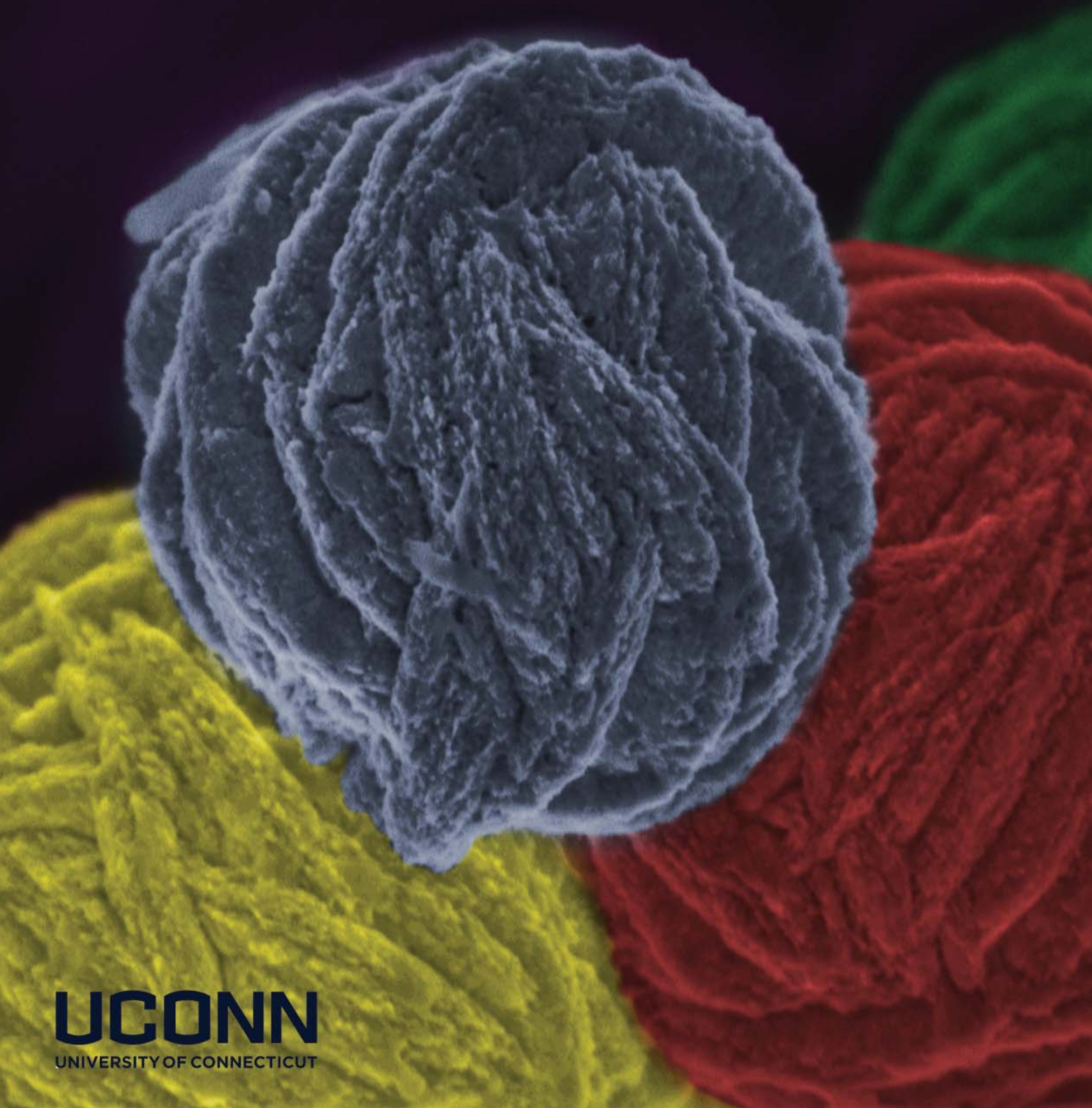
NEWSLETTER 2019

IMS | INSTITUTE OF MATERIALS SCIENCE



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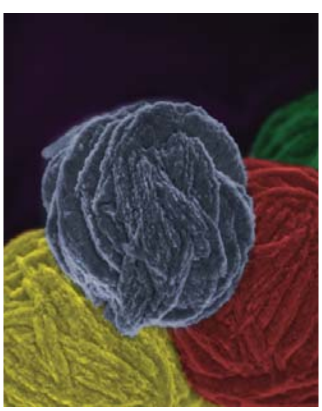

On the Cover: Science as Art

Recently, images created in the pursuit of scientific discovery have drawn attention for their artistic quality. Walking the halls of the IMS administrative offices, the cover image for this year's newsletter has often been interpreted by the human eye as balls of yarn. Even for those familiar with microscopy it is hard for the brain to avoid jumping to this conclusion.

Our cover image is called "Nanoporous Metal Oxide" and was created as a result of research conducted in IMS Director Dr. Steven L. Suib's laboratory. The image was enlarged and colorized by Dr. Challa V. Kumar's group, which has recently displayed many such images in galleries alongside traditional artwork.

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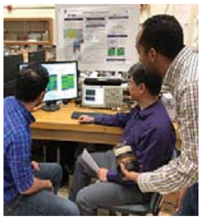


MESSAGE FROM THE DIRECTOR

Greetings from Storrs!

The Institute of Materials Science (IMS) has completed another banner year producing excellent new research programs and conducting groundbreaking research. We have welcomed new faculty and staff members, and our industry outreach program continues to attract new members.

The centers of excellence associated with IMS such as the Thermo Fisher Center for Advanced Microscopy and Materials Analysis (CAMMA), the Electrical Research Insulation Center (EIRC), the Anton Parr Thermal Analysis Center, and the Collins Center for Excellence in Advanced Materials are all state-of-the-art research endeavors that are making a real difference. The Industrial Affiliates Program (IAP) has grown to 40 companies, and continues to expand the breadth of capabilities to leverage resources campus-wide.

Several faculty members have been honored for their contributions to materials research, pursuing innovative solutions to address real life concerns using academic tools. You can read about many of them in this year's annual newsletter as well as the endeavors of our talented students and staff. The Materials Science and Engineering Department, the Polymer Science Program, and the Materials Science Program are all flourishing.

University of Connecticut Administration has been extremely helpful in supporting IMS programs, in the hiring of new faculty and staff members, and in general support of materials research. We welcomed Dr. Haiyan Tan to the CAMMA laboratory and Ms. Lena Mastrangelo to IMS's financial support team. The planning of the new home of IMS in the Science One building is moving along smoothly and designs are nearly complete, looking forward to groundbreaking in 2020.

