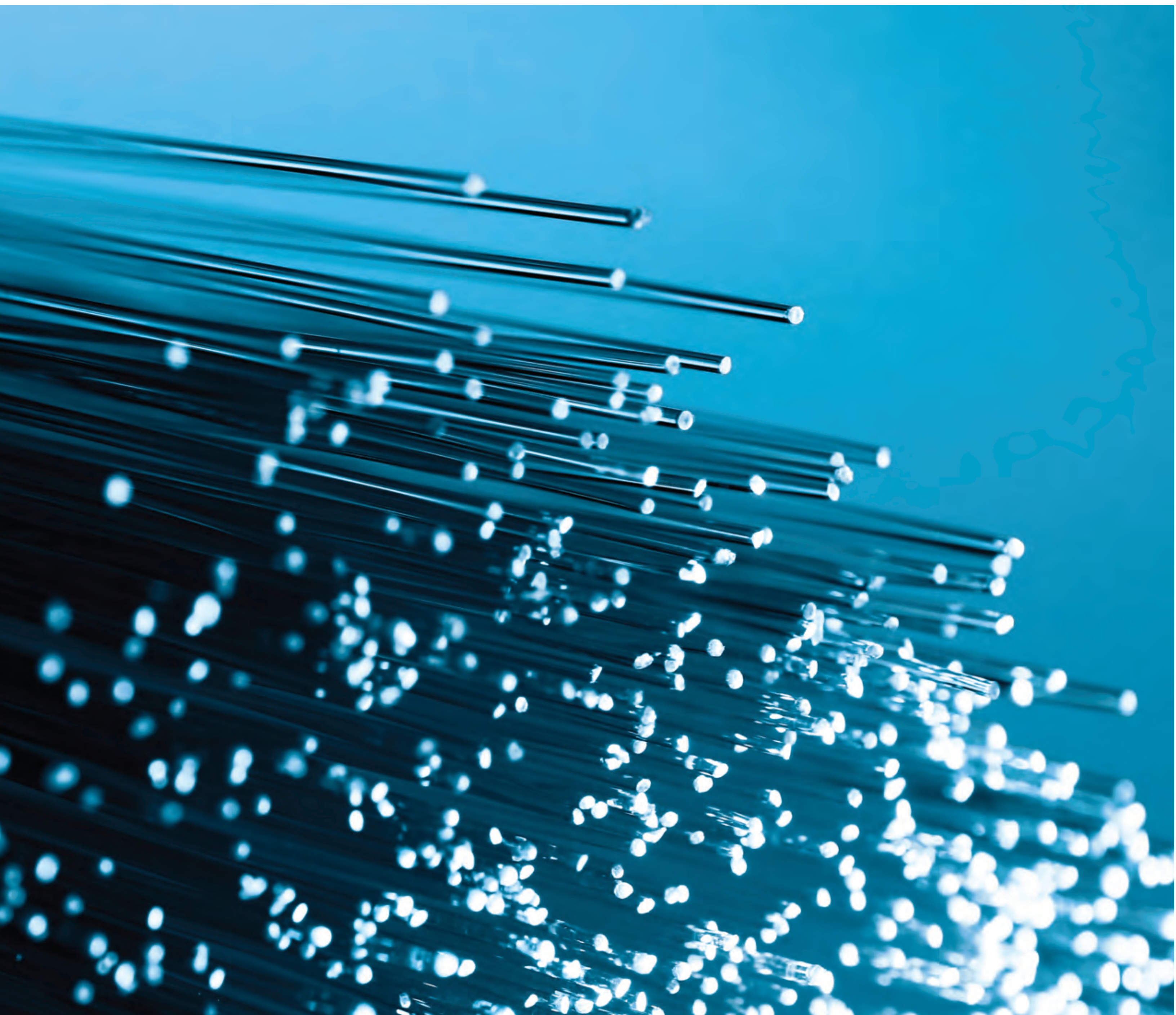
UCONN

materials &ENGINEERING science

2019



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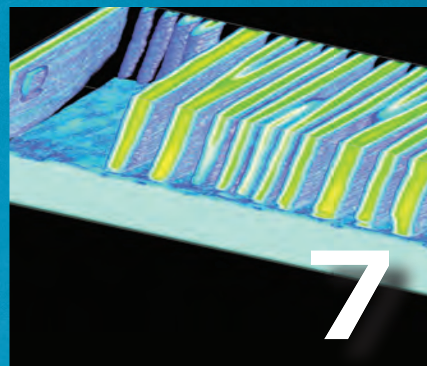

This outreach bulletin is produced for the students, alumni, faculty, corporate supporters, and friends of the Department of Materials Science and Engineering at the University of Connecticut.

Please direct any questions or comments to mse@uconn.edu.

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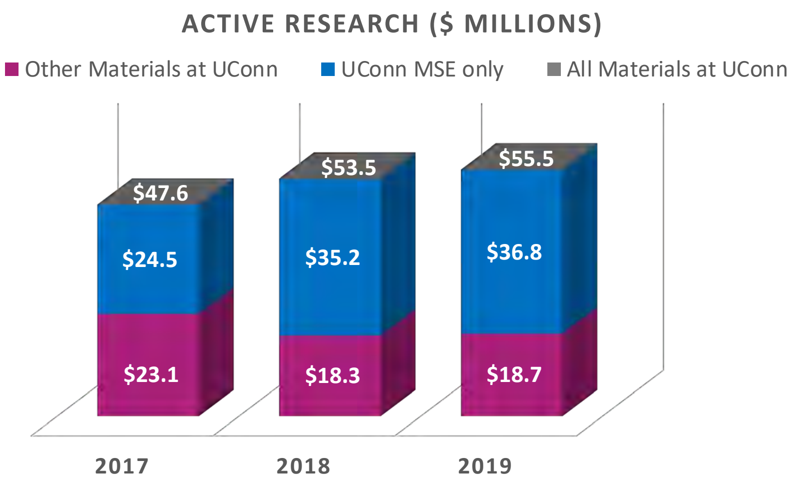
WORD OF THE DEPARTMENT HEAD

2019 has been an extraordinary year for UConn MSE. Once again we are the highest ranked Engineering program at UConn—itself a top 25 U.S. public institution. Our 20 core faculty are PI's on over $36M in active grants and **$13M in new awards this year**. This includes a $5.4M project with AFRL, participation in a $12.5M center with the National Nuclear Security Administration, $2M for a Catalyst Layer Design and Manufacturing effort, $1M in DOE efforts for solid oxide fuel cell technologies, and continued leadership and participation in the UTAS Center for Advanced Materials.

Collectively there are now $56M in materials research projects across campus, amounting to a **50 percent increase** since 2017. Correspondingly, the MSE department **added 6 new faculty members** in just the past 18 months. We also welcomed a new administrative staff member, a new Associate Department Head, and Serge Nakhmanson earned tenure. This all positions us to better serve our growing community of students, researchers, and industry and federal partners.



We published more than 100 peer reviewed articles in journals including PNAS, Science Advances, and Nature Communications, and delivered more than 50 plenary or invited presentations. Distinguished University Professor Cato T. Laurencin won the AAAS Philip Hauge Abelson Prize, and was **inducted into the National Academy of Engineering**, along with alumna Sharon Nunes, Ph.D. ('83), joining more than 21 professional society fellows among our faculty. Our faculty won prestigious recognition on campus as well, with awards for Career Research and Creativity (Alpay) and Student Mentorship (Lee). Our faculty continue to lead in the Additive Manufacturing Innovation Center (Hebert), Center for IN-siTu/Operando Electron Microscopy (Zhu), and Sackler Center for Biomedical, Biological, Physical and Engineering Sciences (Laurencin).

Our students earned NSF GRFP, NDSEG, LSAMP, IBEX, and SURF awards, won numerous speaking and poster competitions, and are working toward the Legacy Leadership and University Scholar programs. Our seniors teamed with 14 companies for sponsored Capstone Design projects. Students opted for internships as far away as Germany, Israel, and Japan, including positions at UTC, P&W, Murata, ARL, AFRL, NRL, NREL, NASA, and Ben-Gurion University of the Negev. We are especially pleased to announce the soon-to-be-built $100M new Institute of Materials Science. In the meantime, we remain the home of the Materials Advantage and MRS student chapters, Alpha Sigma Mu, Keramos, and the 3-D Printing club. **Our new Metalworking club leverages one of the few full foundries** remaining at universities across the U.S. With faculty leadership (Frame, Brody), this student-driven organization already has over 130 members distributed across the schools of engineering, fine arts, agriculture, liberal arts and sciences, and business.

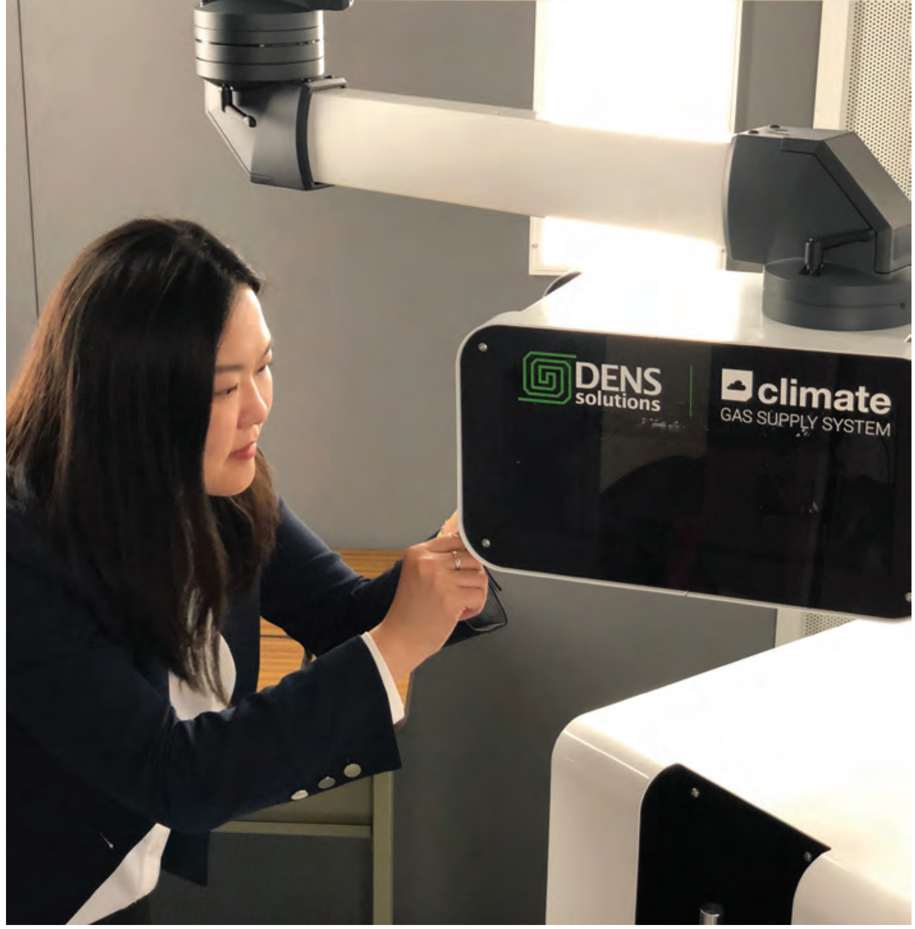
Our numerous organizations and outreach events annually demonstrate MSE concepts to over 1000 members of our community. Professionally, our faculty include a principle organizer for the 7000-attendee MRS Fall meeting (Huey), the primary organizer for an international conference on Electrodes in Energy Systems (Jankovic), and the chief editor for the J. Materials Science (Carter). There are more than 20 further examples of UConn MSE service to materials worldwide, including external advisory board member David Furrer, **head of ASM**. Alumna Janet Callahan, Ph.D. ('90) is now the Engineering Dean at Michigan Technological University, and prior MSE faculty member Mei Wei just moved from UConn to become the Dean of Engineering at Ohio University.

Finally, and most exciting, UConn MSE recently received an unprecedented **$1.9M alumni donation** to the Owen F. Devereux endowment. This will perpetually support substantial scholarships for undergraduate education, certain to help us grow and diversify our student population. Additional donations from our supportive community also enabled student conference travel, student awards, and upgrades in our teaching labs.

I invite you to enjoy this bulletin, where you will see further evidence of the **dramatic rise in UConn Materials**. Stay in touch by following our web or LinkedIn sites, attending our first Fall alumni event at City Steam Brewery in Hartford (11/14/19), joining our next annual banquet (April 3rd '20), or visiting or working with us soon.

Bryan D. Huey

Zhu with the Climate system



Credit: UConn Photo

Yuanyuan Zhu to Lead Multidisciplinary Hub for In-Situ Electron Microscopy

MSE Assistant Professor Yuanyuan Zhu leads a collaboration with DENSsolutions that aims to solve challenges like climate change by studying materials in their native environments.

One year into her UConn Materials Science and Engineering career, Yuanyuan Zhu will be the director of a collaboration between UConn researchers and industry that aims to provide solutions to global societal challenges.

Zhu, Assistant Professor of Materials Science and Engineering, is heading up the collaboration between UConn MSE, the Institute of Materials Science (IMS), and DENSsolutions, a company based in Holland which develops innovative in-situ Electron Microscopy solutions, at the Innovation Partnership Building at Tech Park.

By bringing together scientists from various disciplines, the UConn DENSsolutions Center for IN-siTu/Operando Electron Microscopy (InToEM) aims to solve societal challenges such as climate change by revealing materials dynamics during catalyst interactions in real-time at the atomic level.

"We want the InToEM center to be a hub for materials scientists, chemists, physicists, computer scientists and engineers working together at the frontier of understanding materials dynamics," Zhu said.

Using DENSsolutions' Climate MEMS-based Nano-Reactor TEM system, Zhu and her peers will be able to observe real-time dynamic changes in material crystal structure, morphology, composition and even electronic states under technically relevant working conditions. "These new insights into materials dynamics will provide invaluable insight into structure-property correlations, in order to guide materials optimization and engineering," she said.

The Climate MEMS-based Nano-Reactor TEM system has a unique capacity to probe high-temperature gas-solid reactions with high spatial resolution in a gaseous environment controlled by sophisticated dynamic gas mixing.

"

Being able to study the behavior of materials in their native environment has been a dream for microscopists since the birth of TEM. I'm very excited about the InToEM center...

—Yuanyuan Zhu

Dynamic changes in local site-specific structural information of nanomaterials can thus be monitored in real-time under realistic reaction conditions.

"Being able to study the behavior of materials in their native environment has been a dream for microscopists since the birth of TEM. I'm very excited about the InToEM center, which will provide an optimal scientific 'sandbox' to explore microscopy as it should be."

Zhu joined the UConn MSE department in August 2018 after serving as a post-doctoral researcher and staff scientist at the Pacific Northwest National Laboratory for three years. She earned her Ph.D. in Materials Science at Texas A&M University in 2013, her MS in Materials Science, Solid Atomic Imaging Division, at the Chinese Academy of Science in 2009, and her BS in Metallic Materials Engineering at Sichuan University in 2006.

In early August, Zhu and two of her Ph.D. candidates, Txai Sibley and Rajat Sainju, flew to Oregan to share their research at the Microscopy and Microanalysis conference. There, Zhu and Rajat presented their recent research about Deep Learning assisted high throughput quantitative microscopy image analysis.

“This new research will not only facilitate statistical sound microstructure and defects quantification based on conventional transmission electron microscopy (TEM) characterization, it will also offer a path forward to real-time feature tracking needed for in-situ materials dynamics studies at the InToEM center, ” Zhu said. Their research, titled “Deep Learning for Semantic Segmentation of Defects in Advanced STEM Images of Steels” was published in Scientific Reports in September.

“What attracted me most to UConn is the MSE department’s positive vitality and commitment to diversity,” Zhu said. “That creates an energetic learning and researching community and inspires innovation.”

In MSE research, it is critical to establish a working correlation between materials structure and properties, Zhu said. In many materials applications, the microstructure response of a material evolves under working conditions or at different operational stages. This dynamic process requires novel characterization methods to probe materials systems at relevant spatial or temporal scales. However, these methods were not possible until recent advancements in in-situ transmission electron microscopy (TEM).

The InToEM Center provides access to the equipment and microscopes required to conduct this research. Zhu was interested in working as Director of InToEM because of the emerging needs to go beyond the conventional approach of trying to understand materials behavior from a static microscopic picture. But she was also inspired by the creativity and professionalism in DENSsolution’s development of in-situ transmission electron microscopy instruments, which CEO of DENSsolutions Ben Bormans hopes will contribute to solving societal challenges like climate change and clean/green technologies.

“Although it’s a coincidence that the DENSsolutions’ MEMS-based Nano-Reactor is called ‘Climate,’ there are materials efforts related to energy and environment, including climate change, that can benefit from the in-situ microscopy research,” Zhu said.

One immediate example is heterogeneous solid catalysts used for CO_2 capture and natural gas conversion. The in-situ TEM Nano-Reactor can be used to characterize and identify the catalytically significant atomic sites at work while simultaneously measuring the activity of these catalysts.

“These in-situ and operando studies on working catalysts open up opportunities in discovering novel chemical phenomena and advancing catalyst design,” Zhu said.

The InToEM center is also promising for transformative research in nanomaterials synthesis, corrosion and alloy degradation, fuel cells, and many other materials systems important in everyday life.

“These new techniques connect microscopy more meaningfully with chemistry, materials research and nanotechnology,” Bormans said. “Therefore, here at DENSsolutions, we all are very, very excited about being a partner in the InToEM center.”

Based on DENSsolutions’ news release

Credit: DENSsolutions

Climate In-situ Gas & heating system with featured MEMS-based Nano-Reactor (gas supply not in the picture)

Based on DENSsolutions’ news release

An allegorical view of experimental data being transformed into a database.

Data Mining for Critical Research Traits: Perseverance and Ability to Handle the Unexpected

MSE Associate Professor Serge Nakhmanson explains how his team used data mining and machine learning to predict how liquid ingredients would crystallize into pills.

Unpredictability is a factor that Serge Nakhmanson, Associate Professor of Materials Science and Engineering, has embraced throughout his life. His career paths and research opportunities have especially changed in unforeseen and serendipitous ways.

"Right now, I am involved in projects I never imagined I would be doing," Nakhmanson said. A recent example is a collaboration with Pfizer, a multinational pharmaceutical corporation, that includes employing machine learning, or statistical algorithms, to predict how capsule compounds used for pharmaceuticals crystallize. This can affect dissolving power when swallowed, manufacturing timelines, and the shelf life of the product.

"This is a complicated issue, since there are many different ways the ingredient molecules can arrange themselves when crystallizing out of a dissolved state," Nakhmanson said. Many medicines are taken in solid crystalline form as pills, but they originate as a set of liquid ingredients in a lab. Figuring out the best way to coax a drug into solid form is tricky. There are many different variables that affect the outcome: temperature, pressure, and the specific solvent used for processing the ingredients. Therefore, a machine learning approach might be the best way to attack such a complicated problem.

"According to the FDA regulations, controlling polymorphism of the eventual solid-form drugs is a very important issue and hence something that pharmaceutical companies have to vigorously investigate," Nakhmanson said. "If a polymorph you expect to form during crystallization is supposed to be a cure, the presence of some unintended 'rogue' polymorphs can literally kill you, or at least make the drug much less effective."

So, to better understand how drug ingredients crystallize, UConn Materials Science and Engineering (MSE) researchers mined a vast collection of experimental data provided by Pfizer. They reported their findings in the February cover story of the journal *CrystEngComm*.

Pfizer initially formed the collaboration with Nakhmanson and his colleagues in the MSE Department to evaluate machine learning approaches for their usefulness. Using Pfizer's data and relevant expertise, the MSE team tested three different computer algorithms to figure out the best way to get a pharmaceutical compound to crystallize. The algorithms are referred to as 'machine learning' because the computer builds mathematical models of the data, finds complex patterns, and then 'learns' from those patterns to make accurate predictions.

Nakhmanson's graduate student, Ayana Ghosh – recent recipient of the prestigious John Tanaka Graduate Student Fellowship award – discovered that the Random Forest Regression (RFR) algorithm provided the most accurate crystallization predictions. In addition, RFR was the only one able to identify specific traits which pharmaceutical molecules should possess that would make them easier to crystallize. For example, if a molecule weighs less than X amount and has a certain number of hydrogen bonds, the probability that it can be successfully crystallized is increased.

"This is precisely the sort of information that a synthetic chemist would need in order to decide how to optimally make a new drug in the form of a pill," said Nakhmanson. "The RFR machine learning technique is really helpful to determine which parameters are important for molecular crystallization and which ones are not."

Nakhmanson has long been familiar with unpredictability, with research ranging from materials physics and chemistry to statistical methods and numerical algorithms. His resume includes work at Argonne National Laboratory in Chicago, North Carolina State University, and Rutgers University.

The son of an engineering professor and physicist in Leningrad, Russia (now St. Petersburg), Nakhmanson calls himself an engineering "legacy case." "I graduated from the same department as my father, which was the St. Petersburg State University Department of Physics," he said.
He earned a bachelor's and master's degree in physics in St. Petersburg before crossing the world and earning a Ph.D. in physics at Ohio University, developing theoretical methods for studying amorphous and glassy materials.

One important issue in building atomistic-level models of such compounds is

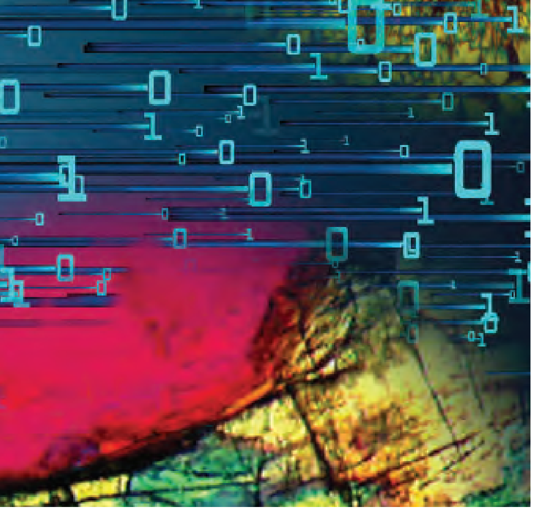


Image courtesy Pfizer

properly accounting for structural (and sometimes compositional) disorder present in the system.

