UNIVERSITY OF DELAWARE

ENGINEERING

MATERIALS SCIENCE AND ENGINEERING

SPRING 2023

MATERIALS MATTERS

CELEBRATING 25 YEARS OF MATERIALS SCIENCE AND ENGINEERING

INSIDE

Q&A WITH FOUNDING CHAIR, JOHN RABOLT

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GROWING OUR

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2023 U.S. NEWS & WORLD REPORT
GRADUATE RANKING

SPRING 2023

MATERIALS SCIENCE AND ENGINEERING NEWS

Materials Science and Engineering News is published for the alumni, friends and peers of the Department.

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DEAR MSEG COMMUNITY

I hope this issue of *Materials Matters* finds you well. As we emerge from the pandemic, this is a big year for the Materials Science and Engineering Department at the University of Delaware! We are celebrating our 25th anniversary as a department and the graduation of our first intrepid class of undergraduates. We are celebrating the successes of our faculty, including through our internationally-recognized research centers. The Center for Hybrid, Active, and Responsive Materials, our Materials Research Science and Engineering Center (sponsored by the National Science Foundation) and the Center for Plastics Innovation, an Energy Frontier Research Center (sponsored by the Department of Energy), are allowing us to address some of the biggest opportunities faced by society. These centers demonstrate our department's place in the upper tier of MSEG departments nationally, and MSEG faculty are leading the way.

Many of our undergraduates have experienced their time at the University of Delaware very differently than a typical college experience, but have flourished, and we are certain they will make us proud as they go out into the world. We believe the experiences we've given them in the lab and the classroom will serve them well. Our graduate program remains strong, with outstanding students from all over the country and all over the world, and they are continuing to be excellent ambassadors for our department. Truly, the outstanding research achievements from our labs would not have been possible without our excellent graduate students and postdoctoral scholars.

Since our last issue, we have brought in new faculty, staff, and students, and it is bittersweet to see the retirement of several of our senior faculty. We are grateful for their contributions to the department. While we are continuing to adapt to a changing world and continuing to make sure we are an inclusive community that respects and celebrates the myriad different backgrounds of our people, we appreciate the history of our department focusing on equity "before it was cool." Day-to-day interactions with these Titans of Materials will be missed, though we are pleased that several will remain actively involved in the department. At the same time, we look forward to a "Springtime" for the MSEG department, as new opportunities emerge to bring in even more outstanding faculty, staff, and students and to continue our trajectory of working collaboratively to make new discoveries and engineer solutions to important problems. We welcome you to catch a glimpse of this through this issue of *Materials Matters*.

JOSHUA ZIDE

DEPARTMENT CHAIR
& PROFESSOR

DIRECTOR,
UD MATERIALS
GROWTH FACILITY

ASSOCIATE EDITOR,
JOURNAL OF
VACUUM SCIENCE
& TECHNOLOGY

@JOSHUAZIDE

John Rabolt shares his remarks at the Materials Science and Engineering 20th anniversary celebration at Harker Lab on May 12, 2018.

MATERIALS SCIENCE AND ENGINEERING:

Evolution, Revolution or Back to the Future?

A Q&A with founding chair John Rabolt

John Rabolt, founding chair and Karl W. and Renate Böer Professor, played an instrumental role in establishing UD's materials science and engineering department.

After working for 20 years at IBM Research in San Jose, California, Rabolt was recruited to UD in 1996 and brought his vision of what a 21st century materials science department should look like. With this forward-looking approach, he created a department that focused on interdisciplinary research, avoided traditional materials silos (e.g., metals, ceramics, semiconductors, etc.) and focused its curriculum on modern materials.

Here, Rabolt provides his reflections on 25 years of materials science at UD, what he is most proud of, and how the department is positioned for future success. →

Q: You came to UD with the goal of creating a modern materials science department. How did you and other founding members of the department help make that a reality?

Rabolt: When we were initially forming the department in 1998, we did not want to be a traditional material science department where everyone is separated into research silos.

Instead, I and Mary Galvin, who was the first person I hired and is currently the Dean of Sciences at Notre Dame, built the department with interdisciplinary areas. We knew that if we wanted to be a 21st century department, we needed to be interdisciplinary from the start.

When we first started, we had four areas of expertise, and we thought that if we recruited faculty who had a foot in at least 2 areas, it would prevent those silos from forming. Now, the science has evolved into more than 4 areas, and there's new areas like nanostructures, biomedicine, and photonics, things that we couldn't have predicted would be major areas 25 years ago.

Q: What are the biggest strengths of UD's materials science & engineering department?

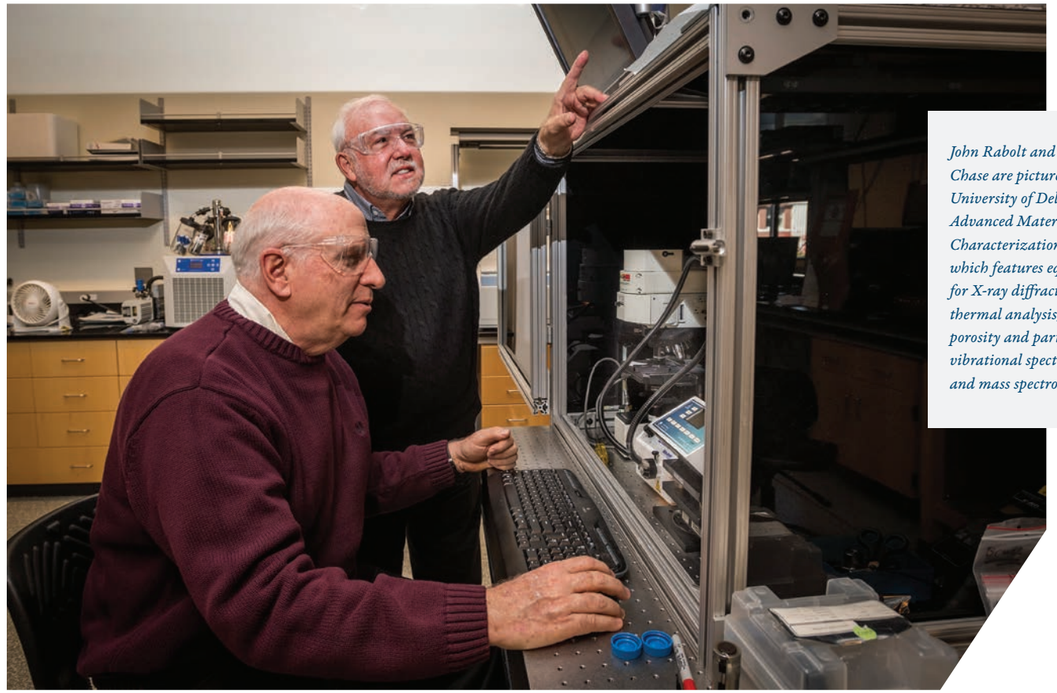
Rabolt: Definitely our culture and our faculty and student leadership potential.

Since we built the department 25 years ago, we've only lost two people, which is amazing for any department. And our faculty stay here because of that strong culture: We like each other, we talk to each other, and we just enjoy working together towards common goals.

One of the things I would do when we were first hiring faculty is the "move the desk" test—We'd go through their research expertise, what they were going to need to start a faculty position, what courses would they teach and then I would say 'We're a new department, if I came to you on a Friday and said I need you to help me move some desks, would you be okay with that?' The answers would really tell me a lot about their personality and their commitment to be a "team player." Surprisingly, some candidates indicated that their research was too important for them to spend time moving desks... *They are not faculty in MSEG at UD!*

In terms of leadership, our department has a lot of great leaders. In addition to our chairs, we have people leading major research centers: Matthew Doty as the Associate Director of the UD Nanofabrication Facility, Joshua Zide leading the Materials Growth Facility (and also our current chair), and LaShanda Korley as the Director of the Center for Plastics Innovation CPI and Co-Director of the Center for Hybrid, Active, and Responsive Materials, to mention a few.

Overall, as a department Mary and I removed barriers so that our faculty could be as great as they could be, both in terms of leadership as well as in science and engineering.



John Rabolt and D. Bruce Chase are pictured in the University of Delaware's Advanced Materials Characterization Lab, which features equipment for X-ray diffraction, thermal analysis, porosity and particle size, vibrational spectroscopy and mass spectrometry.

Q: Talk about what went into developing the courses offered by the department.

Rabolt: When we were defining the basis of our department, we got all the faculty together who were teaching in the previous Material Science Program. As we were trying to decide which courses to keep and which ones we needed to develop, Giuseppe Palmesi (now at Drexel) had a great idea to turn our thinking around and instead list the technical competencies and professional competencies we wanted a materials science student of the 21st century to have.

We came up with a list of technical competencies, and I said that we needed soft skills, so we also developed a list of professional competencies, like the ability to analyze data, be entrepreneurial and how to think critically. With these two lists, we could easily go through, look at our desired competencies and see if each course fit or not, and if there were no courses that fit, we created it.

That's also where the "High Tech Entrepreneurship for engineers" course came from, because that was a key soft skill, so I and Scott Jones from Lerner co-developed the course in the late 90s. And because I came from industry and grew up professionally in Silicon Valley, entrepreneurship was something unique that I realized I could bring to UD.

