changes in surface properties change the way that

penetrants are able to transport is a large and open-ended goal, but that's not unexpected for Conrad's group. Rather than centering direct applications, they often focus on projects that allow them to investigate precisely this type of broad, fundamental question.

"In this proposal, what we're specifically looking at is how much hydrophobicity matters," said Conrad. "We'll change the hydrophobicity of the monomers that make up the polymers in the brushes. Many of the desirable properties of charged polymer brushes are thought to arise from how they interact with water — and, particularly, how much they like it — but how hydrophobicity affects brush conformation and response remains incompletely understood."

"Prior work in this area has shown that there are fundamental knowledge gaps regarding how polymer chemistry influences chain conformations in polymer brushes under various environmental conditions," Palmer said. "Our group's contribution will be to perform complementary computational modeling of these systems to help predict how polymer chemistry influences the stimuli-response behavior of brushes." ⚙️



Jacinta Conrad
Frank M Tiller Professor



Jeremy Palmer
Ernest J and Barbara M Henley Professor

LED BY CHBE'S KARIM, CULLEN ENGINEERS MAKING AI FASTER, REDUCING POWER CONSUMPTION

Team Invents New Thin Film Materials Based on Nobel Prize Winning Methods

Addressing the staggering power and energy demands of artificial intelligence, engineers at the University of Houston have developed a revolutionary new thin-film material that promises to make AI devices significantly faster while dramatically cutting energy consumption.

The breakthrough, detailed in the journal ACS Nano, introduces a specialized two-dimensional (2D) thin film dielectric — or an electric insulator — designed to replace traditional, heat generating components in integrated circuit chips. This new thin film material, which does not store electricity, will help reduce the significant energy cost and heat produced by the high-performance computing necessary for AI.

“AI has made our energy needs explode,” said **Alamgir Karim**, Dow Chair and Welch Foundation Professor at the William A. Brookshire Department of Chemical and

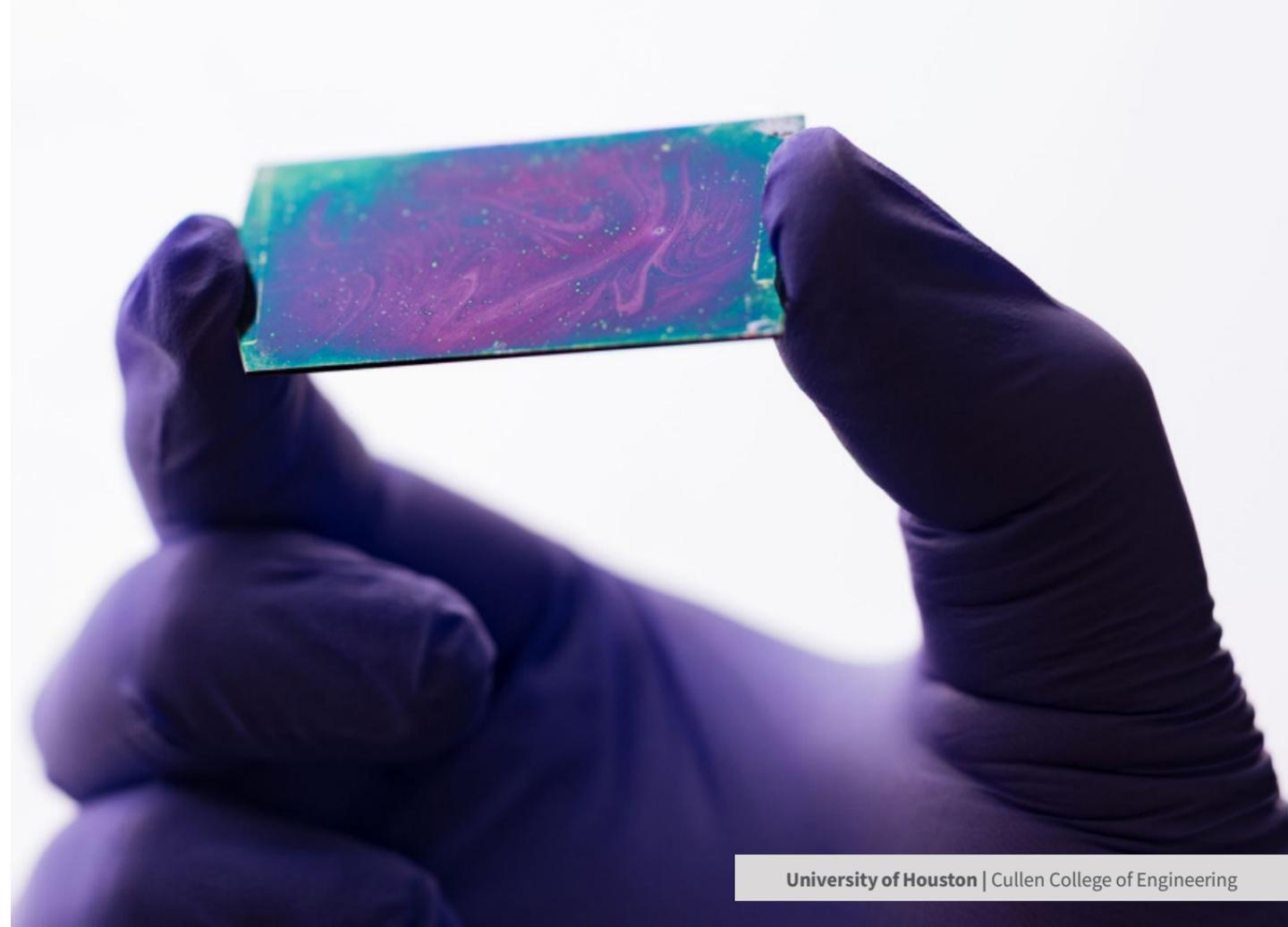
Biomolecular Engineering at UH.