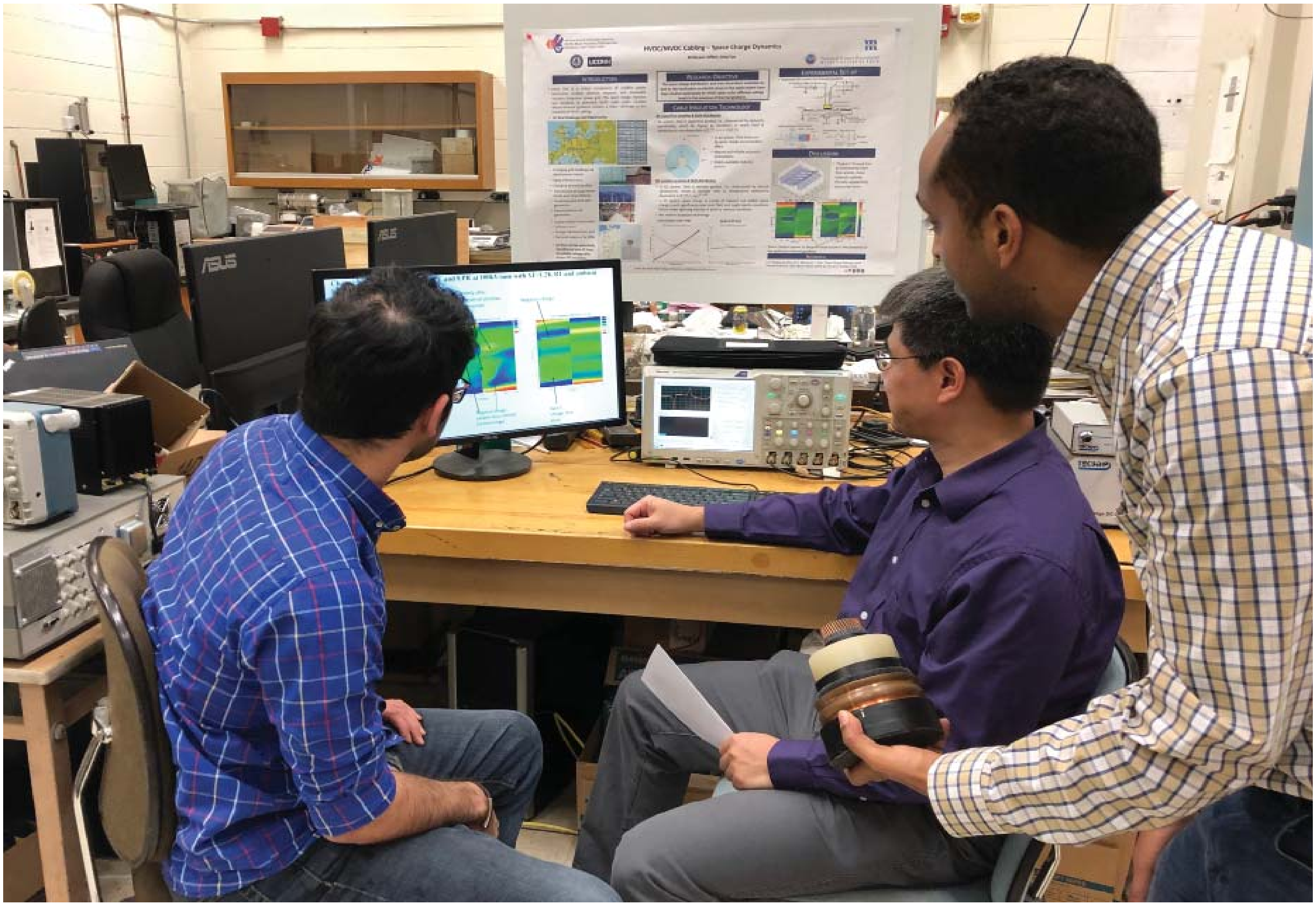
Overall, materials research is alive and well at UConn. In the coming year, we look forward to additional growth in our faculty ranks and several new research partnerships. Stay tuned for more exciting news and updates regarding our ongoing efforts. We would love to hear from alumni and to be able to report your accomplishments in our electronic weekly and annual newsletters. If you would like to receive the former, please let us know.

Steven L. Suib

Steven L. Suib, Director
Institute of Materials Science

Innovators Bridge Divide Between Today's Applied Challenges and the Academic Frontier

by Kayla M. Pittman - Institute of Materials Science



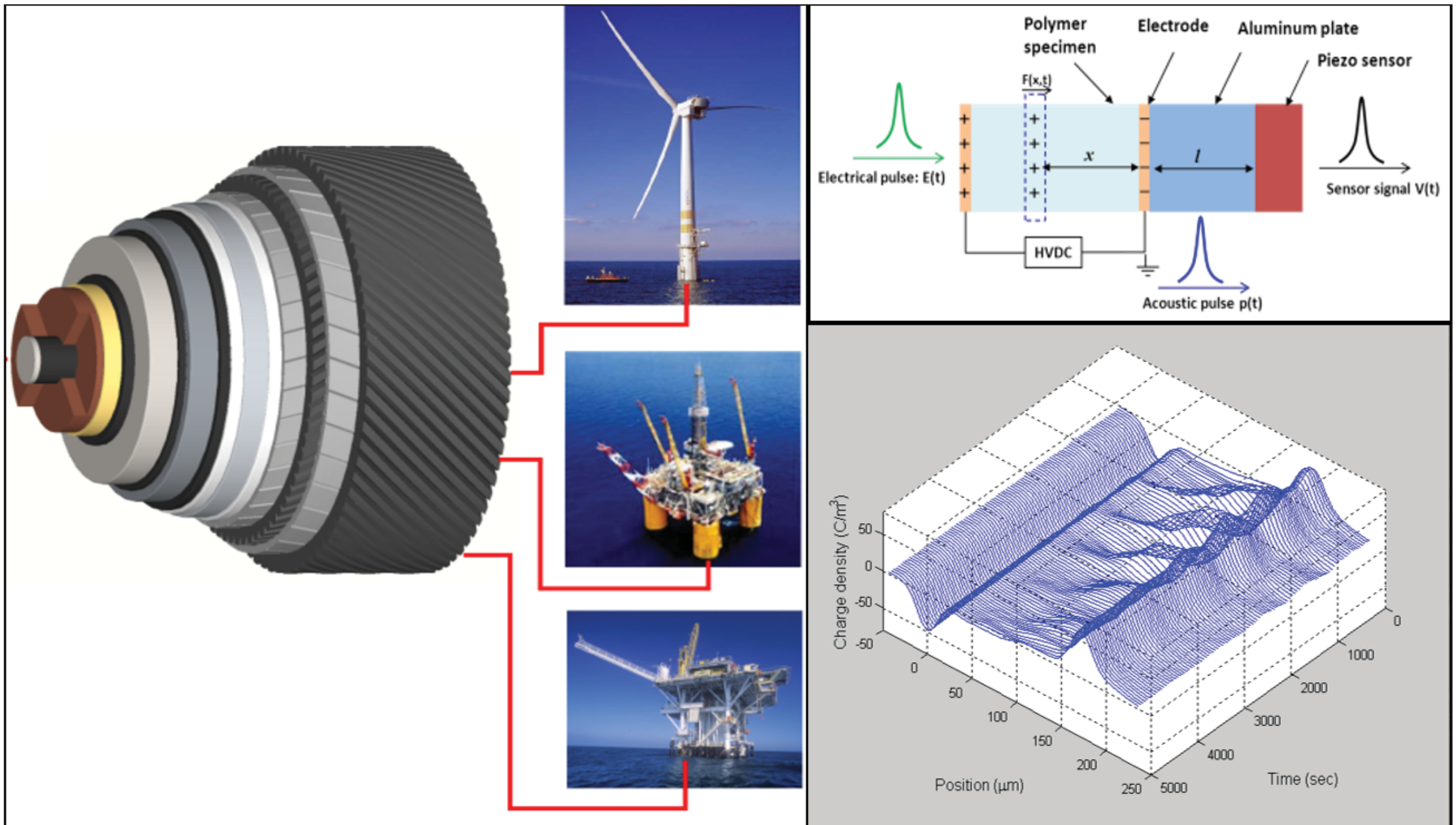
Dr. Yang Cao (center) reviewing space change measurements for electrical insulation materials with graduate students Mohamadreza Arab-Baferani (l) and Mattewos B. Tefferi.