In that course we cover every aspect of starting a small company: Marketing, competition, customer discovery, IP and patents, and legal issues. I initially taught the course with Gonzalo Arce from Electrical and Computer Engineering and Scott Jones but for the last 5+ years Rick Martin from ECE has been the third co-instructor. We just taught our 25th course last fall.

I'm also teaching "Career survival outside the University," this semester, which includes topics like comparisons between university and industry cultures, ethics and accountability, leadership versus management and how to interview for academic and/or industrial positions. The course helps students see what the next 5 or 10 years at a company are going to look like—a lot of the lessons you learn in industry are painful, and you don't want everybody going through that experience if you can give them a heads up instead.

Q: What are you the proudest of from your 25 years here at UD?

Rabolt: The quality of our students, first our graduate students and now the undergraduates.

The competition is tough out there, but within the first few years of the department, graduates would choose us over other places because we carried a reputation of teaching practical materials science that had a "real world" impact thanks to the original faculty's roots in industry.

In addition, our students know that not only would they get information about the materials themselves, but how it all fits together in a system, e.g., a cell phone. This systems approach is not only a good way to teach students about different concepts, but also how things happen in industry.

Q: What do you hope to see in the next 25 years?

Rabolt: I hope that the culture we established is sustainable—I think right now we have the momentum to do so. In addition, our faculty leadership is mid-career, which will help develop the next generation.

I would also like to see our department lead more multi-user grants, such as Engineering Research Centers, while ensuring that the proposed projects keep a broad view of what is good for the department.

I'd also like to see the department set up a rainy-day fund and work more with development. That way, we have support during low funding cycles, funding for named professorships, and undergraduate and graduate fellowships. This would provide a sustainable budget model for the foreseeable future.

BIOELECTRONIC INNOVATIONS, EMPOWERED BY CHEMISTRY

Thanks to a National Science Foundation CAREER award, Laure Kayser, an assistant professor in the College of Engineering's Department of Materials Science and Engineering, will be conducting fundamental research on a new class of polymers that could pave the way for future applications in human health.

UD Professor Laure Kayser received an NSF CAREER award to further her group's materials science research

Whether it's a smartwatch that can detect irregular heartbeats or a continuous glucose monitor, electronics that can interface with biology have already started to revolutionize the future of healthcare. But while the potential of these devices is far-reaching, the materials that make up future bioelectronics have to meet several different criteria — such as not causing damage or irritation to skin and avoiding toxic metals, for example.

Creating new organic, biocompatible materials that can interface with living systems is Laure Kayser, assistant professor in the Department of Materials Science and Engineering at the University of Delaware's College of Engineering. Now, thanks to an award from the National Science Foundation (NSF), she and members of her lab will continue their fundamental research on a new class of polymers that could pave the way for future applications in human health.

The Kayser Lab specializes in designing, synthesizing and characterizing new plastics and polymers that can conduct electricity while safely interfacing with living systems. By working at the intersection of chemistry, polymer science and materials engineering, her lab is able to develop innovative design and synthesis approaches for creating new types of plastic materials.

Kayser, who holds a joint appointment in the Department of Chemistry and Biochemistry in the College of Arts and Sciences, said that what sets her group apart from others in the field of organic bioelectronics is a strong foundation in organic chemistry and their ability to make any material they want instead of only being limited to what's currently available.

"We do modern chemistry, including chemistry that is not necessarily typically used in the field, and apply it to materials science," said Kayser. "Because we have a background in chemistry and synthesis, we can make any material, characterize it, establish structure-property relationships and tailor it so the material can be interfaced with biology."

Design rules for electronic highways and ionic waves

Starting in July, Kayser's group will be investigating a new type of organic bioelectronic material. With a five-year, $654,206 Faculty Early Career Development Program (CAREER) award from NSF, her lab will study the fundamental properties of polymers that have properties inspired by living systems and also meet the criteria for being able to be incorporated into bioelectronic devices.

For this project, the lab will be studying derivatives of PEDOT:PSS. This polymer belongs to a class of materials known as organic mixed ionic electronic conductors, which have the unique ability to conduct both electrons and ions.

This is a necessary yet difficult to achieve property for bioelectronics: Typical electronic devices, such as laptops or cell phones, use electrons to transmit signals, while systems in biology, such as nerves, use ions. This difference in communication methods makes it difficult to "translate" signals from electronic devices into ones that a cell or organ can interpret.

There are also engineering challenges in creating this class of materials, Kayser explained. "There are very different design rules whether you want a material to be an electronic conductor or an ionic conductor," she said. "For example, electronic conductors are very well ordered — like a highway for electrons to travel down. But if you want to make a good ionic conductor, ions usually like to be on a floppy, almost liquid environment, so more like a wave."

Members of the Kayser lab, including doctoral students Chun-Yuan Lo, Vidhika Damani, Dan My Nguyen, and Elorm Awuyah, were instrumental in getting preliminary results for the proposed research. The team recently published a paper in Polymer Chemistry (which was also featured on the journal's May 21st 2022 cover), where they determined the role of different chemical properties in PEDOT:PSS and how they could be changed to make the material more efficient in bioelectronic devices, a key finding that showcased how the group's expertise in this field could be applied to PEDOT:PSS. Through the CAREER award, the lab will continue studying derivatives of PEDOT:PSS to gain a solid, fundamental understanding of how to control both electronic and ionic conduction. The long-term goal is to develop design rules for fabricating bioelectronic devices with this class of materials in the future.

"Our lab's focus is to understand deeply how chemical structures affect the electronic properties of those materials," said Kayser. "Through this grant, we're going to learn a lot about these materials — some of these ideas might fail, but we'll learn something along the way."

Materials science outreach and education

With this CAREER award, Kayser will also be leading different outreach and educational initiatives for both high school students and undergraduates.

Part of this work will include connecting with female students at local high schools. This will be done through both a materials science-focused outreach program as well as a mentorship program, where graduate students and senior undergraduate students will be paired with high school students to provide support throughout the college application process.

Kayser will also be working with Sheldon Hewlett, an assistant professor who leads instruction and teaching in the materials science and engineering department, on integrating research into undergraduate curriculum. With support from the CAREER award, junior year materials science students will conduct a polymerization of PEDOT:PSS, including synthesis, purification and characterization, as part of a laboratory module. There will also be opportunities for students to address additional research questions during the course module, as well as funded research programs for those who are interested in carrying their work into the summer.

Along with introducing students to the process of polymerization, Hewlett added that this project will allow students to work with a class of materials in a laboratory course that they are likely to encounter in their career. "Not only will this award give us an opportunity for students to do real research, but it also provides students with a novel material system to work with," said Hewlett. "You don't see a lot of lab courses working with these polymers at this level — of making a material from start to finish, and then characterizing it afterwards."

Making new discoveries through 'great fundamental science'

"Chemistry will be central to the discoveries that Laure Kayser's research group will advance on plastics and other polymeric materials through this NSF CAREER award," said Joel Rosenthal, professor and chair of the Department of Chemistry and Biochemistry. "Rather than simply tweaking or studying materials that already exist, the Kayser lab is adept at leveraging synthetic chemistry to discreetly control the composition, and by extension, the properties of new polymers for various applications, including bioelectronics. I'm incredibly excited to see how her group's work will continue to develop over the next several years."

Joshua Zide, professor and chair of the Department of Materials Science and Engineering, added, "Professor Kayser is a fantastic contributor to the Materials Science and Engineering Department, and we are lucky to have her. Her research translates the chemistry to myriad important applications, and the perspective she brings is a huge benefit to the whole department."

While Kayser is excited about the potential of her research to potentially impact a wide range of applications and fields, she is also looking forward to the "great fundamental science" that this CAREER award will enable her group to do.

"It's a relatively hot area that is going to continue growing, so it's a good place for us to be leading the pack," she said. "I'm hoping that by learning more about the fundamentals of these materials, it might inspire others to explore different molecular designs and how they can be translated into devices. Overall, I think we're going to make lots of really cool discoveries."

FINE-TUNING TOUCH TECHNOLOGY

UD's Charles Dhong gets $1.9 million to develop new tactile aids

Charles Dhong and his research team at the University of Delaware are studying the mechanical forces that affect the perception of touch, aiming to develop new tactile technologies.

Their research has shown that humans can feel tiny differences in a surface, down to the substitution of a single atom.

Bumps and lines make up touch-based technology such as Braille. But the human sense of touch is keen enough to detect differences that are much smaller. Research by Charles Dhong and his group at the University of Delaware has found that humans can feel differences in the chemical composition of a surface, down to the substitution of a single atom.

That ability is one focus of Dhong's work as an assistant professor in the Department of Materials Science and Engineering and the Department of Biomedical Engineering at UD. He explores new possibilities for tactile technologies and the mechanical forces that affect the perception of touch.

Dhong presented research on this at the American Chemical Society's national meeting in San Diego on Wednesday, March 23, 2022. And he and collaborator Jared Medina, associate professor in UD's Department of Psychological and Brain Sciences, have new support for development of higher-quality tactile aids for people with visual impairments. The $1.9 million grant, which started in February 2022 and continues for five years, is from the National Eye Institute in collaboration with the National Federation of the Blind.

Current technology recreates tactile sense using tiny motors and electricity. But the bumps and buzzes they generate are not that good at mimicking the real thing.

