Fall 2021

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SOARING TOGETHER
WOMEN OF LEHIGH

Celebrating the impact of women engineers

/ Lehigh marks 50 years of coeducation

LEHIGH UNIVERSITY | P.C. Rossin College of Engineering and Applied Science



When asked to put an engineering spin on the Soaring Together logo, Lehigh's Design Labs team, including Wilbur Powerhouse assistant manager Michelle Rodriguez '21, MechE student Simeon Krizan '23, and managing director Brian Slocum, rose to the challenge. On the cover, a long-exposure image reveals the full path of the ultraviolet laser of a stereolithography 3D printer as it cures each letter from a vat of resin. The completed print is placed in a UV light chamber (top right) to fully dry and harden. Krizan (bottom right) uses a Computerized Numerical Control machine to carve the logo out of a piece of aluminum (bottom left), while Rodriguez (top left) etches the symbol into a slab of wood (see page 21) with a laser cutter.

SPECIAL ISSUE

Soaring Together—50 Years of Coeducation
Celebrating the impact of Lehigh women engineers

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Fall 2021

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LEHIGH UNIVERSITY

Celebrating Lehigh women engineers

Welcome to a special Fall 2021 issue of *Resolve*—a magazine dedicated to research and educational innovation in the P.C. Rossin College of Engineering and Applied Science at Lehigh University.

With Fall semester in full swing, autumn's blue skies, brisk breezes, and blazing colors grace our campus as usual. But this year, it's not the rustling of leaves overhead or their crunch underfoot that calls our attention. It's the greetings of our colleagues in passing. The chatter of students as they move between classes. The familiar soundtrack of in-person living and learning at Lehigh that brings a smile and assures us—*we're back!*

While the pandemic has accustomed us to acknowledging small victories, this year, Lehigh marks the 50th anniversary of a particularly significant one: admitting the first women undergraduate students. To commemorate this milestone, the university has launched Soaring Together, a celebration of the impact and contributions of Lehigh women—past, present, and future.

To join in, we've dedicated this special issue of *Resolve* to amplifying the voices of women engineers by sharing their stories of persistence and dedication, creativity and innovation, leadership and scholarship.

Our feature story (page 12) traces back the unsettling journey of women engineering faculty members as they made inroads into an environment that challenged their merit at every turn. For us, wrestling with the narratives of these women, including trailblazer Patti Ota, evoked a range of emotions, including deep gratitude for all those who helped pave the way for our own leadership roles within the college.

The article also overflows with energy and inspiration from promising undergraduate and graduate students, successful alumnae, and accomplished researchers (like civil and environmental engineering professor Kristen Jellison, who co-directs the Lehigh ADVANCE Center for Women STEM Faculty). The women featured on these pages (and in extended content at *engineering.lehigh.edu/soaringtogether*) are making an impact in our labs, across our learning community, and throughout business and industry.

Although much has been achieved over the past 50 years (about a third of Lehigh's institutional history), undoubtedly much remains to be done to realize greater diversity, equity, and inclusion (DEI) for all underrepresented groups in STEM.

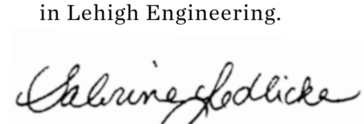
In our Rising Star column (page 24), we detail the ongoing work of the Rossin College's DEI Council and a related faculty hiring search that has advanced strategic goals around increasing both academic excellence and representation.

"Brewing Interest" (page 22) tells the story of a new student-designed class that is open to all majors. "Coffee and Cosmetics: Engineering of Consumer Products" grounds the basic concepts of chemical engineering in relatable applications and invites a broader cross section of students to "taste and see" if the discipline has appeal.

Finally, we are excited to introduce you to Lehigh's new president (though there's a chance you already know him as a former university trustee—or as a classmate and fellow Lehigh Engineering alum). In our Q&A (page 10), Joseph J. Helble '82 discusses his research and public policy work as an environmental chemical engineer. He also shares his experience as an administrator, including as provost and engineering dean at Dartmouth College. Under his leadership, Dartmouth saw a dramatic increase in the share of undergraduate engineering degrees awarded to women. This success demonstrates that, with a concerted, communal effort, it is possible to continue moving the needle on Lehigh's campus as well.

ALTHOUGH MUCH HAS BEEN **ACHIEVED** OVER THE PAST 50 YEARS, MUCH REMAINS TO BE DONE TO REALIZE GREATER **DIVERSITY**, **EQUITY**, AND **INCLUSION** FOR ALL **UNDERREPRESENTED GROUPS** IN STEM.

We hope you enjoy this Soaring Together issue of *Resolve* and we encourage you to visit *lehigh.edu/soaringtogether* to learn how you can engage through networking opportunities, sharing your reflections, and philanthropy. Please reach out with your thoughts and comments. And, as always, thank you for your interest in Lehigh Engineering.



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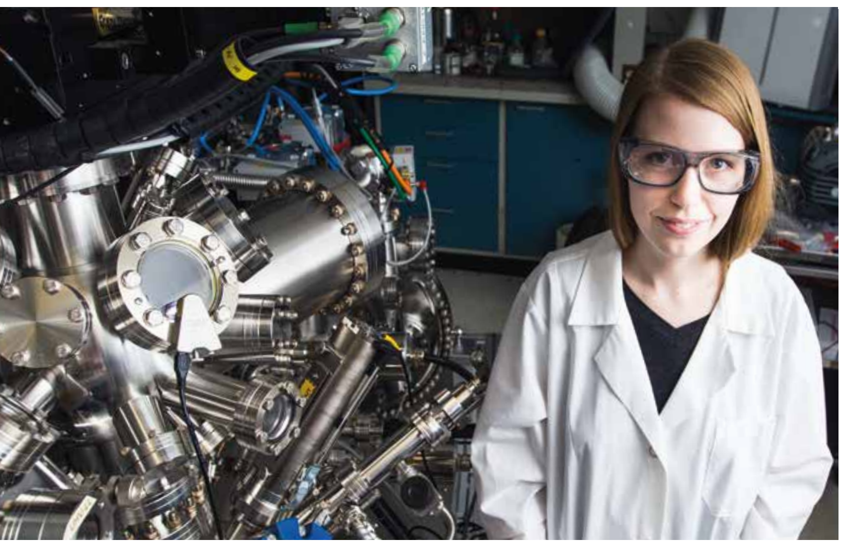
A 'solid' approach to shale gas ethylene conversion

Study of heterogeneous solid acid catalysts—seen as a promising avenue toward cleaner, cheaper chemicals and fuels—uses innovative molecular spectroscopy approaches

Add olefins to the list of things the world is currently short on.

Olefins are hydrocarbons that serve as the building blocks for products and materials we use every day, like plastics, rubber tires, and liquid fuels.



At Lehigh, "we have access to an incredible variety of advanced spectroscopic techniques" capable of performing these cutting-edge studies, Sobchinsky says.

Chemical plants and petroleum refineries make olefins by using a complex, energy-intensive process called steam cracking. Given the current abundance of natural gas, however, industry has shifted to using lighter hydrocarbon feedstocks from natural gas, which has led to decreased manufacturing of critical chemical feedstocks like butene (4-carbon molecule) and propylene (3-carbon molecule).

One way industry is trying to fill that olefin gap is through ethylene dimerization, a chemical reaction that upgrades shale gas ethylene (2-carbon molecule)—which is both plentiful and cheap in the U.S.—to butene. (Butene can be further converted into propylene, which can be converted into polypropylene for use in plastics; further upgrading of ethylene and propylene can create liquid fuels.) But this is an imperfect process that can utilize liquid acids that cause acid gas emissions, damage equipment, and create separation problems with the final product.

A team of Rossin College researchers recently received a $500,000 grant from the National Science Foundation to study an alternative catalytic process based on solid acid catalysts (ethylene dimerization over a nickel sulfated zirconia catalyst) that does not emit acid gases and avoids separation issues.

"Industry often uses homogeneous systems that can require co-catalysts or liquid acids to carry out the reaction, and those can result in problems like acid gas emissions, separation issues, and entrainment of acids in the end product, which can lead to equipment damage," says Erin Sobchinsky, a PhD student in the Department of Chemical and Biomolecular Engineering and one of the co-authors of the proposal. "One solution is to use heterogeneous solid acid catalysts. They don't have to be separated from the final product, and they greatly reduce, if not eliminate, the emission of acid gases, which are harmful to the environment."

The catalyst her team is examining—nickel sulfated zirconia, in which nickel and sulfate are impregnated on a zirconia support—is relatively understudied, says Sobchinsky, who is advised by Israel E. Wachs, Lehigh's G. Whitney Snyder Endowed Professor of Chemical and Biomolecular Engineering. Wachs is the director of Lehigh's *Operando* Molecular Spectroscopy and Catalysis Research Laboratory and the principal investigator on the project.

The research approach they are taking is a novel one.

Many of the catalysis studies to date, she says, have been performed under ultrahigh vacuum conditions—meaning at extremely low pressures with almost no gases present around the catalyst—or under ambient conditions, where the catalyst is exposed to a humid atmosphere at room temperature.

"But those conditions really aren't representative of what the catalysts experience during reaction," she says. "The surfaces of many catalysts can also restructure, which makes characterization during reaction all the more important."

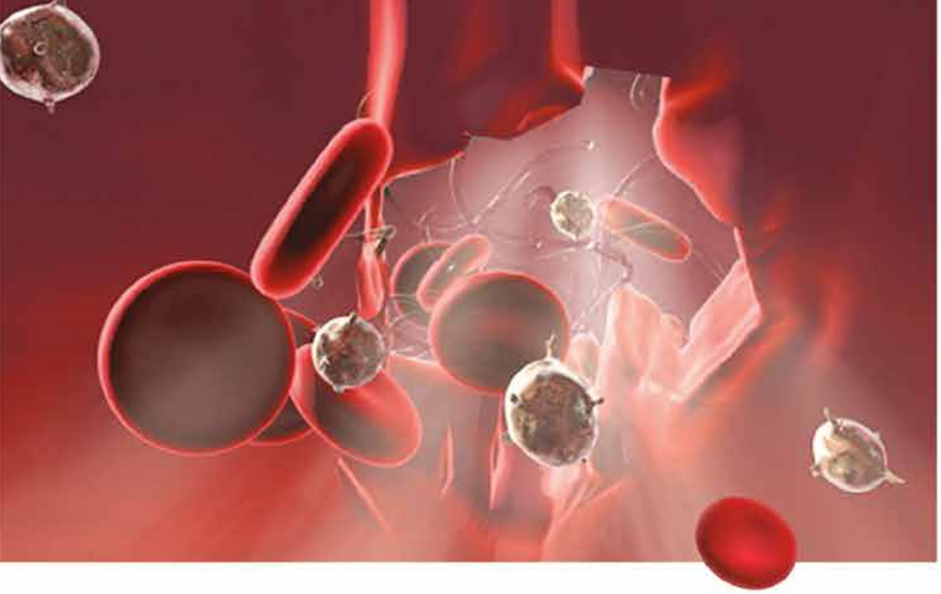
Sobchinsky and her team are using *in situ* and *operando* molecular spectroscopy (conducting experiments under relevant reaction conditions) to characterize their catalyst. Under these conditions, the researchers can better understand what's happening on the surface of the catalyst, which is where the reaction takes place.

"Our current work is focused on determining exactly what the surface structures of the catalyst look like during reaction and understanding the synergy between the nickel and sulfate species," says Sobchinsky. "That will allow us to determine which surface structures are important for enhancing the reaction. We can then rationally design new catalysts with better performance by synthesizing catalysts that contain more of these reaction-enhancing surface structures."

As Sobchinsky and her team develop a fundamental understanding of what is happening at the molecular level, they'll be able to fine-tune the molecular structures toward the goal of designing more active catalysts. The more active a catalyst, the more reactant it can convert, with less energy use and impact on the environment or infrastructure.

"This approach to catalysis, although it is at the cutting edge, isn't always applied by other research groups because of the limited availability of such sophisticated instrumentation," says Sobchinsky. "Doing these *in situ* and *operando* molecular characterization studies is one of the most important ways to move forward in the field."

CHRISTA NEU



Researchers report breakthroughs in study of von Willebrand factor

The protein known as von Willebrand factor (vWF) promotes blood clotting by helping platelets in blood stick to collagen within the walls of damaged blood vessels to form a plug that stops the bleeding from a wound.