Earning his doctoral degree in Materials Science from UConn before working in industry for eleven years, Dr. Yang Cao is no stranger to tackling practical problems with academic research. His work bridges the divide oftentimes found between academia and industry. Dr. Cao explains that both sides have their advantages in that academic research is exploratory as it drills down into the basic touchstones of a discipline, whereas industry is mission-driven with a sense of urgency to attain the end goal.

Succeeding his mentor, the late Dr. Steven Boggs, Dr. Cao now serves as the third Director of the Electrical Insulation Research Center (EIRC) in the Institute of Materials Science (IMS). The EIRC is an academic-based collaborative research center that, over the last thirty years, has developed materials and technical solutions to practical problems. Dr. Cao explains, "The EIRC is lucky in that it is centered between academia and industry, which affords this collaborative research center the opportunity to apply advanced scientific theories to practical problems." He goes on to say, "Knowing the academic principles presented in a problem does not mean you can fix it – the practical application of theory is not easy."

Dr. Cao's success in his role as Director is evidenced by not only the EIRC's collaborators from within IMS, but also global partners and funding stemming from government and industry sources. Despite his success, Dr. Cao remains humble and is quick to point out that long-time EIRC research assistant and lab manager, Ms. JoAnne Ronzello, is a constant in the lab. Fulfilling many roles, Ronzello propels the EIRC forward as the driving-force behind daily operations.

Currently, the EIRC is working on new dielectric materials and high voltage technologies to increase power density and enable high efficiency, as the world embraces renewables and broader ranges of electrification. A variety of ongoing projects include sponsorship from the United States (U.S.) Department of Defense (DoD) for a project focused on high energy density capacitors, the U.S. Navy for the development of marine electric propulsion motor insulation, and the U.S. Department of Energy



Energy efficient high voltage transmission technology for renewable integration

(DoE) for a project on high voltage direct current (HVDC) cabling and accessories.

In concert with his work with the EIRC, Dr. Cao also serves as a co-director of the Center for Novel High Voltage/Temperature Materials and Structures. The Center seeks to increase both the efficiency and reliability of the power infrastructure by working with both UConn collaborators as well as university and industrial partners from across the country. This undertaking is an extension of the National Science Foundation Industrial University Cooperative Research Center on High Voltage/Temperature. There is great synergy between all of Dr. Cao's projects, all working toward increasing power density in electric machines and drive systems.

Success in electrification relies on the ability to increase the high power density of the motor and converter. In doing so, the engine is smaller to decrease weight with the same power, or it generates more power at the same size. Dr. Cao is particularly excited about the future of hybrid propulsion in the aerospace industry. The EIRC is working on a National Aeronautics and Space Administration funded project with United Technologies (as part of a U.S. response to the partnership between Airbus, Rolls-Royce, and Siemens) to develop a hybrid-electric engine for commercial airplanes. The goal is to develop HVDC power distribution system for aerospace compulsion.

Power density is also the focal point of Dr. Cao's projects with the U.S. Navy and DoD. Working on two separate projects, the EIRC confronts a unique challenge in developing technology that fits within the restrictive confines of a battleship. Increasing the power density of the electric engines not only realizes electric propulsion in the engine room as seen on the DDG 1000 ship, but also the mechanism for high voltage breakdown in the U.S. Navy railgun as supported by a Multidisciplinary University Research Initiative (MURI) through the DoD. The current MURI project seeks to develop new capacitor materials for the railgun. This project is within its second award period with each period receiving 7.5 million dollars over the course of five years.

> The EIRC is working on new dielectric materials and high voltage technologies to increase power density and enable high efficiency, as the world embraes renewables and broader ranges of electrification.

As opposed to explosive ordinances, the railgun's destructive energy relies on the speed of the projectile produced by an electromagnetic force. BAE Systems, a railgun manufacturer, states the railgun launches high velocity projectiles at the speed of Mach 7.5; upon impact, the projectile is traveling at Mach 5. Again, the lack of space on battleships drives the need for high power density, which allows for the mechanism of the projectile's propulsion as well as the ability to store an increased