A new approach to controlling perception of texture could have many applications, Dhong said. It could make it possible to design new types of surfaces or provide improved integration of the sense of touch into virtual reality environments. It could also improve existing devices, such as Braille displays, or provide feedback to surgeons conducting surgery remotely.

"When you touch an object, you're feeling its surface, and you can change how it feels by changing the friction between that surface and your finger. That's where the chemistry comes in," Dhong said. "We think materials chemistry could open the door to recreating more nuanced sensations, whether you're designing a product to feel a certain way or creating feedback devices for virtual reality."

Other human senses have had much more attention in today's technology. Visual features are highly refined in computer monitors, smart phone screens and virtual reality headsets. Audio devices, too, recreate voices, music and other sound in high fidelity.

Progress in touch technology has lagged, in part because it involves multiple types of sensations, such as temperature and pain. In addition, some efforts to recreate touch have included systems designed to simulate a sense of moving one's body — a complex sensation.

Dhong's research focuses on a specific type of touch: using the fingers to detect fine textures. Some methods for evoking this kind of fine touch are already available. Your smartphone attracts your attention without sound, using a tiny vibrating device within. A refreshable Braille display for people with low vision or blindness uses an actuator to move pins up to create bumps.

This type of touch depends on a physical force — friction — which is the resistance that skin encounters as it brushes against an object. While attributes such as the contours of a surface influence friction, so does chemistry. The structure of the molecules within a substance and the properties of its surface also influence the sensation.

Dhong and his colleagues suspected that by altering only chemistry-related features, they could change how a surface feels.

In previous work, Dhong's team asked people to touch single-molecule-thick layers of silane, a silicon-containing compound. None of the silane surfaces possessed detectable differences in smoothness.

But those who touched the surfaces could differentiate them based on chemical differences, including the substitution of one atom within each silane molecule for another, because of subtle changes in friction.

"Recent research has shown that people can detect the physical differences between surfaces at a resolution as low as 13 nanometers," Dhong said. "Now we are saying that the sense of touch can also identify chemical changes as small as swapping a nitrogen atom for a carbon atom."

In San Diego, Dhong presented recent work focusing on polymers, the go-to molecules for synthetic materials. Polymers are distinguished not only by their chemical formulas, but also by a characteristic known as crystallinity, which describes how neatly the chain-like molecules are organized. The polymers in these experiments had identical formulas and molecular weights. Only the degree of crystallinity differed.

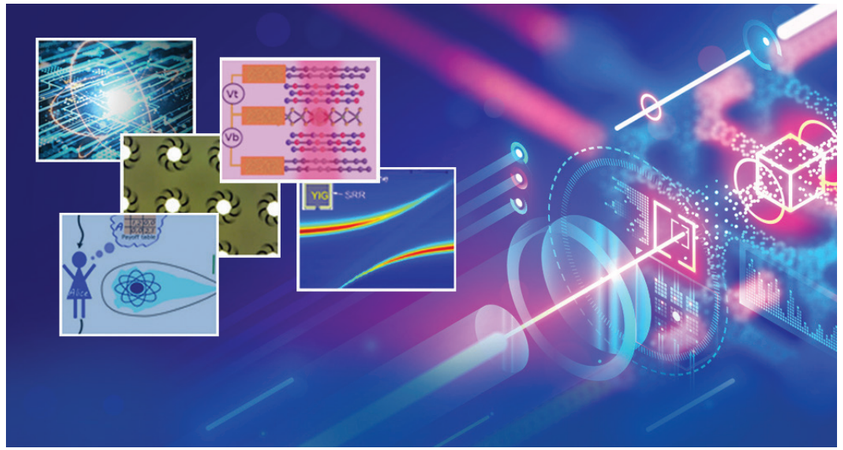
In their experiments, the researchers focused on the perceived texture of thin layers of polymers. As with the silanes, they asked the subjects to slide their fingers across the polymer. This time, too, they found that people could differentiate between the polymers based only on variations in the friction resulting from subtle changes to the crystallinity of the molecules.

About the researcher

Charles Dhong, assistant professor of materials science and biomedical engineering in the College of Engineering, joined the University of Delaware faculty in 2019.

He earned his bachelor's degree in chemical and biomolecular engineering at the University of California, Berkeley, his doctorate at Johns Hopkins University and did postdoctoral research in nanoengineering at the University of California, San Diego.

His research focuses on understanding the mechanical forces that shape the human sense of touch.



QUANTUM COMPUTING WORKFORCE

New graduate program puts UD in select company with in-demand degrees

The interdisciplinary program in quantum science and engineering leverages the talents of diverse experts and is housed within UD's Graduate College.

It's a Sunday morning in the fall, and you have four stops to make before your guests arrive to watch the Eagles game. You just found out your friends are bringing their friends, so you have to hit a grocery store to buy more food. Also, the propane tank for your grill is empty. You need to pick up your blood pressure medication at the pharmacy — especially since today's opponent is the Cowboys, as well as because of the wings of fire you are planning to cook — and supplies must be purchased for your kid's science project that is due tomorrow. You're running out of time, so what is the quickest order in which to make these stops?

Otherwise known as the traveling salesman's problem, to figure this out you need to calculate the most efficient of 24 distinct routes. Sure, you can run through all the combinations on your favorite mapping app, but what if you have to add a stop at the pet supply store too? Now there are 120 potential routes. Soon, thanks to quantum computers, strategizing to-do lists like this can be simplified.

"There are a number of types of computations where quantum computers can outperform classical ones," said Matthew Doty, professor of materials science and engineering at the University of Delaware and program director of UD's new interdisciplinary Quantum Science and Engineering program. "The only way a standard classical computer can solve the traveling salesman's problem is to run through all the permutations, calculate how long it takes for each, and then give you a rank-ordered list from fastest to slowest. A quantum computer can find the fastest solution in one pass."

Classical computers, like the chips in our phones or laptops, are binary logical devices that encode information in bits representing states of 0 or 1. In contrast, quantum computers use qubits that can simultaneously be "partly 0" and "partly 1." This ability to exist in more than one state at the same time is known as a superposition. When you add conditional interactions between the qubits, the superposition states of each qubit become entangled, which essentially means that the state of one depends on the state of another. This effectively leads to a massively parallel processing of all of the possibilities, and thus the computational power increases exponentially with the number of qubits. As a result, quantum computing is significantly faster and more powerful than classic computing for complex problems.

Numerous technological applications

Quantum technology can greatly impact countless sectors, including transportation and logistics, materials discovery and drug development, artificial intelligence, financial services and manufacturing. A personal errand list may not be so daunting, but think of the delivery service making 10 stops while optimizing the best of more than 3.6 million potential routes.

The ideas of quantum computing largely developed within physics departments. Doty said a major disconnect in the training of the workforce needed to develop quantum technologies is that physicists are generally not trained to think in terms of scalability and reliability. Engineers, on the other hand, tend to be extensively trained in scalability and reliability, but not in the principles of quantum information science.

"The biggest need of the industry is people who are trained somewhere down the middle with enough quantum science technical background from the physics point of view to be able to understand what they need to do and why it matters for the purposes of this technology, and also enough engineering education to be able to think like engineers in terms of scalability, reliability and programming," said Doty.

Rampant growth expected

Doty, whose doctoral research focused on materials that could be used for quantum computers, said quantum technology is exploding, and his prediction is heavily supported. A report by Fortune Business Insights, "Quantum Computing Market, 2021-2028," said the global quantum computing market is expected to grow from $486.1 million in 2021 to $3,180.9 million in 2028, which equates to a compound annual growth rate of 30.8%.

"An industry growing at over 30% per year is just unbelievable," said Doty. "IBM, Microsoft, HP, Northrop Grumman and Google all have big quantum initiatives, as do many smaller businesses and startups as well. This is a huge new technology that is growing really fast."

In need of skilled workers

With this growth comes a demand for workers, and McKinsey Digital's June 2022 "Quantum Technology Monitor" cites a dearth of available talent. The report noted that quantum technology job postings in 2021 outpaced qualified talent by nearly 300%. Recognizing this need, the University of Delaware introduced its master's and doctoral degrees in quantum science and engineering late in 2021 and is in select company. Harvard University and the University of Chicago are the only other U.S. universities offering a doctorate in the field, and there are only about a dozen institutions in the country offering a master's degree in quantum technology.

"There is a strong market for employees coming out of both the master's and Ph.D. pipelines," Doty said. "Our program is designed to train a quantum workforce with the skills needed to realize this technological revolution. As we were developing the program, we met with a lot of industry people, and they all told us they have a hard time finding enough workers for the positions they have."

STEM students welcome

With a curriculum designed to rapidly introduce students to the fundamental concepts of quantum mechanics and quantum information processing, as well as establish a shared vocabulary and knowledge base that accelerates collaboration across disciplines, the program equips students with the professional skills required for in-demand career opportunities expected to increase exponentially. Maximizing hands-on, project-based learning, students are trained to use state-of-the art equipment ranging from semiconductor nanofabrication tools to high performance computers.

Featuring faculty representing physics and astronomy, mathematics, computer and information sciences, and several engineering concentrations, the interdisciplinary program in quantum science and engineering leverages the talents of diverse experts. With much of quantum technology yet to be discovered and developed, Doty said nobody knows the rules yet, and students in the program need to have curious minds, a willingness to work hard and invent new things, and an ability and desire to embrace teamwork.