Perfect crystals are by default highly ordered and therefore it is relatively easy for researchers to figure out where the atoms are and what structural patterns they form. Amorphous (disordered) materials are more difficult in this respect.

"Creating a structural model whose properties are in good agreement with experimental results may require great skill, some intuitive feel for what is going on inside the material, perseverance, and always good luck. I.e., it can be an artform," Nakhmanson said.

"Usually people would try to make atomistic models of amorphous silicon by taking models of perfect silicon crystals and 'melting' them with some computer algorithms to introduce disorder," he said. But melting the models with algorithms can be a fast and violent process, resulting in too much disorder. "If you then take that model and compute its properties, such as electric conductivity, it would conduct current like a metal. That's a big no-no for silicon, which is actually a semiconductor. If something is wrong with your basic structural model from the get-go, then you cannot trust anything else you may compute for it. Our new approaches are much better than that," he said.

In general, Nakhmanson considers perseverance or grit to be an important trait for an aspiring researcher –a characteristic possessed by the team of students working in his lab. Since joining UConn as a faculty member in 2012, Nakhmanson said many of the students he's worked with over the years have been "well prepared to handle the tumultuous nature of building a career in research and engineering."

"Teaching our undergraduates is a pleasure. They're very motivated," Nakhmanson said. "By the time they get their degrees, they're ready to join the workforce. We have close to 100 percent job placement. Many of our students find work for major Department of Defense contractors in the area, like Sikorsky, Electric Boat or Pratt & Whitney. Others go on to graduate school."

On his lab page is a quote from the grinning Cheshire Cat, of Lewis Carroll's Alice in Wonderland. Alice asked

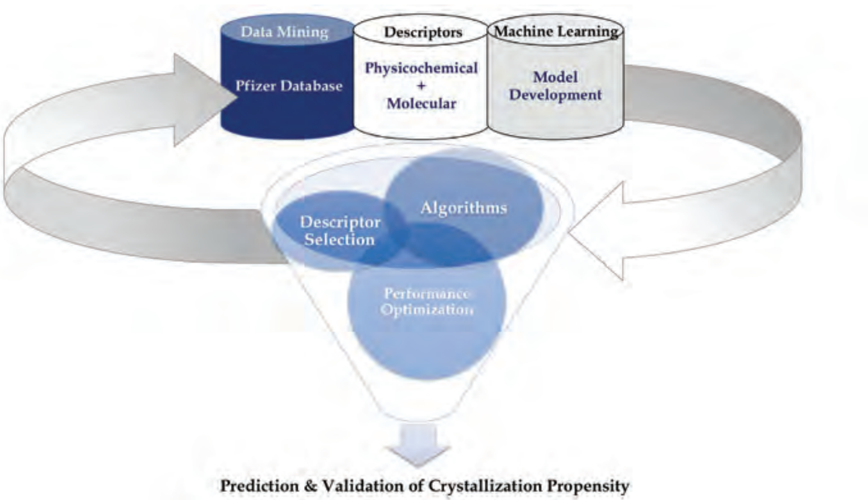
MSE Associate Professor Serge Nakhmanson

the cat: "Would you tell me, please, which way I ought to go from here?"
"That depends a good deal on where you want to get to," said the Cat.
"I don't much care where—" said Alice.
"Then it doesn't matter which way you go," said the Cat.

Nakhmanson said this exchange reflects not only the uncertainties encountered in quantum mechanics (something he usually has to explain to students in the "Electronic and Magnetic Properties of Materials" class he teaches), but also in one's own career choices.

"It may be relevant for career paths in materials science and engineering. If you were to interview me 10 years ago, and tell me about what I'm doing now, I would have never believed you. But, really, you go somewhere, and there you are."

Department Head Bryan Huey observes, "This work is just one example of how UConn MSE faculty and students are working with Pfizer. It's also only a small fraction of Associate Professor Nakhmanson's research portfolio, which includes functional materials and materials manufacturing. There's a common theme that computational approaches are increasingly valuable for fundamental and applied science and technology, with Serge and other UConn faculty very well positioned to further advance this rapidly growing area.



A schematic representation of a machine-learning framework developed by the collaborators from Pfizer and UConn MSE for predicting crystallization propensities of small pharmaceutical molecules.

➲ Artist's rendition of Tomographic AFM "just scratching the surface."

Courtesy Jack Dumala, UConn Squared Labs

A Microscope as a Shovel? UConn Researchers Dig It

An accident during research leads to the discovery of a breakthrough technique for investigating materials properties.

Using a familiar tool in a way it was never intended to be used opens up a whole new method to explore materials, report UConn researchers in the Proceedings of the National Academies of Science. Their specific findings could someday create more energy efficient computer chips. But more broadly, their approach should spur scientists worldwide into trying to use this new approach for a wide range of other materials and eventual applications.

This is all based on Atomic force microscopes (AFM), which materials scientists and other researchers use to carefully trace an ultra sharp tip across the surface of all kinds of materials. The tip can 'feel' where the surface is, and sometimes can also sense properties like electric and magnetic forces emanating from the material. Then, in the same way a farmer methodically drives a plow back and forth and up and down across a rolling field, an AFM can scan the hills and valleys at the surface of a material, developing maps of its holes and protrusions, and even its properties, all at length scales a thousand times smaller than a grain of salt.

And that's where things just got interesting. Unlike the farmer's plow, AFMs are generally designed to barely touch the surface. That's to keep from damaging the sample (churning up the field). But sometimes it happens anyway. A few years ago, Yasemin Kutes and Justin Luria, graduate student and postdoc members of UConn materials scientist Bryan Huey's lab, dug into solar cells they were studying. At first thinking this was an irritating mistake, they noticed that the properties of the material looked different from pictures of the original surface alone. That wasn't too surprising—for materials used in real-world applications, often the surface is actually engineered to have different properties. Yet before, there had simply been no way to measure such underlying properties with the resolution offered by AFM.

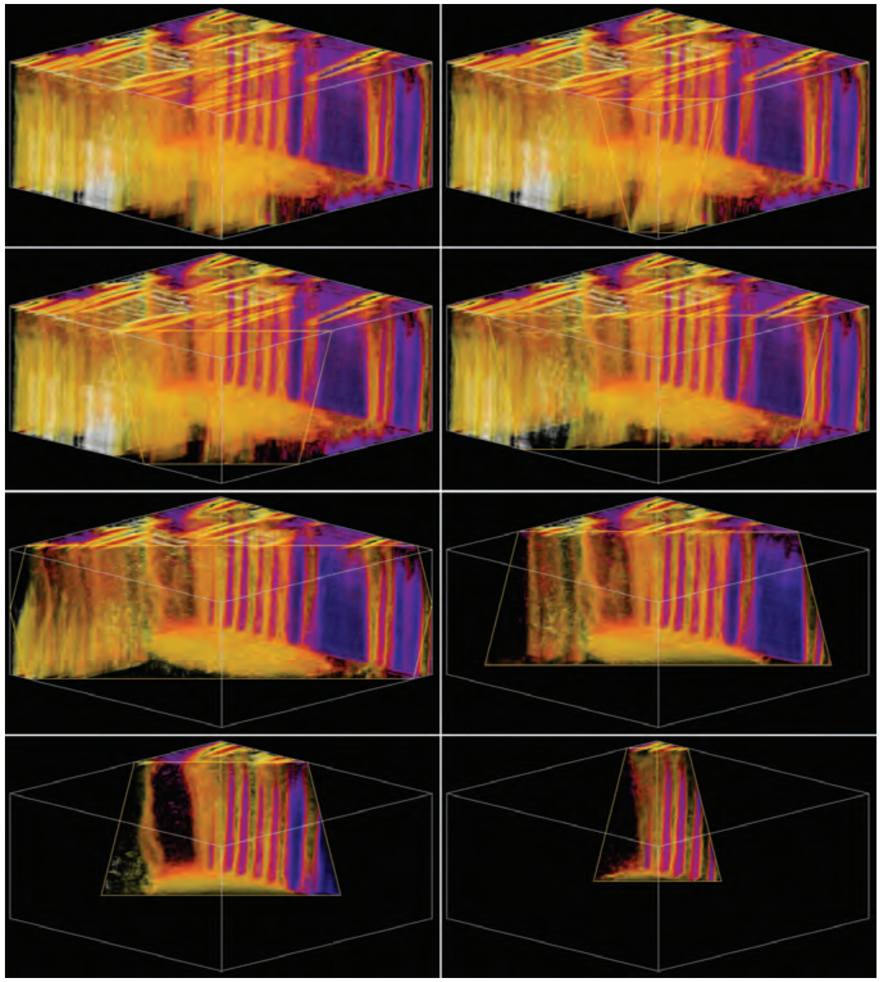
In fact, in the 30 years since AFMs were invented, only a handful of groups worldwide have reported such measurements. This was usually either to finely shape a surface, or to map where electricity flows in a part of a computer chip or in a solar cell like at UConn. But another graduate student in Huey's group, James Steffes, was inspired to take advantage of this discovery for an entirely different class of materials and materials properties. Could he intentionally use the tip of an AFM like the farmer's plow, progressively digging deeper into the material, and at the same time map the electrical or magnetic properties for deeper and deeper layers of a 'functional ceramic?'

The answers, as Steffes, Huey, and their colleagues report in the highly competitive journal PNAS, are yes and yes. To demonstrate the approach, they dug into a sample of bismuth ferrite ($BiFeO_3$), which is a room temperature multiferroic provided by project collaborator Ramamoorthy Ramesh of UC Berkeley. Multiferroics are materials that support both electric and magnetic properties at the same time. For example, "BFO" is antiferromagnetic—it responds to magnetic fields, but overall does not exhibit a North or South magnetic pole—and ferroelectric, meaning it has switchable electric polarization. Such ferroelectrics usually comprise tiny 'domains' that all have similarly oriented electric fields. Think of a whole bunch of tiny batteries, clusters of which are aligned with their positive terminals pointing in one direction, alongside other clusters pointing another direction. These are very valuable for computer memory, because the computer can flip the domains, 'writing' data into the surrounding material. These domains can be fine enough to be serious contenders for replacing the enormous market of thumb drives and other solid state memory that is now in every smartphone, tablet, camera, and most computers.

But when a material scientist "reads" or "writes" such data in BFO, they can normally only see what happens on the surface. Yet they really need to know what lies beneath as well—if that is understood, it might be possible to engineer more efficient computer chips that run faster and use less energy than those available today. That's a very important goal for society—already ~5 percent of all energy consumed in the US goes just to running computers.

So Steffes, MSE Department Head Huey, and the rest of the team used an AFM tip to meticulously dig through a film of BFO and measure the interior piece by piece. They found they could map the individual domains all the way down, exposing patterns and properties which weren't always apparent at the surface. Sometimes a domain narrowed with depth until it vanished, or split into a y-shape, or merged with another domain. No one had ever been able to see inside the material in this way before. It was revelatory, like looking at a 3-Dimensional CT scan of a bone for the first time, when you'd only been able to read 2-D x-ray films before.

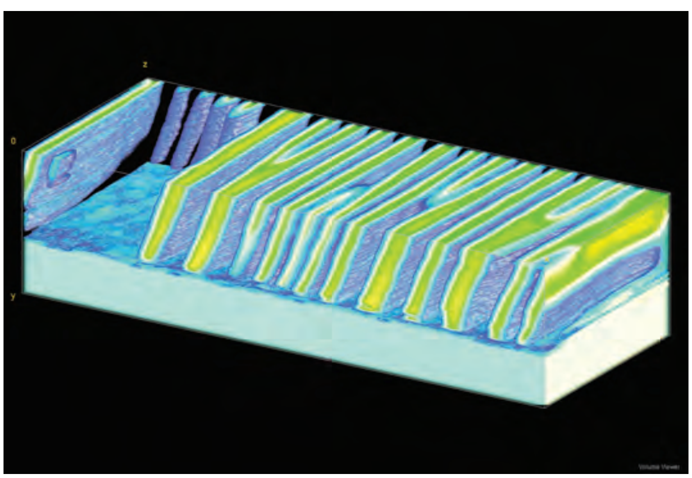
"The systems we have in the IMS are special in many ways, including one we are now developing to advance Tomographic AFM even further thanks to a $1M grant from the National Science Foundation alongside support from UConn, the School of Engineering, and UConn. But worldwide there are something like 30,000 AFMs already installed. A big fraction of those are going to try Tomographic AFM in 2019 as our community realizes that we have literally just been scratching the surface all this time" predicts Huey.



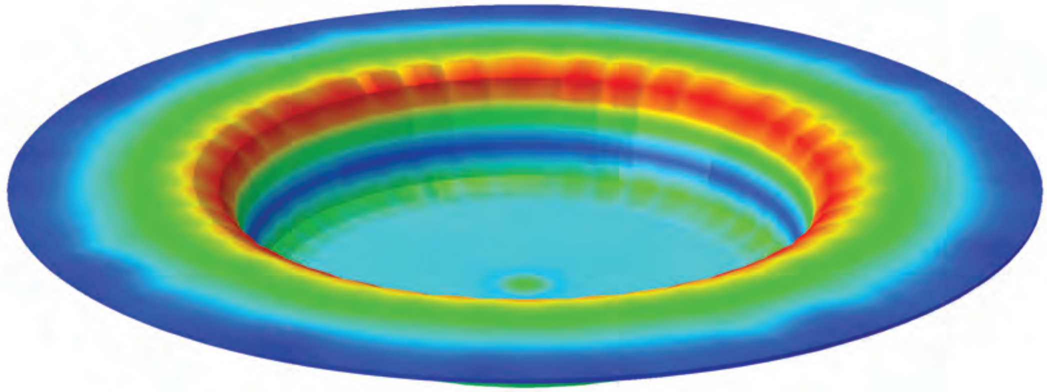
Bryan Huey's lab used the tip of an Atomic Force Microscope (AFM) as a chisel to scrape away the surface of bismuth ferrite and map the electric landscape of the interior.

He also thinks more labs will buy AFMs if 3D mapping works for their materials, and some microscope manufacturers in this substantial high-tech industry will shift their focus to volumetric instead of surface scanning.

Steffes, who drove the project for his PhD research, has subsequently graduated from UConn with his PhD and is applying his skills and knowledge at computer chip maker GlobalFoundries. Researchers at Intel, muRata, and others are also intrigued with what the group discovered, as they seek new materials to extend computing and mobile devices beyond the current state of the art. Meanwhile, Huey's current team of postdoc, graduate, and undergraduate researchers are continuing to use AFMs to dig into all kinds of materials, from concrete to bone to a host of other computer components. Huey says, "Working with academic and corporate partners, we can use our new insight to understand how to better engineer these materials to use less energy, optimize their performance, and improve their reliability and lifetime—those are examples of what Materials Scientists strive to do every day."



Tomographic AFM gives UConn researchers a new perspective on ferroelectric domain configurations and properties as a function of depth.



Abaqus simulation of deep drawn 305 stainless steel with Von Mises plotted.

Lesley Frame Leads Multi-disciplinary Center for Materials Processing Data

MSE Assistant Professor Lesley Frame leads a new research center in producing materials processing data for a wide range of industry applications.

Assistant Professor Lesely Frame

Lesley Frame, Assistant Professor in UConn's Materials Science and Engineering Department, will lead a multi-university research center that aims to generate materials processing data to benefit a wide range of industry applications.

The Center for Materials Processing Data (CMPD) is a research consortium dedicated to producing time- and temperature-sensitive (transient) material property data for use in materials process simulations and process designs. The joint research is member-driven, meaning industry members recommend materials data research questions that are addressed by the University members of the center. The data produced will enable industry members to develop new materials, improve processes or speed up their product development. Pratt & Whitney is a founding CMPD industry member.

"The industry members benefit from the research infrastructure at the member universities, and the universities benefit from the guidance and applied knowledge of the industry members," said Frame.

As Director of the CMPD, Frame will manage the research portfolio of the center and coordinate the efforts across the three founding University Members. She is joined by MSE Associate Professor Rainer Hebert and GE Professor in Advanced Manufacturing Pamir Alpay, who have both been involved in the creation of CMPD. UConn faculty will provide expertise in materials manufacturing and characterization for the collection of transient materials processing data used by industry in process modeling and simulation.

The center consists of three other founding member institutions, including the University at Buffalo whose researchers will contribute their materials informatics expertise, Worcester Polytechnic Institute (WPI) whose researchers will bring process modeling experience, and ASM International which is providing the platform for data archiving and dissemination. UConn's Innovation Partnership Building (IPB) will provide state-of-the-art materials characterization equipment, such as the Gleeble 3500, a thermal and mechanical testing system.

"Over the next year, we will get a pilot research project underway," Frame said. Specifically, Hebert's research group will focus on generating materials processing data for a selection of alloys using the Gleeble 3500. Once the center begins to produce results demonstrating its capabilities and value, Frame said they will be focusing on bringing in new industry members.

"The companies that join would have a specific interest in developing and maintaining high-quality materials processing data," she said.

But Frame's hopes for the collaborative center extend beyond the generation of high-quality data. CMPD will also provide new opportunities to student researchers in the faculty members' groups to work closely with industry professionals and learn about the demands of materials applications prior to graduating.

"Students can work with industry to learn what real questions they face, and professional engineers already in the workforce can interact with students to help guide their learning and education and prepare them for their future jobs in industry," Frame said.

Department Head Bryan Huey added, "Teaming with the CPMD will allow the member companies to make much more rapid and thorough progress than they could independently, especially leveraging the broad range of expertise and capabilities at UConn MSE and the partner institutions. Assistant Professor Frame is especially well-positioned to lead this effort, based on her extensive industry experience in this area as well as her active leadership in ASM, which will host the data for sharing with the broader materials community. "

MSE Faculty Hosts Workshop to Address Clean Energy Production

Fueled by the rising need for clean energy solutions, MSE's Jasna Jankovic organized a workshop to discuss paths to commercializing alternative energy production.

Assistant Professor Jasna Jankovic

Hydrogen is the most abundant chemical element in the universe. It exists on Earth in the water that surrounds us, in the biomass, and even in the air we breathe. Its abundance and highest-existing energy gravimetric density make it a likely candidate for sustainable clean energy. But large volume production of hydrogen, and the manufacturing of fuel cells that use it to generate power, is still costly and challenging, hindering wide-spread commercialization of this technology.

Jasna Jankovic, Assistant Professor of Materials Science and Engineering, has dedicated her career to fuel cell and alternative energy research. Jasna sees a rising need for clean energy solutions and the early commercialization of electrolyzers – devices that split water into Hydrogen (H_2) and Oxygen (O_2) molecules – and fuel cells, which electrochemically combine them to produce power. That's why she organized a conference to bring together U.S. and international researchers to discuss the current challenges and potential solutions to large-volume, advanced fabrication, and quality control of these crucial energy systems.

The conference, Advanced Manufacturing and Characterization of Fuel Cells and Electrolyzers Workshop, brought together 50 leading academic researchers, industry and government agency representatives from Canada, Germany, Israel, South Africa, and across the United States for a two-day workshop on advanced manufacturing and characterization of fuel cells and electrolyzers.

"We need to plan future steps and establish collaborative efforts in order to faster reach our common goal," Jasna said. Her workshop was organized as an overview that established what researchers in different universities or industries are working on, and where they are in terms of achieving the commercial manufacturing of fuel cells and electrolyzers.

Vice President for Research, CT Clean Energy Fund Professor of Sustainable Energy Radenka Maric explains the Reactive Spray Deposition Technology to a conference guest in the Fuel Cell Fabrication Lab at the UConn's Center for Clean Energy Engineering.

"The main challenge is about scaling up production of fuel cells," Jasna said. "If you want to scale up production, you come across challenges with defining the parameters of larger layers of ink. Even the composition of the ink needs to change sometimes."

Students also attended and participated in a poster session, as they are "the future leaders in the clean energy sector," she said.

Jasna joined UConn MSE last year, bringing a wealth of fuel cell and hydrogen technology knowledge from more than 20 years working in industry and research. Currently, her research focuses on the use of fuel cells, batteries, and electrolyzers as clean energy systems.

"We develop advanced 2D and 3D microscopy techniques for characterizing these systems, work on fabrication of electrode materials by electrospinning, and design nature-inspired morphologies for clean energy applications," she said.

The conference was held September 23-24 at the UConn Graduate Business Learning Center in Hartford, CT, and included a tour of the C2E2 building at UConn's Depot Campus and of the IPB at Tech Park.

"UConn has long been a leader in the fuel cell industry and we are pleased that Jasna is carrying on this proud tradition," said Department Head Bryan Huey.

"The best part of the workshop was being in the same room with everyone, experts in their field, and seeing them network and discuss what we all care about," Jasna said.

Assistant Professor Stefan Schaffoener

MSE Researcher Full of Energy for Sustainable High Temperature Processes

MSE Assistant Professor Stefan Schaffoener explores how engineering the microstructure of ceramic materials improves thermal shock damage resistance.

High temperature industry processes such as metal extraction, melting, casting, and cement production are responsible for 22 percent of U.S. Carbon Dioxide (CO_2) emissions, according to a report by the Environmental Protection Agency. CO_2 emissions are a major cause of global warming.

"By developing materials for these processes, we are increasing their sustainability," said Stefan Schaffoener, Assistant Professor of Materials Science and Engineering "If we have certain materials that perform well (maintain their structure) at these temperatures, it enables new processes that are more sustainable. Due to their sheer economical relevance, any improvement in these processes makes a large impact on sustainability."

An excellent example for his research is the processing of titanium alloys. Titanium presents an ideal material for aircraft components because it is as strong as steel but 45 percent lighter–giving titanium the highest strength-to-weight ratio of all metallic materials. But titanium production is extremely costly, energy-intensive, and has a much lower recycling rate than steel and aluminum. That's why Schaffoener is researching high-temperature ceramic materials used in metal melting and casting to make titanium production more sustainable.

The process of melting and shape-casting titanium alloys into product components used in industry requires heating the materials to temperatures over 1700°C (3100°F) and pouring them into a ceramic mold. Under such extreme environments, ceramic molds commonly react heavily to the melt, causing them to crack and break.

In his research titled "Advanced refractories for titanium metallurgy based on calcium zirconate with improved thermomechanical properties", recently published in the *Journal of the European Ceramic Society*, Schaffoener investigates how designing the microstructure in ceramic molds and crucibles can mitigate the cracking under high thermal stress.