“Many AI data centers employ vast cooling systems that consume large amounts of electricity to keep the thousands of servers with integrated circuit chips running optimally at low temperatures to maintain high data processing speed, have shorter response time and extend chip lifetime,” Karim said.

The solution: “Low-k” electronic material

To keep a lid on power usage while improving performance, Karim and his former doctoral student, **Maninderjeet Singh**, used Nobel winning organic framework materials to develop these dielectric films.

“These next-generation materials are expected to boost the performance of AI and conventional electronics devices significantly,” said Singh, a postdoctoral researcher at Columbia University. ⚙️



HENDERSON RECEIVES 2025 AICHE WILLIAM W. GRIMES AWARD

Assistant Professor Jerrod Henderson of the William A. Brookshire Department of Chemical and Biomolecular Engineering has received the American Institute of Chemical Engineers' 2025 William W. Grimes Award, which recognizes "a chemical engineer's outstanding achievements in the chemical engineering profession and as a distinguished role model within the profession."

AICHE's Minority Affairs community "presents this award in honor of William W. Grimes, the first African-American Fellow of AIChE." The award is presented at the Annual Meeting and is commemorated with \$1,000 and a plaque to the awardee.

Henderson has been involved with AIChE since he was an undergraduate student at North Carolina A&T State University and came to appreciate "the power of this tremendous network" in graduate school and as a faculty member at the University of Illinois.

"So many of my lifelong friends and collaborators are AIChE members," he said. "Annually, the AIChE Conference is like a homecoming of sorts, where I get to see and reconnect with former colleagues, professors and students."

Henderson was nominated by William A. Brookshire Department of Chemical and Biomolecular Engineering Abraham E. Dukler Professor and Director of Graduate Studies Jeffrey Rimer, but was still surprised to learn of his selection to receive the award. ⚙️



CULLEN

The University of Houston Cullen College of Engineering

COLLEGE

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.





Cullen College of Engineering

UNIVERSITY OF HOUSTON

UH Cullen College of Engineering
Department of Electrical & Computer Engineering
Engineering Building 1, Room N308
4226 Martin Luther King Boulevard
Houston, TX 77204-4005



@UHEngineering

TRANSPORT