Under normal, healthy circulatory conditions, vWF keeps to itself. The large and mysterious glycoprotein moves through the blood, balled up tightly, its reaction sites unexposed. But when significant bleeding occurs, it springs into action, initiating the clotting process.

When it works properly, vWF helps stop bleeding and saves lives. However, according to the CDC, approximately 60,000 to 100,000 Americans die each year from thrombosis, a disorder characterized by too much clotting. Blood clots can trigger a stroke or heart attack.

Clotting mechanism clarity

According to X. Frank Zhang, an associate professor of bioengineering, only one drug has been FDA-approved to target vWF and treat thrombosis, or excessive blood clotting disorders. Caplacizumab works by binding to vWF and blocking it from binding to platelets. However, no one has understood the specific mechanism behind how it accomplishes this.

Zhang and his colleagues from Emory University School of Medicine and the University of Nottingham have identified, for the first time, the specific structural element of vWF that allows it to bind with platelets and initiate clotting. The team says that the specific unit, which they call the discontinuous autoinhibitory module, or AIM, is a prime site for new drug development. The work is described in an article published in *Nature Communications*. The study was co-led by Wenpeng Cao ’20 PhD.

“The AIM module allows the vWF molecule to remain nonreactive in normal circulating blood, and activates the vWF instantly upon bleeding,” says Zhang. “In our research, we identified that Caplacizumab works by binding the AIM region of vWF and enhancing the force threshold to mechanically remove vWF’s autoinhibitory structures, opening up a new avenue to the development of antithrombotic drugs targeting the AIM structures.”

Zhang, who has been studying vWF for years, specializes in single-molecule force spectroscopy and mechanosensing, or how cells respond to mechanical stimuli. He uses optical tweezers, a specialized tool that utilizes a focused laser beam to apply force to objects as small as a single molecule.

“Optical tweezers can grab tiny objects,” Zhang explains. “We can grab the vWF and at the same time we apply force to see how the protein changes shape, to see how the proteins are activated when there’s a mechanical perturbation or a mechanical force.”

Novel simulation method

Excessive clotting isn’t the only way the process can go awry. The most common inherited bleeding disorder, von Willebrand disease (vWD), affects about 1 percent of Americans, per the CDC. Symptoms include frequent nosebleeds, easy bruising, and heavy and/or longer bleeding after injury, childbirth, surgery, or dental work, or during menstruation.

When vWF approaches an injury site, the increase in blood flow caused by the laceration prompts the globule to unravel. As the protein transitions into more of a string-like shape, sites that are typically shielded become exposed. Those sites are “sticky”—and they bind with platelets and collagen to initiate blood clot formation.

Using a new method of simulation developed at Lehigh, researchers can quantitatively predict, for the first time, blood flow conditions that likely cause pathological unraveling of vWF. The predictions can be used to optimize the design of the mechanical pumps known as left ventricular assist devices used in heart failure patients. LVADs have been associated with causing unexpected vWF depletion and associated bleeding disorders, akin to von Willebrand disease. The method also has the potential to improve diagnosis and treatment of vWD.

In an article published in *Biophysical Journal*, the researchers describe their use of an enhanced sampling technique (called Weighted Ensemble), in conjunction with molecular scale (Brownian Dynamics) simulations, to identify blood flow conditions that cause pathological behavior of vWF. The method allowed them to compute the globular-to-unraveled transition rate of the protein on timescales inaccessible to standard simulation methods.

“This method is all about studying the kinetics of rare events,” says co-author Edmund Webb III, an associate professor of mechanical engineering and mechanics. The lead author is Sagar Kania, a PhD student in mechanical engineering and mechanics. Webb and Kania worked with Zhang and professors Alp Oztekin (mechanical engineering and mechanics) and Xuanhong Cheng (bioengineering and materials science and engineering) on the study.

TOP: NICOLLE FULLER; RIGHT: ISTOCK/ LVCANDY

NSF-funded study to examine college tenure, promotion

At the core of the college tenure and promotion system—a process critical to the integrity of America's research enterprise—is the notion that those who are the most deserving are promoted. But, is that truly the case?

A new study aims to examine the process in academic STEM careers and challenge some basic assumptions regarding merit as the sole driving force. A $2 million award from the National Science Foundation will support the project, helmed by researchers at the University of Houston and Hampton University. Lehigh is among eight partnership organizations working to shed new light on the role of research productivity and extraneous factors in determining who gets to stay in coveted tenured positions and who has to retool or restart their career.

"There are many factors affecting why women faculty and faculty of color are underrepresented in the rank of full, tenured professor," says Kristen Jellison, a professor of civil and environmental engineering and co-director of the Lehigh ADVANCE Center for Women STEM Faculty. Jellison is one of three Lehigh site collaborators on the project.

Over a three-year period, the team will investigate what drives outcomes, with a particular focus on external review letters and tenure clock extensions (often granted to new parents, and more recently used in response to the COVID-19 pandemic).

Very little scholarly research has been done to examine critical questions around external review letters, which are provided by arm's length reviewers and are a vital factor in determining tenure and promotion decisions. The team will extend social psychological theories of language use to diversity research. They posit that candidate and letter writer characteristics unrelated to scholarly productivity shape the linguistic content and length of external review letters, thus introducing a source of bias into tenure and promotion processes.

THE ADVANCE TEAM SUPPORTS EQUITY AND INCLUSION TO ENHANCE THE CLIMATE FOR WOMEN IN STEM AT LEHIGH.

Jellison also points to "the disproportionate service burden that is placed on underrepresented faculty who spend more time than their majority colleagues on service. This work can include formal service, like committee work or directing campus programs, and informal service, like helping underrepresented students who see them as role models and call on them in times of need."

Such service, she says, is often invisible in tenure portfolios. Both external and internal reviews may not see the excellence, leadership, and application and implementation of scholarship by those invested in their institutions or disciplinary transformations.

The long-term goal of the project is to provide an evidence base for evaluating the validity of external review letters and mechanisms for minimizing bias against faculty members from underrepresented groups to broaden participation in STEM and beyond.

'Floating' microgrids: Optimizing naval ships' power systems

"A ship's power system is a special kind of microgrid," says Wenxin Liu, an associate professor of electrical and computer engineering. "If we can improve its performance, we can apply the same approach to the civilian microgrid."

Microgrids, which are smaller networks with multiple distributed generators, are seen as the way of the future in power distribution, says Liu. They are more flexible (operating in both grid-connected and autonomous modes), customizable, and efficient than traditional, centralized power grids. Plus, they're less vulnerable to attack.

Liu recently received two grants from the Office of Naval Research, each providing $450,000 over three years, to support his continued work on the advanced control of power systems.

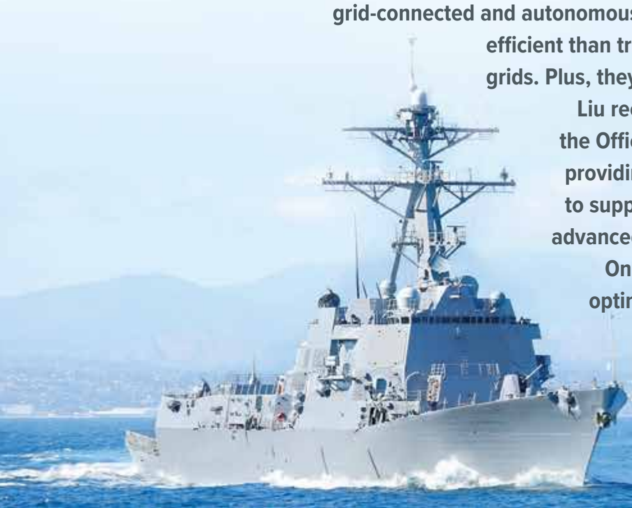
One project examines real-time optimal power flow control in power electronic power distribution systems (PEPDS). Liu is developing an advanced algorithmic design and doing hardware experimentation. Ultimately, his work is laying the foundation that will eventually allow naval ships to travel longer distances. It will also reduce waste energy—and costs—and has implications outside the military.

The second project involves coordinating heterogeneous generators within the ship's power system. Currently, the generators differ in terms of response speed, capacity, and reliability.

"If they're not properly coordinated, both steady and dynamic performance will be low," he says, and it's a waste of capabilities.

Liu is employing the same algorithmic and experimentation approach to optimize the generator system and improve its performance. The end goal is also similar: to improve the reliability of the ship's power system using a technique that can also benefit microgrids in the civilian world.

"Even for basic research, we should bring future applications into consideration," says Liu. "These problems are practical, important, and not well studied. And they need to be solved."



ISTOCK/ VUK8691

Innovating where ‘a river runs through it’

Multi-institutional hydrofoil turbine project could help generate cleaner, more cost-effective energy for cities and rural communities alike

“Hydroelectric power provides an alternative to fossil fuels, but not all generation methods are equally clean or economically viable.

“The classic ‘solution’ involves building a concrete dam and locating a hydroelectric power plant there, but there’s all sorts of associated issues,” says Keith Moored, an associate professor of mechanical engineering and mechanics. “There’s the high cost of building a dam, but there’s also a huge environmental impact. You restrict migration of fish, you change the local river topology, and you affect the whole ecological system around it.”

Moored is a member of a multi-institutional team investigating a different approach to renewable energy: harnessing the power of natural river flows and turning it into electricity through the use of bio-inspired hydrofoil turbine technology. The team’s innovative, river-focused approach has the potential to expand access to cleaner, more cost-effective power sources, especially for rural communities, Moored says.

Hydrofoils are underwater blades that move up and down with the flow of water. The movement mimics the tail fin action of fish and cetaceans (whales, dolphins, etc.) or the flippers of a scuba diver. The team is designing a system that mechanically converts that oscillation into rotary motion that powers a generator; in effect, turning the river’s flow into electricity.

“There’s a huge amount of resources available from constant river flow,” Moored says. “Rivers are near just about every city in our country and across the world. We want a system with a much smaller ecological footprint and cost footprint than those older technologies.”

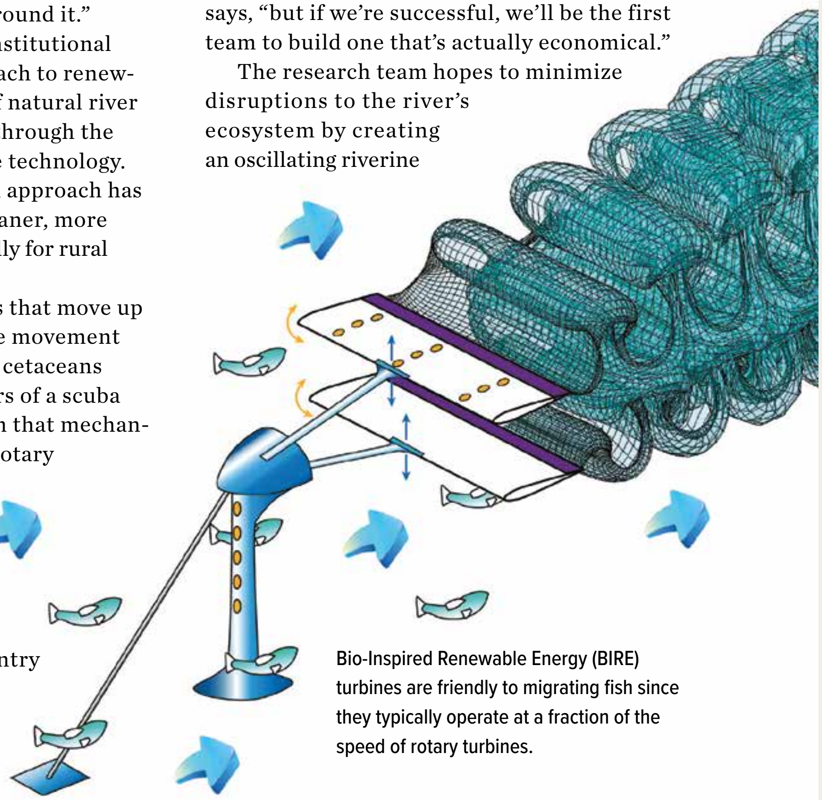
University of Virginia School of Engineering professor Hilary Bart-Smith leads the project, along with additional researchers from Virginia Tech and Sandia National Laboratories. The work is supported by the Department of Energy and is one of 11 projects sharing in $35 million recently awarded by ARPA-E’s Submarine Hydrokinetic and Riverine Kilo-megawatts Systems (SHARKS) program.