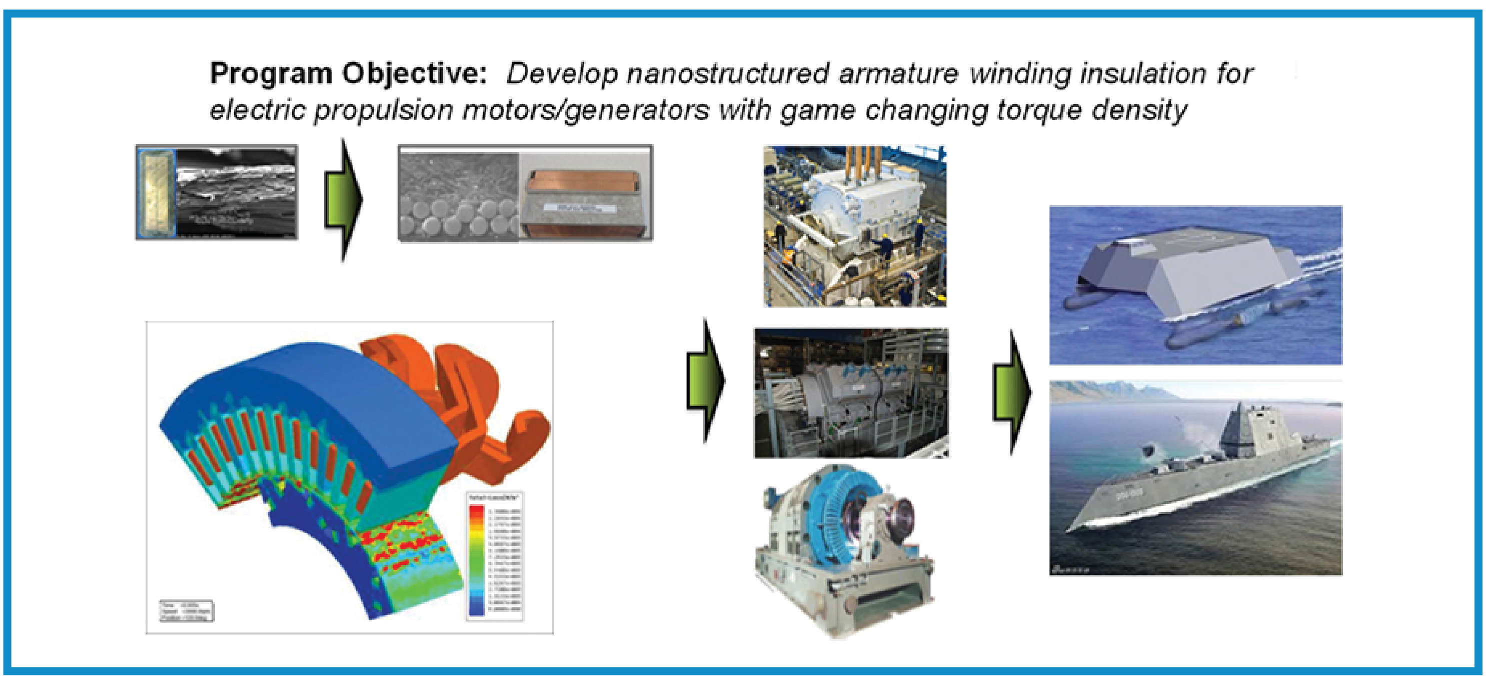
EIRC Lab Manager, JoAnne Ronzello

amount of smaller, non-explosive projectiles with the same or even greater impact.

The EIRC is also applying high power density electric engines to renewable energy applications such as wind power. Dr. Cao's research currently focuses on making improvements to turbine gearboxes for use in offshore wind power. According the U.S. DoE, offshore turbines are similar to land-based turbines in that to generate power, the blades harness the wind's natural kinetic energy and rotate. The resulting mechanical energy rotates an internal shaft connected to the gearbox. The gearbox is responsible for increasing the overall rotation speed by 100, spinning the generator fast enough to produce harvestable energy. However, offshore wind power generates significantly more energy. The Wind Solar Alliance reports that an average land turbine generates approximately two megawatts, or enough energy to power 750 average American homes. Offshore turbines generate approximately 9.5 megawatts. Locally, this is an exciting time to be working on wind power, as the Connecticut Department of Energy and Environmental Protection recently announced a 200-megawatt offshore wind purchase. With this technology on the rise, the EIRC is also developing safer, more efficient means of harvesting energy generated by offshore wind turbines.

In order to harness the high voltage direct current (DC) generated on large offshore wind farms, cables must carry the power from the turbines back to the grid. DC is characterized by electrons flowing constantly in one direction; whereas, alternating current (AC) moves in both positive and negative directions. Less stable than AC, working with DC at this scale presents a large challenge; when disconnected abruptly, it arcs causing a massive fire. Dr. Cao and the EIRC team are developing technology in line with Smart Grid, the digital modernization of the traditional electric grid originally established in the 1890s, allowing for greater power flow control.

With multiple projects both underway and on the horizon, Dr. Cao centers the EIRC on the edge of groundbreaking technological and materials advancements. When asked his goals for the future of the EIRC, Dr. Cao remains committed to fostering a sense of openness and collaboration between students and faculty, as well as industry and governmental partners. His measure of success: well-trained students and increased work.



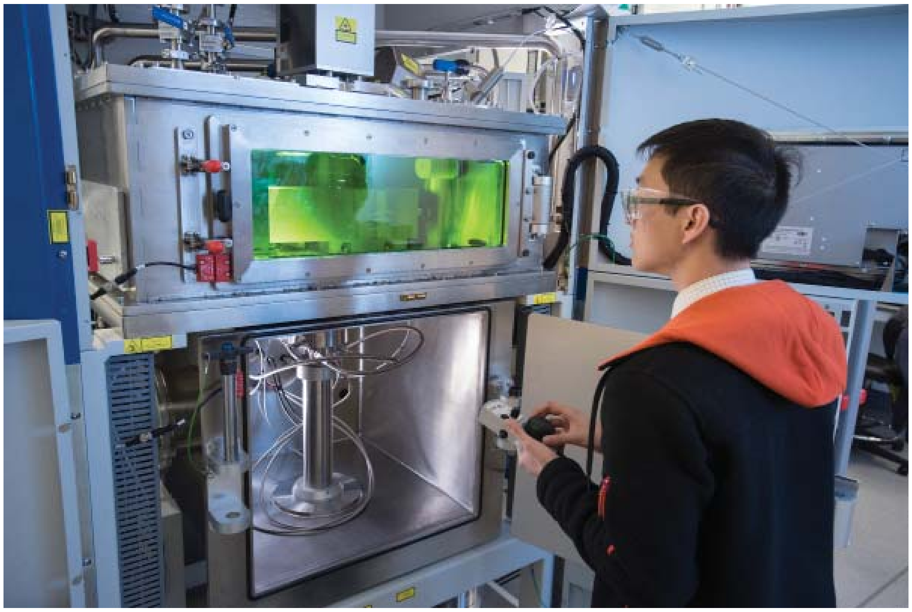
Solving Problems in Real-Time: The Collins Aerospace Center of Excellence Opens Doors to New Scientific Discovery in the Aerospace Industry and State of Connecticut

by Kayla M. Pittman - Institute of Materials Science

MSE Ph.D. student Sarshad Rommel works at the Titan Themis S/TEM (scanning/transmission electron microscope)

The Collins Aerospace (formerly United Technologies Aerospace Systems) Center for Advanced Materials brings together top UConn researchers to solve real-time industrial problems with scientific advancement. Collaborating from their labs across the Storrs campus, Dr. Pamir Alpay, Dr. Rainer Hebert, Dr. Mark Aindow, and Dr. Steven Suib lead research initiatives outlined by Collins as areas of applied interest. Beginning in 2016 and driven by Collins' leadership, this venture continues to grow with increased funding and graduate student participation, as well as undergraduate opportunities provided by Collins during the academic year and through summer internships.