"We designed the program to be open to people coming from a wide range of STEM [science technology, engineering and mathematics] backgrounds, so you don't already have to know quantum mechanics," Doty said. "You don't have to come out of a physics program and know exactly what quantum mechanics means. You will take a quantum science course with us in the first semester and we will teach you what it means."

To get students on-the-job experience, expose them to the work being done in the industry and help them get a foot in the door for later employment, internships play a significant role in UD's program. Students in the first class are interviewing for summer 2023 internships with several major companies.

Quantum technology coming soon

Doty said quantum computing will gradually become part of our everyday lives. Though the devices we carry with us, like phones and laptops, will likely continue to be based on classical computing technologies, IBM and other companies are already offering cloud-like services to solve specific problems with quantum computers. That outsourcing of the hardest parts of a calculation is likely to expand and become increasingly integrated into apps.

While quantum computing is likely the best known quantum technology, other facets include quantum sensing, which can be applied in a variety of ways to make a much more sensitive probe of the environment, and quantum key distribution, a fundamentally secure way of transmitting information.

"Quantum technologies are already in use, and fields as diverse as financial services to bioimaging are trying to figure out how quickly they will expand and how they can be best utilized." Doty said.

UD'S LASHANDA KORLEY APPOINTED U.S. SCIENCE ENVOY

Esteemed engineer to travel the world to advance science and technology cooperation with U.S.

LaShanda Korley, Distinguished Professor of Materials Science and Engineering and Chemical and Biomolecular Engineering at the University of Delaware, has been appointed a U.S. Science Envoy for 2023. The announcement was made by the U.S. Department of State on Tuesday, Dec. 6. 2022.

Through the Science Envoy Program, eminent U.S. scientists and engineers leverage their expertise and networks to forge connections and identify opportunities for sustained international cooperation, championing innovation and demonstrating America's scientific leadership and technical ingenuity.

Korley is among seven distinguished scientists who began service as U.S. Science Envoys in January 2023. Like their 23 predecessors, these esteemed scientists are approved by the Secretary of State and will engage internationally at the citizen and government levels to enhance relationships between other nations and the United States, develop partnerships and improve collaboration.

According to the U.S. Department of State, Science Envoys leverage their international leadership, influence and expertise in priority countries and regions to advance solutions to shared challenges. They travel as private citizens and help inform the State Department, other U.S. government agencies and the scientific community about opportunities for science and technology cooperation.

Korley is a global leader in applying biologically inspired principles and approaches to the sustainable use of polymer-based materials, including plastics. She is the director of the Center for Plastics Innovation, an Energy Frontier Research Center funded by the U.S. Department of Energy that is working to chemically transform plastic waste — a pollution problem plaguing the world — into fuels, lubricants and other valuable products.

She also leads Bio-Inspired Materials and Systems, a global project funded through the National Science Foundation's Partnerships for International Research and Education, which aims to develop programmable materials for soft robotic systems, and she is co-director of the UD Center for Hybrid, Active, and Responsive Materials, an NSF Materials Research and Science Center that is driving materials innovation in fields ranging from biomedicine to cybersecurity.

The recipient of numerous awards and honors, Korley is a fellow of the American Physical Society, the American Chemical Society Division of Polymeric Materials: Science and Engineering, and the American Institute for Medical and Biological Engineering. She received her bachelor's degrees from Clark Atlanta University and the Georgia Institute of Technology and her doctorate from the Massachusetts Institute of Technology. She completed postdoctoral studies at both MIT and Cornell.

Joining Korley in the 2023 cohort of U.S. Science Envoys are Drew Harvell (Cornell University), Jessica Gephart (American University), Christine Kreuder Johnson (University of California, Davis), Prineha Narang (UCLA), Frances Seymour (World Resources Institute) and Kyle Whyte (University of Michigan).

FACULTY AWARDS

Thomas Epps, III
- American Chemical Society, 2021 Class of Fellows
- American Chemical Society, Division of Polymer Chemistry Fellow (2021)
- American Chemical Society, Polymeric Materials Science and Eng. Division Fellow (2023)
- American Institute of Chemical Engineers Fellow, 2023
- American Institute of Chemical Engineers, Minority Affairs Committee, William W. Grimes Award for Excellence in Chemical Engineering (2021)
- American Institute for Medical and Biological Engineering College of Fellows (2022)
- National Academy of Inventors Fellow (2022)

Arthi Jayaraman
- American Institute of Chemical Engineers 2021 Impact Award
- American Physical Society, Fellow (2021)
- Centennial Term Professor for Excellence in Research and Education (2020)
- Deputy Editor of American Chemical Society's Polymer Au (Gold) (2021)

Laure Kayser
- American Chemical Society, Petroleum Research Fund, Doctoral New Investigator Award (2023)
- National Science Foundation CAREER Award (2023)
- UD Research Foundation Award (2023)
- U.S. National Committee/International Union of Pure and Applied Chemistry Young Observer (2023)

Kristi Kiick
- American Association for the Advancement of Science Fellow (2020)
- American Chemical Society Rubber Division, Bioelastomer Award (2022)

April Kloxin
- UD Faculty Senate Excellence in Mid-Career Faculty Scholarship (2022)

LaShanda Korley
- American Chemical Society, Division of Polymer Chemistry Fellow (2023)
- American Chemical Society, Polymeric Materials Science and Eng. Division Fellow (2022)
- American Institute of Chemical Engineers Fellow (2023)
- American Institute of Chemical Engineers, Minority Affairs Committee, Gerry Lessells Award (2021)
- American Institute of Chemical Engineers, Minority Affairs Committee, William W. Grimes Award for Excellence in Chemical Engineering (2022)
- American Physical Society Fellow (2022)
- U.S. Science Envoy (2023)

David Martin
- Fellow of the Materials Research Society (2021)

Darrin Pochan
- American Institute of Medical & Biological Engineering College of Fellows (2022)

Joshua Zide
- AVS: Science and Technology of Materials, Interfaces, and Processing Fellow (2021)
- UD Outstanding Doctoral Graduate Advising and Mentoring Award (2022)

CLASS OF 2023

The Materials Science and Engineering department launched its undergraduate degree program in 2018 and enrolled its first class in Fall 2019. The Class of 2023 are its first cohort of undergraduate students to graduate and, thanks to UD's innovative curriculum, are ready to tackle challenges of the 21st century head on.

Our seniors share what motivated them to choose their major, what MSEG courses and instructors they enjoyed the most, what they hope to achieve in the future and what advice they have for future materials engineers.

Chris Alevrontas

Hometown: Demarest, NJ
Preferred pronouns: he/him/his
Activities and clubs: scuba diving, intramural sports

Why did you choose to study materials science?
I chose to study materials science because it is an ever-evolving field that can be applied to any discipline, as materials are necessary for every aspect of life. During my time at UD, I realized how versatile my experience in materials science can be in making a positive impact on the world, which was a big deciding factor in choosing my major.

Dillon Emory Belser

Hometown: Pembroke, MA
Preferred pronouns: he/him
Activities and clubs: Alpha Epsilon Pi

Why did you choose to study materials science?
I found the field fascinating when Professor Hewlett first introduced the topic to me in EGGG freshman year. Professor Hewlett really encapsulated how amazing the field is and the opportunities within it. I'm excited to continue my education at UD studying for my Masters of Materials Science, and it's all thanks to Professor Hewlett.

Giordana Daniels

Hometown: Jericho, NY
Preferred pronouns: she/her
Activities and clubs: Alpha Omega Epsilon Sorority, Club Equestrian Team, Undergrad Research at The Innovation Health and Design Lab on STAR Campus, College of Engineering Ambassador

What advice do you have for incoming first-year students?
Go in open minded, be prepared to be pushed out of your comfort zone, don't be afraid to ask for help, get involved with activities outside of the classroom, and make friends in your classes because you are all in it together! Most importantly, take advantage of all the resources provided!

Marissa Brumm

Hometown: Bainbridge, PA
Preferred pronouns: she/her
Activities and clubs: Club Gymnastics

What has been your favorite course or instructor?
All of the instructors in the materials science department are amazing but Professor Sheldon Hewlett has been one of my favorite instructors. Every class I have taken with him has been interesting and taught me a lot about materials science. I have also always felt like he cares about every one of the students and that has really made a big impact on my time in materials science.

Matt Dunnington

Hometown: Hamilton, NJ
Preferred pronouns: he/him
Activities and clubs: AFROTC

Why did you choose to study materials science?
I chose to study Material Science because it seemed to be very hands-on. I initially came in as a Chemical Engineer, but the MSEG class we had to take as part of that curriculum as well made me realize what I actually wanted to do.

Lauren Bulger

Hometown: Crofton, MD | Preferred pronouns: she/her
Activities and clubs: Women's Club Ice Hockey Team, Materials Science and Engineering Diversity, Equity, & Inclusion Committee, Club Swimming Team, Orthotics and Prosthetics Club

What is your dream job? A career in renewable energy would be very rewarding, especially because of the challenges we face globally due to climate change. I am particularly interested in offshore wind power as a source of clean energy. I would love to live in a coastal town to tackle this challenge!