“Hydrokinetic energy is an abundant renewable resource that can boost grid resiliency and reduce infrastructure vulnerability, but it is currently a cost prohibitive option,” according to ARPA-E Director Lane Genatowski. “SHARKS teams will address this barrier by designing new, efficient [hydrokinetic turbine] systems.”

For three years, five sub teams will design individual components that, if successful, will combine to create an economical and environmentally friendly oscillating river turbine. Moored heads up hydrodynamic logistics and is using simulations to optimize the hydrofoils and maximize their energy production. The challenge will be making sure that all the components are integrated properly, he says.

“These types of devices have been built before, so we certainly aren’t first out of the gate,” Moored says, “but if we’re successful, we’ll be the first team to build one that’s actually economical.”

The research team hopes to minimize disruptions to the river’s ecosystem by creating an oscillating riverine turbine that moves vertically at a slower rate compared with existing rotary river turbines. Sensors in the system will allow it to adapt to natural changes in the river’s depth and maintain steady energy production.



Bio-Inspired Renewable Energy (BIRE) turbines are friendly to migrating fish since they typically operate at a fraction of the speed of rotary turbines.

ILLUSTRATION COURTESY OF KEITH MOORED

Moored points to the advantages hydrokinetic energy has over other types of renewables when it comes to dependability and accessibility.

“There are days where the sun doesn’t shine or the wind doesn’t blow,” Moored says. “Rivers always flow. The technology we are developing will provide energy for more rural communities that are otherwise unable to take advantage of solar and wind energies due to lack of infrastructure or differing climate conditions.”

RESEARCH RECOGNITION

» **Jeffrey Rickman**, a professor of materials science and engineering and physics, has been named a Fellow of the American Ceramic Society. Rickman is a distinguished computational materials theorist recognized for contributions “moving ceramic and glass science and technology forward.”

» Industrial and systems engineering professor **Frank E. Curtis**, co-author of a highly regarded review paper on optimization methods for large-scale machine learning, was awarded the 2021 Lagrange Prize in Continuous Optimization. The honor is jointly given by the Mathematical Optimization Society and the Society for Industrial and Applied Mathematics every three years.

» **Panayiotis “Panos” Diplas**, P.C. Rossin Professor of Water Resources Engineering, received the 2021 Hunter Rouse Hydraulic Engineering Award from the Environmental and Water Resources Institute of the American Society of Civil Engineers. He was recognized for “fundamental contributions to the role of turbulence in sediment transport, eco-hydraulics, stream restoration and scour.”

Top of the NSF CAREER AWARD class

The long-standing tradition of Rossin College faculty members earning recognition through the National Science Foundation's Faculty Early Career Development program continued in 2021, with three assistant professors joining this nationally distinguished group of teacher–scholars.

BY **CHRISTINE FENNESSY** | PHOTOGRAPHY BY **DOUGLAS BENEDICT/ACADEMIC IMAGE**

// COMPUTER SYSTEMS

Optimizing RDMA for a faster, more robust internet

We are not a species that likes to wait. Especially when it comes to our online demands—we want instant responses to our queries and immediate confirmation of our posts.

Meeting such expectations requires distributed computing systems capable of meeting demand while still preserving the integrity of the data they are providing. Distributed systems enable resource sharing in the form of hardware, software, or data, and comprise multiple machines connected through a network. The internet is the largest, best-known example; others include social networks, online gaming, and e-commerce. Such systems must perform innumerable complex interactions—fast—for potentially millions of users, without ruining the data.

Improving that speed is at the heart of Roberto Palmieri's research proposal to optimize the technology known as Remote Direct Memory Access (RDMA) to better serve the massive number of internet-user requests.

RDMA is a fairly recent technology that changed the way computers communicated. At a basic level, that traditional communication involved one machine sending a request to another for a particular service. The second machine had to devote resources to processing and responding to the message, and that all took time. RDMA disrupted that pattern.

"So now, if a machine wants something from another machine, it will not ask for it," he says. "It will just take it by interacting directly with that machine's RDMA card. Which means that, instead of spending resources handling the message, the machine can focus on its specific business application. With RDMA, we're talking about tens of nanoseconds for two machines to interact. Whereas before, we were talking about tens or hundreds of milliseconds. If you're posting something on social media, and one interaction takes hundreds of milliseconds, and you need 10 interactions, the user is now waiting nearly a second, and starting to think, *Why am I waiting so long?*"

Palmieri and his team plan to redesign algorithms and protocols to fully exploit the capabilities of RDMA. Everything they produce will eventually become open-source, so others can build on it.

ROBERTO PALMIERI, Computer Science and Engineering

SIDDHA PIMPUTKAR
Materials Science and Engineering

// CRYSTAL SYNTHESIS

A pathway to next-gen semiconductors

Every researcher has their holy grail. For Siddha Pimputkar, it's cubic boron nitride.

Nitrides are a broad set of chemical compounds in which a nitrogen atom is bonded to another element such as gallium or boron, or most metals.

Some of these nitrides are powerful semiconductors, more efficient than silicon, that ubiquitous presence in just about every device you power on or plug in. Some nitrides rival diamond in their hardness. Some are also capable of working in extreme environments. And some, like cubic boron nitride, can do all those things.

"Compared with silicon, cubic boron nitride has the potential to work under more extreme conditions, including higher voltages and currents," says Pimputkar. "This allows the elimination or re-envisioning of whole components of circuitry, thereby reducing the size of these power converters, and hence, their cost."

As a material, nitrides have exciting, far-reaching potential. They're also really, really hard to make.

But Pimputkar is proposing to do just that. He will attempt to overcome a long-standing problem—the inability to inexpensively grow large, single-crystal nitrides with no defects—and then scale that growth.

His novel solution involves a precursor containing lithium nitride, along with a specialized pressure cooker of sorts capable of containing the highly reactive lithium. Using the same principles you might employ to cook a roast in an Instant Pot, Pimputkar will be able to heat the system to a higher temperature and turn the material into a liquid without the nitride falling apart.

The potential impact, he says, is huge. Pimputkar believes his approach will allow him to make a range of nitride materials, including binary materials like gallium nitride and aluminum nitride (used in visible light LEDs, transistors, and diodes), and ternary materials like aluminum gallium nitride (found in UV LEDs and lasers and UV detectors, among other devices), as well as demonstrate the existence of other novel nitrides. He says it will also allow him to control the activity of each element in the nitride material, giving him control over the composition of the crystal he's growing. And he'll be able to grow—for the first time—large-diameter crystals of cubic boron nitride.

"My system is easier to work with, and can be built for larger volumes, so we can now start thinking in terms of industrial scale, say, 6-, 8-, or 10-inch systems. Of course, we will start small, as having even a 1-inch diameter crystal would already prove transformative."

// COMPUTATIONAL PROCESS DESIGN

Understanding catalytic transfer hydrogenation

Is it possible to build safe, sustainable chemical plants on a small scale? The kind of plants that could—among other things—convert biomass into biofuel, on the very farms producing those crops?

Possibly. But doing so requires figuring out, in part, a more benign process of hydrogenation, the chemical reaction between molecular hydrogen and other compounds and elements that is used to create new molecules.

Srinivas Rangarajan is developing novel tools to better understand a promising chemistry called catalytic transfer hydrogenation (CTH).

"The problem with molecular hydrogen is that it's very light," says Rangarajan. "To transport it, you need to compress it using very high pressures. And to use it, you need very high pressures. But if you can use a different molecule that can carry hydrogen chemically, that molecule could be used as a hydrogen donor. It will decompose or get converted, and in the process, lose hydrogen, which then becomes available for something like biomass conversion."

The process of transferring hydrogen atoms from a hydrogen donor to a hydrogen acceptor is called catalytic transfer hydrogenation. "So instead of using a molecular hydrogen, you're using a liquid molecule that can be shipped very easily from where it's produced to wherever it's needed," he explains. "It can then be used at near-ambient temperatures, and at one atmospheric pressure. So in that sense, CTH could lead to a more compact, safe, modular process."

Rangarajan's work will attempt to answer two fundamental questions: How does this hydrogen transfer work exactly at the molecular scale, and what's the right donor and the right catalyst for a given acceptor?

To address possible combinations of donors and catalysts that number in the tens of thousands, Rangarajan will build on his prior research to create a technique called high-throughput kinetic modeling. It incorporates quantum chemistry, optimization, and machine learning to build models that will provide data on how different parameters affect performance.

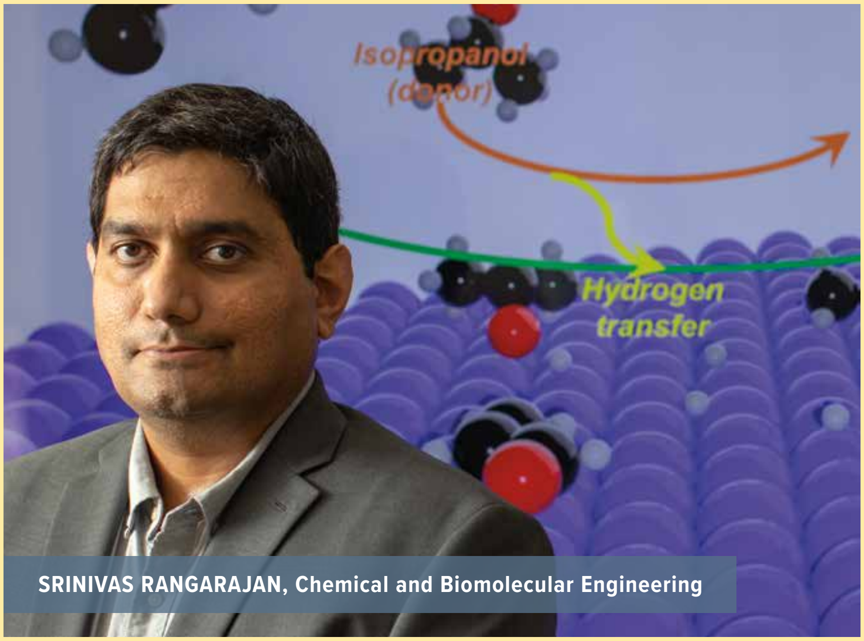
"This technique allows us to determine how the parameters affect the speed of the reaction and whether the desired product will actually be formed," he says. "This hasn't been done before."

The ultimate goal is to develop processes that are more energy efficient. The potential impact could be huge, he says, given that 45 million tons of hydrogen are used globally every year to make chemicals and fuels.

ROSSIN COLLEGE FACULTY

16 NSF CAREER AWARDS

IN THE PAST 5 YEARS



SRINIVAS RANGARAJAN, Chemical and Biomolecular Engineering

Desalination tech uses CO_2 to tap into municipal wastewater as alternative freshwater source

Turning cities' wastewater into usable freshwater is an environmental win. Engineering the system to be more energy efficient makes a good idea even better.

Using a greenhouse gas—carbon dioxide—to power the process?

It's an approach that's potentially transformational, according to Rossin College professor Arup SenGupta, a world-renowned researcher, educator, author, and and inventor who has dedicated his career to addressing problems relating to the lack of safe drinking water.

"Municipal wastewater treatment plants in large cities are insulated from the negative effects of climate change, and treated wastewater can serve as a potential water source, provided appropriate sustainable and cost-effective technologies are available," he says.

In 2019, SenGupta and his Lehigh doctoral students were awarded a U.S. patent for their innovative CO_2–driven ion exchange desalination process, HIX-Desal.

Existing wastewater desalination systems use semipermeable reverse osmosis (RO) membrane processes that require a separate electrical and/or mechanical energy source. Approximately 1 to 1.5 kWh of energy is required to produce 1000 liters (264 gallons) of treated water, or just over the average amount three Americans use at home each day.

HIX-Desal harnesses the unique chemistry of CO_2 to replace that energy requirement. And, SenGupta says, when paired with existing generators of carbon dioxide, the process can be effectively carbon negative.

"Carbon dioxide, which is safe to handle and nonhazardous, can serve both as a weak acid and a weak base concurrently in a single process for desalination," he says, "avoiding the need for energy-intensive RO membrane processes." The system also reduces water pretreatment required to protect the membrane in reverse osmosis setups, resulting in cost savings.

SenGupta's team will gain insight into the energy advantages and scalability of the technology in a new collaboration with the Lehigh County Authority's wastewater treatment plant in Allentown, Pennsylvania.

The two-year project was recently funded by the U.S. Bureau of Reclamation as part of an $5.8 million investment in 22 laboratory and pilot-scale desalination research projects to enable broader deployment of desalination and recycled water technologies.