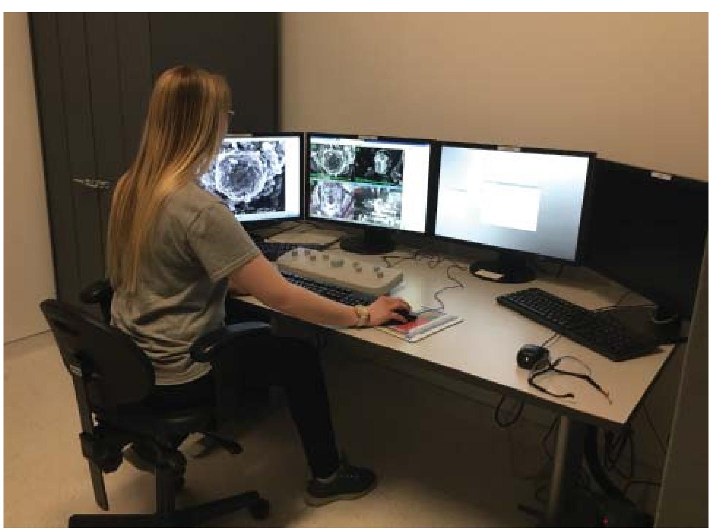
The Center for Advanced Materials provides great advantages for Collins Aerospace, UConn, and the State of Connecticut as a whole. Dr. Sonia Tulyani, Senior Director of Materials Engineering for Collins Aerospace states, "The excellent interaction between our employees and the UConn students and faculty has helped drive the development of advanced materials for our business." In directing the research, Collins identifies applied research areas pertinent to the aerospace industry. UConn researchers, using state-of-the-art-facilities housed in the Innovation Partnership Building (IPB), the Institute of Materials Science, and Chemistry Department, provide solutions to problems faced by Collins. Dr. Alpay states that Collins collaborators, "[are] visionary people who understand the power of academic research to help their business." Dr. Alpay believes UConn is unmatched in the ability to provide 3D printing, extreme conditions testing, as well as metal and materials processing and testing. Additionally, the UConn - Thermo Fisher Scientific Center for Advanced Microscopy and Materials Analysis offers seven industry-leading electron microscopy instruments.



MSE Ph.D. student Cain Hung operates the IPG Open-Architecture Metal Powder Bed Fusion System

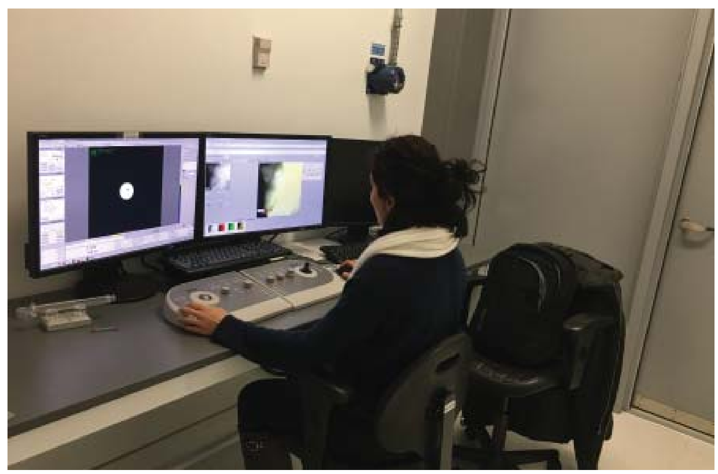
Dr. Alpay is quick to point out that the University, with support from the Provost's Office and School of Engineering, is keenly aware of its role in the development of the State and its economy; the Center of Excellence is an investment in the Connecticut. Not only does the work performed at UConn drive the State economy by serving a major aerospace company, but also students who will soon enter the professional workforce are directly benefiting from the breadth of experience that this collaboration provides. Students have the opportunity to work with an industry leader through their UConn research programs, while gaining invaluable research experience. In turn, Collins accesses leading scientific breakthroughs and a highly educated, diverse workforce. UConn graduates are a unique hiring pool as they are already familiar with the company, its goals, and the types of work on which Collins is concentrating its efforts.

Currently, Collins is targeting three main research areas directed by UConn researchers:



Chemistry Ph.D. student Anne Mirich, operates the Verios 460L SEM Data Station

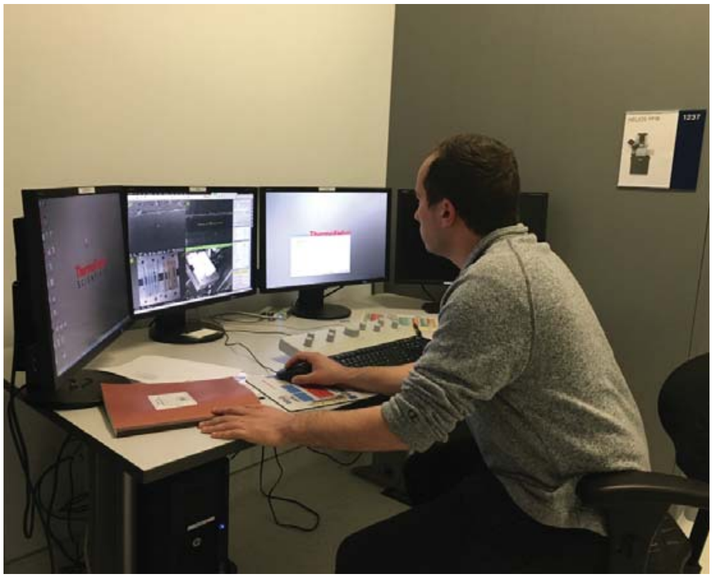
A group led by Drs. Alpay and Hebert includes a team of graduate students and postdoctoral associates working to develop new aluminum alloys for additive manufacturing. Industry and government entities have embraced this new manufacturing technology, as aluminum alloys are very important for the aerospace sector. Current aluminum alloys lend themselves to traditional manufacturing technologies such as castings and forgings. Alloys specific to additive manufacturing are more suitable for the unique processing conditions and exceed the properties of benchmark aluminum alloys. The team combines state-of-the-art computational materials science with experimental methods, drawing from State and University investments into cutting-edge instrumentation. The team's materials genomics approach has already led to promising candidate alloys that are currently in the refinement process. Dr. Hebert states, "Collins will benefit from the knowledge that emerges from this alloy development project in terms of the additive manufacturing process and, of course, from the new aluminum alloys that should impact a wide range of their parts."



Chemistry Ph.D. student Bahareh Deljoo at the Talos 200 S/TEM Data Station

Another group, Dr. Suib and his team, is responsible for developing ceramic matrix composites. Ceramics are versatile materials with many applications. They are highly sought after materials in the aerospace industry, as ceramics remain stable at high temperatures. Collins implements ceramic materials in a variety of capacities including in nozzles for rockets, engine parts, and vehicles. However, there is a drawback to working with this material as it is brittle and does not stand up to various environmental and mechanical stresses. When a pulling tension is applied on either end of a ceramic fiber, it retains its strength; however, when tension is applied from the side, the fiber is weak and ultimately fails. In order to increase material strength, Dr. Suib and his researchers are developing ceramics in which the internal fibers lay across one another, forming a matrix resembling a lattice structure. Matrix materials fill the holes in the lattice, preventing the propagation of cracks. According to Dr. Suib, UConn is a natural partner to Collins in this research endeavor as "we do and have done exploratory research in ceramic fiber composites for many years."