"If you have a cold glass and pour boiling water into it, it usually cracks," Schaffoener said, describing a process called "thermal shock." But that's only a nominal temperature difference. Titanium is cast from about 1750°C (3182°F), causing a tremendous temperature increase in the ceramic mold.

"The ceramic materials used to melt and cast titanium must not crack or deform under their own weight. If you have a crack, the worst case would be that a crack shoots entirely through the structure due to thermal shock," Schaffoener said. Usually, cracking of such high temperature ceramics cannot be avoided, but the damage can be minimized. He found that by engineering the microstructure of the material, the thermal shock damage resistance can be significantly improved. He and his collaborators increased the number of pores and reduced the median pore size, which increases the number of points of crack deflection. "If there's a pore, it blunts and deflects the crack, preventing it from spreading through the structure." Ultimately, it ensures structural integrity of the material.

To develop ceramic materials for sustainable high temperature processes, Schaffoener studies the entire process chain, from developing a ceramic material, to creating components such as casting molds, and investigating industrial performance under extreme thermal and corrosive environments.

Schaffoener's graduate student, Sharon Uwanyuze, is also researching high temperature corrosion of ceramics. She spent the summer interning at Oak Ridge National Laboratory in Tennessee, investigating ceramic materials for accident-tolerant nuclear reactors. Sharon was one of three students in the U.S. who received The Refractories Institute Scholarship in 2019.

Sharon is one of six students—three Ph.D. candidates, one master's candidate and two undergraduates—who have joined Schaffoener's lab since he began working at UConn in 2018.

"I want all my graduate students to spend at least one summer working at another lab or in industry, to see other environments, new opportunities and gain new perspectives," he said.

Schaffoener joined UConn's Materials Science and Engineering department after completing his post-doctoral research at the Norwegian University of Science and Technology in 2018. Prior to that, he earned his Doctorate in Engineering at TU Bergakademie Freiberg (the Freiberg University of Mining and Technology) in Germany.

He chose UConn because of the excellent research environment, access to world-class equipment at the IPB, including the Pratt and Whitney Additive Manufacturing Center, and strong industry partners in close vicinity.

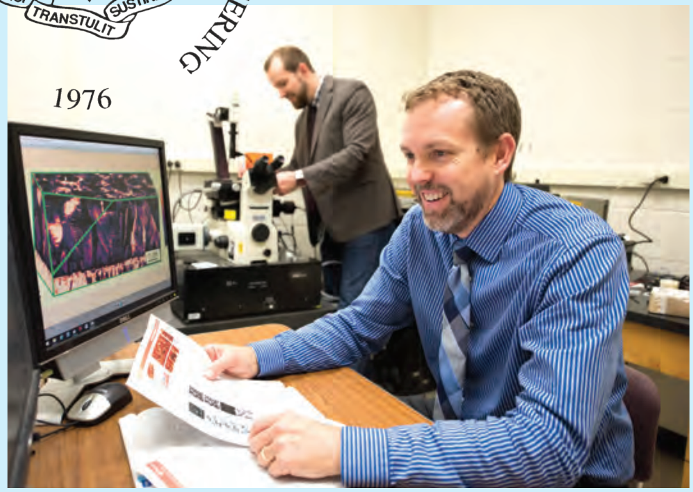
"I felt a strong sense of community and opportunities for collaboration in the School of Engineering, the Institute of Materials Science, and the MSE department," he said.
Communication and collaboration are also essential to his approach as a researcher and professor. Earlier this year, Schaffoener helped organize the Graduate Student Speaking Contest, which encourages MSE graduate students to present their research in practical terms, as if to a general audience.

"Being able to communicate with different audiences is very important for undergraduate and graduate students alike. Even within the STEM field, not everyone understands the terminology," Schaffoener said. "Graduates must be able to communicate effectively, which helps them to convince other people that their work is viable, and to establish relationships." For the same reasons he also emphasizes communication and collaboration through groupwork in his undergraduate classes.

In spring 2020, he will develop a course called "Particle-based Materials" that will introduce the properties of powders and particles in areas such as additive manufacturing, and explore their use in products such as pharmaceutical materials. In addition, he will be looking for opportunities to get involved in the community and foster STEM education for youth and underrepresented groups. He especially hopes to encourage girls and women to pursue a career in engineering.

Overall, Stefan is motivated to make a difference in the world. "We need to learn from diverse perspectives to solve major global challenges, such as making industrial processes more sustainable, while maintaining their competitiveness."

Bryan Huey Among 7 New UConn CASE Inductees



Professor Bryan Huey, foreground, and a colleague in the lab. (Ryan Glista/UConn File Photo)

Materials Science and Engineering Department Head Bryan Huey is among 24 new members elected to the Connecticut Academy of Science and Engineering (CASE), chosen from Connecticut's leading experts in science, engineering, and technology. Seven of the new electees are faculty researchers at UConn or UConn Health.

"What the 2019 CASE electees from UConn and UConn Health have achieved throughout their respective careers is truly astounding," said Radenka Maric, Vice President for Research at UConn and UConn Health. "Our preeminent researchers are tackling major challenges that affect our citizens and our society – from cybersecurity to rare disease and everything in between. We are grateful to CASE for recognizing them through this prestigious award."

Election to CASE is based on scientific and engineering distinction through significant contributions in theory or applications, demonstrated by the pioneering of new and developing fields and innovative products, outstanding leadership of nationally recognized technical teams, and external professional awards in recognition of scientific and engineering excellence. The Academy also identifies and studies issues and technological advances of concern to the people of Connecticut, and provides expert advice on science- and technology-related issues to state government and other Connecticut institutions.

"With their impressive backgrounds, these preeminent researchers will help the Academy provide invaluable, unbiased advice on science- and technology-related topics to the state legislature and government. I congratulate them all," said Baki Cetegen, CASE president and United Technologies Chair Professor in UConn's Department of Mechanical Engineering. With the addition of these new members, the total number of CASE regular members from UConn and UConn Health is 118.

Based on a UConn Today article by Jessica McBride.

MSE Researchers Lead Program for Air Force R&D in Advanced Manufacturing

A pair of F-15 Eagles from Eglin Air Force Base, Florida, taxi after landing at Wright-Patterson Air Force Base, Ohio in preparation for landing and safe haven, Oct. 9, 2018. The F-15 was one of several plains taking safe haven at Wright-Patterson AFB in 2018, as Hurricane Michael threatened their home station. (U.S. Air Force photo by Wesley Farnsworth)

The University of Connecticut has secured a four-year, $5.4 million contract with the Air Force Research Laboratory (AFRL) to provide next generation manufacturing solutions for the aerospace sector. This project will allow the U.S. Air Force to fully take advantage of new manufacturing technologies and maintain a position of strength in international defense. This is the first phase of a larger contract, which is expected to grow significantly in the next year.

The program is led by Materials Science and Engineering faculty Pamir Alpay, General Electric Professor in Advanced Manufacturing and Executive Director of the Innovation Partnership Building at UConn Tech Park, as well as Rainer Hebert, Associate Professor of Materials Science and Engineering and Director of the Pratt & Whitney Additive Manufacturing Center.

The project, titled “Simulation-Based Uncertainty Quantification of Manufacturing Technologies,” will help the U.S. Air Force develop more efficient manufacturing processes. To manufacture the complicated parts used to build an aircraft, OEMs (original equipment manufacturers) start with relatively inexpensive raw materials. These then go through several steps to be shaped and formed into a very expensive component for use in the aerospace sector. At each step in the manufacturing process, there is the potential for uncertainties about the quality of the parts, which could lead to the part being scrapped.

“Through UConn’s expertise in specialized manufacturing simulation, extensive materials analysis, and process modeling, we will provide transformative capabilities for AFRL, OEMs, and their supply chains to reduce scrap rates, increase yield and performance, and cut down failures,” said Alpay.

The UConn-AFRL collaboration seeks to understand each and every step of the manufacturing process to eliminate failures in specialized aerospace parts. Better understanding the manufacturing process will lead to reduced costs, improved component and system quality, and enhanced industrial capability.

“UConn is uniquely positioned to support major research and training initiatives for aerospace materials development, thanks to our world-class research capabilities and existing ties with major aerospace corporations,” prior-UConn President Susan Herbst told UConn Today. “On behalf of UConn, I am very excited that our institution is supporting our nation’s defense capabilities through this important collaboration.” The award was first announced publicly in March by U.S. Sens. Chris Murphy and Richard Blumenthal and U.S. Rep. Joe Courtney.

“Connecticut is home to the best universities and manufacturers in the world, so we are thrilled to announce that UConn is receiving this grant from the Air Force Research Lab,” the members of Congress said in a joint press release. “This critical funding will be used for new aerospace research and developments that will go towards developing advanced materials and manufacturing processes for the Air Force.” Research and development activities will be conducted at UConn’s Innovation Partnership Building (IPB) at UConn Tech Park. The IPB is UConn’s premier center for cutting-edge research and industry collaboration. To date, IPB partners have invested more than $80 million for research projects in a variety of sectors, including additive manufacturing and aerospace.

Seven faculty researchers, 10 doctoral graduate students, and two postdoctoral researchers from UConn’s School of Engineering will work on the projects—nearly all from the MSE department. Industry partners for the program include Pratt & Whitney, Aero Gear, and GKN Aerospace. Collins Aerospace and Sikorsky are also expected to collaborate on the project in the future.

“The intellectual depth, capabilities, and capacity, combined with state-of-the-art research facilities at UConn, will provide the tools necessary so that our federal and industry partners can integrate them into U.S. defense strategies and strengthen the nation’s global dominance in materials development for the aerospace sector,” said Radenka Maric, MSE professor and UConn’s vice president for research.

Other UConn MSE faculty involved in the program include Hal Brody, Distinguished Professor of Materials Science and Engineering, and Serge Nakhmanson, associate professor of materials science and engineering.

Jessica McBride - Office of the Vice President for Research

The UConn MSE graduates in front of Ulbrich Steel's Wallingford Facility. From the left: Samuel Guerra, Allie Kelley, Keith Grayeb, Sean Ketchum, and Samantha Brantley

Ulbrich Steel's MSE Alumni Foster Collaboration and Partnership

UConn MSE Alumni share how their growing collaboration with current students can create even more opportunities for students and industry.

Sean Ketchum, a 2008 UConn MSE alumnus and director of metallurgy at Ulbrich Stainless Steels & Special Metals, was one of the first UConn MSE graduates to work at the world-renowned Wallingford steel company. But now, Sean is joined by Samantha Brantley (BS 2015), Samuel Guerra (BS 2017), Allie Kelley (BS. 2015), and Keith Grayeb (BS 2009), all alumni of the Department of Materials Science and Engineering.

Keith, a senior process metallurgist at Ulbrich, was the first UConn MSE intern at the company, working there over the summer between his sophomore and junior years in 2007. When he graduated, he worked at Sikorsky for a year before Ulbrich reached out to him with an offer. He is now in his tenth year at Ulbrich.

Sean, on the other hand, started his position immediately after he graduated based on a recommendation from a professor.
"I really liked the flexibility of Ulbrich, in terms of being able to chart my own course," he said.

The other MSE graduates found opportunities as the company began to have a greater presence in UConn's career fairs, and began supporting MSE Senior Design projects. Allie Kelley, an associate process metallurgist at the company, was hired at Ulbrich after the company funded her Senior Design project.

> The MSE department is really positioned to care about what happens to alumni after they graduate. They get students ready to enter, and succeed in, the workforce.
>
> —Sean Ketchum

"When they interviewed me for the job, I realized I loved the group I was going to be working with," Allie said.

Since Keith's internship and Sean's hiring, the two have made an effort to include UConn in hiring new graduates, and in including Ulbrich in UConn's growth as a premier STEM-based university and research hub for Connecticut.

"It feels that the UConn presence has grown with the materials science program size," Sean said. "From there, we've followed the progression of the program. We've funded more Senior Design Projects, we've hired more interns from MSE, we've recognized our need to have young, technically-educated people in our company. MSE has grown to meet that need."

"We've developed this manufacturing-academic relationship with UConn MSE," Sean said. "We know the professors, we get to know the students through their Senior Design projects and internships. It's been an interesting progression."
It's not just projects and hires that Ulbrich is looking at now, Keith said. Soon, the company will start to use UConn MSE's new resources at the Innovation Partnership Building.

"We're expanding beyond just a pipeline of internships," Keith said. "UConn has a lot of resources in analytical equipment, like AFMs, to test new products. Now with the Innovation Partnership Building, we're hoping to form a further partnership with UConn for using, and training with, the analytical equipment MSE has to offer. This equipment will help Ulbrich be able to better adapt to the market."

"In order to best serve our customers, we need to look at things the same way our customers do- and they often have the analytical equipment that UConn does," Keith said. As the University continues to adapt and expand toward Connecticut's industry needs, companies like Ulbrich are given more opportunities to partner with the university for R&D, creating a two-way street between business and the academic world, Sean said.

"

Hard classes that we all took have a way of breeding critical thinking, which help foster the mindset that we're looking for.

—Keith Grayeb

"UConn MSE's expansion is beneficial to Connecticut-based manufactures like Ulbrich," Sean said, "that may not have the room or resources for the analytical equipment they need. UConn funding so much equipment and expertise at the IPB is a great fit, which means we can begin to create that knowledge here."

As Ulbrich continues to look to expand its relationship, the company plans to keep on hiring interns and MSE grads—both due to the quality of MSE's education.
"We all had different backgrounds and internships, but we're all in the same kind of mindset," Sean said. "When we come into manufacturing, we're able to bounce different ideas off of each other. We have a desire for connectivity. We all just want to exchange information."

Even though many of the alumni have different ideas and experiences, many of them have gone through the same courses that Sean and Keith went through 10 years ago. "Those classes are a way of proving that an applicant has an acceptable work ethic," Keith said. "Hard classes that we all took have a way of breeding critical thinking, which help foster the mindset that we're looking for."

Sean added that many of the concepts and contexts that his fellow MSE graduates are taught are easily relatable, even though many of the graduates are in different departments of the company.

"Being able to reference a common experience or example that a professor taught us really helps with understanding," he said.

For many of the alumni, their professors and advisors were a keystone in their development as engineers and dedicated students.

"Professor Harold Brody is the fundamental reason I began at Ulbrich," Sean said. "Professor Brody knew directly of an opening at Ulbrich which was a perfect fit to me. By Friday morning of that same week I had an interview, and by Friday afternoon I had an offer. Our small graduating class reflected as we parted MSE on how our advisors had all worked to support our professional or academic transitions."

For Samantha, the support her advisor, Professor Pamir Alpay, gave her during her time at UConn helped her through her journey as an MSE student, and gave her contacts for her career in Ulbrich.

"The professionals I met through his guidance clarified the differences between academia and industry, providing me with the confidence a minority in STEM needs. Professor Alpay always encouraged me when the MSE curriculum tested my stamina," Samantha said. "If I had a month of rigorous workload ahead, he would frequently check-in and even schedule weekly meetings for support. Pamir has a well-established network and would often recommend that I get in contact with his colleagues currently in industry. By creating an open and honest mentorship, Professor Alpay truly influenced my career path for the better."

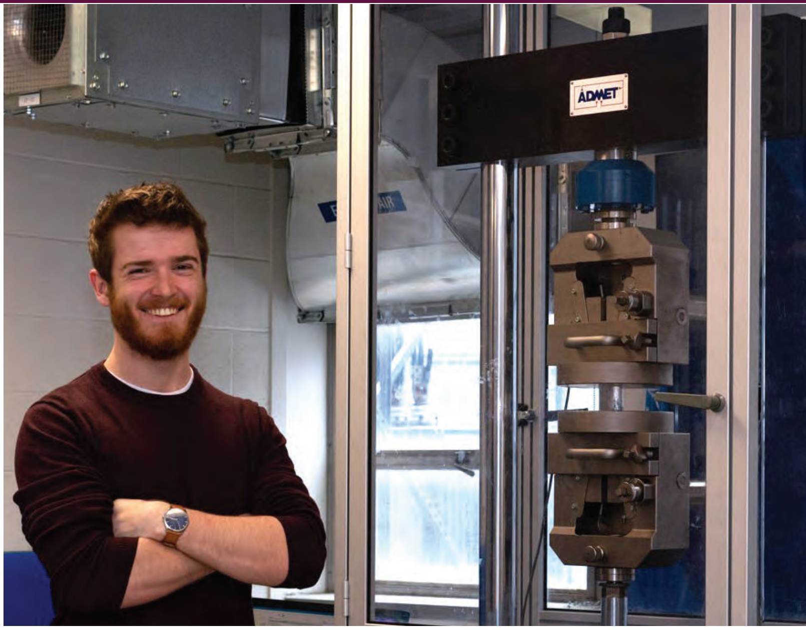
Overall, Sean said that he is grateful for the experiences that MSE was able to provide for him and his team of MSE graduates. Sam Guerra, associate process metallurgist, said that without the University, he wouldn't be as successful as he is today.

"The MSE program was able to give us so many resources we wouldn't be able to access normally," Sam said. "It's really great to see my company hiring people from the same program, and to see that they've been able to keep up with the industry."

Sean agreed.

"The MSE department is really positioned to care about what happens to alumni after they graduate," he said. "They get students ready to enter, and succeed in, the workforce."

Joseph Podbielski next to a mechanical tester in Associate Professor Volkan Ortalan's lab, which is used for pressure and stress testing of materials.



Undergraduate Joe Podbielski Juggles Class, Lab Duties and Working on Blackhawks

Joe shares how his MSE classes led to opportunities at Sikorsky, how he manages his full schedule, and some advice for fellow undergraduates.

Senior student Joseph Podbielski spends his school days helping manage labs for engineering students, and his summers helping design helicopters for Sikorsky that can save people's lives. Originally a transfer from UConn's Avery Point campus, and a Mystic, CT native, Joe's dream was to work at Sikorsky like his father.

"Joseph is a natural leader whose persistent habit is volunteerism, and through these efforts he has gained a level of mutual respect from UConn's Materials Science and Engineering community," said his lab supervisor, Francis Almonte.

We sat down for an interview with Joe about his experiences in the MSE department as both a student and an experienced lab technician.

How did you become interested in materials science?
My dad was an engineer for Sikorsky, and as a kid I was always playing with Legos and K'NEX. My dad always pushed me toward that and encouraged me to pursue it.
For me, it was when I took 'Mechanical Behavior of Materials' with Seok-Woo Lee and Adam Wentworth, who was my lab instructor. In that class, we were getting into real-world scenarios and doing hands-on experiments. Both of my professors were excited about what they were teaching, and that rubbed off on me. My personal favorite module from that lab was when we did a geopolymer project and used a custom concrete blend to try and reduce CO_2 emissions.

I feel like I apply what I learn in class right out the door. I've always loved working with my hands and fixing things. I'd definitely like to go into mechanical behavior, seeing why things break, how they break and how they can be improved.

How did you find a way to stay in the lab?
I started working as a laboratory technician for the undergraduate labs. I also worked as a teaching assistant for Volkan Ortalan's Mechanical Behavior class. I help prepare samples, run the samples, and collect data. For the undergraduate labs, I helped prepare modules and labs for the students. I spent about 15-20 hours a week in the lab on top of a full class schedule, which I manage with a lot of coffee!

What do you enjoy about managing a lab?
Generally, the students are very excited to get into the material. In the junior labs, they're given a lot of freedom—they have a material they're working with, and it's up to them what to do with it, how they're going to test it. I just guide them. I do my best to get them enthusiastic and help them enjoy the experience.
I also love using the mechanical testing machine to see how a material can withstand stress. It's really cool seeing how much load something can take, and also how it breaks.

Which professors and mentors have helped you in your journey?
Adam Wentworth, for sure. Professor Lee and his excitement for MSE has truly inspired me as well. I get to work with people who are excited to do what they do, which is a motivating experience. All of my lab classes have been extremely helpful, since it's something you can see and apply to your work. At one point, I was helping Professor Lee do some research, and he had thumbtack-sized cylinders of magnesium. We were doing strength tests on them, and it was amazing how much weight these tiny little cylinders could hold—thousands of psi.

Tell me about your work with Sikorsky.
I've interned at Sikorsky every summer since my freshman year, in 2015. I think I've logged over 600 hours since I started there. I began doing basic design checks for the helicopter parts. The senior engineers would draw up designs and send them over to me, and I'd check them for any errors before sending them off to our boss. Now, I draw the

designs myself, and help train new interns to do design checks like I did. We're working on ways to upgrade the aircraft we're producing. I've worked on Blackhawks, Seahawks, and some commercial aircraft.

This last summer, I applied what I learned both in class and in the lab to help optimize certain processes, making them more accurate and less time-consuming. I've been able to apply teamwork and leadership skills that I have gained from the team projects throughout the curriculum to collaborate with coworkers and managers, improving our team dynamic and overall productivity.

To actually be handed responsibility and have a say in aircraft that people will use for decades to come, it's unique. My coworkers are wonderful, and it's awesome to see the designs I helped put together as they literally take off. During Lockheed Martin day at UConn, I got to see one of the helicopters I worked on, a Blackhawk, and I talked to the flight crew who had just flown in from North Carolina after rescuing people from the recent hurricane. Seeing that, and seeing the mechanics I worked on have had an impact on people, that's priceless. I hope I can work full-time there after I graduate.

What advice would you offer to undergraduates looking for an internship like yours?
Apply yourself. Talk to your professors, talk to industry people. Senior Design really helps, especially if you do a good job and show a good work ethic.

What is one challenge you had to overcome during your time in the MSE Department?
Moving away from home. I used to commute to school at Avery Point and go home every night. When I moved here, it was a brand-new world. I was a little overwhelmed, but I buried myself in my work and my studies. I spent as much time as I could in the lab and got to know as many people there as I could. Now, I always have a home in the lab. I have a great group of lab mates, and I'm happy to be a part of it.

George A. Rossetti, Jr. Appointed MSE Associate Department Head

Associate Professor George A. Rossetti Jr.

George A. Rossetti, Jr. accepted appointment as Associate Department Head for Materials Science and Engineering this year.

George received his BS in chemical engineering and MS in materials engineering from Worcester Polytechnic Institute, his Ph.D. in solid-state science from The Pennsylvania State University, and he conducted postdoctoral research in solid-state chemistry at Princeton University. He is recognized internationally for his contributions to fundamental research into structure-property relations in dielectric and piezoelectric ceramics. He is an author on about 75 peer-reviewed articles and book chapters, holds two U.S. patents, and his work has been cited nearly 2000 times. His more recent published work includes cover, feature and invited articles for *Journal of the American Ceramic Society, Applied Physics Reviews* and *Materials Research Society Bulletin*. He is a frequent invited or plenary speaker at major conferences devoted to electronic and functional ceramics.