The Kline's Island plant treats nearly 35 million gallons every day, says SenGupta, and investigations show that the salinity of the treated wastewater can be reduced by more than 60 percent by the HIX-Desal process, without requiring any reverse osmosis. If successfully deployed using carbon dioxide from the facility's anaerobic digester, he explains, the technology could lead to a savings of approximately 1 million kWh per day (or about enough energy to power 94 U.S. homes for a year).

"This concept forms the basis of a circular economy, in which waste from one process is a potential resource in another process," he says. "It's a great challenge, but one that's exciting as well."

Studies have revealed another potential benefit, says SenGupta. Phosphate in the wastewater at Kline's Island can be selectively removed, concentrated, and recovered as a potential fertilizer.

‘Rocket’ science

It’s the rare engineer who gets to conduct experiments in space. But the Rossin College now has three who will be doing just that.

A multidisciplinary trio recently received $400,000 from the National Science Foundation and the Center for the Advancement of Science in Space (CASIS) to fund their project studying thermophoresis in quiescent fluids for bioseparations. The team is led by chemical and biomolecular engineering professor James Gilchrist, and includes Xuanhong Cheng, a professor of bioengineering and materials science and engineering, and Kelly Schultz, an associate professor of chemical and biomolecular engineering. Their experiments will take place aboard the International Space Station (ISS) and are expected to launch in the next one to two years.

Thermophoresis is a natural phenomenon in which a temperature gradient causes particles to migrate. It’s used to separate molecules within a sample; for instance, to detect the presence of disease in bodily fluids or in air.

The problem is, no one really understands how it works. It’s an old problem, says Gilchrist, and one he joined forces with Schultz and Cheng to solve.

“I realized that we can track how the particles are moving,” he says. “They can move thermophoretically, but they can also jiggle, and tell us about the microenvironments. That allows us to know what the fluid around the particles is doing while it’s migrating.”

The team soon learned what made the problem so intractable: gravity.

“As you heat something up, or cool it down, its buoyancy changes and it causes this recirculation,” says Schultz. “So you wouldn’t get this concentration on one side because the particles are constantly recirculating.”

Their answer? Propose experiments to be conducted on the ISS.

The team has designed 12 such experiments that will take place inside a roughly 18-inch cubed “lab in a box,” that they’ll control from the ground.

It’s safe to say that all three engineers are over the moon about this opportunity. And it’s one they couldn’t have secured working as individuals.

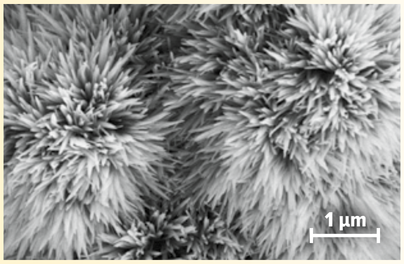
“We have very different, and very complementary skills,” says Cheng. “Jim is the expert in transport phenomena. He’s very good with theory development. Kelly is an expert in microrheology and complex fluids. My interest is more on the application side. And I never thought that as a biomedical engineer, my research would ever have any connection to space. These interdisciplinary projects not only present fantastic opportunities, but have given me so much new knowledge and insight into things. There’s always more science behind the phenomena in life.”

UNLOCKING THE MYSTERY OF THE BIO/NANO INTERFACE

An interdisciplinary team has unraveled how functional biomaterials rely upon an interfacial protein layer to transmit signals to living cells concerning their adhesion, proliferation, and overall development.

According to an article published in *Scientific Reports*, the nanoscale features and properties of an underlying substrate do not impact the biological response of cells directly. However, these properties indirectly influence cell behavior through their control over adsorbed proteins.

The researchers demonstrated that living cells respond to interfacial layer characteristics that arise as a consequence of micro- and nano-scale structures engineered into a substrate material. These infinitesimally tiny structures have an enormous impact upon the nature of the proteins and how they restructure themselves and electrostatically interact with the material, which in turn influences the manner in which cells attach to the substrate and develop over time.



“There are others who have studied the interfacial protein layer,” says materials science and engineering professor Himanshu Jain, who also directs Lehigh’s Institute for Functional Materials and Devices (I-FMD). “But this work showed directly and unambiguously for the first time how some specific nanoscale features of the substrate can impact the secondary molecular structure of the proteinated interface that in turn affects the response of the cells that are thousands of times larger.”

Study collaborators also include Matthias Falk, a professor of cell biology in Lehigh’s College of Arts and Sciences, as well as two doctoral students jointly supervised by Falk and Jain.

REMOVING BARRIERS

With a track record of success in closing the gender gap in engineering education, Joseph J. Helble ’82, Lehigh’s new president, sees strength in diversity

For the second time in the university’s history, a Lehigh engineer is at the helm. Joseph J. Helble ’82 is a chemical engineering alumnus and Lehigh’s 15th president. He returns to South Bethlehem having pursued research related to air pollution, carbon dioxide capture, and other impacts of fossil fuel use. Most recently, Helble served as provost at Dartmouth College, following a 13-year tenure as dean of the Thayer School of Engineering. Under his leadership, Dartmouth became the first comprehensive research university in the nation to have more women graduate with a bachelor’s degree in engineering than men. Diverse communities are stronger communities, says Helble. “I believe universities can and should lead in valuing diversity and striving for equity.”

Q: What got you interested in studying chemical engineering as a way to tackle environmental challenges?

A: I was an undergraduate at Lehigh in the late ’70s and early ’80s, shortly after OPEC imposed an embargo on the supply of petroleum. The oil crisis disrupted everyone’s lives and had us seriously considering energy supply for the first time. The 1979 nuclear accident at Three Mile Island made me—a runner and someone who has always liked the outdoors—think about energy in a more immediate way. These were the days of limited environmental regulation, and there was sometimes the smell of sulfur on campus and unfiltered diesel buses driving down the roads emitting plumes of black smoke.

I’ve always referred to myself as an environmental chemical engineer. I liked chemistry but was interested in problems in energy and the environment. It was the combination in the application that was important to me. In talking to faculty and doing some reading, it was clear that if I wanted to dedicate my career to working on those problems, chemical engineering was the path to pursue.

Climate change wasn’t much on anyone’s mind back then. So, I was thinking about more visible problems of air pollution: sulfur and nitrogen oxides, soot, and particulate matter. I ended up devoting a large part of my research career to those areas.

Over time, I started working on questions of CO_2 capture. By the 1990s, the modeling was more and more consistent that this was a looming crisis. I’m a realist. I didn’t think the world could flip a switch and just stop utilizing fossil fuels. I still don’t think that’s possible today, with so many nations still in the early stages of economic and structural development.

In addition to pursuing alternatives, we have to think about developing materials

Helble was the first in his family to attend a residential college. He credits Lehigh with opening "a world of possibilities for me that I didn't even know existed." Helble earned a PhD from MIT, and his private sector career led to multiple patents. He's also done national public policy work on technology and environmental initiatives.

and technologies to take CO_2 out of exhaust gases and out of the air. There are huge opportunities for anyone interested in the chemistry and engineering challenges, the materials challenges, and the policy challenges.

Q: Why was the gender parity milestone Dartmouth achieved so important?

A: It was an important symbol—a way to show that decades-old arguments about differences in interests or aptitude are wrong.

Engineering is about applied problem-solving. It's about inventing and creating something that provides new opportunities, helps address important problems, maybe even changes the world. It's about serving society through the application of science.

What we did at Dartmouth, where students aren't accepted into a college and are free to choose any major, to me, showed that it is possible to graduate a class that looks like the rest of the university—and the rest of society—if you have programs that are engaging and interesting to a broad cross section of students.

Q: What did it take to accomplish this goal?

A: I'm a numbers person. I'm data driven. While I was dean, the national data showed that the percentage of undergraduate engineering degrees received by women was 20 percent. At Dartmouth, it was around 25 percent and moving toward 30 percent. That sparked a series of conversations with the faculty and staff.

We know from the literature that a lot of the challenges are perceptions of barriers to entry. What could we do to lower them? We already had classes designed for nonmajors, and we significantly expanded our offerings. We increased the amount of hands-on group work, even in the earliest project classes. We didn't change the content but rather our approach to delivering it.

We started to think very intentionally about the composition of project review boards for our classes. We made sure there was gender diversity on every single board, and that we were drawing people in from the outside. We thought about search

committees in the same way. We focused on hiring more women faculty, but we thought about our technical staff instructors as well. We looked at the composition of our advisory board and our seminar speakers. We started to intentionally build more project work into middle- and higher-level classes.

And when we saw success, we talked about it openly. Some of the greatest ambassadors for the effort at Dartmouth were the students. When we reached 40 percent, I would say publicly, we're at twice the national average—what would it mean if we could be the first to get through this imagined glass ceiling? The effort drew the focus of the entire community.

Every university has a distinct structure and different approach. But to effect change requires examining absolutely every process, absolutely every structure that's in place. Is it inclusive of everyone? And is the program represented that way to the outside world? Because perceptions help drive decisions.

Q: What will be the impact of achieving greater diversity in STEM professions?

A: It's important that scientists and engineers reflect the community and comprehend the problems at hand. That brings a better understanding of the importance of different weighting factors, which is something we ask engineering students to consider when designing solutions. There are always several different paths you can pursue. What are your objectives and what's important to the community? How you ascribe weights to each of those different parameters for one community might not be right for another. It's beneficial if you have professionals who understand the community they're trying to help. Every argument about diversity applies here. You have different perspectives approaching a problem or a question in different ways with different life experiences that they bring to the table.

Q: What is your vision for Lehigh as the university strives toward achieving greater diversity, equity, and inclusion?

A: One of the greatest strengths of Lehigh is the strength of the community. Each and every individual is valued and brings something unique to contribute. They are here because they have something to offer and because they can learn from being part of this community. And that means every single individual. Not the majority. Everyone.

We want everyone to have the opportunity to fully engage and be fully valued. To bring their whole selves to the classroom and to work. It's important the community knows that's what the administration stands for. It's who we are as a community. We're committed to doing everything we can to make sure that there are no barriers that prevent anyone from pursuing their interests.

TOP AND RIGHT INSET: CHRISTA NEU; LEFT INSET: JOHN KISH IV



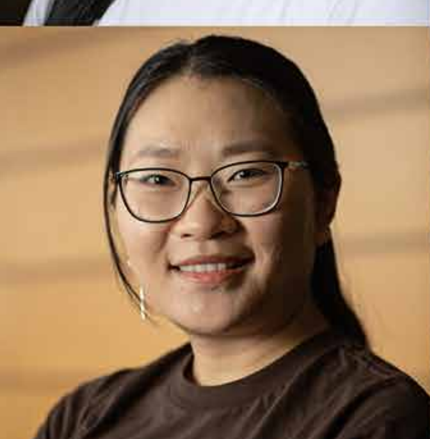





Soaring Together

Celebrating Lehigh Women and 50 Years of Coeducation






UNFINISHED BUSINESS

They're improving the efficiency of drug delivery, creating faster ways to process data, and building machines to grow films for electronics. They're authoring papers, launching startups, and mentoring youth. A new generation of women is taking research and scholarship in the Rossin College to greater heights. But the path for women in STEM at Lehigh hasn't always been smooth—and is still a work in progress. Here, we trace back where we were, where we are, and where we aspire to be.

BY **CHRISTINE FENNESSY**

PHOTOGRAPHY BY DOUGLAS BENEDICT/ACADEMIC IMAGE

It isn't easy being the first person to do something. In the case of Patti Ota, Lehigh's first woman engineering faculty member, that fact is an understatement.

In 1971, Ota was finishing up her PhD at the University of Pennsylvania when her dissertation supervisor recommended her for an adjunct position teaching electrical engineering at Lehigh.

As she walked across campus that first day, she wasn't thinking about how she was about to make history. Having completed her master's in electrical engineering and her PhD in computer science at Penn, Ota was used to being the only woman in most things she did—and what that meant.

"If you were a woman back then," she says, "you knew that if you were going to compete in this, let's call it 'man's world,' you knew that all kinds of things were going to happen, and you just had to grin and bear it."

For Ota, the grinning and bearing it started before she even made it through the front door of Packard Lab.

"I remember walking up the steps to the main entrance, and having two of my male colleagues greet me, and tell me that I shouldn't have been hired."

This is odd, she thought to herself. But it wasn't surprising, and so she kept walking, went through the door, and joined roughly 200 men on the engineering faculty. She would be the only woman for nearly a decade.