MSE Ph.D. students Sarshad Rommel and Hannah Leonard operate the Titan Themis S/TEM



Chemistry Ph.D. student Zachary Tobin operates the Helios PFIB Data Station

> Research conducted at the Collins Aerospace Center of Excellence will revolutionize the aerospace industry, pushing the edge of scientific study and innovation for applied solutions to problems faced in real-time.

A third group, led by Dr. Aindow, is concentrating on the exploitation of quasicrystals in aluminum-based composite materials for the aerospace industry. Professor Dan Shechtman, Nobel Prize recipient for his pioneering work in this area, first discovered quasicrystals in the 1980s. Quasicrystals exhibit unique combinations of properties, but to date there are no commercially successful applications of these materials. Dr. Aindow has collaborated with researchers at Pratt & Whitney and Collins to develop new powder-processed composites of aluminum and quasicrystals. These composites have excellent mechanical properties and thermal stability, making them good candidates for replacing heavier high-strength alloys such as those based on titanium. The composites are also much more resistant to corrosion than conventional aluminum alloys, making them ideal for environmental coatings. Dr. Aindow's students are utilizing the advanced microscopy instruments in the UConn Tech Park to develop an understanding of the structure/property relationships in these materials. He notes, "through the collaboration with Collins Aerospace we are moving rapidly towards the first practical applications of quasicrystal-based materials."

Research conducted at the Collins Aerospace Center of Excellence will revolutionize the aerospace industry, pushing the edge of scientific study and innovation for applied solutions to problems faced in real-time. The Collins – UConn partnership not only supports advancement in the industry, but also opens the door to new areas of research, setting a course of discovery for current and future Connecticut researchers alike.

> "The excellent interaction between our employees and the UConn students and faculty has helped drive the development of advanced materials for our business."
>
> ~Dr. Sonia Tulyani, Senior Director of Materials Engineering Collins Aerospace

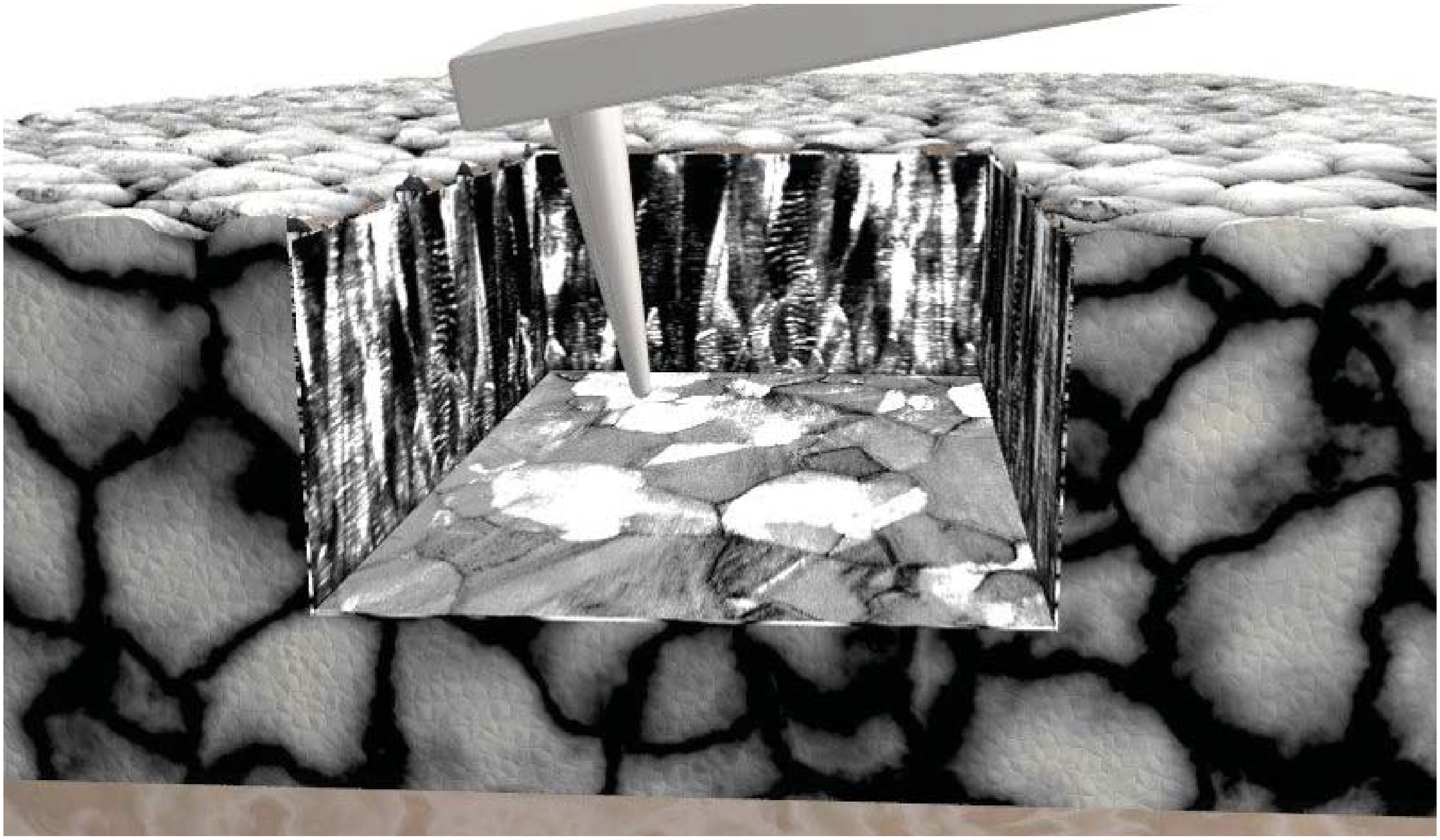
IMSQUICKFACTS

FACULTY

36 Resident Faculty Members

6 Resident Emeriti

60+ Non-Resident Affiliated UConn Faculty



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. (Image courtesy of the Huey Lab)

A Microscope as a Shovel? UConn Researchers Dig It

by Kim Krieger - UConn Communications

Using a familiar tool in an unconventional way can open up a completely new method to explore materials, report UConn researchers in the Proceedings of the National Academies of Science (PNAS). Their specific findings could someday create more energy efficient computer chips. 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.