Mallory Gehrer

Hometown: Fort Worth, TX
Preferred pronouns: she/her
Activities and clubs: UD Esports. MSEG Student Ambassador

What has been your favorite course or instructor? Senior Design was my favorite class. I was able to work with my team and apply all that I had learned over the course of my degree in a meaningful way.

Angelique Gordon

Hometown: Stowe, PA
Preferred pronouns: she/her
Activities and clubs: CHARM 2022 Summer REU

What has been your favorite course or instructor?
My favorite course is probably the Nanoscale Materials Laboratory. It was a great experience to practice the techniques that we had been learning about through our other classes. Creating functional devices that we could test and collect data from was also very fulfilling and exciting.

Eduardo Nombera Bueno

Hometown: Lima, Peru
Preferred pronouns: he/him/his
Activities and clubs: ChemE-Car, ChemE-Cube, AIChE, MRS, ACS, SHPE

What has been your favorite course or instructor?
My favorite instructor has been Professor Sheldon Hewlett. Not only is he one of the best lecturers I've had at UD, but he cares about his students and is always there to help students in any way.

Caitlin Iannetta

Hometown: Perkasie, PA
Preferred pronouns: she/her
Activities and clubs: Alpha Delta Pi chapter, Special Olympics club, intramural sports

What is your dream job?
My dream job is one that combines my passion for science, engineering and technology with my drive to help others. I am looking for a position that challenges me, gives me the opportunity to grow and build on my existing skills. I would love to hold a position that contributes to the advancement of global health whether that be through biopharmaceuticals, medical devices or biomaterial study.

Samson Porta

Hometown: San Jose, CA
pronouns: he/him

What is your dream Job?
My dream job is to be a chip hardware manufacturer. There is going to be a need for young engineers to bring new options to the table and I plan to be one of them.

Marina Hastings

Hometown: Middletown, DE
Preferred pronouns: she/her/hers
Activities and clubs: Research in the lab of Laure Kayser

What has been your favorite course or instructor?
Junior lab was my favorite set of classes. It was the first time we got to see what MSEG was all about hands on. It also gave me a lot of reassurance in knowing that I had picked the right major.

Will Quintana

Hometown: Middletown, DE
Preferred pronouns: he/him/his
Activities and clubs: SAMPE, Tau Beta Pi

What is your dream job?
I have always loved sports and learning about the technology that is used in sports performance clothing and shoes. A few summers ago, my REU went on a virtual tour of the Adidas facilities in Portland and I think some of the stuff they do there is fascinating. I am really interested in sustainable polymers like recyclable shoes or shoes made from ocean plastics.

Townsend Long

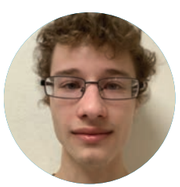
Hometown: Seattle, WA
Preferred pronouns: he/him
Activities and clubs: Board Game Club (currently president), Formula SAE, intramural recreational soccer

Why did you choose to study materials science?
Material science and engineering is the practical application of chemistry, physics, and biology to design and redesign the materials we interact with, including everything from plastic cups to solar cells. This kind of applied science has always fascinated me, and I can't think of anything I'd rather do.

Ben Smith

Hometown: Pittsgrove, NJ
Preferred pronouns: he/him
Activities and clubs: UD Club Swim Team

What advice do you have for incoming first-year students?
Put in an effort to interact and become friends with your peers. These are the people you are going to spend the next four years of your life with, and while you will all start off as strangers, you'll quickly come to realize that those people are going to become frequent members of your everyday life.



Scott Toreki

Hometown: Sewell, NJ | Preferred pronouns: he/him
Activities and clubs: Galadrim

Why did you choose to study materials science?
The wide range of possibilities that it offers. It allows access to pretty much any field, as most are materials-limited in some way, and you can do anything you want with it.

UNDERGRADUATE CURRICULUM INNOVATIONS

From creating lightweight yet durable prosthetics to designing new types of solar panels and batteries, materials engineers combine their expertise in physics, chemistry, biology, and engineering to help meet the needs of modern-day life.

This page: Students in MSEG315 (Materials Science and Engineering Laboratory II) characterize the mechanical properties of 3D printed structures.

Training the next generation of materials engineers means equipping students with the ability to understand the structures and properties of a wide range of materials, from "classics" like metals, polymers and ceramics to newer materials that are created using nanotechnology, unique composites and even artificial intelligence.

With the future of materials engineering in mind, UD's College of Engineering enrolled its first class in Fall 2019. Thanks to its forward-thinking curriculum that embraces modern materials, the program's first graduates will be ready to address the challenges of the 21st century head on.

Structure, properties, processing and performance

At the core of the field of materials engineering is understanding the relationship between structure, properties, processing and performance. These four pillars are what Sheldon Hewlett, assistant professor in the Department of Materials Science and Engineering who leads instruction and teaching, and other faculty members reiterate throughout the curriculum.

Along with its focus on these four pillars, the curriculum offered here at UD is one that looks at engineering problems more holistically, Hewlett added. "Engineering as a whole is moving away from binned discipline thinking to more systemic, problem-solving thinking," he said. "In our curriculum, everything is geared toward different flavors of material science and understanding the structure-property relationships from different points of view.

These different flavors cover a wide range of topics, from fundamental sophomore year courses in topics like thermodynamics and kinetics to advanced junior and senior year courses in polymers, solid state physics and quantum mechanics. And accompanying a breadth of lecture-based courses, students are actively integrating what they learn in lectures during hands-on laboratory work, both inside the classroom and as part of independent research projects.

"We try to make sure everything meshes together, so they're using all the things that they are learning," added Hewlett. "We're also trying to integrate real materials and problems and to understand how to embed those in the class and have this rich experience."

One of the places where students integrate what they learn in lectures to address real-world research challenges is during the two-semester Materials Science Engineering Lab (MSEG 305 and MSEG 315) which students take during the fall and spring semesters of their junior year.

Working in teams of three to four people, students collect data as they go through laboratory techniques and problem solving together. This year, students developed a solar cell and tested its efficiency, studied polymer synthesis with PEDOT:PSS (a unique polymer used in the lab of assistant professor Laure Kayser), conducted thermal conductivity experiments, and learned the ins and outs of 3D printing.

Arriana Bisram, a materials science and engineering junior minoring in biological sciences from Bear, Delaware, is currently taking MSEG 315. She said that the thermal conductivity lab had the groups working much more independently than their labs from the previous semester, which allowed the group to foster their problem-solving skills. "We had to do a lot of critical thinking on our own, to think about how we could create the best thermocouple that would fit into a desired situation," said Bisram.

Essential skills for a materials scientist's toolbox

Another essential laboratory experience for future materials engineers is being able to work in a clean room, a complex laboratory setting where engineers manufacture devices that have structural elements in the 10 to 100 nanometer range.

Here at UD, upperclassmen gain this important skill in Nanoscale Materials Laboratory (MSEG 402), a course that includes both lectures and an opportunity to work in teams to design, characterize and fabricate devices at the UD Nanofabrication Facility (UDNF). The course also ensures that students know how to work in a clean room safely while following standard operating procedures (SOPs), a key skill for both future industry scientists and graduate students.

"Nanofabrication is a big field — it involves design, lithography, etching, deposition, packaging, and for each component there are detailed subdivisions," said Xi Wang, an assistant professor who will be the lead instructor of MSEG 402 next fall. "Through this course, students will be familiar with almost all the components of nanofabrication and will become familiar with equipment that will be important for future research or work experience."

Along with essential laboratory skills, UD materials science and engineering students also gain experience with cutting-edge computational tools during Computational Materials Science and Engineering (MSEG 304), where juniors learn how to develop algorithms so they can study materials in silico.

"Computer modeling has become a tool like any other experimental technique," explained Anderson Janotti, associate professor and MSEG 304 instructor, about the importance of these tools for the field. "And computational modeling is a lot more flexible: You can mold, transform, and probe various different aspects of a material."

In MSEG 304, students learn key concepts in computational materials engineering, including molecular dynamics and Monte Carlo techniques, and receive an overview of commonly used programming languages such as Python. "The programming language is one thing, but how you think about the materials science side of the problem is another," added Janotti. "I try to emphasize the core concept of how to translate your idea into an algorithm, then writing the code depending on the language you use."

In MSEG 402 (Nanoscale materials laboratory), upperclassmen learn how to safely work in a clean room as they design, characterize and fabricate devices in the UD Nanofabrication Facility (UDNF).

Making connections, seeing the world, pursuing interests

There's also plenty of opportunities available for UD students to engage with materials engineering outside of the classroom. For sophomore Melanie Heider from Newark, who was attracted to the field after working at the Center for Composite Materials during high school, this means connecting with professors and learning more about their research as a student member of the UD Materials Research Society. Heider added that she's also been able to make strong connections with her classmates thanks to the smaller size of the program here at UD. "I have the same 15 people in my classes for the next three years, so building those connections, doing homework, studying for tests, is something that I appreciate about having a small major where you basically know everyone," said Heider.

Sophomore Caitlyn Edgar from Washingtonville, New York, chose UD because of her ability to take materials science and engineering as an undergraduate major, which she said will enable her to pursue her passion for sustainable materials. Both Edgar and Heider had the opportunity to take Materials Science for Engineers (MSEG 201) and participate in Ismat Shah's winter study abroad trip on material science, physics and history, where students traveled to Greece, Turkey, North Macedonia, Serbia, Kosovo, Italy and Switzerland.