The same year that Ota unwittingly made history, Lehigh itself was doing the same by opening up undergraduate education to women. This year marks the 50th anniversary of that 1971 milestone. The university is commemorating the occasion through Soaring Together, a multiyear celebration that is recognizing the impact of all women on campus—past, present, and future.

For Lehigh Engineering, that impact began, in many ways, with Ota, and it continues today with 33 women on the faculty of 154. Representation in the Rossin College's student body also continues to grow: 32 percent of all undergraduates enrolled in engineering are women, a level that exceeds the national average (in 2019) of 23.8 percent, according to the American Society for Engineering Education.

But to appreciate where we're at, it's good to know where we've been. And to continue to increase the number of women in engineering—and ensure an equitable future for all engineering students, faculty members, and staff—it helps to understand the challenges, the efforts, and the wins inside our community today. >>

Ota went on the record with *The Brown and White* back in 1982 saying that it took her six years to feel comfortable on campus. In that time, she says she faced some form of harassment and/or discrimination nearly every day. Her car tires were slashed—twice. Vulgar and demeaning graffiti was scrawled on her office door. ("I had to ask my colleague, 'What does this word mean?'" she says.) When she complained about pay inequity, she says she was told, "We all know that women don't work as hard as men." (To which she says she responded, "Please tell me what this other individual is doing that I'm not doing." She got no response. And then she got a pay bump.) She says she wasn't allowed to go to conferences ("I was told the wives of my male colleagues would get jealous.") She says she was informed that if she wanted tenure, she had to sit through all the undergraduate electrical engineering courses, do all the homework, and take all the exams. She says faculty and departmental meetings always started with the word, "Gentlemen." When she objected to it, she says the

'I'M LOOKING INTO A VOID NO ONE HAS LOOKED INTO BEFORE'

ALEXANDRA HOWZEN, PhD student, Materials Science and Engineering

Her mom was trying to tell her she had to make a choice in life. She could, for example, be the one who builds the electronics that power a ship. Or, she could be the one who designs the ship itself. "When I said I want it all, she was like, 'You can't do that,'" says Alexandra Howzen. "And I said, 'You're gonna stop me?'"

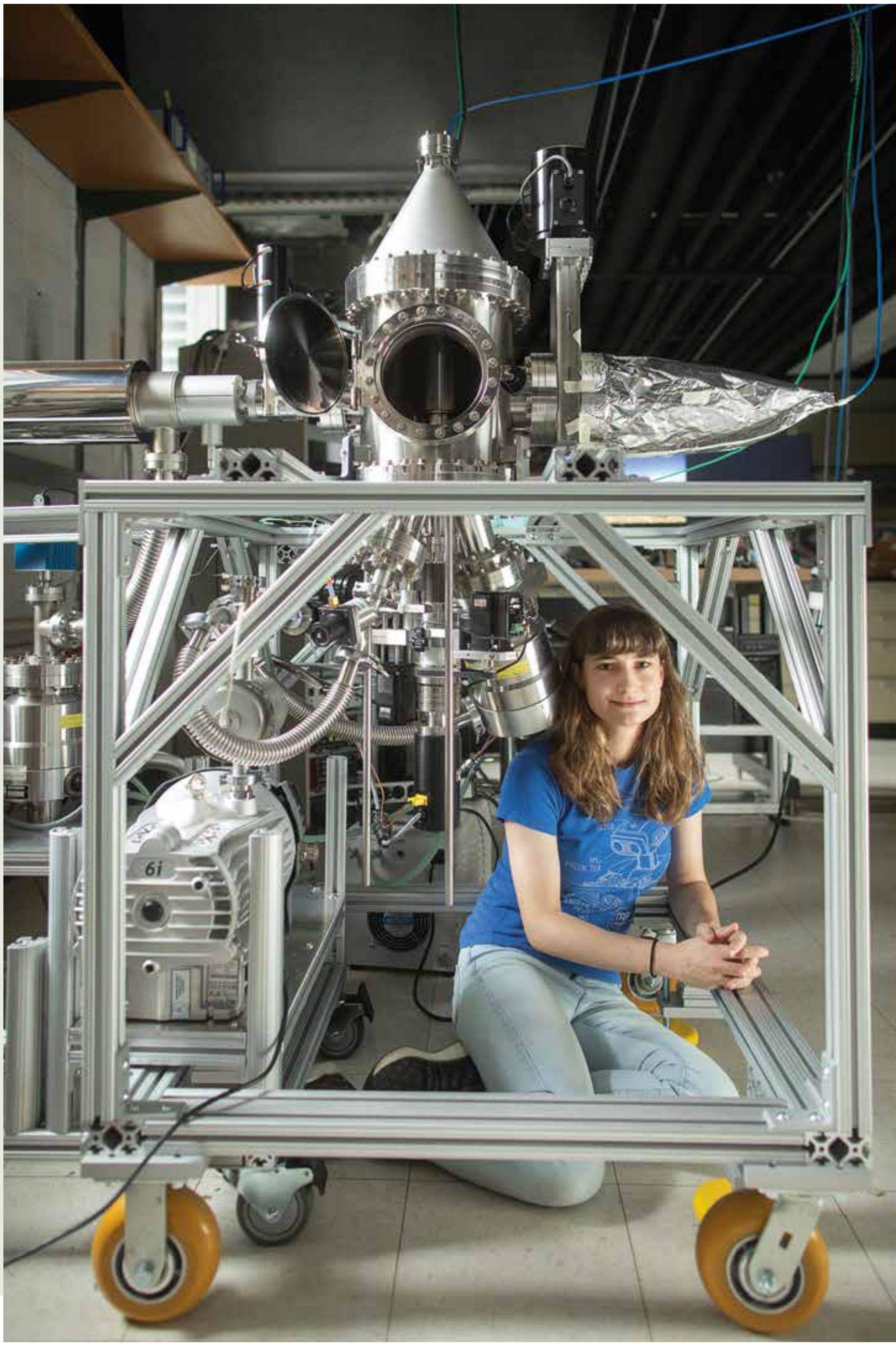
It was a rhetorical question. Howzen has never been the type to be stopped by anyone or anything. She loved solving puzzles and pushing boundaries, and the idea that she could take an idea from test to product to market sold her immediately on materials science.

She's stubborn, she says, and that trait has served her well in what she describes as the love-hate relationship with the machine that she has designed as part of her research. It's a 100-plus-pound atomic layer deposition chamber that resembles, in part, an old metal milk jug (her dad thinks so, anyway), and is used to grow films for electronics.

Howzen uses the machine's specific capabilities to study the surface science of ultrathin films used for semiconductors, with the ultimate goal of improving the efficiency and reliability of chips used in electronic devices such as computers and phones.

"This chamber is quite unique," she says, "there's only one other in existence." Which means when it doesn't work or it breaks, she can't turn to the literature or her advisor for solutions. And that's why she likens grad school to boot camp. An experience that tears you down, then builds you back up.

"When the machine failed or didn't work, I used to think, *What's wrong with me?* But I'm looking into a void that no one has looked into before. I'm the one gaining the knowledge. Now every time I look at my chamber, I feel immense pride. And also annoyance—because it's put me through a lot."



reply was, "Only that type of language is appropriate in engineering." There were no women's restrooms in Packard, so she had to wait until the men's room was empty and then recruit a male student to stand guard.

So, how in the world was she able to thrive in that environment?

"It's very hard to explain in today's culture, but I accepted it," she says. "It was not surprising. You expected to be treated differently as a woman."

Things did change, and Ota herself became an instrument of that change. After getting tenure in 1980, she began a long administrative career that saw her rise from assistant to the provost to interim provost to vice provost (with a couple dean appointments along the way). As an administrator, she had the power to change the culture.

She's particularly proud of implementing a maternity leave policy. Back in 1976, when her second son was born, she had taught on a Wednesday, delivered him the following night, and was back in the office full time by Monday (when, she says, she was met by a colleague who said, "It must be nice to be a woman, have a baby, and get a few days off."). As acting provost, Ota was interviewing a woman for a position, and when the candidate asked about the university's policy for new mothers, which was nonexistent, Ota made one up on the spot.

"That night, I went home, wrote a memo to the faculty, and said, 'Here's our new maternity policy,'" she says. "And no one questioned it."

Throughout the '80s and '90s, Ota became the point person who handled all instances of sexual harassment and racism on campus. She created the women's studies department, hired the first Black woman director of admissions, and was the first woman to receive the Hillman Faculty Award for lifetime achievement. By the time she left Lehigh for the University of Arizona in 1999, she saw women in leadership positions across the university, and a far more balanced ratio of female to male students. >>

ALUMNAE PERSPECTIVES

> "Why wouldn't you want a broader talent pool to solve the most challenging problems that we face? More women and diversity in engineering results in more approaches to problem-solving and, frankly, more success."
>
> —Judy Marks '84, President and CEO, Otis Worldwide Corporation

FROM DISASTER TO PERSONAL DISCOVERY

ALYSSA ARIZOLA '23, Civil Engineering major

The worst part of the blackout was not being able to get in touch with her professors. When Alyssa Arizola and her family lost power for three days during the deadly winter storm that hit Texas last February, Arizola thought, *They're going to think I'm skipping class. They're going to think I'm a bad student.*

"I was stressing out. I should have been doing my homework. I should have been studying. And I couldn't because I couldn't charge my laptop," she says. "I feel lucky that they were so understanding."

So understanding, in fact, that they asked her to join a research project looking at energy poverty and the failure of the Texas power grid. Specifically, she's exploring potential connections between socioeconomic status and the length of time communities went without power.

"Looking at how many people were without power and how long they went without it has been eye-opening," she says. "I realized that experience was a piece of history that we lived through." The project has been enlightening in other ways, too. Arizola had planned to pursue structural design, particularly of large houses, in part because she's got a serious creative side, but also because she's from a large family that's always lived in too-small homes in not-so-great neighborhoods. But now, she's increasingly interested in renewable energy and learning how to avert the looming crisis of climate change.

She's also discovered that she really likes research. "Before Lehigh, I used to think of research like, oh, that sounds so boring. Who wants to sit in a lab all day? But being on this project and seeing the work of the other professors in the department has definitely changed my perspective."

>> For other women engineering faculty in those early years, it was an entirely different experience. Helen Chan came to Lehigh as a postdoc in 1982 and joined the materials science faculty in 1986 as its first female professor. "I always felt it was a very welcoming place," she says.

There were little things. Like the time someone outside the university was sitting in on a faculty meeting and asked if she had made the cookies that were on the table. "I don't think he meant anything bad by it, but it's a little bit of an assumption, isn't it?" says Chan, who is now the New Jersey Zinc Professor in the Department of Materials Science and Engineering.

She does remember feeling grateful when the maternity policy went into effect, and the tenure clock stopped for female faculty. And it's a trivial example, she says, but when she was department chair in the fall of 2012, she achieved "potty parity" in Whitaker Lab. "It had just always struck me that we had five floors, and the only ladies' room was on the third floor," she says. "And by that point, we had so many more female students and female faculty. So I brought it up to the head of facilities who immediately responded with saying, 'We can take care of this.'" The university also added a lactation room.

The same year Chan became the first woman faculty member in materials science, Sibel Pamukcu became the first for the civil engineering department. She recalls Patti Ota as a driving force for change. "She was the one bringing more women not only into engineering, but into the sciences, mathematics, and physics—places where women traditionally were not on the faculty," says Pamukcu, who is now a professor in the department.

Like Ota, Pamukcu was used to being one of very few women throughout her academic career, and so being the first in her department wasn't all that unusual. And also like Ota, it took Pamukcu a long time to get comfortable in her position. But for her, it wasn't about enduring sexism and discrimination, but lacking the confidence to say no to her colleagues' many requests.

"I felt like I had to be loyal here and loyal there, rather than being loyal to myself," she says. "That happens to a lot of young faculty." >>

RESEARCH-INSPIRED ENTREPRENEURSHIP

SAREENA KARIM '22, Bioengineering major

If there's one thing that research has taught Sareena Karim, it's to have an open mind. Karim, whose mother has multiple sclerosis, had long targeted a career in regenerative medicine and tissue engineering. She came to Lehigh as a bioengineering major with an entrepreneurship minor, and as a RARE scholar. The Rapidly Accelerated Research Experience is a four-year program that provides students from backgrounds underrepresented in STEM with experiential learning opportunities meant to accelerate their development as scientists. As a sophomore, she began working with Lesley Chow, an assistant professor of bioengineering and materials science and engineering. Karim was part of the Chow Lab team designing tissue scaffolds that promote tissue growth when she had a lightbulb moment for her haircare startup, Foli-Q.