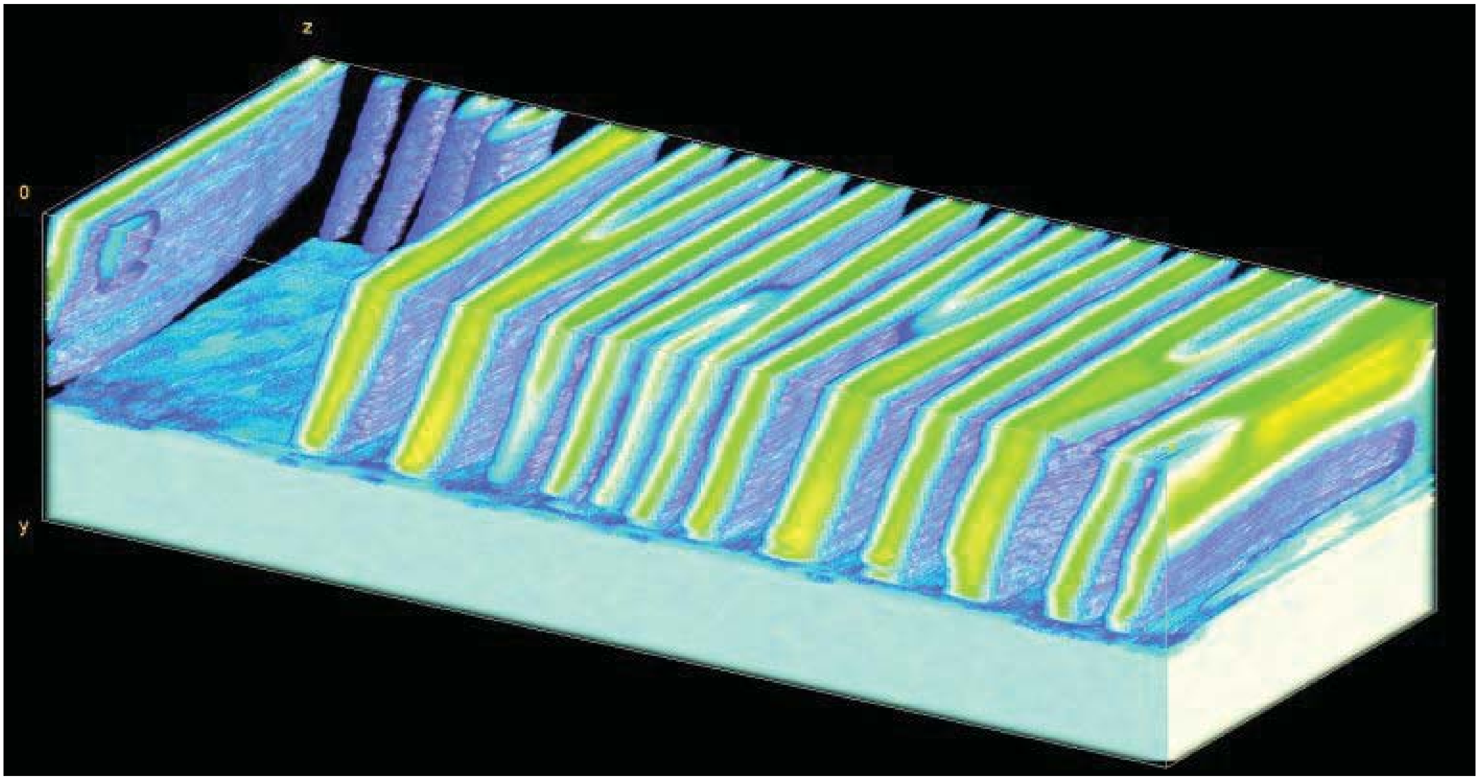
The research is based on the atomic force microscope (AFM), which is used by materials scientists and other researchers to carefully trace an ultra-sharp tip across the surface of all kinds of materials. The tip can 'feel' the surface and sometimes can sense properties like electric and magnetic forces emanating from the material. Then, in the same way a farmer methodically drives a plow back and forth or up and down 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.

Unlike the farmer's plow, AFMs are generally designed to barely touch the surface in order to prevent damage to the sample (churning up the field). Nevertheless, it does sometimes happen.

"Working with academic and corporate partners, we can use our 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."

~Dr. Bryan Huey
Head of Materials Science and Engineering Department

A few years ago, Yasemin Kutes and Justin Luria, graduate student and postdoc members of Materials Science and Engineering (MSE) Department Head 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 was



A new domain. The researchers were able to show how the domains (tiny sections of material with the same electric polarization) in the bismuth ferrite changed in shape with depth. (Image courtesy J. Steffes, B. Huey)

not 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.

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 hoe (see artist's rendition at right), 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. In order to demonstrate the approach, they dug into a sample of bismuth ferrite (BiFeO3, or BFO), a room temperature multiferroic that was provided by project collaborator, Ramamoorthy Ramesh of UC Berkeley.

Multiferroic materials support both electric and magnetic properties simultaneously. 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 large number 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.

When a materials scientist "reads" or "writes" such data in BFO, they can normally see only what happens on the surface. Yet they really need to know what lies beneath as well. If the data beneath the surface is understood, it might be possible to engineer a more efficient computer chip that runs faster and uses

Artist's rendition of ultra-fine material removal and measurements (tomography) with the AFM (image: Jack Dumala, UConn SquaredLabs)

less energy than those available today. That is a very important goal for society as about five percent of all energy consumed in the U.S. goes just to running computers.

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

Dr. Bryan Huey

the individual domains all the way down, exposing patterns and properties that were not 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 had 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. Worldwide there are around 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.

Steffes, who drove the project for his Ph.D. research, has subsequently graduated from UConn with his Ph.D. 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 continue to use the AFM 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."

UConn Partners in $12.5M DOE Research Center on US Nuclear Security

by Jessica McBride - Office of the Vice President for Research

Materials science and engineering graduate student Marco Echeverria (seated) and Rajesh Kumar, postdoctoral researcher in materials science and engineering at the Institute of Materials Science. (UConn Photo)

The U.S. Department of Energy's National Nuclear Security Administration (DOE/NNSA) 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.

Avinash Dongare, an associate professor from UConn's Department of Materials Science and Engineering and the Institute of Materials Science, serves as one of the principal investigators for the Center for Research Excellence on Dynamically Deformed Solids (CREDDS), which has received $12.5 million over five years. CREDDS will be led by Michael Demkowicz of Texas A&M University. In addition to Dr. Dongare, Amit Misra, chair of materials science and engineering at the University of Michigan, and Irene Beyerlein, a professor of mechanical engineering at the University of California Santa Barbara, are also principle investigators.

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.

"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."

~Dr. Avinash Dongare
Associate Professor of Materials
Science and Engineering

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 is happening as the material undergoes stress and deforms.

UConn's role in CREDDS focuses on the understanding of individual mechanisms that determine materials behavior in these extreme environments at the scale of 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," says 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 by complementing experimental approaches."

Dr. Avinash Dongare

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.

"This is about educating the next generation of scientists and engineers to support stockpile stewardship," says Andrew L. Ross, the Brent Scowcroft Chair of International Policy Studies in the Department of International Affairs at The Bush School of Government & Public Service at Texas A&M and director of the National Security Affairs Program. "We need to have people who can do this, not just now, but 10, 20 years down the road."

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 visiting the national laboratories involved in the stockpile stewardship program.