In addition to his accomplishments in academia, George spent nearly a dozen years in industry. He began his career as research engineer with Norton Company (now Saint-Gobain Corporation) where he developed a patented process for fabricating reaction-bonded silicon nitride ceramics and composites. In subsequent work as senior research engineer, he patented environmentally friendly oxide-abrasive machine tools, for which he was awarded the Saint-Gobain corporate research prize recognizing innovation across business units worldwide. Later he joined Continuum Control Corporation, a MIT spin-off startup, where as director of functional materials he oversaw $7M in DARPA S&T funding to develop piezoelectric fiber composites for vibration suppression and active structural control systems in air and space vehicles. There he was also a key participant in the commercialization of piezoelectric technology for the Head Intelligence® line of actively damped sporting goods and Direct-Light® beam-steering all-optical switches.

Since joining UConn's faculty some 10 years ago, George has received support for his work from ARO, DHS, ONR and many industrial partnerships. During his sabbatical in 2014-15, he was a visiting scientist at Technische Universität Darmstadt. His teaching in the MSE department has included core graduate courses covering crystallography and transport phenomena, as well as undergraduate and graduate course offerings in ceramic materials.

George will continue to oversee the MSE graduate program as well as assist with the many administrative, academic development and strategic planning activities of the department.

Dr. Cato T. Laurencin Honored for Advancing Science, Serving Public Good

University Professor Laurencin's research launched the use of nanotechnology in musculoskeletal regeneration and led him to develop breakthrough soft tissue implant technologies.

Dr. Cato T. Laurencin, Chief Executive Officer of The Connecticut Convergence Institute for Translation in Regenerative Engineering and Director of The Raymond and Beverly Sackler Center for Biomedical, Biological, Physical and Engineering Sciences at the University of Connecticut, is the winner of the 2019 Philip Hauge Abelson Prize, presented by the American Association for the Advancement of Science during their 185th AAAS Annual Meeting in Washington, D.C.

An eminent materials scientist, biomedical engineer, and orthopedic surgeon, Laurencin is being honored for his unique contributions to the advancement of science. The Abelson Prize recognizes his global leadership in biomedical technology innovation, public service in shaping United States technology policy, and invaluable mentorship to a generation of minority scientists. The AAAS Board of Directors established the Abelson Prize in 1985 to recognize individuals who have "made signal contributions to the advancement of science in the United States."

"Professor Cato T. Laurencin is the foremost scientist-biomedical engineer in our country today, and a national and international leader in science and technology innovation," Kazem Kazerounian, Dean of the University of Connecticut School of Engineering, wrote in the award nomination. "Dr. Laurencin is a towering figure in science and technology."

This year, Dr. Cato Laurencin was also one of two UConn professors elected as members to the historic and prestigious American Academy of Arts and Sciences.

Founded in 1780 by John Adams and James Bowdoin, the academy honors exceptionally accomplished individuals who are engaged in advancing the public good.

"I am very honored and humbled to be elected to the American Academy of Arts and Sciences. I thank my mentors, especially Professor Robert Langer, and my students who continually inspire me," said Laurencin, the first UConn Health physician faculty member to be elected.

Laurencin's seminal papers and patents have had wide-ranging impacts on human health, launching the use of nanotechnology in musculoskeletal regeneration and ushering in a new era in orthopedic therapies. His research inspired the development of biocomposite interference screws, which fix bone to soft tissue and are used in at least 25 percent of the more than 500,000 anterior cruciate ligament (ACL) reconstruction surgeries performed worldwide each year.

Likewise, the soft tissue implants that Laurencin has developed — the STR graft for rotator cuff regeneration and the Laurencin-Cooper (LC) Ligament for ACL regeneration — have been declared breakthrough technologies. The rotator cuff graft lessens pain and speeds up recovery time following shoulder surgery, and the ACL device, expected to play a similar role in knee surgeries, has been implanted in patients as part of a large clinical trial in Europe. National Geographic named the LC Ligament one of its "100 Scientific Discoveries that Changed the World" in 2012.

Laurencin has also used his authoritative voice to guide national technology policy. Because of his successful experience serving on the Food and Drug Administration's orthopedic device panel, Laurencin was appointed to the National Science Advisory Board to help revamp the agency and

University Professor Cato T. Laurencin

its mission of providing scientifically based evidence to support the approval of devices, drugs and biologics. He has served on numerous advisory boards for the National Science Foundation and the National Institutes of Health, and was the faculty leader in the development of the Bioscience Connecticut Initiative for the State of Connecticut. Bioscience Connecticut now serves as a model for government-academic innovation partnerships around the country.

In addition to his pioneering research and policy work, Laurencin has provided invaluable mentorship to a new generation of minority STEM professionals. Eight of his 125 former minority mentees now hold tenured or tenure-track faculty positions in biomedical engineering.

"Considering that only a handful of African Americans hold tenure-track appointments in biomedical engineering nationally, it is difficult to overstate the impact that Dr. Laurencin has had on diversity in this field," said Yolanda George, former deputy director of AAAS Education and Human Resources, in presenting him with the 2012 AAAS Mentor Award.

Among Laurencin's recognition is the National Medal of Technology and Innovation and the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring from former President Obama. He is a peer-elected member of the National Academy of Engineering and the National Academy of Medicine, and the American Institute of Chemical Engineers named him one of its 100 Chemical Engineers of the Modern Era.

Dr. Laurencin is internationally known for his contributions to Materials Science. He is a Fellow of the Materials Research Society and has been the Fred Kavli Distinguished Lecturer and Plenary Speaker for the Materials Research Society. He is a life member of the American Ceramic Society and has delivered two of their most prestigious lectures. He has served as the Edward Orton, Jr. Memorial Lecturer and the Rustum Roy Lecturer for the American Ceramic Society. He has been recognized as one of the most highly cited researchers in Materials Science and Engineering (Scopus).

Laurencin serves as the 8th University Professor in UConn's history. He is Professor of Materials Science and Engineering, Professor of Chemical and Biomolecular Engineering, and Professor of Biomedical Engineering. He is also the Albert and Wilda Van Dusen Distinguished Professor of Orthopaedic Surgery.

Pamir Alpay Appointed as Associate Dean of Engineering

Pamir Alpay, Materials Science and Engineering GE Professor in Advanced Manufacturing, has been appointed as Associate Dean for Research and Industrial Partnerships at the School of Engineering (SoE). Alpay will continue as the Executive Director of UConn Tech Park, with the dual roles enabling him to lead engineering centers and applied research initiatives.

Professor S. Pamir Alpay

"We are thrilled to have someone with Professor Alpay's experience taking the lead on our industry relations and research development," Kazerounian said, adding that he is "excited for the future" of the school.

As executive director of UConn Tech Park, Alpay leads the University's efforts to increase strategic partnerships with businesses in a state-of-the-art research and development facility. Alpay joined UConn's MSE department in 2001 and served as its Program Director and subsequently as its Department Head from 2011 to 2017. He received his Ph.D. in 1999 from the University of Maryland.

He is an elected member of the Connecticut Academy of Science and Engineering (CASE) and a Fellow of the American Physical Society (APS) and the American Ceramic Society. He is the recipient of several awards including the NSF CAREER grant in 2001, the UConn School of Engineering Outstanding Junior Faculty Award in 2004, the UConn School of Engineering Outstanding Faculty Advisor Award in 2013 and the AAUP Excellence in Career Research and Creativity Award in 2018. Alpay has over 200 peer-reviewed journal publications and conference proceedings, four invited book chapters and a book on functionally graded ferroelectrics.

Based on an email by Dean K. Kazerounian

Elected Fellows among MSE Faculty:

- American Association for the Advancement of Science
- National Academy of Engineering
- American Ceramic Society
- American Physical Society
- Materials Research Society
- Microscopy Society of America
- Connecticut Academy of Science and Engineering
- Royal Microscopy Society
- Alexander von Humboldt Foundation
- United States National Academy of Inventors
- Japan Organization for Promotion of Science
- National Association of Corrosion Engineers
- American Society for Metals
- United Technologies Corp (UTC)

➲ Seok-Woo Lee and his student, Hetal Patel, accepting the Mentorship Excellence Award at the Frontiers in Undergraduate Research Reception.

Seok-Woo Lee Honored with Mentorship Excellence Award

In honor of his outstanding excellence in mentoring and supporting undergraduates in the MSE Department, Assistant Professor Seok-Woo Lee has been awarded the UConn Mentorship Excellence Award from the Office of Undergraduate Research.

The award recognizes professors who help develop their mentees' education and goals, support student research and growth, help their students develop a broader understanding of the field they are working in, connect students with resources for research, educational, and career-related endeavors, and generally aid students in becoming well-rounded and driven scholars.

"This is a great honor for me. This award gives me a lot of meaning, much more than any other awards related to research and funding," Lee said. "I have worked closely with UConn undergraduate students for the last four years, and I was always amazed by their positive mindset, enthusiasm, and creativeness. I will keep working hard to provide the best MSE education for our hard-working MSE undergraduate students."

His ability to educate and inspire young students extends beyond the UConn labs, too. Lee joined the Materials Advantage Student Chapter in their visit to East Farms Elementary School in Farmington, CT for an MSE outreach event. During the public STEAM Night (STEM + the arts), Lee and three MSE undergraduates showed off their liquid nitrogen marshmallow trick—in which a marshmallow is dunked in liquid nitrogen, frozen, and shattered— along with several other engaging ways to manipulate materials.

Lee joined the department five years ago, after completing a postdoc fellow position at the Kavli Nanoscience Institute of California Institute of Technology and earning his Ph.D. from Stanford University. He has won numerous awards for his research and teaching, including the NASA Early Career Faculty Award (CAREER) in 2016, UConn Research Excellence Awards in 2016 and 2018, and MSE Teaching Excellence of the Year awards in 2017 and 2018. He has also received the student-evaluation-based "undergraduate teaching excellence" award four times since joining UConn.

His lab, which presently hosts four Ph.D. graduate students and two undergraduate students, focuses on the mechanical behavior of advanced structural materials at multiple length scales. They use a state-of-the-art in-situ nanomechanical testing system to understand the role of crystalline defects in plastic deformation of metals, ceramics, polymers, and intermetallic compounds. Undergraduate students in his laboratory typically use an ex-situ nanomechanical testing system and explore mechanical behavior of materials at the nanometer scale. One of his former undergraduate students, Hetal Patel, nominated Assistant Professor Lee for the university-wide Mentorship award because of his continued and outstanding support of her and her research throughout her time in MSE.

"Having Professor Lee as my research advisor is the best thing that happened to me at UConn. He is the highlight of my day and a hallmark of my UConn career," Hetal said. "Overall, Professor Lee has changed the trajectory of my career through his kindness, his passion for science, and his dedication toward student success. Coming into UConn, I knew nothing about research, and if I hadn't met Professor Lee, I would have never thought of applying to be a University Scholar, pursuing a Ph.D. at a top graduate school, or applying for graduate research fellowships to facilitate this next step in my career." Notably, Hetal won such extraordinarily competitive awards from NDSEG as well as NSF, the first such dual-honor in UConn's history.

These mentoring efforts by Lee were honored at the Frontiers in Undergraduate Research Poster Exhibition reception in April, one of the largest, annual, school-wide student research exhibitions. There, Hetal gave a poster presentation for her work on the effects of tip radius on mechanical behavior of single crystal tungsten under spherical nanoindentation. Hetal's speech for Lee's mentorship is available on the webpage of UConn Mentorship Excellence Award.

New Online Course Introduces MSE to Non-Majors

MSE Assistant Professor Lesley Frame has developed an online version of Introduction to Materials Science and Engineering for non-MSE majors (MSE 2101) to provide a summer option for this highly-attended course.

The 3-credit course ran during Summer Session 2 from July 15 to August 16, and packed a semester's worth of material into five weeks. Frame expects the course to run again next summer. The course satisfies requirements for many engineering majors.

"MSE did not have any online summer courses before this, and we thought this course would be a great way to venture into a new area of teaching and learning opportunities," Frame said. Her goal with the online course is to reach more students without sacrificing "person to person connections that are integral to the learning process."

"I love teaching because I enjoy interacting with students to help them discover new aspects about the world around them, and I wanted that to come across in this online course," she said.

Frame, who joined UConn MSE as an Assistant Professor in 2018, was named a member of Heat Treat Today 40 Under 40 Class of 2018 for her research on heat treating, metallurgy, and thermal manufacturing processes. Frame also wrote a guest editorial on Heat Treatment in education in ASM's May/June Materials Solution Publication.

Frame's online course includes many different learning activities that facilitate interaction among students and between the students and her, as they absorb the new materials. The students watch lectures, post on discussion boards, and conduct small experiments at home, such as testing the fatigue of paperclips. They even post videos and selfies as they describe materials around them.

Frame worked with an eCampus designer, Eileen Stuyniski, in the Center for Excellence in Teaching and Learning (CETL) to make the online course a success, and she said, "I would not have been able to create this course without all of the input and support from CETL, which is truly a remarkable resource on campus!"

Dongare Named UTC Professor in Engineering Innovation

Associate Professor Avinash Dongare

MSE Associate Professor Avinash Dongare has been named the United Technologies Corporation (UTC) Professor in Engineering Innovation. The appointment carries a three-year funding award of $5,000 per year for professional development and growth.

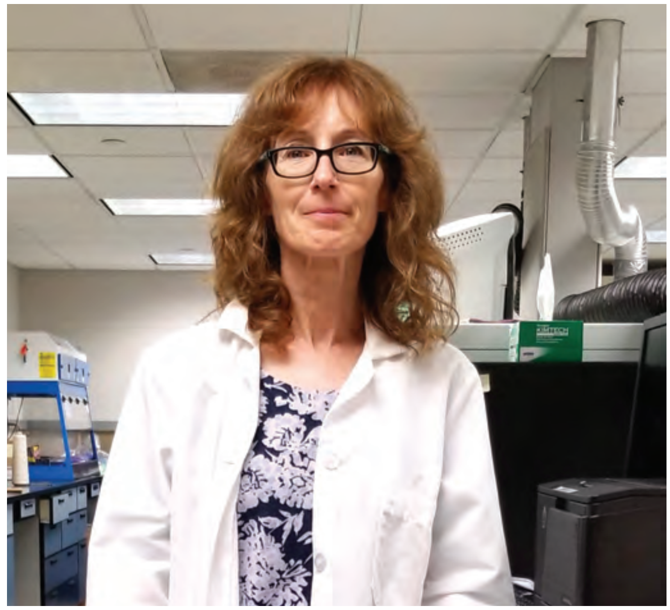
"I am immensely humbled and honored to be selected as the United Technologies Corporation Professor in Engineering Innovation in the School of Engineering," Dongare said. "This is a recognition for my collaborators, teachers/mentors, and for the scientific pursuit and hard work of the students and researchers in my group."

Dongare joined UConn in 2012 as an assistant professor in the MSE department with an appointment in the Institute of Materials Science. His current projects are based on density functional theory (DFT), molecular dynamics (MD), Monte Carlo (MC) simulations and machine learning (ML) methods, and mesoscale modeling methods. Of particular relevance is his development of the mesoscale modeling method called "quasi-coarse-grained dynamics" (QCGD) that scales up the capability of MD simulations to model materials behavior at the mesoscales to model microstructural evolution at the time and length scales of experiments.

"Avinash and his group continue to be extremely successful in their research, earning grants from diverse sources, winning student prizes, and having their work featured on journal covers," said Department Head Bryan Huey. "The Professorship in Engineering Innovation is a small recognition of these accomplishments."

Rhonda Ward, Institute of Materials Science

Materials Scientist Fiona Leek Joins MSE as Assistant Professor-in-Residence



Fiona Leek, Assistant Professor-in-Residence

The Department of Materials Science and Engineering is pleased to welcome Fiona Leek, Ph.D., a UConn alumna and long-time employee of UConn's Institute of Materials Science, as an assistant professor-in-residence.

In her new role, Leek will teach undergraduate lab courses and manage the MSE laboratories. She will work with other MSE faculty to enhance student research, coordinate outreach programs, and mentor senior design projects.

After earning her BA in Museum Science & Archaeology at Wesleyan University in CT, Leek worked as textile conservator treating historic textiles including those owned by major museums such as the Metropolitan and the Smithsonian. It was this that sparked her interest in materials science. She went on to earn a master's degree in Textile Science and Engineering from North Carolina State University and master's and doctoral degrees from the Polymer Science Program at UConn.

Thereafter, Leek worked as a technical expert in the thermal analysis of polymers, foods and pharmaceuticals for T.A. Instruments in Delaware. She later moved to Massachusetts to become a Senior research scientist in corporate analytical at Millipore Corporation, a multinational company providing advanced filtration products to food and pharmaceutical industries and analytical sciences. Here she managed the polymer analysis facilities and provided polymer expertise for R&D, Manufacturing, QC, Technical Services and Supply Chain.

In 2006, Leek returned to UConn's Institute of Materials Science (IMS) where she served as the Associate Director of the Industrial Affiliates Program (IAP) for 10 years. She worked with scientists and engineers from a wide variety of Connecticut companies to solve various materials-related challenges using the wide range of analytical tools and faculty expertise within IMS. During this time, she also served as a co-advisor for several MSE Senior Design teams and as a mentor for the Society of Polymer Engineers (SPE) Polymer Graduate Student Chapter and the UConn Connects program. In 2016, she joined Travelers' Risk Control Lab as a Senior Forensic Scientist where she investigated materials failures as they relate to loss of property, business and personal injury.

MSE Quick Facts 2019

$37M

in active grants among core MSE faculty

4

Research Facilities

» Institute of Materials Science
» Center for Clean Energy Engineering
» Institute for Regenerative Engineering
» UConn Tech Park

21

elected fellows in professional societies

49

20 full-time professors and professors-in-residence
10 additional faculty in graduate program
19 teaching, research, adjunct, and emeritus faculty

>100

peer-reviewed publications

NSF Grant Allows Seok-Woo Lee to Investigate Strong-but-Flexible Solid Structures

Assistant Professor Seok-Woo Lee has received a $600k grant from the National Science Foundation's (NSF) Mechanics of Materials Structures (MOMS) program in collaboration with Mechanical Engineering Assistant Professor Ying Li. Lee is the Co-Principal Investigator on their research titled "Unraveling Mechanics of Anomalous High Strength and Low Stiffness in Polymer Nanocomposites."

The project combines Lee's ongoing experimental research into advanced structural materials and Ying Li's work with advanced computer simulations to discover how oxide nanoparticles can produce a strong but flexible material. Lee's research group developed a polymer nanocomposite, which exhibits high strength and low Young's modulus—or elasticity—and published their findings in 2017. Meanwhile, Ying Li has also investigated polymer nanocomposites using advanced computer simulations.

In most cases, a strong material exhibits a high Young's modulus, requiring high stress to deform it elastically, such as steel. But a weak material, such as rubber, exhibits a low Young's modulus and is easily elastically deformed.

"Our special nanocomposites do not follow this conventional trend," Lee said. By understanding how oxide nanoparticles, which are embedded in a polymer matrix, can improve the yield strength significantly but still preserve the low Young's modulus, they aim to unveil a new mechanism "to simultaneously obtain high strength and low elasticity (Young's modulus)."

This kind of material will be able to absorb and release a large amount of mechanical energy. Such a durable but elastic material would provide increased protection and resistance from mechanical loading, for instance to develop flexible displays for foldable electronic devices.

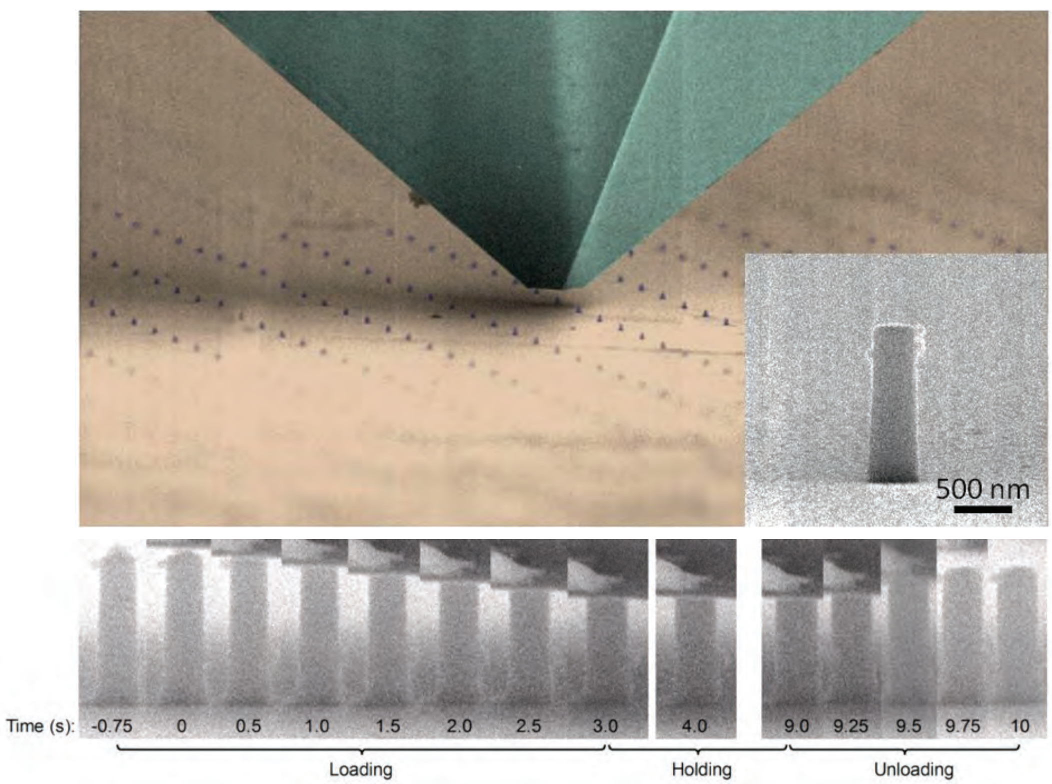
Lee and Li initiated their collaboration through UConn's Research Excellence Program in 2018. The seed money allowed them to obtain additional experimental and computational results, which then led to a successful grant from the NSF.