"My sisters and I are all mixed, and we've always struggled to find products that actually fit us," says Karim. "With Foli-Q, I analyze a customer's hair, and based on that analysis, pair specific ingredients for their hair's optimum health."

The company is currently in beta, and Karim is planning for a formal launch after she graduates. It's a path that never would have materialized without the research skills she developed in Chow's lab, and what she calls "idea thinking."

"Realizing that I want to run a business meant taking a step back from what I initially came to do, and figuring out who I am," she says. "I'm definitely a scientist and an engineer, but I'm a creative scientist and engineer."

'I GREW UP NOT KNOWING ANY WOMEN IN TECH'

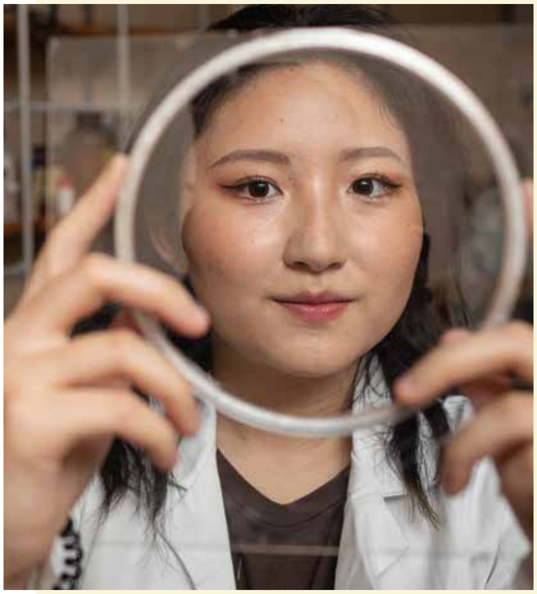
AMANDA BARAN '21, graduate student, Computer Science and Engineering

She loved all things tech, and when gadgets around the house didn't work, she was her family's go-to problem solver. So why not dive into computer science in high school? "It would have been a social death sentence," says Amanda Baran. "I came from a very traditional, small-town school where a girl doing computer science is not okay. We still had cooking classes that were all women."

So Baran started at Lehigh as a finance and accounting major. But during an internship in Prague, she realized that she really didn't care about the data she was seeing on her dashboard—she wanted to know what was going on *inside* her dashboard. So she switched to Computer Science and Business and started her master's research during her senior year.

She's now leading research in next-generation distributed synchronization protocols within Lehigh's Scalable Systems and Software Research Group. Together, the team is designing and building faster, more reliable ways to process data so consumers can get what they want, when they want it.

Baran loves the challenge of improving existing systems. And it's that determination and drive that carries her through the moments of doubt and imposter syndrome brought on by being in a male-dominated field. She came late to a discipline she loves, and sometimes, she says, her peers won't let her forget it. But she has professors who remind her that she is heard, she is seen, and she belongs.



‘IF YOU WANT TO PROVE SOMETHING, THEN GO FOR IT’

YIHAN HU ’22, Chemical and Biomolecular Engineering major

Had she ever been under the impression that women couldn’t be engineers? “Oh yeah,” says Yihan Hu. “I mean, I come from China, right?” She half laughs when she says it, but she means it. Her father’s parents were, she says, biased against girls. They weren’t happy that their son’s only child was female, and so they treated her differently. She remembers watching her grandfather give out red envelopes stuffed with cash to her and her cousins on the Lunar New Year. Her male cousins got more than she did.

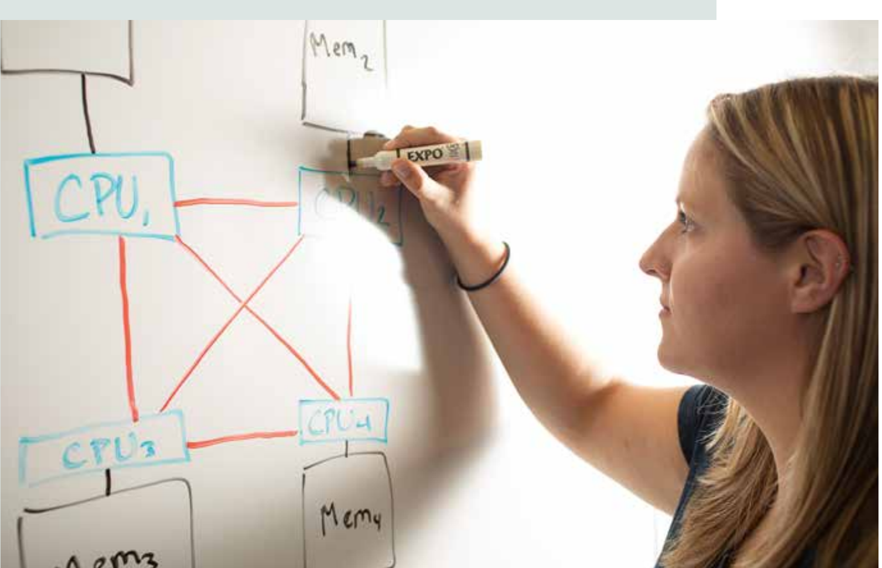
It wasn’t until she moved to the U.S. at the age of 14 and lived with her host family that she began to learn that girls didn’t have to stick to subjects like literature while boys did math and science. Her host mom in Pennsylvania had worked in a lab as a young woman, and she was always saying things to Hu like, *If men can do it, you can do it*.

And so she did. Hu is now researching techniques that can separate carbon dioxide from nitrogen in flue gas emissions from chemical plants. Specifically, she’s part of a team designing a polymer membrane that could present a cheaper, more efficient alternative to current CO_2 absorption methods. She loves the work, but even more perhaps, she loves feeling inspired and motivated by the female faculty around her. They embody a simple but profound message: *You can do this.* And so that’s what Hu would say, too, to any young woman struggling to find her way around the expectations of others. “You only live once,” she says. “You’re not living for your family. If you want to prove something, then go for it.”

ALUMNAE PERSPECTIVES

> “Embracing your differences doesn’t come without challenges, which is why inclusiveness is critical in every organization. But I encourage people to lean into it because there is value in distinction.”
>
> —Stacey Cunningham ’96, President, NYSE Group

Baran is also determined to be the role model she never had. She’s co-president of Lehigh’s Women in Computer Science, and until COVID-19 hit, she volunteered with TechGYRLS, a community program that engages 8-to-11-year-old girls in STEM activities. “I grew up not knowing any women in tech, and now as a student, having a lack of women to look up to is intimidating,” she says. “If you think of the big people in tech right now, it’s Jeff Bezos, Bill Gates, Elon Musk. It’s like, where’s my technical role model? I’m trying to change that for future generations.”



>> Fortunately, Pamukcu had an excellent friend and mentor in her department chair, Irwin Kugelman, who advised her on how to negotiate the gauntlet of academic demands.

Pamukcu’s experience has, by extension, now helped countless young faculty members, particularly women. In 2010, Pamukcu was part of a team that submitted a proposal for the National Science Foundation’s ADVANCE Institutional Transformation Grant. The overarching goal of the grant was to increase the number of women faculty in STEM.

It was a goal the university was eager to pursue. And in doing her research for the proposal, Pamukcu was surprised by just how low the institution ranked when it came to women STEM faculty. “We were way down in the lower percentile for universities of our size,” she says.

The team was successful. Lehigh was one of just seven recipients of the ADVANCE grant. Their proposal, “Building community beyond academic departments,” likely stood out, she says, because it recommended interdisciplinary research as a means by which women could meet each other across departments and colleges, form a community, and potentially work together on projects. >>

>> "At the time, it was very hard to bring about this sense of community. If a woman came to civil engineering, she would have felt pretty isolated, bound to her own labs and her own students," says Pamukcu. "We wanted to promote community through interdisciplinary research, through mentorship, meetings, and a variety of programs. Creating that environment would help us not only attract faculty, but retain them, and help them advance in their careers."

Lehigh ADVANCE pursued numerous goals over the five years it was funded by the NSF (it's now supported by the university): increasing women in STEM faculty positions; supporting their advancement; studying interdisciplinarity as a strategy for gender equity and leading national dialogue around that approach; and transforming the university's culture through policies and programs.

The program built a Women in Science and Engineering (LU-WISE) community that hosted regular formal and informal gatherings, created a mentoring network, held seminars and workshops focused on research and professional development issues, provided best practices and support to departments for recruiting, and reviewed policies around promotion and tenure to improve retention. >>

MODELING THE 'PERFECT' MENTOR

KAREN VAZQUEZ, PhD student, Civil Engineering

Being the first is hard, but it's nothing new for Karen Vazquez.

As a first-generation college student, Vazquez is determined to show young Latinas that they belong in the field of civil engineering. That the imposter syndrome and the insecurity they might feel can be overcome. And that there are engineers who look like them, understand their stories, and believe in their potential.

"I've always looked up to my mentors," she says. "And thinking about how I can potentially have that impact on someone else keeps me going."

Vazquez is part of Lehigh's Pasteur Partners PhD (P3) Fellowship program, and she is working with the nonprofit Gas Technology Institute on virtual energy districts. "We're trying to see if we can tackle issues like brownouts in California, so states can meet unexpected demand and people have energy."

While she's just starting the second year of her PhD program, Vazquez has already found in Shalinee Kishore, Iacocca Chair Professor of Electrical and Computer Engineering, the "perfect" mentor she intends to someday model.

"She's everything I want to be, a successful woman in engineering, a woman of color with a beautiful family. She's able to publish and present and still go to games and recitals. Seeing her do it all makes me think, *Okay, it* is *possible.*"

FINDING FASHION IN ENGINEERING

SARAH HORNE '22, Computer Science and Business major

"I have a very creative brain," says Sarah Horne. "I do a lot of sewing projects, and to me, computer science goes hand in hand with that mindset. You're creating a program with a specific end goal, and you have to piece together how you'll get there and what tools you'll need."

Horne, a creator of patchwork jackets and hats and T-shirt quilts made from high school and college spirit wear, always figured she'd have to give up—to some extent, anyway—her love for fashion if she were to pursue computer science. But when she landed a remote internship as a software engineer this summer at Gap, Inc., it changed everything.

"The internship opened my eyes to the fact that computer science can be applied to the retail space. And even though I'm not picking out the fabric or the collections, I still have a hand in a lot of the retail marketing. I love it."

Horne credits her capstone experience at Lehigh with giving her a meaningful edge over some of her fellow interns. That project involves developing a transportation app for a real-world client, and she didn't realize just how realistic the process was until she started the internship. She understood immediately how Gap ran their meetings, what was expected in a stand-up meeting versus a retrospective, and what it meant to be on a sprint timeline.

"I knew the goal of every meeting before my manager explained it to me," she says, "so it was just a really comfortable transition into the real world."

And a successful one. After she graduates, Horne will join Gap full time as a software engineer.

LEFT: KATIE KACKENMEISTER

>> Pamukcu co-directed ADVANCE until 2013 and then "handed the baton," as she likes to say, to Kristen Jellison, who now co-directs the program with Marci Levine Morefield, PhD, who works in the Office of the Provost. Jellison, now a professor of civil and environmental engineering, accepted the position because she knew from experience that the program works.

After becoming tenured in 2010, Jellison had a couple of really low years. "I was teaching new classes, running a research lab, advising students, and serving on lots of committees," she says. "I was up working until 1 o'clock in the morning, then up again at five with my kids. I was exhausted, drained, and had very low morale. And so I turned to ADVANCE."

She got involved with the community. She attended professional development workshops on time management, imposter syndrome, and work-life balance. She got tips and advice, support and encouragement. But most of all, she got validation. "You feel like something's wrong with you. Like, I just can't cut it. I'm not made to do this. Getting involved with ADVANCE changed my mindset, and made me realize that a lot of people were dealing with similar things, and that helped a lot."

Eight years into her tenure as co-director, Jellison has seen real change. In 2010, for example, 16 percent of Lehigh's tenure-track faculty in STEM were women. Now they make up about 26 percent. ADVANCE runs yearly workshops for search committees to ensure an equitable recruitment process, and their "toolkit" includes how to write job descriptions to diversify the pool of applicants, how to evaluate candidates in a way that minimizes or eliminates implicit biases, and how to treat candidates once they arrive on campus.