"It was interesting, and beneficial to my overall understanding, to see Dr. Shah's perspective on the course content; as a professor, he prefers to focus the most on concepts and why certain phenomena happen the way they do," Edgar said. "We also held our lecture on polymers in the Casartelli Science Museum in Como, Italy, with a professor from a nearby university whose expertise is in polymers. Dr. Shah has connections with people all around the world, and he is generous enough to use them to the benefit of his students' experience."

Bisram, who found out about the program through her sister, said that she "fell in love with the work that was being done and how broad the research was" in materials engineering, which is evident in the research project she's been working on with Kristi

Assistant Professors Sheldon Hewlett and Ioanna Fampiou.

Kiick, Blue and Gold Distinguished Professor and chair of Biomedical Engineering. Bisram connected with Kiick through a colloquium professor and has been able to use her materials science expertise and coursework on a research project that has potential biomedical applications.

"We're working with resin-like polypeptides that are biocompatible, and we're figuring out what chains of amino acids we can add to it to make it flexible and strong, so we can use that to deliver drugs," explained Bisram. She added that she plans on expanding this project for her honors thesis and, thanks to the positive interactions she's had with professors here at UD, hopes to become a professor in the future. "Through the lectures I've been in, the material I've learned, and what I've gained through the program, there are lots of things that I want to incorporate into what I eventually teach," she said.

Putting everything together

A key part of any engineering program is the final year capstone project, also known as senior design. UD's materials science and engineering program is no exception, where seniors take a 6 credit hour course during the fall semester and work on an open-ended, previously unsolved problem.

Assistant Professor Ioanna Fampiou, who leads senior design, said that this capstone course is designed to give students the opportunity to apply the knowledge they've gained over the previous three years. Along with lectures on technical report writing, budgeting and presentation guidelines, Fampiou also brings in guest lecturers to discuss engineering ethics, sustainability, IP, patents, and entrepreneurship.

"The major is organized in a way that helped them acquire a lot of knowledge, and that was obvious when they had to make choices in their design projects," she added. "They knew how to handle the different aspects of the design project, what techniques they needed and which labs to go to, and they performed all the tests on their own."

Fall 2022 was the first time the capstone course was held, and all the projects that students worked on were sponsored by UD faculty. Projects included evaluating degradation, performance and life cycle of reusable bags (sponsored by LaShanda Korley and the Department of Natural Resources and Environmental Control), designing a pH sensor for biological materials (sponsored by David Martin), testing out the usability of NodaxTM, a bio-based plastic made from vegetable oils, as a material for a biodegradable hot-cold cup (sponsored by John Rabolt and danimer scientific) and 3D printing a device to improve quantum yield measurements of photon upconversion materials (sponsored by Matthew Doty).

"Students worked on projects that really captured their interests in various aspects of materials science and engineering, including synthesis, characterization, mechanical testing, and 3D printing. Our students were well-equipped to lead and succeed in the senior design projects and have acquired a unique set of skills during their studies that will allow them to find jobs in industry or pursue advanced graduate degrees upon graduation," Fampiou said about this year's senior class.

"I was so impressed with the seniors when they did their poster presentations. They were all speaking about their projects so easily, they were so comfortable with the topic, with the science, and they were able to answer all the questions that were being fielded," added academic advisor Suzy Rogers about the first cohort of graduating seniors.

Embracing the future

While UD's materials science and engineering curriculum was already designed with the future in mind, the faculty have learned a lot from this first cohort of students and are excited to incorporate more innovations into the undergraduate curriculum moving forward. Specific ideas include integrating computer modeling into additional courses, providing additional opportunities for independent research and community service, and finding external and industry sponsors for future senior design projects.

"We are very excited about the educational outcomes from our first class of graduates, and we look forward to continuing to refine our program and expanding to include more students. Because materials are such a critical component of so many technological challenges facing society, we are excited to help educate engineers whose education is inherently interdisciplinary," said Joshua Zide, professor and chair of Materials Science and Engineering. "There are so many opportunities for these students, and we can't wait to see what they accomplish as they go out into the world."

To explore areas of interest for her future career, Edgar is currently looking into summer research and internship opportunities, including research experience for undergraduates (REU) programs available at UD that are offered by the Center for Plastics Innovation and the Center for Hybrid, Active, and Responsive Materials. "Materials science combines several different engineering fields, and because of that I think you can apply materials science to so many different things," added Edgar. "There's such a variety of jobs out there that people can have with a materials science background, all depending on what you might want to do."

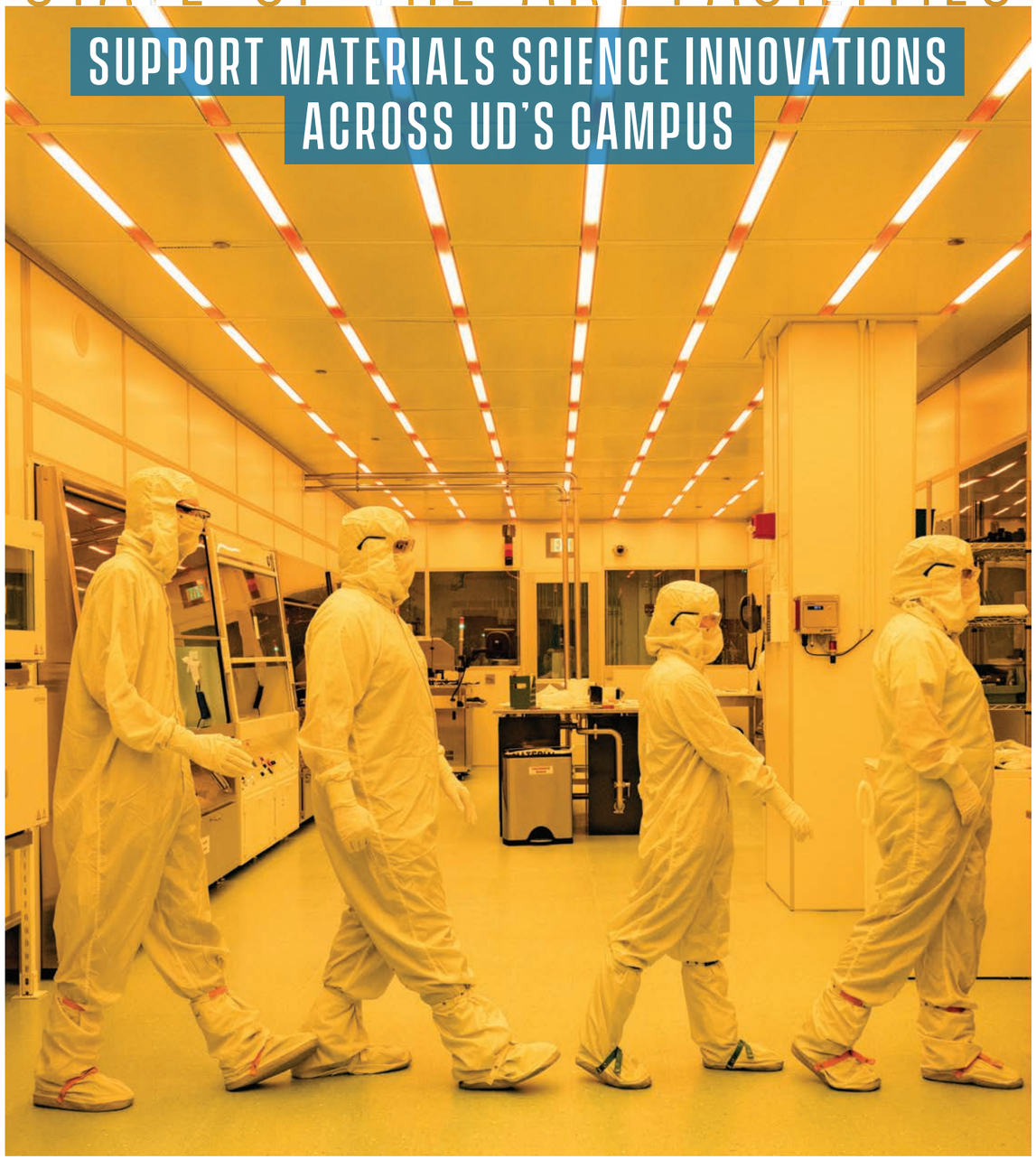
Heider is currently interested in pursuing a Ph.D. after graduation and said that having a degree in materials science is "definitely a plus" for her next career move. "Being a materials science undergrad major, and being able to learn all about materials, is something that UD has above other schools," she said. "Overall, I think being in a smaller program, one that just focuses on materials science, will definitely help me in grad school."

"Materials science is a broad field of study, and there's really no limitation of what you can do," added Bisram. "Because of its wide scope, it's a place where you can get connected to a lot of different professors, a lot of different fields, and overall I think it's a great opportunity."

Above: Juniors in UD's materials science and engineering major take two semesters of laboratory courses (MSEG 305 and 315), where they collect data as they go through new laboratory techniques and problem solving as part of a team.