"I am really happy to see that we moved smoothly from a pilot grant to such a large award. We hope that we make more fruitful research results through this new NSF project," Lee said.

The NSF grant follows a burst of good news from Lee's lab group. Earlier this summer, two of Lee's doctoral students, Tyler Flanagan and Gyuho Song, had four papers published in one month.

"Those four papers were submitted at different times, but they were officially published in the same month, June. Tyler and Gyuho have worked very hard last year. I am happy to see that their efforts finally came out as these high-quality papers," Lee said.

The NSF Mechanics of Materials and Structures program supports fundamental research in mechanics as related to the behavior of deformable solid materials and structures under internal and external actions. The program supports a diverse spectrum of research with emphasis on transformative advances in experimental, theoretical, and computational methods. It is one of the primary federal programs which fund ongoing research for UConn MSE faculty.



In-situ nanomechanical characterization of SISed polymernanocomposites

Materials science and engineering graduate student Marco Echeverria (seated) and Rajesh Kumar, postdoctoral researcher in MSE, investigate the fracture of metal on the atomic scale.

MSE Research Partners in $12.5M DOE Research Center

Avinash Dongare, Associate Professor in Materials Science and Engineering, is part of a multi-university partnership working to advance nuclear security research and train future nuclear scientists.

The U.S. Department of Energy's National Nuclear Security Administration (DOE/NNSA) has designated four new Centers of Excellence at universities across the nation. The NNSA is the agency behind the nation's Stockpile Stewardship Mission (SSM), which works to strengthen the U.S. nuclear security enterprise by advancing relevant areas of science and ensuring a robust pipeline of future nuclear scientists.

Dongare will serve as one of the co-principal investigators for one of these new centers. The Center for Research Excellence on Dynamically Deformed Solids (CREDDS) has received $12.5 million over five years, distributed amongst team members led by Texas A&M University, and also including the University of Michigan and the University of California Santa Barbara.

CREDDS focuses on the science of the metallic materials behind the nation's nuclear weapons and will explore new materials produced by advanced manufacturing processes. These materials, which can have properties superior to their predecessors, have complex multiphase microstructures that challenge conventional knowledge of how materials change under the conditions associated with nuclear reactions. Of special interest to CREDDS researchers is how the materials deform under very high strain rates, or how quickly the shape of a material changes under extreme conditions.

Among other challenges, CREDDS researchers aim to observe what happens on the level of individual imperfections in a metal when it is exposed to high strain rates. They will not only examine the material afterwards, but also see what's happening as the material undergoes stress and deforms. UConn MSE's role in CREDDS focuses on the understanding of individual mechanisms that determine materials behavior in these extreme environments at scales down to individual atoms. Dongare's Computational Materials and Mechanics Group (CMMG) develops and employs state-of-the-art computational methods that will allow the center to investigate the role of microstructure, chemistry, and loading environments on materials performance in extreme environments.

"We are very happy to be a part of this exciting project, and to contribute to an issue of such great importance to the nation," said Dongare. "A challenge with the use of advanced materials manufacturing methods is the ability to test for expected performance, and more importantly, identify how they might fail under extreme conditions so we can work to prevent those failures before they happen. Our specialized computational methods now equip us with the unique capability to model the behavior of materials in virtual environments as well as visualize the complex mechanisms of deformation and failure at the atomic scales. Such specialized computational methods can expedite the testing and performance enhancements by complementing experimental approaches."

While the scientific research is a critical part of the NNSA awards, training future scientists to support such specialized needs is also a top priority. As a result, the UConn team comprises both undergraduate and graduate students, as well as a postdoctoral researcher who will be working alongside Dongare and also visiting the national laboratories involved in the stockpile stewardship program.

Jessica McBride
Office of the Vice President for Research

MSE Welcomes Administrative Services Assistant Jennifer Steszewski

Jennifer Steszewski

The Department of Materials Science and Engineering extends a warm welcome to new staff member Jennifer Steszewski, who takes over as the Administrative Services Assistant for MSE.

Jennifer joins the department with a strong background in education and administrative services, and a passion for helping others. After graduating Roger Williams University in Rhode Island with a BA in Elementary Education and Psychology, Jennifer worked as an elementary school teacher in North Carolina for five years, teaching 4th and 5th grade students. There, she worked with faculty and staff to implement Professional Learning Communities to monitor student growth, in addition to participating in the School Improvement Team.

Later, as a Service Instructor with Because Early Education Matters, Jennifer provided specialized instruction to children ages birth to three years with global developmental delays. She continued to pursue early childhood education as a Service Coordinator and Developmental Specialist at Wake Forest Baptist Health, Winston-Salem Children's Developmental Services Agency. There, she transitioned into a more administrative role, coordinating targeted family service and case management, maintaining billing records, and educating colleagues and families on early intervention topics.

In July 2018, Jennifer moved back to New England, where she joined UConn as an Office Assistant in Dining Services, where she developed a streamlined business process to improve coordination between the sales and business office departments.

Jennifer has certifications in teaching English as a second language and elementary to 6th-grade education, and as an infant-toddler family specialist. She was recognized as the Technology Teacher of the Year at Liberty Drive Elementary School in 2011.

She is married to Craig, a 7th grade math teacher, and is mother to their three-year-old son, Jacob. Jennifer is very excited to join the MSE team.

Sonia Tulyani Brings Innovation to the MSE External Advisory Board

Sonia Tulyani, Ph.D.,
Senior Director MS&E,
Collins Aerospace

The Materials Science and Engineering Department is pleased to welcome Sonia Tulyani , Ph.D., as the newest member of the External Advisory Board. She joins nine other industry partners in working to strengthen the visibility of the UConn MSE Department at the university, state, and national level, and to assist with strategic planning.

As the new Senior Director for Collins Aerospace, Materials Science and Engineering, Tulyani plans to expand materials innovation by developing a network of experts and increasing communication across UTC's many business units. Collins Aerospace is one of the world's largest suppliers of technologically advanced aerospace and defense products, designing, manufacturing and servicing integrated systems and components for the aerospace and defense industries.

For over 15 years, Tulyani has led materials innovation in various roles at United Technologies. With a background in high temperature materials and coatings and experience working in experimental and simulation settings, Tulyani has worked on the development of coatings, catalysts, lubricants and gearboxes for UTC's business units. She has earned five U.S. patents and two Outstanding Achievement Awards, the highest awards granted by United Technologies Research Center (UTRC).

Driven by a desire for learning about new products and how to improve their performance with materials engineering, Tulyani earned her BS in chemical engineering at MIT, her MS in chemical engineering at Princeton University, and her Ph.D. in chemical engineering at the University of Massachusetts, Amherst.

MSE Department Head Bryan Huey is especially pleased to welcome Sonia as the newest member of the board.

"She has already been very supportive of our department, and her insight into the needs of local industry are invaluable as we in MSE continually improve our educational and research program," Huey said.

Tulyani will replace Venkat Vedula, Ph.D., Executive Director, Additive Manufacturing, UTC, who served on the board for five years.

Meet Our Advisory Board Members

Comprising of ten highly-reputable industry partners, the Industrial Advisory Board works to augment the visibility of the UConn Materials Science and Engineering Department at the university, state, and national level.

This past year, Sonia Tulyani, Senior Director, Materials Science and Engineering at Collins Aerospace, joined the Board. After serving on the board for one year, Alexandra Merkouriou accepted a Project Management job for the Air Force Research Lab - Research in Advanced Manufacturing (AFRL-RAM) contract. She will also be pursuing her Ph.D. in the coming semesters. Venkat Vedula, Executive Director, Additive Manufacturing, UTC, also moved on after serving on the Board for five years.

ANGIE CHEUNG

Chief Materials Science Engineer

Stanadyne LLC

PETER CHOMOWICZ

Senior Analyst

General Dynamics Electric Boat

BILL FALLON

Senior Technical Fellow, Materials & Processes Engineering

Sikorsky Aircraft

DAVE FURRER

Senior Fellow Discipline Lead, Materials and Processes Engineering

Pratt & Whitney

DANIEL GOBERMAN

Associate Director Discipline Leader, Materials Characterization

United Technologies Research Center

PETER JARRETT

Chief Technology Officer

Ocular Therapeutix

HOWARD ORR

President and CEO

KTI Inc.

KATHY SAINT

President

Schwerdtle Stamp Co.

STEPHEN THOMAS

Structural Engineer II

General Dynamics Electric Boat

SONIA TULYANI

Senior Director, Materials Science & Engineering Collins Aerospace

UTC Technology

ASM President Looks Forward to "Integrated Engineering" Community

The world's largest organization for materials scientists and engineers focused on metals is preparing to expand links between engineering disciplines with physics-based computational modeling tools. As part of these efforts, the American Society for Metals (ASM International) is working toward a SaaS (software as a service) model to provide service and support to small and medium size organizations that cannot or do not want to license large software packages.

As the ASM International president David Furrer transitions into a new role, he reflected on the importance of what he calls "Integrated Engineering."

"The efforts within ASM International have further reinforced my belief that Integrated Engineering is one of the most important and critical challenges and opportunities that face engineering as a whole today," Dave said.

Increased computational capabilities, enhanced physical understanding of materials and processes, and associated physics-based models in the engineering community made computational linkage a reality. ASM International is working to partner with organizations to create software that would enable engineers to develop new materials and improve component design and manufacturing methods. The society is also working to link the materials community with other engineering disciplines through the support, development and deployment of physics-based computational modeling tools and methods.

"The society is looking deep at itself relative to how best to serve its members, both on an individual, chapter and organizational level," Dave said. As a result, Dave made nearly 20 chapter visits throughout the U.S. and Canada while president, with several visits to chapters in India coming up. The ASM Hartford Chapter is closely linked with UCONN and the MSE Department student Materials Advantage Chapter.

MSE Department Advisory Board member and Senior Fellow Discipline Lead, Materials & Processes Engineering at Pratt & Whitney, Dave was named as the president of ASM International in October 2018. The American Society for Metals (ASM) is the world's largest organization of materials scientists and engineers focused on metals, with nearly 30,000 members worldwide. It is a global network of materials engineering and industry workers dedicated to forming connections, educating others and exploring new innovations in the field of materials science. Dave led

David Furrer, Senior Fellow Discipline Lead, Materials & Processes Engineering at Pratt & Whitney

the society for a year, connecting materials scientists across the globe and continuing to forge a better future for the next generation of engineers.

Dave has been a part of MSE's advisory board since 2012. A passionate scientist and leader, Furrer has been an active part of the materials science world for over two decades.

After graduating from University of Wisconsin-Madison with a bachelors and masters in metallurgical engineering, he launched his career as a materials engineer at Pratt & Whitney in 1986. He also worked at the Ladish Company, Inc. and SSI Technologies as a metallurgical engineer before returning to graduate school for a Ph.D. in engineering from the Universität Ulm in Germany. After becoming chief metallurgist at Ladish and working at Rolls Royce, he rejoined Pratt & Whitney in 2010 as the Senior Fellow Discipline Lead, Materials & Processes Engineering. As an advisory board member, Dave helps direct the MSE department in developing its curriculum and student focuses on industry needs, so that graduates of the program can enter the workforce prepared to meet the challenges and demands of the rapidly-expanding global demand for engineers. His expertise and contacts within the industry make him a valuable asset, both for professors looking for opportunities for their students, and for the students themselves as they grow and develop during their time at UConn.

Dave looks forward to continuing his work with ASM International and the materials community to further establish links with other engineering disciplines. He would like to work with students and student groups to provide them the perspective of inter-disciplinary engineering and how materials can be integrated with system and component design. "We will see large changes in future product engineering through this integrated approach," Dave said.

Former Advisory Board Member Continues Education at UConn

UConn MSE graduate and MSE External Advisory Board member Alexandra Merkouriou gives back to the community by helping others grow in their STEM careers.

Alexandra Merkouriou, Project Manager for AFRL-RAM

Alexandra Merkouriou enjoys helping others grow in their STEM careers. As a two-time student at UConn, she experienced the community and sense of growth the Materials Science and Engineering department provides, helping her choose her career path. Now an alumna and MSE Industrial Advisory Board Member, she gets to provide those opportunities to other young scientists and engineers.

After graduating with a BS from UConn's MSE program in 2015, Alexandra went on to complete the Edison Engineering Development Program at GE Industrial Solutions. Later, while working at M Cubed Technologies making silicon carbide ceramic composites for the semiconductor industry, she returned and earned her master's degree in MSE from UConn. The department also invited Alexandra to join the MSE Industrial Advisory Board to represent the perspective or recent students. She accredits her success and passion for materials science to her professors here at UConn and her colleagues at her workplaces.

"The Department was my home throughout my undergraduate and graduate career. I got to test my limits as a scientist, learn how much I love research and forge a path to a career I'm in love with," said Alexanrda, who now works at UConn Tech Park.

While working on her master's thesis, Alexandra continued to work on developing new products and materials. One such material she's developed is a diamond silicon carbide called Thermadite.

"I'm fortunate enough to be working on characterization of a new formulation of Thermadite," she said. She hopes that once the work is complete, they can slowly introduce it into the industry. "It's really great to see my research applied in the industry almost as soon as I discover something new."

In addition to her work, Alexandra devoted much of her time to giving back to the community that fostered her interest in materials science and engineering.

Alexandra first became interested in materials science and engineering in high school, after attending the Explore Engineering summer program at UConn.

"I was immediately drawn to the materials science portion of the program. One of the demos they showed us was a superconductor. As soon as I saw the magnet hovering in midair, I was hooked," she said.

Among her most influential experiences while at UConn were tutoring high school students and serving as a member, and eventually President, of UConn Material Advantage—an outreach club that introduces the STEM field to k-12 students. She saw the position as a way to help members network and make connections that could help with their future careers.

"I loved teaching younger kids about the world of engineering, and helping current members of the club prepare for their future careers."

While tutoring two seniors at South Windsor High School for a STEM competition, Alexandra experienced another very important moment.

"I came up with lesson plans incorporating some of my demos from Material Advantage and gave them an introductory lesson to a lot of the topics in our introductory materials engineering classes. I loved the teaching aspect of it."

After participating in some Industrial Advisory Board student feedback meetings as an undergraduate, Alexandra received an invitation from Department Head Bryan Huey to become a board member.

"I have always enjoyed finding the opportunities that allow me to help others grow in their careers, and being part of the Industrial Advisory Board gives me the chance to continue that work and also to give back to the program (UConn MSE) that has gotten me to where I am today," she said.

Though she is disappointed to resign her seat on the MSE Industrial Advisory Board after only a year, Alexandra has decided to continue her education in Materials Science at UConn by accepting a Project Management job for the Air Force Research Lab - Research in Advanced Manufacturing (AFRL-RAM) contract. She will also be pursuing her Ph.D. in the coming semesters.

Mei Wei Becomes Dean of Russ College of Engineering & Technology

After a 17-year career at UConn, Professor Mei Wei is leaving to start a new journey as Dean of the Russ College of Engineering and Technology at Ohio University in Athens, OH. Wei's trajectory from assistant professor in MSE to School of Engineering Centennial Term Professor and Associate Dean for Research and Graduate Education speaks to her success as an educator, researcher, and administrator.

"UConn was my first stop in the U.S. when I came from overseas, and the only place I can call home," Wei said. "Here, I learned how to be an educator. I established my research laboratory, I graduated my first doctoral student, and mentored numerous graduate and undergraduate students."

After establishing herself as a researcher, Wei became involved in administrative duties within the MSE Department and School of Engineering at large. In addition to serving as the Associate Dean for Research and Graduate Education at the School of Engineering, she served as the Director for the General Electric Center of Excellence in Advanced Materials and Modeling, Director for Masters of Engineering in Global Entrepreneurship, and, from 2015 to 2016, served as Mechanical Engineering interim department head.

"All these experiences have prepared me well for the new position as Dean of Russ College," she said.

One thing Wei looks forward to, in addition to serving her new role as Dean, is continuing to mentor students.

"As a professor, I really enjoy interacting with students. Good mentorship is extremely important for students' academic and career development. In my new role, I will continue to mentor students, learn their needs, and work with my colleagues to create a welcoming and uplifting study environment for the students."

Mei Wei added that she enjoyed the time with her colleagues at MSE. "I am extremely grateful for the support I received from MSE. I will miss all my colleagues at UConn," she said.

All of us at MSE will miss Wei as well, and we wish her continued success and growth in all her endeavors.

GRADUATES WITH MSE MINOR

George Ferdinand Andrews III
Katherine Atamanuk
Sidhant Athilat
Sayan Basu
Kenneth Edward Berkery
Victoria Blair
Ewelina Bucior
Gregg M Carrara
Caylin Alanna Cyr
Peter Disabella
Ryan Patrick Durney
Roy Joseph Graham
Shreya Shailesh Hegde
Deirdre Rose Hennessy
Paige Nicole Holden
Megan McConnon Houlihan
Natalie Anne Krebs
Steven Hoang Chuong Lam
Alexandra Nicholle Liberti
Alyson Georgine March
Kathryn Morozov
Steven Olenski
Bennett Elihu Propp
Katherine Ann Russo
Quinn Rose Shields
Robert Silverman
Mitchell Simon Uretsky
Zhouxuan Wang
Robert Arthur White III
Qingqing Zhang

PH.D. GRADUATES

Garvit Agarwal
Major Advisor: Avinash Dongare
Doctoral Dissertation: Mesoscale Modeling of Defect and Damage Evolution in Lightweight Metallic Materials Under Shock Loading Conditions

Rohit Batra
Major Advisor: Ramamurthy Ramprasad
Doctoral Dissertation: Computational Study of Ferroelectricity in Hafnia and Other Binary Oxides

Jie Chen
Major Advisor: Avinash Dongare
Doctoral Dissertation: Unraveling the Role of Interfaces in the Deformation and Failure Behavior of Metallic Materials under Dynamic Loading Conditions

Keith Dusoe
Major Advisor: Seok-Woo Lee
Doctoral Dissertation: In-situ Micromechanical Characterization of Materials with High Mechanical Potential Energy Absorption Capacity

Yomery Espinal
Major Advisor: Pamir Alpay
Doctoral Dissertation: Synthesis and Modeling of Ferroelectric Nanocomposites

Congratulations to the Class of 2019!

BACHELOR OF SCIENCE GRADUATES

Skylar Buswell
Piotr Chaber
Ryan Corbett
Ryan James Cordier
Cayman Cushing
Anthony Patrick Dean
John Eron
Michael Matthew Fazzino
Jonathan Everett Gager
Andrew Joseph Gagnon
Jordan Obre Gomes
Avery Scott Gray
William Howard Iv
Lara Naomi Huapaya Rojas
Gabrielle A Joseph
Janos Edwin Kanyo
Tatsuki Katakura
Timothy Dwight Ketelhut
Steven Kha
Kevin Arnold William Knowles
Brendan Kristie
Linghao Li
Baylee Elizabeth Loewen
Yanghuang Lu
Tyler Maclean
Spencer John Matonis
Dean Adam Mazzola
Anna Maria McDonald
Joshua Aaron Moskow
Tochukwu Didacus Oparaocha
Hetal Dinalkumar Patel
Zachary Louis Putney
Grace Catherine Quinlan
Kierstyn Mikayla Raines
Kenna Rose Ritter
Chase William Sheeley
Andrew Philip Spak
Truman Strodel
Aubrey Yu Tang
Beril Tonyali
Manjoor Ahmed Vahora
Meghan Marie Van Wie
Mikaela Rose Whittington-Baschoff
Iwona Wrobel
Ryan Joseph Wrobel

MASTER OF ENGINEERING GRADUATES

Lauren Anderson
Anna Brosler
Drew Capolupo
Michael Martin
Douglas Read
George Shaw
Noah Wadsworth

MASTER OF SCIENCE GRADUATES

Thomas Balzano
Can Cui
Alexandra Longacre
Alexandra Merkouriou
Thomas Reid

Su Jeong Heo
Major Advisor: Prabhakar Singh
Doctoral Dissertation: Stability of $LiAlO_2$ in Molten Carbonate Fuel Cell: Mechanism of Particle Coarsening and Phase Transformation

Nasser Khakpash
Major Advisor: George Rossetti Jr.
Doctoral Dissertation: Phenomenal Theory of $BaTiO_3$- Based Piezoelectrics

Tulsi Patel
Major Advisor: Pamir Alpay
Doctoral Dissertation: Hybrid Additive Manufacturing of Ferroelectric Oxides and Aerospace Alloys

Krishna Pitike
Major Advisor: Serge Nakhmanson
Doctoral Dissertation: Multiscale Modeling of Perovskite Ferroelectrics: From First Principles to Coarse- Grained Descriptions

Daisy Ramos
Major Advisor: Cato Laurencin
Doctoral Dissertation: Determining the Efficacy of Insulin for Use in Factor Delivery Device for Tendon Healing and Regeneration

James Steffes
Major Advisor: Bryan Huey
Doctoral Dissertation: Thickness Scaling of Ferroelectricity in $BiFeO_3$ By Tomographic Atomic Force Microscopy

John Sypek
Major Advisor: Seok-Woo Lee
Doctoral Dissertation: Superelasticity and Cryogenic Linear Shape Memory Effects of the Intermetallic Compound $CaFe_2As_2$

Xiaoyan Tang
Major Advisor: Cato Laurencin
Doctoral Dissertation: Electroconductive Nanofiber Matrices for Muscle Regeneration

Sriram Vijayan
Major Advisor: Mark Aindow
Doctoral Dissertation: In-Situ Investigation of Thermally Activated Processes Using MEMS-Based Devices: Practical Challenges & Applications

Yang Wang
Major Advisor: Radenka Maric
Doctoral Dissertation: Flame Combustion Synthesis of Nanomaterials for Application in Lithium-Ion Batteries and Supercapacitors

(Carson Stifel/UConn Photo)

➲ Riley Blumenfield, a materials science and engineering student, discovered her passion for research thanks to Research Connections, an annual networking event for students and faculty.

MSE Research Led One Student Closer to Her Life Goal

Riley Blumenfield, a materials science and engineering (MSE) student, Honors Program STEM scholar, and president of engineering sorority Phi Sigma Rho, came to UConn knowing she wanted to be involved with research. But, she didn't know where to start.

After attending an annual event to expose undergrads to a host of opportunities, she not only found a unique lab experience, but also discovered a passion for polymers that she never knew she had.