"We have seen big differences at every level of the process, from the makeup of the pool that makes the cut, to who gets invited to campus, to who is getting offers," she says. >>

OBSESSED WITH PROBLEM-SOLVING

NUSAIBAH ALQASAWAH, PhD student, Environmental Engineering

When Nusaibah Alqasawah was a kid growing up in Jordan, she wanted to know why there was so much pollution around her—in the air, in the water, on the streets—and what she could do about it.

She soon became "obsessed" with the idea that she could solve these pollution problems with environmental engineering. She earned undergraduate and master's degrees in the field before eventually moving with her husband to Bethlehem.

At first, he alone was the Lehigh PhD student, and Alqasawah was the mother of their one-year-old son. It was hard to think about balancing family life with grad school, but, remember, she was obsessed. And so she applied to the civil and environmental engineering graduate program and had her pick of multiple research positions. Today, her son is four, and she's in her second year as a doctoral student working with professor Kristen Jellison.

It's been a wild research ride. She started out studying the presence of *Cryptosporidium* in recreational waters. The microscopic parasite causes cryptosporidiosis, which leads to diarrhea and, in some people, serious illness. It can enter rivers, lakes, and streams through fecal matter runoff from nearby pastures. After the pandemic hit, funding for the project dried up, and she was crushed. But then Lehigh funded something similar: detecting COVID-19 RNA in wastewater, specifically in the effluent from the university.

It's an opportunity, she says, to contribute in a significant way toward early detection measures that could guide decision makers trying to control virus outbreaks. It is immensely rewarding work. The kind of work that would make her younger self proud.

"I think this is a very good thing that I can do for my community," she says. "I'm totally satisfied with my life."

ALUMNAE PERSPECTIVES

"It takes knowing your strength, knowing what you bring to the table and that you deserve a seat at that table, and networking with others, to succeed."

—Ricole (Edwards) Johnson '89, Engineering Project Leader–Product Development & Innovation, Boeing

>> As Jellison knows well, it's not just about getting more women on campus, but supporting them once they're here. To that end, they've expanded the reach of LU-WISE. There are now versions for undergraduates, graduate students, and faculty. Women faculty from across the university get together once a month for lunch, workshops, and guest speakers (during the pandemic lockdown, there were a lot of Zoom coffee hours). Jellison says she and her co-director Morefield poll the community at the beginning of the academic year for topics of interest and work hard to deliver that content at the monthly sessions.

They've also instituted a mentoring program, called INC, which stands for Interdisciplinary Network Committees. New professors are paired with a senior faculty member in their department, and with another mentor/mentee pair from another department. "This gives them a network of mentors," says Jellison.

They've run a couple of grant-funded mid-career mentoring programs and are working on establishing a permanent such program. They're also starting the conversation around criteria for promotion.

"The associate professor with tenure rank is where women take longer to get promoted to full professor because they're doing important, transformative service," she says. "Can we have a pathway to promotion where we recognize significant leadership in institutional efforts? Because if we don't promote that, people aren't going to do it, and what kind of institution would we have if everyone was hunkered down in their labs and no one was mentoring undergraduate students or running graduate programs or professional development programs or leading research centers? You need people who are going to contribute to the mission of the institution." >>

MERGING AVENUES OF CREATIVITY

ANDREA JONES '23, Arts and Engineering major (Mechanical Engineering and Product Design)

It all started with a sewing machine. Andrea Jones was 12 and she wanted to make pillowcases, but sometimes the needle jammed and the machine would just quit. So she'd take it apart, and after a while, she'd figured out the guts of the thing. Soon, she was making bags, skirts, and shirts. Her interest in solving mechanical mysteries and bringing ideas to life eventually led her to Lehigh's dual degree program in mechanical engineering and product design and an internship at Air Products. There, she was tasked with conceiving a new way to design heat exchangers for the transport of gas.

"I have to think about the materials I'm going to use, and what the end product will look like," says Jones. "It's a good example of how you need to be able to translate your ideas onto paper and present them in a compelling way to your managers."

She plans to go into industry after graduation, although which industry is another mystery. "With this degree, I have so many opportunities. I could get a job in mechanical engineering or in product design or in both," she says. "I'm excited about how I can use my knowledge from Lehigh, integrate it into the real world, and make the world better."

WORKING TOWARD PAIN-FREE MOVEMENT

DIANA HAMMERSTONE '20, graduate student, Materials Science and Engineering

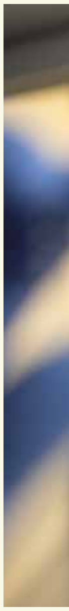
Diana Hammerstone is many things. As an undergraduate in the Department of Materials Science and Engineering (MSE), she was a Clare Boothe Luce Research Scholar and member of Lehigh's cross country and track and field teams. Now a graduate student in MSE, she is a President's Scholar and a National Science Foundation Graduate Research Fellow, and, when there's time, she volunteers as a running coach for the women's team. Hammerstone is also a published researcher: She is a co-author on a recently accepted paper on expediting the polymer printing process.

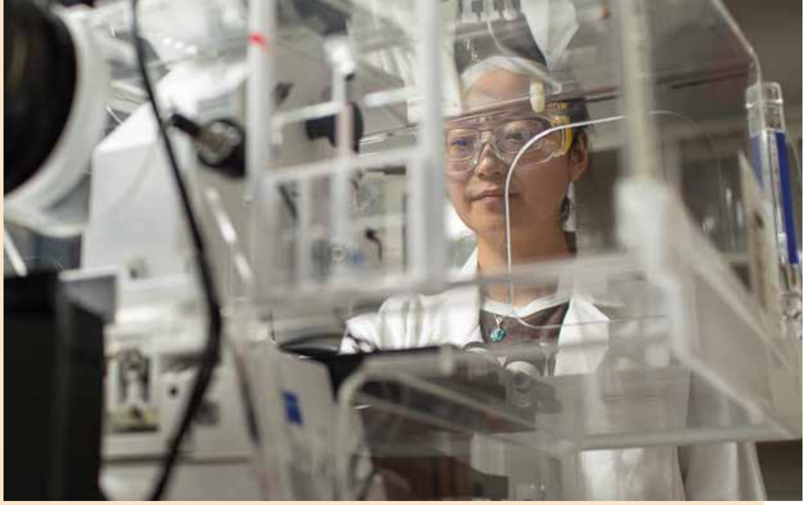
As a member of the Chow Lab, Hammerstone is studying how to regenerate cartilage in the knee using 3D-printed scaffold materials that guide the formation of tissue with the same properties as the native tissue. The ultimate goal is to intervene early in patients with osteoarthritis, before they require a knee replacement.

It's a path she hadn't foreseen. "I never envisioned myself being so closely tied to bioengineering. I didn't study a lot of biology in high school. But being part of this lab, and getting to work in an interdisciplinary field is really cool," she says. "I'm using what I learned in materials engineering to work with bioengineers to basically guide stem cells to do what we want them to do."

She's also not one to dwell on all the awards or recognition; if anything, they inspire her to work even harder. She wants to continue putting good data and good research out into the biomaterials community. And she wants to keep moving toward the day when her team's research can truly start changing lives.

"When people ask me about my work and I explain it to them, they say, 'Can you get that done faster? Because my knees are done now.' I say, yes, that's the goal. We'd like for people to never have to say that in the first place."





DEVELOPING THE FUTURE OF DRUG DELIVERY

NAN WU, PhD student, Chemical Engineering

Her dad was an engineer working with an oil company, and when Nan Wu was a kid, he took her to the factory. She learned how the place worked, and that she wanted to be an engineer, too. But she knew she wanted to work with a different material. Today, Wu works with Kelly Schultz, an associate professor of chemical and biomolecular engineering, and focuses on developing novel techniques to understand how hydrogels degrade in response to biologically relevant stimuli.

"Our work is looking at how to design these biomaterials as vehicles for controlled, sustained release of drug molecules to the target," she says. Essentially, ensuring that molecules get delivered to the right place, at the right time, with the right amount of the drug. Such efficient delivery could lower the dosage or frequency of meds or injections, she says.

To date, Wu is the author of four papers, one of which was recently featured on the inside front cover of *Soft Matter*. She plans to go into industry and continue working toward drug delivery technology commercialization. "To me, the most exciting thing about this research is that I can see how we can bring science to real treatment," she says. "Novel drug delivery technology development is urgent, and can help with a range of serious diseases, and potentially give patients options."

There is clearly important work to be done when it comes to increasing the number of women in STEM—and supporting them so they stay and build fulfilling careers. But much has been done since that day in 1971 when Patti Ota was met by her male colleagues and told she was unwelcome.

The idea that diversity is inherent to our success is no longer just a bullet point awaiting a check mark. Conversations have shifted, and there's a willingness to try new things. Jellison points specifically toward the college's creation of its Diversity, Equity, and Inclusion Council (see page 24), and its strategic plan to improve its policies and practices. And to the fact that diversity and inclusion is now a core value along every step of the search process, from job posting to job offer. That value system also now permeates the research groups, says Jellison, and increasingly, she's been asked to advise them on how to write proposals and form groups in ways that are more inclusive.

"We're starting to see that attention to diversity and inclusion issues on campus, which we would traditionally lump into service, is starting to trickle into teaching and research, and all that we do as faculty members," she says. "There's the recognition that when we talk about this, we're not just talking about changing the demographics of who is here, but we're talking about changing the way we do our jobs. Things are moving in the right direction."

SOARING TOGETHER: ABOVE AND BEYOND

Our pages couldn't hold all there is to showcase! Head to **engineering.lehigh.edu/soaringtogether** for more student stories, alumni interviews, and faculty profiles, including a special episode of the Rossin Connection podcast. Learn more about the university-wide celebration of Lehigh women and 50 years of coeducation at **lehigh.edu/soaringtogether**.

ALUMNAE PERSPECTIVES

> "Remember, no matter how much you learn or think you know, every single person in a room knows something that you do not know."
>
> —Jill Duerig '74, retired water utility manager

BY CHRISTINE FENNESSY

BREWING INTEREST

Chemical engineering can be intimidating. But a new student-designed class—open to all majors—serves up key concepts through the study of two everyday essentials: coffee and cosmetics.

She had to take a second after reading the email.

It was May 2020 when Veronica Meyer ’22 saw the message from chemical and biomolecular engineering (ChBE) professor James Gilchrist.

“He wanted to know if there were any students interested in doing something over the summer if their internship had fallen through due to COVID-19,” says Meyer. “He was basically asking us, how can we improve the ChBE program? As a student, you don’t usually get asked that.”

Soliciting that level of feedback was new for Gilchrist, too. But after the pandemic derailed so many internships, Lehigh instituted a virtual research opportunity for undergrads—and it got him thinking. His work on the fundamentals of particulate systems was too experimental for Zoom, but he didn’t want to miss out on tapping students for their expertise. “They have so much to offer,” he says.

The result was a focus group of students like Meyer who got a chance to do something they never imagined having the opportunity to do: conceive and design a new class for their peers. “Coffee and Cosmetics: Engineering of Consumer Products” is open to all Lehigh students and introduces the concepts of chemical engineering in relevant, relatable ways. It debuted virtually in Spring 2021 and is being held in person this fall.

Taking a fresh look

It’s safe to say that chemical engineering has an image problem.

“When I tell people my major, their first reaction is, ‘Are you sure you want to do that? How do you have a life?’” says Megan Walker ’22, who, along with Meyer, helped develop the course and served as a teaching assistant this past spring.

Part of the problem, says Gilchrist, is that the focus hasn’t been on making the material fresh and pertinent to students. On day one, he says, they’re shown a distillation column (a vessel used to separate liquids) and process equipment, and it’s just expected that they’ll memorize the equations and (eventually) grasp the concepts. “But as a consumer, you don’t interact with those things,” he says. “Historically, not much thought has gone into how to relate these ideas to things students actually use, like refrigerators and coffee makers.”

Gilchrist had already started addressing this relevance problem with the introductory chemical engineering course, which he co-teaches with associate professor Angela Brown. So it was top of mind after he assembled the student focus group last summer. As a team, they came up with several ways to improve the program. They started mapping out activities they

ISTOCK/PHIVE2015/NASTCO

could do with local schools and how to build a stronger social media presence. When Gilchrist mentioned a coffee course a colleague had started at the University of California, Davis—one that eventually grew into a research and teaching facility—the group loved the idea of creating a similar class. But they wanted theirs to have a broader scope.