STATE-OF-THE-ART FACILITIES

SUPPORT MATERIALS SCIENCE INNOVATIONS ACROSS UD'S CAMPUS



Researchers strike a familiar pose in The UD Nanofabrication Facility

LABS AND FACILITIES

Students, faculty and researchers in UD's Department of Materials Science & Engineering have access to an array of advanced research facilities that support the innovative research and educational activities happening across campus.

"These capabilities enable both the research efforts within the department and also support the needs of researchers across campus and around the world. One of the many roles Materials Science and Engineering plays is as a primary supporter of materials synthesis, fabrication, and characterization efforts. We're also excited that these same state-of-the-art capabilities are a core part of our graduate and undergraduate curriculum, and we remain dedicated to continuing to expand and revitalize the capabilities," said Joshua Zide, Professor and Chair of the Materials Science and Engineering Department.

The W. M. Keck Center for Advanced Microscopy and Microanalysis supports the structural and chemical characterization of materials from angstrom to micron scales. Supported by funding from the W. M. Keck Foundation, the National Science Foundation, and the University of Delaware, the center is located in UD's Harker Interdisciplinary Science and Engineering (ISE) Laboratory and is available for both research and educational purposes.

The Keck Center houses a set of advanced transmission electron microscopes (TEM), including two 200 kV field emission TEM devices, a high-resolution 120kV TEM, two scanning electron microscopes, and two scanning probe microscopes.

The UD Nanofabrication Facility (UDNF) enables researchers to create cutting-edge devices. Also located in the ISE Laboratory, UDNF provides members of the UD community and corporate partners with the infrastructure, equipment and staff support necessary to undertake competitive research and development in fields that rely on nanofabrication.

UDNF houses world-class capabilities in the areas of lithography, deposition, etch, thermal processing, characterization, and device packaging. The facility has an 8,500-square-foot clean room divided into Class 100 and Class 1000 spaces.

UD's Materials Growth Facility (MGF) develops unconventional semiconductor materials to unlock new functionalities and advance technologies for fields ranging from biomedical diagnostics to quantum computing. Supported by funding from the National Science Foundation Materials Research Science and Engineering Centers (MRSEC) program for UD's Center for Hybrid, Active, and Responsive Materials (CHARM), NSF funding through the Major Research Instruments (MRI program), and the University of Delaware, the MGF is located in DuPont Hall.

The MGF houses two molecular beam epitaxy (MBE) reactors, which allows the growth of a diverse range of high quality materials with exquisite control of material composition, deposition thickness, material growth rate, and substrate temperature. The MGF also contains an ultrahigh vacuum sputtering system that allows the integration of magnetic materials with these other material platforms.

The Advanced Materials Characterization Lab (AMCL) supports innovative projects while fostering an atmosphere of collaborative interdisciplinary research and industrial partnership opportunities. Located on the ground floor of the ISE Laboratory, the AMCL is available to members of the UD community as well as external educational and industrial partners.

Equipment available at the AMCL includes mass spectrometry, x-ray analysis, vibrational spectroscopy, particle size analyzers, and thermal analysis devices.

Other resources available include the College of Engineering machine shop, a full-service research shop that supports research and course-related projects for COE students, staff and faculty. Available services include professional machining and welding, design assistance, and hand and power tools available for loan. There are also several core facilities housed in the Delaware Biotechnology Institute, including capabilities for bioinformatics, DNA sequencing and bioimaging analyses.

MS/PHD GRADUATES

PHD

Henry Carfagno
Advisor: Matthew Doty
Towards a Scalable Quantum Photonic Platform Based on Quantum Dot Molecules

Shrirang Chhatre
Advisor: David Martin
Molecular-Scale Analysis of the Polymerization of Poly (3,4- Ethylenedioxythiophene) (Pedot)

Cristobal Garcia
Advisor: Kristi Kiick
Phase Separation of Resilin-Based Intrinsically Disordered Proteins: From Compositional Control to Hydrogel Microstructures

Olivia George
Advisor: Xinqiao Jia
Novel Hydrogel Microfibers and Microparticles Via Interfacial Bioorthogonal Tetrazine Ligation

Nicole Halaszynski
Advisor: Christopher Kloxin
Coiled-Coil Peptide Bundles as Building Blocks Towards Hybrid Materials

Alexander Harding
Advisor: William Shafarman
On The Formation of Methylammonium Lead Iodide Perovskite Thin Films Using a Sequential Close Space Vapor Transport Process

Jenna Harris
Advisor: Emily Day
Enabling Targeted Cargo Delivery to Hematologic Cells With Biomemetic Membrane-Wrapped Nanoparticles

Daseul Jang
Advisor: LaShanda Korley
Leveraging a Peptide-Polyurea Hybrid Platform to Develop Mechanically-Tunable and Stimuli-Responsive Materials

Austin Kuba
Advisor: William Shafarman
Development of an All-Vapor Process Using Two-Step Close Space Vapor Transport For the Deposition of Perovskite Solar Cells

Isaac Lam
Advisor: William Shafarman
Advances for Solar Cells: Cigs Absorber Fabrication; Capacitance-Voltage Characterization and Predictive Modelling

Iflah Laraib
Advisor: Anderson Janotti
Structure-Property Relationships in Complex Oxides: Lattice Distortions, Excess Charges, and Small Polarons

Lauren McCabe (Nowicki)
Advisor: Joshua Zide
Epitaxial Growth of Spatially and Spectrally Controlled Quantum Dots and Quantum Dot Molecules

Faheem Hameen Muhammed
Advisor: John Gillespie
Analysis of the Pyrolytic Behavior of Benzoxazine-Derived Carbon/Carbon Composites

Peter Sitarik
Advisor: David Martin
Electrochemical Synthesis and Characterization of Poly (3,4-Ethylenedioxythiophene) (Pedot) and Pedot Derivatives

Jiyeon Song
Advisor: Xinqiao Jia
A Bioorthogonal Hydrogel Platform for the Development of an Engineered Vocal Fold Tissue Model

Zhengtianye (Daniel) Wang
Advisor: Stephanie Law
Epitaxial Growth and Plasmonic Coupling in Topological Insulator Heterostructures

Zijian Wang
Advisor: Robert Opila
Mechanistic Studies of Magnetic and Electronic Materials Atomic Layer Etching Using in Situ X-Ray Photoelecton Spectroscopy

MASTER'S (NON-THESIS)

Md Nazmul Alam

David Angel

Avery Boyer

Harrison Chuma

William Manning

STUDENT AWARDS

DEPARTMENTAL AWARDS

Chairperson's Outstanding Graduate Student Award
Chaoya Han (2022)
Shrirang Chhatre (2021)

Outstanding Graduate Student Research Award
Nicole Halaszynski (2022)
Zhengtianye (Daniel) Wang (2021)

Outstanding Graduate Student Teaching Award
Derek Bischoff (2022)
David Angel (2021)

Outstanding Graduate Student Service Award
Vidhika Damani (2022)
Tory Welsch (2021)

Art in Materials Winner
Quintin Baugh (2022)
Vidhika (Shashikant) Damani (2021)

Chairperson's Outstanding Undergraduate Student Award
Eduardo Nombera-Bueno (2022)

Undergraduate Academic Achievement Award
William Quintana (2022)
Scott Toreki (2022)

Outstanding Undergraduate Service Award
Mallory Gehrer (2022)
Giordana Daniels (2022)
Townsend Long (2022)
Lauren Bulger (2022)

UNIVERSITY AND GRADUATE AWARDS

Director's Award– Center for Composite Materials
Munetaka Kubota (2022)
Faheem Muhammed (Team Award, 2022)

University Dissertation Fellowship Award, Graduate College
Matthew Langenstein (2022)

University Doctoral Fellowship Award
Vishnu Mambakkam (2022)

EXTERNAL AWARDS

Fulbright Award
Prashant Ramesh (2022)

NASA Delaware Space Grant College Program
James Bork (2022)
Jill Cleveland (2022)
Tory Welsch (2022–2023)

Preston C. Townsend Biotechnology Fellowship
Luisa Palmese (2021, 2022, 2023)

THANK YOU!

The MSE Department's outstanding staff keeps the department efficient, effective – and safe – we could not succeed without them. The faculty and students are eternally grateful for their efforts!

BETTY COWGILL
Administrative Assistant

KATHY FORWOOD
Graduate Program Academic Advisor

BRENDA RADZIEWICZ
Business Administrator

SUZY ROGERS
Undergraduate Program Academic Advisor

SCOTT STINNER
Laboratory Manager

JOSHUA ZIDE NAMED MATERIALS SCIENCE AND ENGINEERING CHAIR

Zide joined the College of Engineering faculty in 2007, and also has an affiliate appointment in the Department of Mechanical Engineering. He received his undergraduate degree in materials science and engineering from Stanford University, and his doctorate in materials science from the University of California Santa Barbara. He is an expert in new materials and molecular beam epitaxy who complements his research with mentoring and university service. In 2022 he earned the Outstanding Doctoral Advising and Mentoring Award from UD's Graduate College and the Faculty Award for Excellence in Service and Community Engagement from the College of Engineering.

Zide said he was drawn to UD's Department of Materials Science and Engineering, which was founded in 1998, in part due to the University's vibrant and energetic environment, where he felt like he could play a role in shaping the future of the department. As it approaches its 25th anniversary, he said he's looking forward to opportunities to bring in new talent and maintain a culture that is both supportive and welcoming.