Over the last year, she has been working with MSE Professor Cato Laurencin, an internationally recognized expert in tissue and regenerative engineering, to regenerate human limbs by 2030.

"Before I worked with Dr. Laurencin, I was certain that I wanted to work with nanomaterials alone. After working in the lab, I fell in love with polymers," Riley said.

Riley works closely with MSE graduate student Kenneth Ogueri, a Ph.D. candidate in the Laurencin lab at UConn Health, who synthesizes and studies polymer blends to be used as scaffolding in the regeneration of bone tissue. Last year, she helped create thin films of the polymers for mechanical testing, and studied how the polymer degrades in in-vitro conditions.

To land this once-in-a-lifetime opportunity, Riley took advantage of an informational networking event that helps students learn more about UConn research and make connections with researchers across academic disciplines.

Organized through a collaboration between UConn's Office of First Year Programs, Learning Communities & Academic Achievement Center, and the Office of Undergraduate Research, Research Connections exposes first and second year students to undergraduate research by engaging in meaningful interactions with faculty, staff, graduate students, peers and other key partners.

Riley credits finding her research experience to the Research Connections event, which helped make the process of finding a research opportunity less intimidating and more accessible to her. Her work in Dr. Laurencin's lab ultimately led her one step closer to her goal.

"My main goal for the future stems from an obsession with Spider Man. I want to invent the web fluid he uses!" Since concluding her research in the lab last semester, Riley has been working on converting her research into her honors thesis. She also had the opportunity to intern at the Naval Undersea Warfare Center in Newport, RI, where she worked with polymer nanocomposites.

"Specific to my hero, I was actually lucky enough to get to work on an independent research project into the required properties of, and potential materials for, Spider-Man's web fluid," Riley said. She also checked off another life goal: to work for the U.S. Department of Defense.

"The experiences I had synthesizing and thermally analyzing polymers with Ken are a large part of why I was offered the summer position," Riley said.

Her future plans include continuing to employ regenerative engineering to find innovative technologies.
"I am sure my career will take me along various paths, but I truly love research and believe that through the intersection of polymers and nanomaterials, I can achieve my dreams."

Extracted from UConn Today,
Carson Stifel, Office of the Vice President for Research

MSE Undergraduate Develops Skills as Legacy Leadership Student

MSE senior Victoria Reichelderfer

MSE senior Victoria Reichelderfer is paving new paths for interdisciplinary leadership. Through a 'Legacy Leadership' experience, she connects her love of biology, teaching, and materials science and engineering through the opportunities provided by this prestigious program.

UConn's Legacy Leadership Program aims to help students deepen their abilities as leaders, develop their connections with both peers and alumni in their given career paths, and prepare to make a better future for themselves and others as selfless, practical, responsible, and forward-thinking individuals. The program requires nomination by a faculty member and an extensive interview process to be accepted. Victoria was nominated by MSE Department Head Bryan Huey.

With a passion for biomaterials, she's devoted her time to doing research in Professor Serge Nakhmanson's lab since her sophomore year, working on simulations for nanomaterials.

Professor Nakhmanson calls Victoria an "exceptional, very hard-working student."

"I am very happy to hear that Victoria finds this program enjoyable and useful for the development of her career," he said. "Considering how closely we work now on multiple research topics, with Victoria already taking my graduate-level class on phase transformations in materials, it is amazing how she finds extra time to participate in all of these outreach and leadership activities."

On top of her research, Victoria has also been teaching physics at a correctional institute since her freshman year, through the 'Second Chance Educational Alliance.' The prison education program helps reduce recidivism, Victoria said, and gives the prisoners a goal to work toward. Aided by two teaching assistants, Victoria visits her students once a week.

"That's probably my favorite thing I've done in college," Victoria said. "I make all the homework, and I get notes from my previous teachers and professors. The prisoners love it. They are amazingly smart and motivated, which motivates me, and it's why I like it so much."As a member of the Legacy Leadership Program, Victoria further develops those skills through meetings and activities.

"We talk about things that challenge us. We try and push ourselves out of our comfort zone," Victoria said. "It does a good job of encouraging personal development and showing you opportunities to grow every day. We also learn to understand others and appreciate and develop empathy as a leader."

Earlier in the year, Victoria and her fellow leaders visited the Connecticut Forum in Hartford, where the youngest-ever American Ambassador to the UN, Samantha Powers, spoke.

"She gave a talk on America in the world, how we as a country are a leader in the world, and the kind of responsibility which comes with that. It was cool to get her inside perspective and see how it really works," she said.

All Legacy Leaders are paired with a faculty advisor and an alumni advisor to help with academic and career guidance. Because of her interest in working with biomedicine, Victoria chose Molecular and Cell Biology Assistant Professor Thomas Abbott.

"It's nice to have somebody who has a different perspective to add to my engineering rigor," Victoria said. Abbott said working with Victoria has gone so well because they share a similar leadership.

"Victoria is quite passionate about her interests, and it shows. This spring she was a peer mentor instructor for my Biology 1107 course," he said. "What impressed me when she was a student in my class continues, and I look forward to our future Legacy interactions."

Victoria said she went into materials science to combine both her love of biology and human medicine with her passion for engineering and analytics. When she graduates, she plans to study and develop biomaterials that act as drug delivery systems to the body.

"I love materials science because I can't make up my mind. I was almost a pre-med major, but with materials science, I can incorporate that by working with biomaterials," she said. "My favorite one is the PLGA polymer (polylactic-co-glycolic acid), which degrades into chemicals that your body can handle. They make it in wafers and fill it with a drug for glioblastoma, a type of brain cancer. They open your head, cut out the tumor, leave the wafer, and it delivers the drug. It increases your life expectancy by 20 percent that way."

Victoria said she wants to go into biomaterials engineering to continue doing what she's doing as a leader and as a teacher: helping others.

"I want to know that every day when I'm going to work, I'm helping someone," she said.

MSE Department Celebrates Accomplishments, Looks to Future at 2019 Banquet

The Department of Materials Science and Engineering enjoyed an evening of celebration, science jokes, and mingling at the sixth annual MSE Banquet in April. Held at the UConn Alumni Center, attendees included undergraduates, graduates, professors, administrators and alumni from Lockheed Martin, M Cubed Technologies, and more.

MSE undergraduate students participating in the banquet

Organized by UConn Materials Advantage (UCMA) president Kenna Ritter, now graduated, and presented by UCMA Social Chair Amanda Agui, this year's banquet successfully combined networking and mingling with fun activities and light-hearted chatter from attendees and speakers alike. A mix of graduate students, professors, alumni and undergraduates sat at each of the tables, which were named after periodic elements such as cobalt and nickel.

"We try and make it a nice event," Kenna said. "We want to make it conversational and inviting."

While the activities offered a sense of fun, the banquet was also a time for celebrating and reflecting on the accomplishments of the MSE department over the past year.

Department Head Professor Bryan Huey highlighted the recent accomplishments of MSE's faculty, such as Assistant Professor Lesley Frame's Heat Treat Award, Associate Professor Avinash Dongare being named UTC Professor in Engineering Innovation, and Assistant Professor Seok-Woo Lee's award for teaching excellence. Professor Huey also commented on the bright future of the MSE department, especially with UConn's new Science1 complex providing future opportunities as MSE and the IMS continue to expand.

Alpha Sigma Mu inductees 2019

Special guest Diana Lados, Ph.D., a distinguished professor in mechanical engineering at Worchester Polytechnic Institute and Vice President for Alpha Sigma Mu International Professional Honor Society, helped Professor Hal Brody induct over a dozen graduate and undergraduate into the society. Other students received awards for their work in research, teaching and leadership activities.

"When evaluating and selecting candidates for awards, I am consistently impressed by the scope and strength of their research accomplishments and professional achievements during the course of their graduate studies," said Associate Department Head George Rossetti, Jr., who presented the awards.

The evening ended with a classic materials science and UCMA demonstration: freezing marshmallows in liquid nitrogen for a special frozen treat as attendees left the Alumni Center.

Alumna Alexandra Merkouriou, who founded the event in 2014, said "I'm really proud of where it's come. I hope it continues years into the future."

Engineering Clubs Meet and Compete at Friendly Soccer Tournament

The two teams stand for a group photo after a friendly game, the UCMA members in white shirts, and the AIChE students in colored shirts. Photos by Bryan Huey.

Undergraduate students from the department of Materials Science and Engineering proved victorious in a friendly soccer match against Chemical and Biomolecular Engineering (CBE) undergraduates last year, as the two groups competed and mingled with each other given the overlap in their majors. The game, organized by student outreach clubs UConn Material Advantage (UCMA) and the UConn chapter of American Institute of Chemical Engineers (AIChE), helped the students in both organizations learn more about each other, said former UCMA president Kenna Ritter.

"We figured that Chemical Engineers and Materials Engineers have a lot of similarities between our fields so joint events just made sense to us," Ritter said. "We happen to have some competitive people in our major too, so both clubs jumped at the chance for a friendly game."

Department Head Bryan Huey showed up to enjoy the competition and, in the end, celebrate the victory.

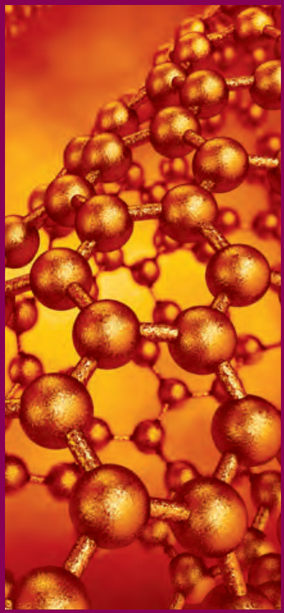
"It's natural for MSE and CBE to meet up over an oversized Bucky ball, since traditional soccer balls look just like a C60 molecule, Huey said. "Probably the best part of all was how this connected students four years apart, across majors, and drew men and women on both sides. Next time we'll see what sport gets arranged—and instead of sitting at the sidelines, I might even sub in. Regardless, I hope this will become an annual tradition—winning the trophy, that is."

Ritter worked with AIChE president Alex Olivera to put together the event, which attracted students from freshman to senior years. She added that with the success of this weekend's game there will be more collaborations to come between the two groups.

"I was especially happy to see a lot of freshman come, I love seeing people get involved with clubs early on in their time at UConn," Ritter said. Undergraduate MSE senior Justin Greenwood and undergraduate CBE senior Michael Castelpoggi were instrumental in getting this game started. Alex and I both hope to plan more joint UCMA-AIChE events this year–social or otherwise. Everyone had a great time!"

Educating

The Next Generation of Engineers



Seize the unique opportunity to become a Senior Design industry partner and tap into the exceptional student talent, distinguished faculty, and state-of-the-art materials processing and characterization laboratory equipment that the UConn Department of Materials Science and Engineering has to offer!

Our MSE program was established to meet the high local demand for materials engineering professionals. Our students enjoy excellent employment opportunities, a choice of five academic concentrations (biomaterials, energy materials, nanomaterials, metallurgy, and electronic materials), first-rate faculty instruction, and hands-on laboratory experience and research opportunities. UConn MSE is the number one public MSE program in the Northeast, boasting a student-to-faculty ratio of 13 to 1, industry co-ops, internships, and departmental scholarships.

The UConn MSE experience culminates with Senior Design, a two-semester project that provides students with exposure to real-world engineering problems, stimulating design challenges, collaboration with local companies, and potential future employment opportunities.

As an industry partner, you can expect collaborative impact with UConn MSE and the Institute of Materials Science, project updates and documentation, secure proprietary information, and the opportunity to hire skilled, engaged engineering students. Visit our Senior Design webpage for more information!

Materials Science & Engineering

University of Connecticut
Department of Materials Science & Engineering
97 North Eagleville Road, Unit 3136
Storrs, CT 06269-3136

www.mse.engr.uconn.edu

www.mse.engr.uconn.edu/undergraduate-program/senior-design

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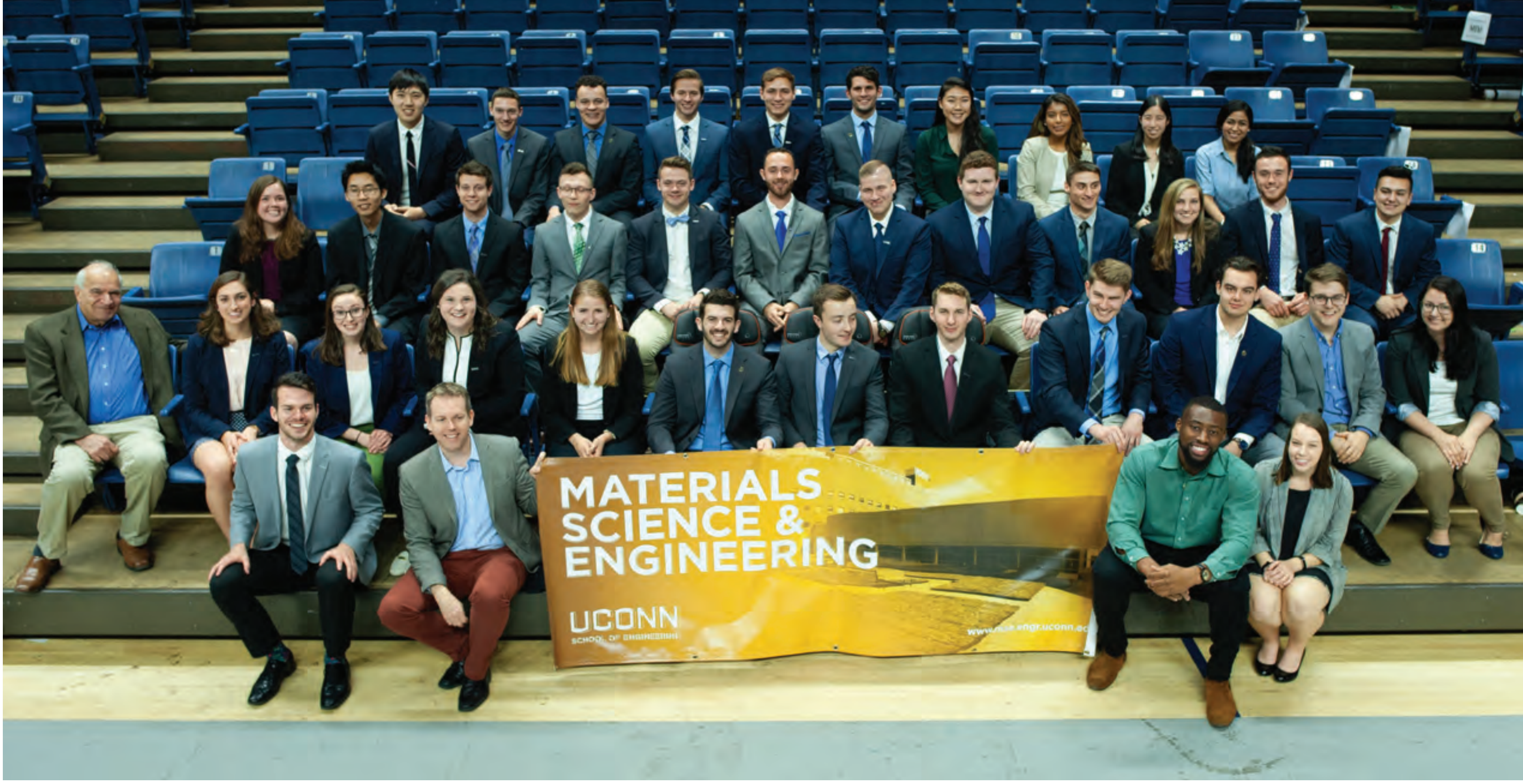


Senior Design Day 2019

Congratulations to our graduating MSE seniors who presented capstone projects at Gampel Pavilion. During the annual MSE Senior Design Day, 42 students presented 15 projects to a panel of industry judges, showcasing the analytical and practical skills they gained from the program. A total of $1,000 was distributed among four winning teams.

1st Prize

Design of a Machine Learning Algorithm to Design/Discover Layered Materials for Battery Applications
by Hetal Patel
Industry Sponsor: Eagle-Picher
Industry Advisor: Arthur Dobley
Faculty Advisor: Avinash Dongare

2nd Prize

Post-Porcessing Heat Treatments of Additively Manufactured Aluminum Alloy, AlSi10Mg
by Beril Tonyali, Avery Gray, Lara Huapaya Rojas
Industry Sponsor: Sikorsky
Industry Advisor: Thomas Derco, Bill Fallon
Faculty Advisor: Seok-Woo Lee

3rd Prize (split)

Compression Molding of Carbon Block Filters
by Iwona Wrobel, Jordan Gomes, Linghao Li
Industry Sponsor: KX Technology
Industry Advisor: William Li
Faculty Advisor: Stefan Schaffoener

3rd Prize (split)

Sheet Metal Properties and their Effects on Deep Drawing
by Grace Quinlan, Steven Kha, Joao Carlos Barbosa
Industry Sponsor: Ulbrich Stainless Steel and Speciality Metals
Industry Advisor: Sam Guerra, Sean Ketchum
Faculty Advisor: Lesley Frame

Other Capstone Projects

Additive Manufacturing for Prototype Components
by Anna McDonald, Baylee Loewen, Mikaela Whittington-Baschoff
Industry Sponsor: Stanadyne
Industry Advisors: Connor O'Neill, Angie Cheung
Faculty Advisor: Rainer Hebert

Hardenable Stainless Steels and Magnetism
by Tyler MacLean, Janos Kanyo, Dean Mazzola, Tochukwu Njoku
Industry Sponsor: Stanadyne
Industry Advisors: Dominic Myren, Richard Pellini
Faculty Advisor: Puxian Gao

Characterization of Effects of NSCT Scotchbriting Process
by Michael Fazzino, Matthew Prue, Nicholas Wells
Industry Sponsor: Ulbrich Stainless Steel and Specialty Metals
Industry Advisors: Keith Grayeb, Sean Ketchum
Faculty Advisor: Yuanyuan Zhu

Process Design for 3D Printing of Ceramic Components
by Kenna Ritter, Andrew Spak, Ryan Corbett
Industry Sponsor: Precision Combustion
Industry Advisors: Jeff Weissman, Richard Mastanduno
Faculty Advisor: Pamir Alpay

Support Structure Design for Powder Bed Additive Manufacturing
by Cayman Cushing, Andrew Gagnon, William Howard
Industry Sponsor: Collins Aerospace
Industry Advisors: Loren Brandenburg, Colette Fennessy
Faculty Advisor: Rainer Hebert

Design and Evaluation of Recoater Systems for Powder Bed Additive Manufacturing
by Meghan Van Wie, Kierstyn Raines, Tatsuki Katakura
Industry Sponsor: Pratt & Whitney
Industry Advisors: Michael Bennett, Rebecca Runkle
Faculty Advisor: Rainer Hebert

Optimization & Data Analysis of High Temperature, High Strain Rate Compression Tests with Gleeble Systems
by Yanghuang Lu, Steven Gomez, Aubrey Tang
Industry Sponsor: Pratt & Whitney
Industry Advisor: Jean-Philipp Thomas
Faculty Advisor: Rainer Hebert

Development of Novel Feedstocks for In-Space Additive Manufacturing
by Ryan Wrobel, Spencer Matonis, Jonathan Gager, Zachary Putney
Industry Sponsor: NASA
Industry Advisors: Tracie Prater, Curtis Hill, Jennifer Edmunson
Faculty Advisor: Volkan Ortalan

Design of Improved Methods for Tubing Deformation and Powder Distribution Characterization in Linear Shaped Charges
by Piotr Chaber, Brendan Kristie, Chase Sheeley
Industry Sponsor: Ensign Bickford
Industry Advisors: Sean Keon, Christen Thomsen
Faculty Advisor: George Rossetti Jr.

Optimization of Laser Welding Parameters for Electrical Conductivity
by Justin Greenwood, John Eron, Kevin Knowles, Timothy Ketelhut, Rory McCormick
Industry Sponsor: Cadenza
Industry Advisor: Michael Suba
Faculty Advisor: Jasna Jankovic

MSE Seniors Reach for the Stars with NASA Senior Design Project

Four MSE seniors worked with NASA scientists to develop a 3D printing material to print physical objects essential for use on the International Space Station.

Four MSE seniors participated in the opportunity of a lifetime: helping building the next generation of 3D printing in space. As part of their Senior Design Project, Zachary Putney, Jonathan Gager, Ryan Wrobel and Spencer Matonis worked to develop a recyclable polymer composite for 3D printing objects for NASA astronauts. In March, they visited their Senior Design sponsor at the George C. Marshall Space Flight Center (MSFC) in Huntsville, Alabama. There, they met some of the aeronautics engineers and researchers, toured the facility, and dropped off some of their samples for further testing.

“We’re really thankful and happy to be able to be working on this,” Spencer said.

The group’s efforts were a part of their Senior Design Project, a two-semester course that partners a small team of senior MSE students with industry sponsors to use their materials science knowledge, creativity, and problem-solving skills to tackle real-world engineering issues and tasks. Throughout, they’re mentored by MSE professors, and experts from their sponsor company.

NASA has been collaborating with the MSE department for eight years now, with a focus on 3D printing. The process of making, or “printing,” a physical object from a 3D digital model is now an essential part of living and operating in an enclosed microgravity environment like the International Space Station (ISS).

“This is an opportunity for the students to work both with each other and with a groundbreaking agency,” the group’s advisor Associate Professor Volkan Ortalan said.

“Our student team has taken on a big challenge—development of novel feedstocks for in-space manufacturing utilizing 3D printing,” Ortalan said. “I have observed our students bringing their ideas and engineering designs to life. I have seen them working on several technical presentations and reports, working on novel filament development for 3D printing, collaborating as a team, and working diligently to meet the numerous NASA deadlines.”

The students’ Senior Design project ultimately focused on creating a printing material that’s both light and

➲ Left to right: Zachary Putney, Jonathan Gager, Ryan Wrobel, Spencer Matonis

(Photo courtesy of Tracie Prater, NASA MSFC)

durable—perfect for crafting tools needed to operate a space station—without sacrificing strength for weight economics. This is critical when sending materials to the ISS, or to possible future human colonies on the Moon or Mars.

"We're looking at how we can create stronger plastics that can match the properties of metals," Zach said. "We also need to be able to replicate the properties of some specialty items."