"Of the 10 students, seven were women," says Gilchrist, "and they said, 'You must have cosmetics in here, it's such an easy way to connect with, well, everyone." Sure, the industry is more heavily marketed toward women, but products like deodorant, lotion, toothpaste, and shampoo are universal. "They came up with the idea of developing a syllabus and pitching it to the department as a new class."

The students split the course into separate sections on coffee and cosmetics, ending each with a project. They designed the class structure and the instruction sheets, homework, quizzes, and final projects. They came up with the grading criteria, too. They wanted the class to be accessible to all students, so all math, physics, and chemistry was high school level, and there were zero requirements to memorize and spit back equations on tests.

The group focused on developing modules and hands-on labs that would engage students' creativity. They also wanted to give them ownership over what they learned. To that end, they came up with using Google Jamboard, an interactive whiteboard, to kick off each section. The tool would allow students to identify and rank what it was about coffee (roasting, harvesting, extraction, environmental impacts, for example) that piqued their interest, and the lectures would be tailored to those topics. Final projects would be open-ended. They could do a case study or create a new product utilizing the principals they'd learned throughout the course.

"In engineering, you usually have a pretty tight curriculum," says Gilchrist. "We don't stop to ask, 'So what do you think about what you're learning?' I was floored by all the creative ideas they had about how we could teach better."

Stirring up discussions

When the students presented their syllabus to the ChBE faculty at the end of last year, "it was definitely nerve-racking," says Meyer. "I was a junior, so they were my professors."

But their pitch, done over Zoom, was a hit.

"They did a great job of explaining the benefits and why we should do this," says Brown. "At that point, the program didn't offer any classes to nonmajors." She says that people often don't know what chemical engineers do—"I didn't know when I chose this as a major," she admits—so the class gives students a chance to experience the discipline and see if it resonates.

The first Coffee and Cosmetics cohort included students majoring in finance, business, and chemical engineering, and since it was on Zoom, some high school students as well. TAs like Meyer and Walker were in constant touch with their student groups, guiding them through the class and asking for feedback.

And that feedback? It was overwhelmingly positive.

"The students really liked how the class was focused more on applications as opposed to memorizing calculations and taking exams," says Walker.

They also liked how accessible it was: "It was taught at a level that wasn't exclusive," says Meyer. "It was comprehensible to everyone, and they were excited to be learning about something they use every day."

It wasn't just the students who were learning. Because the focus group had designed the course, and because students in the class were following their own interests within the topics of coffee and cosmetics, Gilchrist found himself in an unusual position.

He says he "learned a ton," especially from the business majors as they presented ideas around the design and marketing of new products like tea bags for coffee, or coffee-infused wine, or cosmetics blended to a customer's specifications.

Their discussions about products often went beyond chemistry and biology to culture and diversity. For example, how the marketing of cosmetics is often centered around those with relatively pale skin. Or how socioeconomic factors can have a real impact on how students interpret some of those foundational engineering concepts, like the Bernoulli equation (the relationship between flow rate and pressure).

"I can lecture for two hours on something like that, but if I were to instead start by asking the students, 'Can you give me examples of where you see fluids moving very slowly or very fast?' there could be some culturally rich answers to a question like that," he says. "What I've learned most is to ask the students what *they* know, before I tell them what I know."

Coffee and Cosmetics is now underway in person, and Gilchrist hopes to add a competitive aspect (another of the focus group's ideas) that will have students vying for who can brew the best coffee and make the best lip balm.

For him, the genesis of the class and its rollout has been an inspiring, humbling, and eye-opening experience. And it's changed his perspective on what it means to engage his students, and by default, what it may take to attract more of them to this unique, varied—and yes, tough—discipline.

COFFEE (AND COSMETICS) TALK

Listen to our in-depth conversation with Professor Gilchrist in a new episode of the Rossin Connection podcast. Visit **go.lehigh.edu/rossinconnection** to download and subscribe.

TOP: ISTOCK/KAT-KA/S847; BOTTOM: ISTOCK/SUCHINAN

Star search

An out-of-the-box faculty recruiting approach opens doors to new professors who combine academic excellence with a commitment to advancing equity and inclusion

It was a quintessential "good problem" to have for Svetlana Tatic-Lucic, the Rossin College's associate dean for faculty development, and the individuals and committees involved in faculty hiring.

The pool of more than 800 applicants represented an unprecedented response to an unconventional approach to recruiting talent in unusual times.

"The pandemic caused most universities, especially large and state-supported institutions, to freeze their typical hiring cycles," says Tatic-Lucic, who has a joint appointment with the departments of bioengineering and electrical and computer engineering. "We saw this as a moment for Lehigh to follow a different path, an excellent opportunity to open our doors—when so few institutions did—to attract top scholar–educators in areas of critical importance."

Tatic-Lucic is also a chair of the Rossin College Diversity, Equity, and Inclusion Council. Formed in 2019, the DEI Council includes representatives from each of the eight engineering departments and a staff member. Tatic-Lucic has directed the group in conducting a historical review of the college's DEI efforts, identifying baseline metrics, and outlining objectives for creating and maintaining an equitable and just environment (the basis of a strategic plan adopted over the summer).

Those activities contributed to a university-level milestone: earning Bronze status from the American Society for Engineering Education's Diversity Recognition Program. Over the past two years, more than 120 institutions have been recognized by ASEE for making "significant, measurable progress in increasing the diversity, inclusion, and degree attainment outcomes of their programs."

Numerous DEI Council members helped facilitate the college's recent faculty search, which, Tatic-Lucic says, focused primarily on academic excellence, while also "putting particular emphasis on identifying new professors with passion and leadership experience around initiatives that help to create diverse, equitable, and inclusive learning environments."

The call for applicants was intentionally broad—not tied to specific disciplines or departments, nor level of experience or seniority. The evaluation process was inherently demanding, requiring multiple rounds of screening and interviews (conducted via Zoom in the midst of the pandemic) to narrow the sea of candidates down to a pool of the most promising. And the result—seven new faculty members (five of whom are either women or members of other historically underrepresented groups) with enthusiasm for DEI work—was unquestionably successful in advancing the college's strategic priorities.

The disciplines and research directions of these new faculty members range widely, from modeling, optimization, and resilience of interconnected infrastructure systems to novel material design strategies inspired by nature. There's also commonality in the high degree of interdisciplinarity in their envisioned research. (For example, one is a joint hire with Lehigh's College of Health.) Some are making the jump from postdoc to professor. All, says Tatic-Lucic, hold exemplary credentials and extraordinary promise.

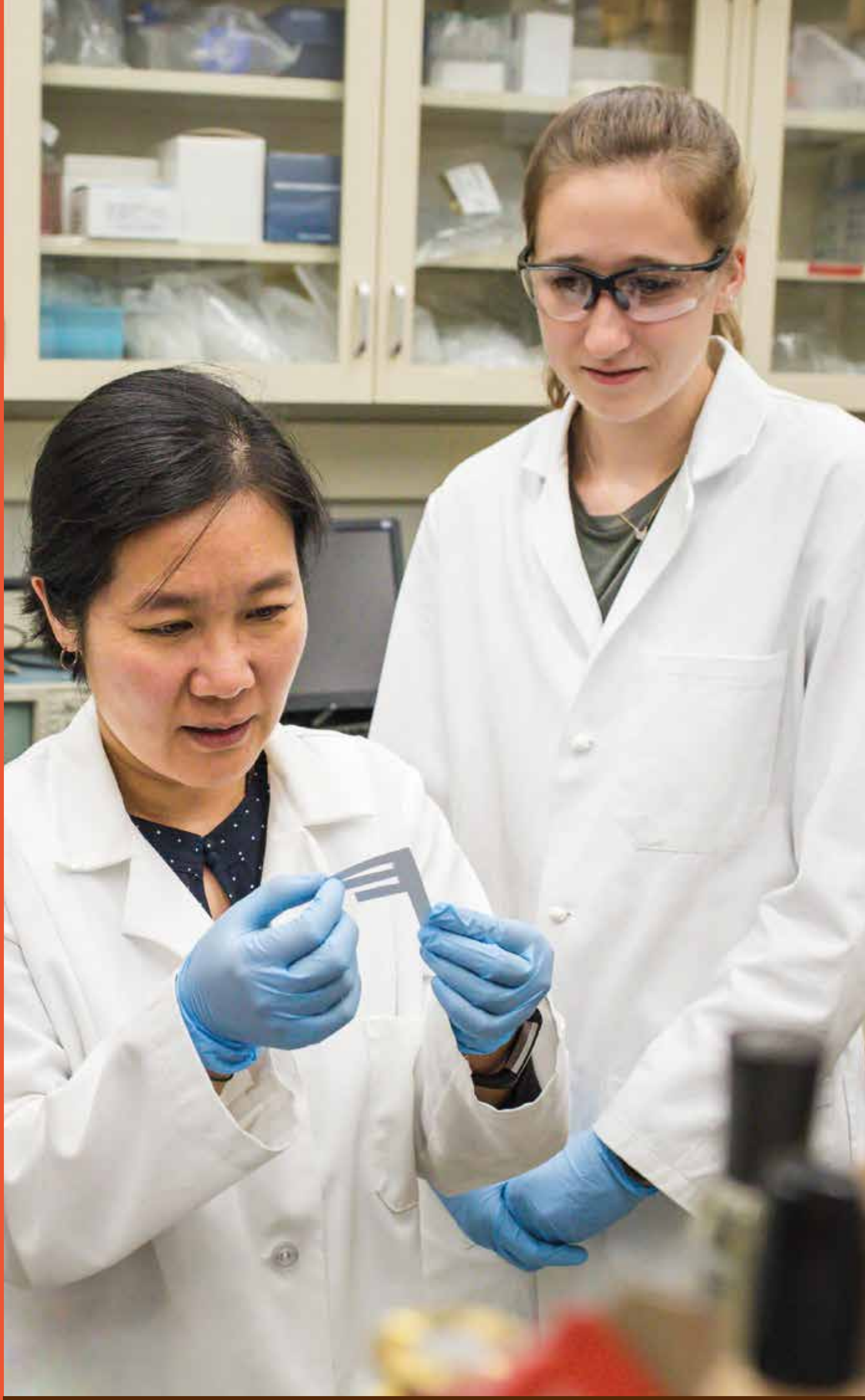
And, as prescribed, they share a passion for advancing diversity, equity, and inclusion in the academic setting. In some cases, the new professors have demonstrated their support for increasing representation in STEM by taking on leadership positions in student and young investigator sections of their professional societies. Others have focused on community outreach, tutoring teenage immigrants and motivating them to pursue college degrees, or volunteering with organizations that provide mentoring and other support for children and families in low-resource areas.

"Many of our new hires were inventive in the way they made a difference," explains Tatic-Lucic, "and, likewise, they have wonderful ideas on how to make an impact here at Lehigh, too." She points to a proposed initiative to increase representation of Hispanic and LBGTQ+ communities, as well as a suggested plan to secure external funding and promotion for research conducted by those who are underrepresented in STEM fields.

"We are inspired by the talent this search has delivered and we look forward to significant contributions from this group to our educational and research missions," says Stephen P. DeWeerth, professor and dean of the Rossin College. "Our department leadership, working with the DEI Council, seized an opportunity for broader visibility and interest amid a hiring cycle upended by the pandemic. The result has enhanced the diversity of our community in terms of representation and academic focus."

CHRISTA NEU

HELP OUR ENGINEERS SOAR



Backed by a heritage of innovation, collaboration, and leadership, Lehigh engineers make an incredible difference in our world.

Now, during the Soaring Together celebration of 50 years of undergraduate coeducation, we highlight the contributions of Lehigh women and renew our commitment to ensuring they are able to soar as high and as far as possible.

As part of **GO: The Campaign for Lehigh**, the university is raising $50 million for a wide range of initiatives that support Lehigh women, including:

- Endowed Scholarships
- Experiential Learning Funds
- Faculty Support
- Graduate Student Support
- Research Funding
- The Lehigh Fund
- And many more…

Let's GO! Take action now to support Lehigh women in engineering and STEM during this milestone year. Visit **lehigh.edu/soaringtogether** for more information on the celebration and how you can help Lehigh women of today and tomorrow reach their full potential.

Soaring Together

Celebrating Lehigh Women and 50 Years of Coeducation

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AN INCLUSIVE COMMUNITY

“I’m always asking students questions,” says Lehigh’s new president Joseph J. Helble ’82, a chemical engineering alum and former Dartmouth College provost. “I’m curious about what motivates them and finding common ground.”

See page 10