"What makes our department so special is how incredibly collaborative it is," he said. "Everyone aspires to collaborate, but there's something special about a department where I've had an opportunity to collaborate with a huge cross-section of people, both in obvious and very-not-obvious projects."

Zide, who also serves as Director for UD Materials Growth Facility, said he looks forward to working with and learning from all of his colleagues, within the department and beyond, on an enormous range of interdisciplinary challenges.

"There is a critical materials component to virtually every technological problem we face as a society, and so materials scientists and engineers have a critical role to play in virtually every new innovation," he said. "More and more, problems require collaboration between materials scientists and colleagues in other fields. I'm also excited by the recent advances in computational materials. More and more, we can understand what we want to make and how it might perform before we actually make it. I'm very happy to see our department take such a leadership role in the College and the field at large."

He succeeds Darrin Pochan, who joined the UD faculty in 1999 and served as department chair since 2014.

In addition to his accomplishments at UD, Zide also serves as associate editor for the Journal of Vacuum Science & Technology, was named a Fellow of AVS (formerly the American Vacuum Society) in 2021, earned the Department of Energy Early Career Award in 2012 and was named an Office of Naval Research Young Investigator in 2009, among many other awards and accolades.

Professor and Graduate Program Director Joshua Zide is the new Chair of the Department of Materials Science and Engineering at the University of Delaware as of July 1, 2022.

NEW FACULTY

Chitraleema Chakraborty
Assistant Professor since 2020
Joint appointment in the College of Arts and Sciences' Department of Physics and Astronomy

Dr. Chakraborty is focused on building, developing and characterizing nano-photonic devices and quantum materials, including 2D materials, semiconductor quantum dots, and quantum sensing-based technologies. She has a Ph.D. in materials science from the University of Rochester.

Charles Dhong
Assistant Professor since 2019
Joint appointment in the Department of Biomedical Engineering

Dr. Dhong's research involves measuring and controlling mechanical forces at biological interfaces, ranging from cells to the human sense of touch, by building devices, conducting experiments, theory and simulations, and integrating new functional materials. He has a Ph.D. in chemical and biomolecular engineering from Johns Hopkins University.

Ioanna Fampiou
Assistant Professor since 2022

Dr. Fampiou's primary focus is on undergraduate curriculum development and instruction and is the lead instructor for senior design. She has a Ph.D. in mechanical engineering from the University of Massachusetts Amherst. Prior to joining UD, she was a visiting assistant professor in the Department of Mechanical Engineering at Villanova University.

Laure Kayser
Assistant Professor since 2019
Joint appointment in the College of Arts and Sciences' Department of Chemistry and Biochemistry

Dr. Kayser is designing, synthesizing and characterizing the next generation of soft organic electronics, with the goal of finding new ways to study and repair the nervous system. She has a Ph.D. in chemistry from McGill University.

Xi Wang
Assistant Professor since 2018

Dr. Wang conducts research on materials and devices that include nanophotonics, dynamically tunable photonic devices, metamaterials and metasurfaces, phase transition materials and two-dimensional materials. He has a Ph.D. in electrical engineering from the State University of New York at Buffalo.

Pictured from top: Charles Dhong, Laure Kayser, Xi Wang

CORE FACULTY

PRIMARY APPOINTED

Joshua Zide
Department Chairperson, Professor, and Director of the Materials Growth Facility

Chitraleema Chakraborty
Assistant Professor, Joint in the Department of Physics and Astronomy

Elise Corbin
Assistant Professor, Joint in Biomedical Engineering

Charles Dhong
Assistant Professor, Joint in Biomedical Engineering

Matthew F. Doty
Professor and Director of Quantum Science & Engineering Program

Thomas H. Epps, III
Allan & Myra Ferguson Distinguished Professor, Director for the Center for Research in Soft Matter & Polymers (CRiSP), and the Center for Hybrid, Active, & Responsive Materials (CHARM), and Joint in Chemical and Biomolecular Engineering.

Ioanna Fampiou
Assistant Professor

John (Jack) W. Gillespie Jr.
Donald C. Phillips Professor and Director of the Center for Composite Materials

Sheldon Hewlett
Assistant Professor, Director of Undergraduate Program

Anderson Janotti
Associate Professor

Arthi Jayaraman
Centennial Term Professor for Excellence in Research and Education, Joint in Chemical and Biomolecular Engineering

Xinqiao Jia
Professor, Joint in Biomedical Engineering

Laure Kayser
Assistant Professor, Joint in the Department of Chemistry and Biochemistry

Kristi L. Kiick
Chair of Biomedical Engineering and Blue and Gold Distinguished Professor

April M. Kloxin
Thomas & Kipp Gutshall Professor, Joint in Chemical and Biomolecular Engineering

Christopher J. Kloxin
Associate Professor, Director of Graduate Program, and Joint in Chemical and Biomolecular Engineering

Lashanda Korley
Distinguished Professor, Director of the Center for Plastics Innovation, and Joint in Chemical and Biomolecular Engineering

Mark Ku
Assistant Professor, Joint in the Department of Physics and Astronomy

Michael E. Mackay
Distinguished Professor, Joint in Chemical and Biomolecular Engineering

David C. Martin
Karl W. and Renate Boer Professor

Chaoying Ni
Professor, Director of the W.M. Keck Center for Advanced Microscopy and Microanalysis

Robert L. Opila
Professor

Darrin J. Pochan
Professor

John F. Rabolt
Karl W. and Renate Boer Professor

William N. Shafarman
Professor and Director of the Institute of Energy Conversion

Syed Ismat Shah
Professor

Xi Wang
Assistant Professor
Joint Faculty

AFFILIATED

Emily Day
Joint Associate Professor, Department of Biomedical Engineering

Joseph Fox
Joint Professor, Department of Chemistry and Biochemistry

Raul Lobo
Joint Professor, Department of Chemical & Biomolecular Engineering

Swati Singh
Joint Assistant Professor, Department of Electrical & Computer Engineering

John Slater
Joint Associate Professor, Department of Biomedical Engineering

Erik Thostenson
Joint Professor, Department of Mechanical Engineering

John Xiao
Joint UNIDEL Professor, Department of Physics & Astronomy, Affiliated Faculty and Secondary Appointments

Robert Akins Jr.
Affiliated Professor, A.I. duPont Hospital

Steven Aubuchon
Affiliated Professor, W.L. Gore & Associates, Inc.

Frederick (Rick) Beyer
Affiliated Professor, U.S. Army Research Lab

Bruce Chase
Distinguished Affiliated Professor, UD Department of Materials Science & Engineering (Retired)

Michael Crawford
Affiliated Professor, UD Department of Physics & Astronomy

Ujjwal Das
Secondary Associate Scientist, UD Institute of Energy Conversion

Sigrd Langhans
Affiliated Professor, Nemours Children's Health

Stephanie Law
Affiliated Associate Professor, Penn State University

Isao Noda
Affiliated Professor, Danimer Scientific (Retired)

OUR ADVISORY BOARD

The External Advisory Council's role is to advise College and department leadership on strategic direction and how to meet the needs of their students. Comprised of experts from industry, academia, and national labs, the department is grateful to these stakeholders for their invaluable service.

WELCOME OUR NEW MEMBERS

Dr. Garnett Bryant
National Institute of Standards and Technology, Group leader, Atomic-Scale Device Group

Dr. Pernell Dongmo
IBM, Unit Process Engineer/ Advisory Scientist

Dr. Jeannie Stephens Epps
Terumo Medical Corporation, Director, Applied Technology & Evaluation

Dr. Timothy Hopkins
Chemours, Chemours Discovery Hub Site Manager

Dr. Isao Noda
Danimer Scientific, Board of Directors

Dr. Venkat Pallem
Air Liquide, Deputy CTO

Du Pont Hall in spring – Home to Materials Science and Engineering at UD

MSE ADVISORY BOARD

Dr. Garnett Bryant
National Institute of Standards and Technology, Group leader, Atomic-Scale Device Group

Dr. Russ Composto
University of Pennsylvania, Associate Dean for Undergraduate Education

Dr. Pernell Dongmo
IBM, Unit Process Engineer/ Advisory Scientist

Dr. Jeannie Stephens Epps
Terumo Medical Corporation, Director, Applied Technology & Evaluation

Dr. Moses Haimbodi
Lincoln University, Associate Professor

Dr. Timothy Hopkins
Chemours, Chemours Discovery Hub Site Manager

Dr. Matthew Lamm
Merck Research Laboratories, Director, Preformulation

Dr. Isao Noda
Danimer Scientific, Board of Directors

Dr. Bulent Ozbas
Infineum.com, Technologist

Dr. Venkat Pallem
Air Liquide, Deputy CTO

Dr. Adam Rawlet
U.S. Army Research Laboratory, Chief Scientist, Weapons and Materials Directorate

Dr. Nancy Sottos
University of Illinois, Willett Professor/ Chair, Materials Science and Engineering

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Department of Materials Science and Engineering

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CELEBRATING 25 YEARS of MATERIALS SCIENCE and ENGINEERING

1998–2023

LOOK INSIDE TO SEE HOW WE'VE GROWN THE PAST 25 YEARS! *And our plans for the next 25.*