The properties include dielectrics, which effectively store a charge and can be incorporated into batteries. One of the team's challenges was efficiently integrating dopants into the matrix material so it still retains the properties and the printability of plastic, while also supporting that electric charge. The group is using Ultem, a highly-durable 3D printing material, as a base.

"A lot of this project has been figuring out how to get the dopants into the Ultem," Spencer said.
The group's methodology was to use strong solvents to dissolve small pellets of the Ultem into a gel, mix them with a powder form of the dopants, and cast this into wafer molds. These can then be fed into a high-temperature extruder and wound onto a spool for transport before it's loaded into a fiber-fed 3D printer.

As part of the Design Project, the group sent several of the wafers to a professor at Auburn University, who will work to characterize the material and see if the dopants are working as expected.

"So far, NASA has been super happy with our results," Spencer said. "We've encountered our share of problems, but we work through them and have been able to stay on track."

After graduating, Spencer accepted a job as a Materials Engineer working with one of the Senior Design advisors at NASA MSFC in Alabama, where he will continue to explore printable circuitry and sensors. He designs conductive inks for interconnects, dielectric inks for supercapacitors, and various sensors for monitoring ISS crew health.

For all four students, the opportunity to work with NASA was an exciting prospect, especially as they established connections and helped solve real issues as part of their Senior Design. Ryan said he someday wants to work at NASA as well , and sees this as a way to get his foot in the door.

"Ever since I was young, I've been fascinated by space," Ryan said. "Even if we're not directly contributing to what NASA is doing, we're still a part of it." Ryan said working with NASA's engineers has been especially great, as the agency is open with their communication and enthusiastic to work with students.

Spencer is grateful that he's able to contribute to the "Second Space Race."
For Jon, the ability to gain hard experience on the project is one of the most valuable benefits.
"This is the first open-ended project I've ever had," he said. "I get to find and develop solutions and work with others. You can't learn that from a classroom. It's very rewarding."
Though the Senior Design Project ended after a final presentation, NASA engineers will continue to work with Ultem, Spencer said, and the team's work is crucial to helping NASA create their own composites.

"I remember we were invited to bring our samples to Huntsville and meet with the engineers on the team at NASA," Ryan said. "When we gave them the samples, one of the engineers replied 'It feels like Christmas.'"
While it is a student-based project, the team is expected to meet the expectations of the agency they're working with, Ortalan said.

"This project was treated like a regular NASA approved project and necessitated maintaining a budget, meeting numerous technical requirements, and communicating with NASA officials," he said. "This work can have an important impact on current and future NASA research and programs. It is truly fulfilling to see what students can achieve when presented with an opportunity and given the support to explore their curiosities."

Graduate Student Ayana Ghosh Wins Prestigious Fellowship Award

John Tanaka Graduate Student Fellowship award recipient Ayana Ghosh.

MSE graduate student Ayana Ghosh has been named as the recipient of the prestigious John Tanaka Graduate Student Fellowship award, which is given annually to a UConn graduate student in the United States' oldest honor society, Phi Kappa Phi.

The award, which was established in 1993, is named after chemistry professor emeritus and former Director of the Honors Programs, Professor John Tanaka. Professor Tanaka led Phi Kappa Phi at UConn for many years during his 45-year career at UConn. He also taught inorganic chemistry, and advised many undergraduate and graduate students. Although he passed away seven years ago in April 2012, his name lives on in this prestigious award.

"This type of recognition always acts as a catalyst for me to continue my daily efforts in research, learn more, and perform better," she said. "I am extremely grateful to receive exceptional mentorship from my advisors at UConn, Pfizer Inc. and Los Alamos National Laboratory as well as my previous institutions that have shaped my academic career to date. I wish to continue performing cutting-edge research on a wide-range of materials with present-day and prospective technological and medical applications while being engaged in events to encourage younger individuals to pursue careers of their choices, especially in STEM fields."

Candidates for this award are judged based on their research, career goals, academic success, achievement, and rigor, and service and leadership skills and activities.

Ayana has achieved many of these markers, winning Best Design for her poster in the third annual School of Engineering Poster Session in 2017, and departmental first place in the 2019 competition. She came to UConn in 2016, starting work in Professor Serge Nakhmanson's lab working on evaluating Machine Learning methods to accurately predict the crystallization of pharmaceutical compounds, a project funded by Pfizer Inc and UConn MSE.

She is currently studying Computational Materials Design using Density Functional Theory (DFT), Machine Learning and Data Mining in Professor Nakhmanson's lab. Ayana has previously been a graduate student at New Mexico University. She earned her Bachelor of Science in physics and abstract mathematics from the University of Michigan-Flint in 2015.

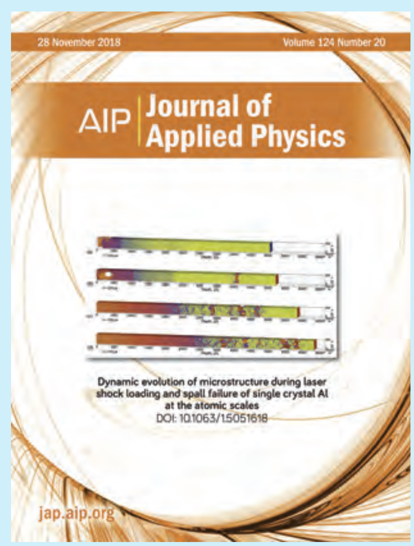
"Obviously, I am extremely happy about Ayana receiving this well-deserved award," Professor Nakhmanson said. "The Tanaka fellowship emphasizes excellence in research and academics, and therefore is a great match for Ayana's numerous accomplishments. She managed to complete not only a bunch of projects with me, but also collaborated with Pfizer researchers and did multiple internships at the Los Alamos National Laboratory working on something else entirely. She published extensively on all of these efforts and will surely publish more before she graduates."

Joining UConn

Sergey shares how the scientific process of discovery is both challenging and motivating.

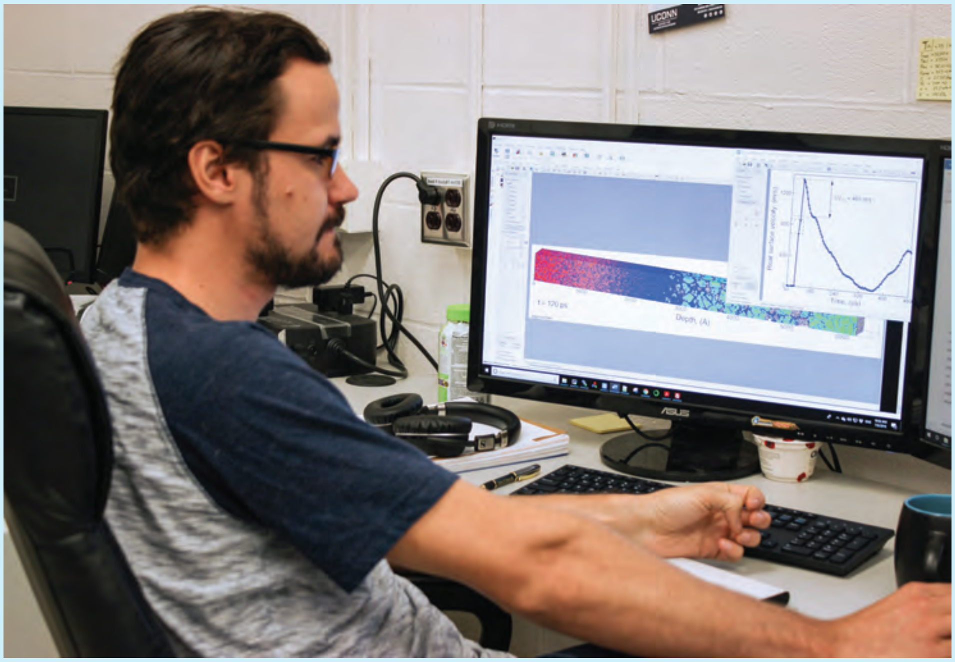
Exploring ways to strengthen lightweight structural materials in order to withstand deformation and survive under extreme environments is understandably complex. But this scientific process motivates Sergey Galitskiy, Ph.D. student in Associate Professor Avinash Donagre's lab, to continue his research on modeling the material response of metallic systems under conditions of impact/shock loading. When he does produce results, the chance to share that with the Materials Science and Engineering community is thrilling.

Sergey's research focuses on investigating the mechanisms of fracture for Al and Mg based materials under shock loading conditions that result in very high strain rates (~10^7 – 10^{10} s^{-1}). His primary focus is examining how these Al and Mg structures react on the atomic scale to plate impact or laser induced shock, which has not previously been theoretically investigated. The work uses classical



Sergey's research titled "Dynamic Evolution of Microstructure During Laser Shock Loading and Spall Failure of Single Crystal Al at the Atomic Scales" featured on the cover of the *Journal of Applied Physics*.

MSE Led Sergey to Receive the 'Best Gift' in Science



Sergey Galitskiy examines the fracture of nanocrystalline material due to laser irradiation in Associate Professor Dongare's lab.

molecular dynamics (MD) simulations to investigate the evolution of defects (dislocations) and phase transformations (melting) during failure.

"What we're doing is modeling the irradiation of a thin film by an ultra-fast laser, generation of a resulting shock wave, and usually the consequential fracture of the material," Sergey said. "There are pros and cons of investigating a material's strength with laser-induced shock. On the one hand, very high temperature leads to material ejection. On the other hand, in comparison to high-velocity flyer (explosive) approaches, lasers provide precise control of the energy deposition which can more readily be compared to our theoretical work."

The understanding of material behavior (fracture) in such extreme conditions can be useful for the defense and aerospace technologies. For instance, if they can create an aluminum-based structure that is both lighter and stronger than what is already used to build airplanes, they could potentially reduce fuel costs and enhance maneuverability.

Sergey's first article, highlighted on the cover of the *Journal of Applied Physics*, demonstrates the ability to model the spall failure under laser shock loading. He and Associate Professor Dongare were able to investigate how laser loading conditions and crystal orientation result in variations in dislocation density evolution and failure behavior.

"One challenge in the applicability of the MD method is that one can usually only model systems with sizes of a few hundred nanometers," Sergey said. But his advisor developed a technique that scales the MD simulations to model large systems, up to tens of microns. This method, Quasi Coarse Grain Dynamics (QCGD), is able to retain the atomic scale characteristics of the defect evolution, phase transformation behavior, and failure behavior, all for a fraction of the cost of running MD simulations.

"We have extended the capability of the QCGD simulations to model laser interactions with metals, allowing the modeling of systems and phenomena that are relevant for laser shock loading and additive manufacturing."

Building on some of his predecessor's work is part of what makes the scientific process exciting for Sergey. The opportunity to meet and work with pioneers in the MSE field, including the chance to work with his advisor, Associate Professor Avinash Dongare, was a major factor in his decision to join UConn's MSE program as a Ph.D. student.

Before coming to UConn in 2016, Sergey earned a bachelor's and master's degree in Physics from South Federal University in Russia, and was working as a Research Assistant at the University of Kassel in Germany, experimenting with organic atomic systems.
"During my last project in Kassel, I worked in modelling the processes in neuron cells on the atomistic level. There, I gained experience in MD simulations, and I wanted to continue my scientific work with this method," Sergey said.

When Sergey discovered that Dongare's group is also doing MD simulations—with metallic, rather than organic, systems—he knew he had to join them. When he eventually joined the lab, he got to build on his experience working with a Two-Temperature Model (TTM), which describes laser radiation interaction with matter on an atto - femto second scale of (10 ^-18 - 10 ^-15 seconds), and extend the model to some metallic systems.

But transitioning from Physics to MSE, and from consuming others' research to meeting the researchers and producing his own theories, isn't easy. Sergey credits UConn's MSE program for helping him develop as a scientist, providing him with the training and MSE courses to become successful in his research, and providing professional development opportunities.

"When I started my scientific career in Russia and Germany, I never spoke to the scientists who came before me. I just read their books," he said. "But here, at TMS conferences, for instance, scientific book authors came up to my peers and were introducing themselves. Those people who created the field, who are on the tip of the science, you get to meet them," he said.

"To me, appreciation is one of the best gifts in scientific society."

We Are MSE

2018-19 Alumni Briefs

Jie Chen, Ph.D.

Advisor: Avinash Dongare

Jie's Ph.D. research focused on the use of atomic scale modeling methods to understand the role of nanoscale interfaces on the deformation and failure behavior of metallic materials. During his graduate studies, Jie was the recipient of the APS travel award to present his work at the Shock Compression of Condensed Matter meeting in 2017.

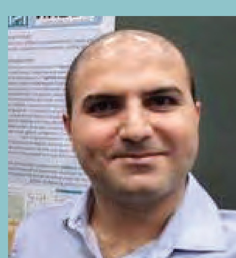
Yomery Espinal, Ph.D.

Advisor: Pamir Alpay

Yomery is now a Science & Engineering Technical Advisor to Defense Advanced Research Projects Agency (DARPA). During her graduate studies Yomery received the ORAU Journeyman Fellowship, U.S. Army Research Laboratory, Adelphi, MD (2016-2018); the Multicultural Scholars Fellowship, UConn, Storrs, CT (2013-2018); and the NSF LSAMP-Bridge to the Doctorate Fellow, UConn, Storrs, CT (2013-2015).

Nasser Khakpash, Ph.D

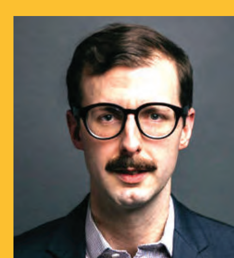
Advisor: George Rossetti, Jr.



Nasser is now employed as a Yield Engineer at Intel Corporation. During his graduate studies, Nasser served as CFO for the UConn Chapter of Keramos, the National Professional Ceramic Engineering Fraternity. He has authored or co-authored research published in journals which include the Journal of Materials Science, Physical Review, Applied Physics Letters, and Acta Materialia.

Keith J. Dusoe, Ph.D.

Advisor: Seok-Woo Lee



Keith is currently a Postdoctoral Associate at the University of Massachusetts at Amherst. During his graduate studies, Keith was awarded the Gold Prize at the TMS (the Minerals, Metals and Materials Society) 2017 national meeting in San Diego, CA; he was also the winner of the 2016 UConn School of Engineering Graduate Student Poster Competition.

Tulsi Patel, Ph.D.
Advisors: Rainer Hebert,
Pamir Alpay

Tulsi is now an NRC Research Associate at the Air Force Research Laboratory in Dayton, OH. During her graduate studies, Tulsi's honors included DoED FIPSE-ATLANTIS fellowship (2012-2013); NSF GK-12 fellowship (2014-2016); NSF EAPSI fellowship in Korea (2016); Invited Participant for AAAS Catalyzing Advocacy in Science and Engineering (CASE) Workshop (2018); Best Oral Paper Award at 27th Annual Symposium of Connecticut Microelectronics and Optoelectronics Consortium.

Garvit Agarwal, Ph.D.
Advisor: Avinash Dongare

Garvit is currently a Postdoctoral Researcher at Argonne National Laboratory. Garvit's Ph.D. research focused on developing scaling relationships for mesoscale modeling of the evolution of microstructure (defects/damage) in lightweight metallic materials under dynamic loading conditions. During his graduate studies, Garvit received the 2018 Doctoral Dissertation fellowship and was also the winner of the 2018 Graduate Student of the Year Award in MSE.

James Steffes, Ph.D.
Advisor: Bryan Huey

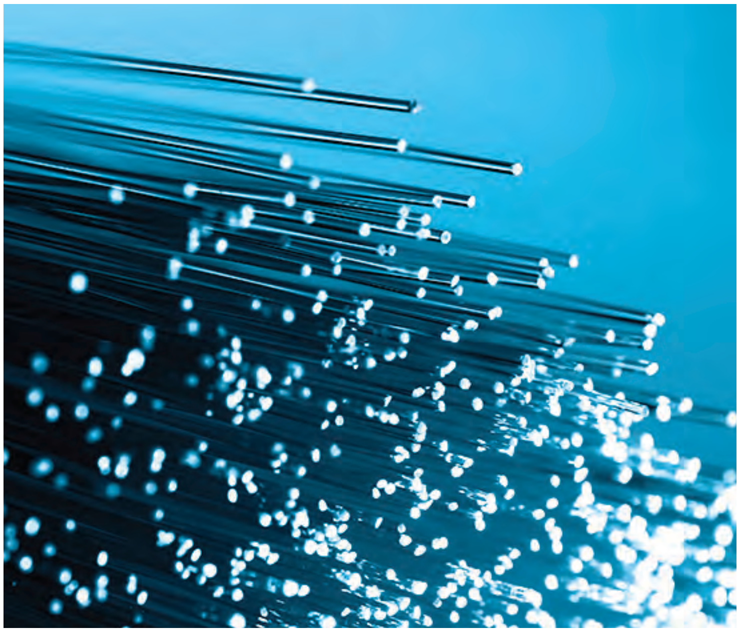
James now works as a Principal Engineer at GlobalFoundries in Santa Clara, CA. He earned his Ph.D. on tomography and thickness-dependent switching in ferroelectrics, and his groundbreaking work was featured in the Proceedings of the National Academy of Sciences, Science, Science Advances, the Journal of the American Ceramic Society, and Nano Letters.

John T. Sypek, Ph.D.
Advisor: Seok-Woo Lee

John is currently employed at Collins Aerospace as a Staff Research Scientist. During his graduate studies, John's honors included Best Poster Award - 18th International Conference on the Strength of Materials (ICSMA) 2018, Materials Science and Engineering Department Graduate Student Speaking Contest Award; Graduate Student Award (Gold) at Materials Research Society's (MRS) 2018 national meeting; and 1st Place for the 2017 School of Engineering Graduate Student Poster Competition.

Sriram Vijayan, Ph.D.
Advisor: Mark Aindow

Sriram is now a Postdoctoral Researcher at The Ohio State University. During his graduate studies, Sriram authored and co-authored numerous research papers which have been published in journals including Nature: Scientific Reports, Journal of the Minerals, Metals & Materials Society (TMS), the Journal of Materials Science, Ultramicroscopy, and Microscopy and Microanalysis.



From Undecided to Dean of Engineering at Michigan Tech

When Janet Callahan, Ph.D., present Dean of Engineering at Michigan Technological University, first arrived at the University of Connecticut as a sophomore transfer student, she was undecided about her major. A decade later, she had earned three degrees from UConn and a clear career path.

"My most basic message to every entering student is this: explore your interests, embrace them as part of your toolkit, while also moving forward and taking the fundamental courses."

Callahan started UConn taking pre-med courses before selecting chemical engineering as a major. But when she was preparing to enter the workforce post-graduation, an encounter with UConn Engineering Professor, Donald Potter, pivoted her trajectory towards the academic world.
"In my last semester as an undergraduate, Professor Potter introduced the idea of graduate school," Callahan said.

He convinced her to delay her plans to enter industry and get a master's in metallurgy. When she entered graduate school, she had no intention of getting a Ph.D., but fate intervened again:

"After about a year in graduate school, I realized how much I liked to do independent research," Callahan said.

After leaving UConn, Callahan completed post-doctoral work in Melbourne, Australia, became a faculty member in the Materials Science and Engineering Department at Georgia Tech, and held various leadership roles at Boise State University. She eventually arrived at Michigan Technological University, where she was appointed Dean of Engineering in 2018.

As Dean at Michigan Tech, Callahan leads the academic and research mission of the college. She is also the first female dean of engineering at Michigan Tech.
"My personal message to women is that engineering is a place where we certainly belong. Academia— being a professor—we belong there too. Why not choose a career where you can make a difference in the world, which is what engineers do?" Callahan said.

Even though Callahan never intended to dive into a career in the academic world, she is forever grateful for everything that UConn Engineering has given her:

"My entire engineering foundation is based on what I learned in UConn's School of Engineering. Beyond my technical foundation, I learned about persistence, independence, and camaraderie," Callahan said. "For alumni who may read this—keep in touch with your home department and with your colleagues—these are your life-long allies."

Eli Freund, Editorial Communications Manager, UConn SoE

Janet Callahan, Dean of Engineering at MTU, and alumna of the UConn School of Engineering MSE program.
(Photo Courtesy of Janet Callahan)

Distinguished MSE Alumna Leads the Next Generation of Engineers

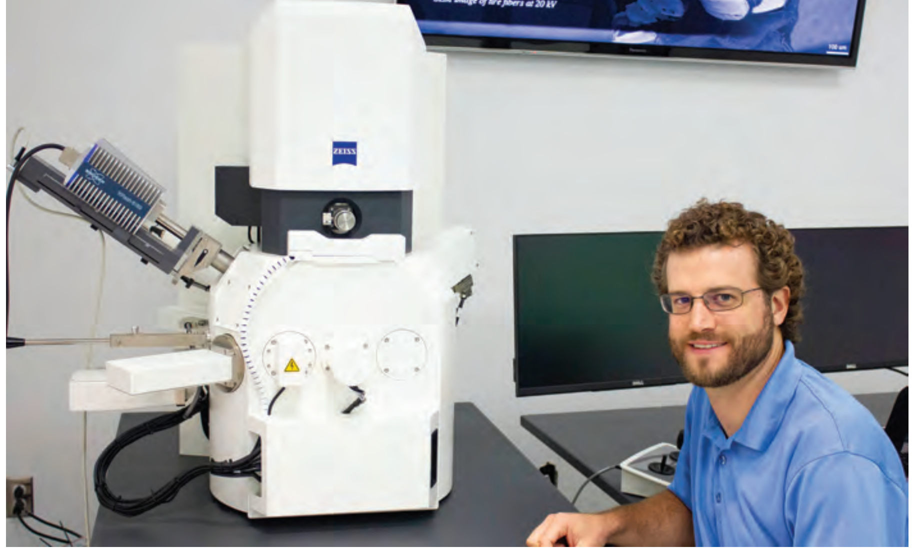
A highly accomplished and distinguished MSE alumna, Jacquelynn Garofano (MS '09, Ph.D. '11), has been named Program Manager of the prestigious Margaret Ingels Engineering Development Program at United Technologies (UTC). The program is named after Margaret Ingels, the first American woman to receive a professional degree in mechanical engineering (BS 1916; MS 1920, University of Kentucky) and the first female engineer at Carrier, where she spent a distinguished technical career and was a close associate of Willis Carrier, credited with the invention of the first modern air conditioner.

Garofano began her career at UTC as a senior research scientist at the Research Center (UTRC) in 2011. For more than seven years, she worked to solve technical challenges, provide failure investigations, and develop innovative technologies for UTC's aerospace and building industries, leveraging her materials engineering expertise from her years in UConn MSE. Now, she draws on her solid technical foundation, leadership competencies and social impact to head UTC's newest leadership program.

"In my new role, I have the privilege of cultivating and leading the next generation of engineers who will shape our future," Garofano said. She was excited to welcome the first cohort into UTC in June.

The Ingels program is a two-year, entry-level engineering development program designed to build engineering, leadership, and business acumen through a challenging, fast-paced rotation experience. Program associates will receive a holistic view of United Technologies through four six-month rotations at Pratt & Whitney, Collins Aerospace

MSE alumna, Jacquelynn Garofano



(Photo courtesy of Kyle Crosby)

Kyle Crosby in the ZEISS lab next to a scanning electron microscope.

and UTRC across engineering disciplines that expose them to the entire product life-cycle: design, manufacturing, testing & validation, operations, delivery, and so on.

Garofano is responsible for recruiting top engineering talent for UTC and is actively seeking engineers for future cohorts, next starting in 2020. In addition to the Ingels program management, she said, "I also have an opportunity to support UTC's strategic initiatives in STEM education and workforce development to ensure that we are fostering a diverse and competitive technical engineering workforce and pipeline."

Previously, Garofano was named one of the 2011 Women of Innovation by the Connecticut Technology Council, and is a recipient of the Collegian Innovation and Leadership Award. Early in her professional career, she earned the unique distinction of landing on the 40 Under Forty outstanding young professional list for Connecticut Magazine (2013) and Hartford Business Journal (2015). Most recently, she was recognized as a 2018 Future is NOW awardee by the CT Women's Education and Legal Fund for her work to advance women and girls in the STEM field.

Congratulations to Jacquelynn Garofano for all of her accomplishments, for promoting the next generation of emerging leaders in engineering and, above all, for being an exemplary leader for the Margaret Ingels program.

Five-year Ph.D. Alumnus Paves Way for Breakthrough Electron Microscopy

Kyle Crosby, a three-time UConn MSE graduate, shares how the department prepared him for work with a global SEM industry leader.

Kyle Crosby, earned his undergraduate degree, master's degree, and his Ph.D. in materials science at UConn after spending nearly a decade working and researching in the department. He now works for ZEISS Microscopy, the German company behind MultiSEM, the world's fastest scanning electron microscope, used to scan everything from mouse brains to microchips to shale rocks. A Pennsylvania native, Crosby came to UConn MSE to experience something new, and to receive a top-notch engineering education. Below, he discusses how his UConn MSE background prepared him for a business development role at ZEISS.

Tell us about your work.
Imaging and spectroscopy, specifically electron microscopy, are subjects I've been interested in since I worked with these tools at UConn. I'm currently in a business development role supporting sales and service colleagues from an applications and product marketing perspective. While I'm not directly operating a microscope much of the time, the hands-on experience from the MSE department and from my experiences as a research assistant are a huge help in understanding customer challenges and showcasing products to potential clients. The work I've done with MultiSEM, which is a highly unique multiple parallel-beam electron microscope, has allowed me to interact with leading researchers at Harvard, Sandia National Lab, and other innovative institutions around the world. I also coordinated sponsorship and served as an industry advisor on an MSE Senior Design project for students doing work that relates to this technology, so the journey from student to mentor has truly come full circle.

What was your time at MSE like?
Compared to the intro to Bio and Chem courses, MSE student/faculty ratio was very beneficial. I had eight to ten students in a typical class, thus having a one-on-one type relationship with the professors was highly productive. I first got the opportunity to work as a summer research assistant casting metal for Professor Hal Brody. This turned out to be a very enriching and informative experience and one of the main reasons I later took on a research position in grad school.

Why did you choose UConn MSE for your undergraduate and, later on, graduate education?
There were a lot of incentives for me, both in terms of quality of education and overall college experience. The

MSE faculty had outstanding credentials, including numerous awards for excellence in education, research, and professional service. They offered hands-on lab courses and sponsored Senior Design research projects to build practical skills. I received scholarships from UConn, and later I was awarded a Graduate Research Assistantship which motivated me to continue. Also, given that Storrs is the basketball capital of the world, it was an easy choice with respect to extracurriculars.

How did you first get into materials science?
In high school I took college-prep courses to narrow down my interests as they related to potential STEM careers. Materials science kept popping up, and UConn was flagged as having one of the few dedicated materials science programs in the northeast at the time [and still]. I never expected that I would get into imaging and spectroscopy, but it worked out for the best given my current opportunity with MultiSEM.

What got you into electron microscopy in particular?
Certainly, the MSE program as a whole. The characterization courses involving microscopy always sparked a strong interest in me. As an undergrad and graduate student, I had user access to some fantastic characterization equipment, which I now know is non-standard for many university settings. I worked with Professor Aindow and Professor Carter in my graduate years, taking advanced courses on the subject, so I feel I got a thorough philosophical and hands-on academic experience in that way.

What compelled you to attend graduate school?
After four years of undergrad I honestly had no intention. However, the UConn MSE department strongly encouraged their homegrown students to stay and help build the program. The opportunity was too attractive to turn down, because I was offered a graduate stipend as a research and teaching assistant, which meant my continuing education was essentially free and I was getting a paycheck every two weeks to boot. Of course, that's normal now at UConn for Ph.D. students.

What did your graduate years entail?
On the research side, I focused mainly on powder processing under the guidance of Professor Leon Shaw. My master's project, which was funded by the Department of Energy, involved developing solid-state hydrogen storage materials for mobile fuel cell applications. After two years, I transitioned to my Ph.D. project, which was funded by the National Science Foundation, involving additive manufacturing (3D printing) of next-generation biomaterials for orthopedic implants.

What did you do after you earned your Ph.D.?
Before I had even defended my dissertation, ZEISS interviewed me and had a position waiting. Moving forward, I feel like I have a lot of opportunities within the company because of the breadth of our portfolio and the breadth of my materials science knowledge. I frequently have the opportunity to travel to ZEISS HQ in Germany, and I have many opportunities to work internationally as part of the greater MultiSEM team. This makes for a dynamic work week to be sure.

How else has the MSE department helped you in your career?
It was a top-notch education, and the value of my degree just continues to climb as the department and university continue to rise in the rankings. The MSE department is filled with really knowledgeable and supportive people. Even though MSE has grown significantly since my time, professors truly do try to maintain close personal relationships with students past and present. I learned to communicate, interact, and work within a team effectively thanks to them. Working closely with other prestigious universities in the northeast, I can honestly say that UConn is definitely making itself known, particularly in the materials science field.

MSE alumna Stephanie Higgins Bealing

40 Under 40 Entrepreneur Uses Engineering Skills to Bring People Affordable Glasses

Stephanie launched Replacement Lens Express, an online, home-delivery eyeglass lens replacement service as a new way for people to get affordable glasses.

MSE alumna and Connecticut businesswoman Stephanie Higgins Bealing is using her materials science and engineering experience to reform the eyeglasses industry. Since founding Replacement Lens Express in 2010, she has won numerous awards, been named as one of Connecticut's 40 under 40, and earned national recognition for pioneering eyeglass replacement services.

Stephanie launched Replacement Lens Express, an online, home-delivery eyeglass lens replacement service, as a side project. After earning her masters degree in MSE and working in the engineering world for a while, she had decided to pursue an MBA from Carnegie Mellon University in 2008, where she gained valuable business acumen. But her side project took off.

"The popularity exploded after just one year, and I continue to pursue it to this day," she said.

The company offers prescription glasses at an affordable rate to people who need replacement lenses. The prices are 30 percent less than commercial prices for most major brands, and they offer their own in-house lens. As the only female-owned online optical lens company, they're bringing in a great amount of new and repeat customers in over 55 countries.

"It's a new way for people to get affordable glasses," Stephanie said.

Stephanie's success builds on her MSE degree and her previous work as a fuel cell engineer for Rolls Royce, a technology developer for UTC Aerospace and a project lead for an MCHX coating project at Carrier Corporation.

"My master's experience really taught me how to put myself out there, to be assertive and to stand up for myself. As a businesswoman now, it's a crucial skill," she said.

Though she was only a student in MSE for two years, Stephanie remembers working on a variety of projects with many excellent people. While working as a graduate assistant at the Connecticut Global Fuel Cell Center (now C2E2), Stephanie had the chance to travel internationally and collaborate with some of the top industry experts in the field, including a visit to Imperial College in London for a conference about solid oxide fuel cells.

"I felt like I was an entrepreneur with my projects. I got to design my master's thesis project as I wanted to, and work with measurement equipment that I never could have imagined getting access to. I made a ton of great connections and got a lot of lifelong exposure to a field that holds a very dear place in my heart," she said.

Stephanie first got into engineering because of her admiration for Stephen Hawking as a kid, and some encouragement by her father to study the sciences. She earned a degree in physics with a focus in geophysics from Hamilton College, where a unique opportunity opened up.

"I got to go to Antarctica and study the geochronology of underwater volcanoes through the United States Ocean Drilling Program, using alpha-decay spectroscopy. We actually discovered a new underwater volcano on that trip," she said. During college, she took a class in ceramics, which inspired her to learn more about the physical and engineering aspect of materials. Searching for a college with a good engineering program that was close to home, she found UConn was ideal, and pursued her masters in solid oxide ceramics soon after earning her bachelor's degree in 2004.

At UConn, Stephanie delved into materials science and engineering, while also improving her communication skills during a class with Professor Mark Aindow.

"It was very writing-intensive, and he wanted to help us, the students, improve our writing. It helped me learn to communicate my ideas clearly and effectively, which is a skill I use all the time now," she said.

Professor Mark Aindow and Professor Pamir Alpay connected Stephanie with a large range of people in the field, which ultimately helped her land a job working with fuel cells for Rolls Royce in London, and later with UTC Power (now called UTC Aerospace).

"When I graduated in 2006, I left UConn MSE with such a great mindset about industry and collaboration."

Zach Stone '04 (far left) discusses a concept with his fellow panelists (left to right), Horea Ilies, Ph.D, Michael Astrachan '87, and Patrick Belanger '16, '18 MFA at the Jan. 2019 Science Salon. (Peter Morenus/UConn Photo)

MSE Alumnus Pushing the Envelope with VR and AR Technology

One of UConn MSE's first students shares what it's like working at a company that's paving the way for augmented reality technology.

Zach Stone was one of the first undergraduate students to join the Materials Science and Engineering program back in 2001. Starting with a class of only five students, his skills in metallurgy landed him work with Sikorsky and UTC Aerospace Systems after graduation. Now, he works at Vuzix Corporation, one of the leading companies in breakthrough augmented reality (AR) technology, paving the way for new innovations in the video game, medical, business, and educational fields. Recently, he appeared at the UConn Science Salon series, for a public discussion about the future of AR and VR with students, faculty, and the wider community.

How did you get started in Materials Science?
I originally started in computer science, which I quickly realized I was woefully unprepared for. At the time, UConn was trying to get their undergraduate materials science program up and running. I decided to give it a try after seeing some of the demos they had on display during an informational meeting. In my graduating class, there were five people, which meant there was a great student-professor ratio. We were all really close, and I still keep in contact with everyone I graduated with.

What appealed to you about the program?
We had a truly unique experience. Like I said, we had a low student-to-teacher ratio. The professors were developing the courses as we went along. I felt like everyone wanted this undergraduate program to succeed, and we rose to the occasion. The classes were tough, but we learned so much from them.

One of my favorite courses was our casting course. We were casting aluminum in one of the physics buildings, and the casting facility had all these CRT monitors around it. When we worked on the aluminum foundry, the magnetic field distorted all the monitors and they had to turn them off. So, every time we melted aluminum, everyone in the building got mad at us.

What were some unique experiences you had in the program?
In my senior year, I learned to step outside my "safe zone," so to speak. My senior design project was studying recycled aluminum and removing impurities from it, like iron and steel contamination. This is genuinely important for airplane and automobile recycling and reprocessing. We took bars of aluminum and tried different methods to remove impurities. It was me and one other student, and we were sponsored by Bodycote, a metallurgy company. Our research did end up having an impact, and Bodycote even sponsored follow-up projects with UConn to verify our findings.

Where did you go after UConn?
I was at Sikorsky for five years as a member of the failure analysis team. Later on, I was with UTC in their Operations Leadership Program for two years and then served as a materials manager in Orange County, California. In 2008, I went to the University of New Haven for my MBA/MSIE. After working in the world of engineering for a while, I got the opportunity to work with a startup company in Rochester, called Vuzix. That was three years ago. I started as a quality manager for products, but I'm now vice president of operations there.

Tell me about your work.
Our products are AR glasses. We implement video and camera technology into wearable items, allowing people to see through a camera or into a video input. One of our products, Blade, is a pair of sunglasses that pulls up your phone apps, calls and information right in front of your eyes, so you aren't looking down at your phone all the time.

How do you bring materials science and engineering into it?
One of my jobs is overseeing the supply chain and manufacturing of the products we sell. Part of the reason I'm able to do what I do is because I have a strong engineering background. It's a whole mindset behind how you can use the materials at hand to make what you need. So, I can look at costs, strengths and weaknesses, implementation, and the overall effect a material can have on the product. I use these advanced material concepts to my advantage—and, of course, it helps to have a broad base. It's been a lot easier that way, for me to expand into different roles.

What influenced you the most during your time in the MSE department?
Definitely my advisor, Professor Brody. He taught me how to be flexible and how to roll with the punches, which has been critical throughout my time in the department and after I graduated. My time as a student was a nonstop group of challenges that I had to adapt to, and that level of demand shaped me and how I handled it. Really, though, every professor I had was engaged in our success. We got a lot more facetime than most students, which I hear is still the case now for current MSE students. I look back at my time there fondly. It really was a good program.

Zach shows off some of Vuzix's latest technology in VR and AR. (Peter Morenus/UConn Photo)

(Sean Flynn/UConn Photo)

➲ Six of this year's 11 UConn recipients of National Science Foundation Graduate Research Fellowships. From left, Hetal Patel, Eric Lepowsky, Leann McLaren, Angela Lanning, Connor Ligeikis, and Shaylin Cetegen.

MSE Undergraduate Hetal Patel Earns Two Competitive Fellowships

Hetal Patel is the first UConn undergraduate to receive the NDSEG graduate fellowship.

UConn MSE 2019 graduate Hetal Patel has become the first undergraduate to receive the National Defense Science and Engineering Graduate Fellowship (NDSEG) in the history of the fellowship at UConn. The NDSEG fellowship was one of two fellowships Hetal received, including the National Science Foundation Graduate Research Fellowship Program (NSF GRFP), as she begins a Ph.D. program at UC Berkeley this fall.

Hetal Patel of South Windsor, CT graduated summa cum laude from UConn with a bachelor's degree in MSE and Computer Science and Mathematics minors as an Honors Scholar, a STEM scholar, and a University Scholar. She is the recipient of numerous awards and scholarships while at UConn including the NASA-CT Space Grant, and Owen F. Devereux, GE Advanced Materials, and UConn STEM Leadership Scholarship. She conducted research in Assistant Professor Seok-Woo Lee's lab since her freshmen year, and in Associate Professor Avinash Dongare's lab since 2018. She was also the President of the Materials Engineering Honor Society, Alpha Sigma Mu, and the Vice President of UConn Materials Advantage.

As an undergraduate, Hetal accumulated an impressive research and community outreach profile which led her to win the two nationally prestigious graduate fellowships. Hetal said she was "shocked" when she found out she won NDSEG.

"I found out from the UConn Office of National Scholarships and Fellowships that I might be the first undergraduate that has ever managed to secure the NDSEG fellowship in the history of UConn, and that I am definitely the first NDSEG fellow we have had in the last five years," Hetal said.

She was also grateful to have received the NSF fellowship, as it is a nationally recognized program for graduate students.

"I try very hard to submit my best work and had been working on the applications several months beforehand, so it feels good for all the hard work to pay off."

Hetal thanked Professors Lee, Dongare, and Huey for writing her letters of recommendation.

"My application would have been incomplete without the extremely strong letters of recommendation, and I am very grateful to all the professors in the MSE department who have helped me get this far in my materials career."

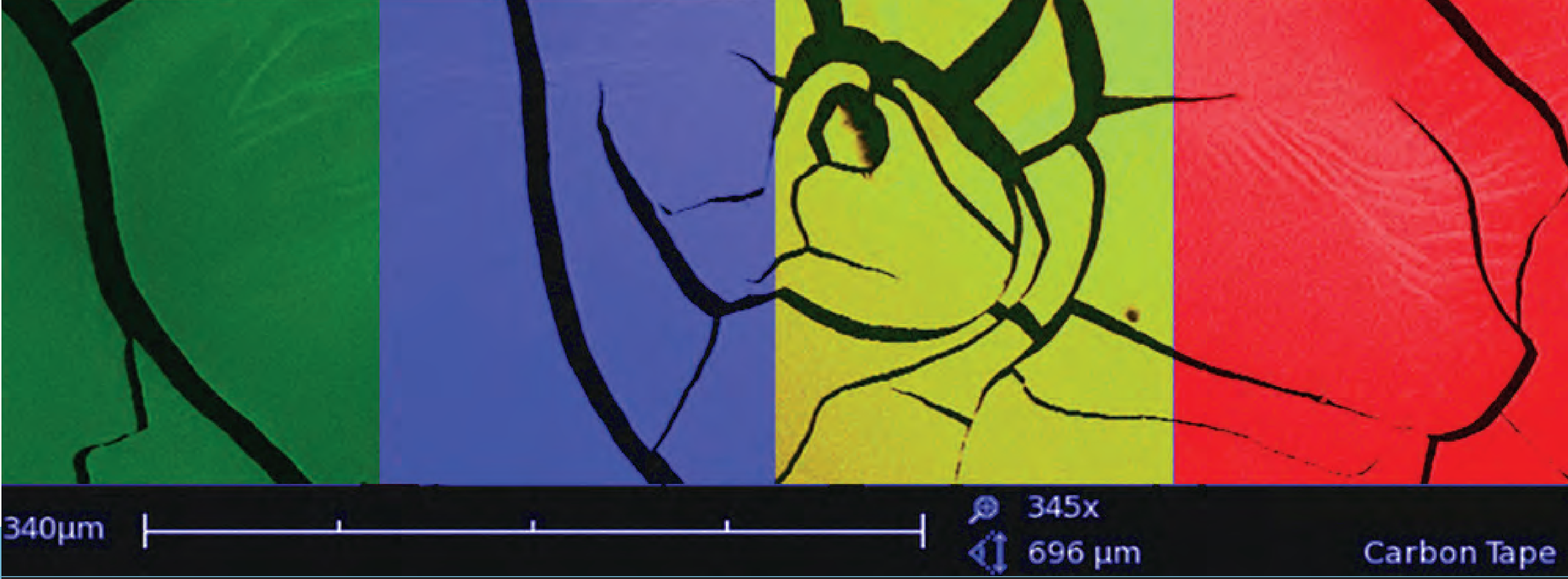
The NSF GRFP, which is the country's oldest STEM graduate fellowship, recognizes students with outstanding work in the STEM field to do Ph.D. work. The NDSEG is funded by the U.S. Department of Defense to students pursuing a Ph.D. in a field that advances U.S. defense science and engineering. Those who earn it display a high aptitude for advanced study and scholastic enterprise. It is sponsored by the Air Force Office of Scientific Research, The Army Research Office, and the Office of Naval Research, all of which fall under the Director of Defense Research and Engineering.

The fellowships provide tuition, fees, and a monthly stipend, which is standard for Ph.D. students. But recipients of these special fellowships earn a slightly higher stipend, and with the NDSEG there is also a generous travel allowance. Both of these awards are very hard to earn, with less than a 15 percent success rate for the NSF, and a 10 percent success rate for the NDSEG. But Hetal could only select one of them to fund her Ph.D.

"I have chosen to accept NDSEG, as it is more selective, extremely prestigious, and has a better financial package," Hetal said. "NDSEG will fully fund my research as I head to UC Berkeley this fall to pursue a Ph.D. in materials science and engineering in the field of computational materials science. I will be utilizing atomic-scale quantum mechanical modeling methods and high-performance computing technology to accelerate the design and discovery process of materials for battery and other energy storage technologies."

Her advisor, Assistant Professor Lee, said Hetal is "certainly one of the most brilliant, creative and productive undergraduate students I ever met at UConn."

"She deserves all of the fellowships that she has received," he said. "I have no doubt about her future success. I wish her all the best in her endeavors as a materials scientist."



Your Continued Support Helps Power Materials at UConn

UConn's MSE department celebrated an unprecedented $1.7M donation last year in support of undergraduate scholarships through the Owen F. Devereux fund—this is certain to change the face of our department in the coming years. We are also looking toward breaking ground on our new building in the coming year, and soon after beginning to fill it with upgraded equipment to enhance our teaching and research mission. We continue to grow, with 6 new faculty hires including 4 women in 2018 and 2019. Altogether we are now 20 faculty members and almost 250 dedicated undergraduate students, graduate students, postdocs, staff members, and research and adjunct faculty. This includes expertise in the areas of metallurgy, ceramics, energy materials, nanomaterials, biomaterials, and electronic materials, in all facets of our discipline, including processing, characterization, selection, design, modeling, and manufacturing of materials.

50 years after our first awarded Ph.D., and 15 since our first Bachelor of Science degrees, there's never been a better time to support those who are following your lead as members of the rapidly expanding UConn MSE community. Please consider donating to the MSE Department, where your contributions will directly enhance our efforts to promote research, education, and outreach.

For further information about personal and corporate opportunities for matching donations, establishing endowments, naming labs in our new building, equipment donations, sponsored lectures, hosted events, or other ways to give back to UConn MSE, please reach out to Department Head Bryan Huey.

MATERIALS SCIENCE AND ENGINEERING (MSE) GENERAL FUND ACCOUNT (22156)

This account supports the overall efforts of the Department of Materials Science and Engineering, with a primary focus on opportunities for undergraduate and graduate students, professional networking, investments in our teaching labs, and outreach. These funds also support ~15 undergraduates per year to attend conferences, and this year helped to establish the new Metalworking club guided by Lesley Frame and Hal Brody, which already has more than 100 members from across the University.

THE OWEN F. DEVEREUX MSE UNDERGRADUATE EXCELLENCE SCHOLARSHIP (31384)

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