'Smart' Machine Components Alert Users to Damage and Wear

by Colin Poitras - UConn Communications

Sameh Dardona, center, principal research engineer and associate director, United Technologies Research Center, with Associate Professor of Chemical and Biomolecular Engineering Anson Ma, right, and Alan Shen, a Ph.D. student, look at a prototype wear sensor at the UTC Research Center in East Hartford. (Peter Morenus/UConn Photo)

Scientists at the United Technologies Research Center and UConn are using advanced additive manufacturing technology to create 'smart' machine components that alert users when they are damaged or worn.

The researchers also applied a variation of the technology to create polymer-bonded magnets with intricate geometries and arbitrary shapes, opening up new possibilities for manufacturing and product design.

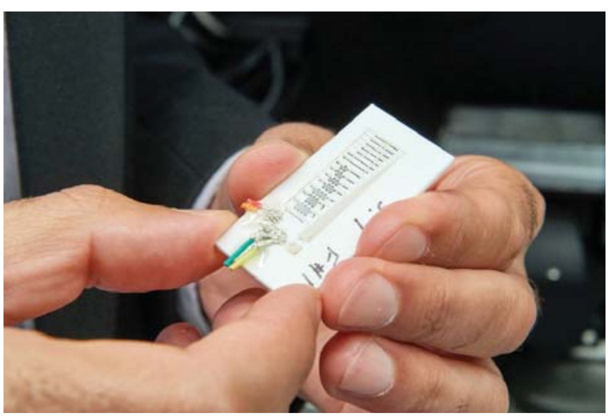
The key to both innovations is the use of an advanced form of 3D printing called direct write technology. Unlike conventional additive manufacturing, which uses lasers to fuse layers of fine metal powder into a solid object, direct write technology uses semisolid metal 'ink' that is extruded from a nozzle. The viscosity of the metal ink looks like toothpaste being squeezed from a tube.

This process allowed the UConn-UTRC scientists to create fine lines of conductive silver filament that can be embedded into 3D printed machine components while they are being made. The lines, which are capable of conducting electric current, act as wear sensors that can detect damage to the part.

Here is how they work. Parallel lines of silver filament, each coupled with a tiny 3D-printed resistor, are embedded into a component. The interconnected lines form an electrical circuit when voltage is applied. As lines are embedded deeper and deeper into a component from the surface, each new line and resistor are assigned an increasingly higher voltage value. Any damage to the component, such as wear or abrasion caused by friction from moving parts, would cut into one or more of the lines, breaking the circuit at that stage. The more lines that are broken, the greater the damage. Real time voltage readings allow engineers to assess potential damage and wear to a component without having to take an entire machine apart.

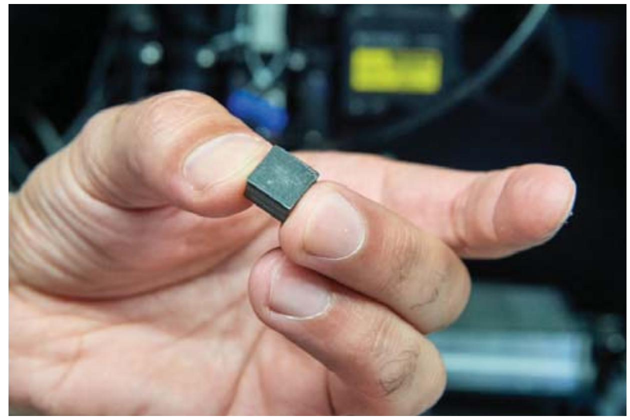
To get a better idea of how these micro sensors might be used, imagine them being embedded in the ceramic coating of a jet engine turbine fan blade. These blades are subjected to tremendous physical forces and heat. A microscopic crack in the protective coating could potentially be catastrophic to the blade's performance, yet invisible to the naked eye. With the embedded sensors, mechanics would be alerted to any blade damage promptly so it can be addressed.

"This changes the way we look at manufacturing," says Sameh Dardona, associate director of research and innovation at UTRC, which serves as the innovation engine for United Technologies Corp. "We can now integrate functions into components to make them more intelligent. These sensors can detect any kind of wear, even corrosion, and report that information to the end user. This helps us improve performance, avoid failures, and save costs."



UConn and UTRC scientists are using advanced additive manufacturing to create novel wear sensors that can be embedded into machine parts. (Peter Morenus/UConn Photo)

The UConn-UTRC team was able to embed sensor lines that were just 15 microns wide and 50 microns apart. That is much thinner than an average human hair, which is about 100 microns. This allows detection of very minute damage. Developing such a precise sensor is not easy. UConn associate professor of chemical and biomolecular engineering Anson Ma and a Ph.D. student from Ma's



A 3D-printed magnet created using direct write technology at the UTC Research Center. (Peter Morenus/UConn Photo)

Complex Fluids Laboratory, Alan Shen, measured and optimized the flow properties of the silver-infused ink so that micron-sized lines could be reliably deposited without clogging the nozzle or causing substantial spreading after deposition.

UTRC's Dardona has applied for a patent for the embedded wear sensor technology.

> "Imagine magnets that can take on different shapes and fit seamlessly between other functional components."
>
> ~Dr. Anson Ma
> Associate Professor of Chemical and Biomolecular Engineering

The scientists also used direct write technology to create novel components that have magnetic coatings or magnetic material embedded inside them. These polymer-bonded magnets are capable of conforming to any variety of shape, and eliminate the need for separate housings in machines requiring magnetic parts.

"This opens up a lot of exciting opportunities," says Ma. "Imagine magnets that can take on different shapes and fit seamlessly between other functional components. Also, the resultant magnetic field that is created may be further manipulated and optimized by changing the shape of the magnets."

The magnet fabrication method developed by UConn and UTRC significantly improves upon existing manufacturing practices in other ways too. Current methods for creating custom 3D-printed magnets rely on high-temperature curing, which unfortunately reduces a material's magnetic properties as a result. The scientists at UConn and UTRC found a way around that problem by using low-temperature UV light to cure the magnets, similar to how a dentist uses UV light to harden a filling. The resultant magnets exhibited significantly better performance than magnets created by other additive manufacturing methods.

Magnets have a wide range of industrial applications, from creating electric currents in alternators to tracking the position or speed of moving parts as high-grade sensors. Embedding magnetic material directly into components could lead to new product designs that are aerodynamic, lighter, and efficient, Dardona says.

"This is a great example of collaboration between industrial research and academic research," he says. "We always have new concepts that we'd like to try and explore. This collaboration allowed us to leverage the knowledge, expertise, and facilities available at UConn to help us address some of these technological challenges."

The collaboration also benefits UConn. Shen, the Ph.D. student in Ma's lab, served as a lead researcher on the two projects, developing, testing, and re-testing the new technology over the past three years.

"These kinds of collaborations allow us to help companies like UTC develop new technologies that we know they are going to take to the next level," says Ma. "It's also very rewarding for our students. Students involved in these projects are fully integrated into the research team. It's not only great from a workforce development perspective; it also gives students a chance to work closely with professional engineers in a beautiful facility like UTRC."

New Findings May Lead to Sea Change in Desalination Technology

by Colin Poitras - UConn Communications

Desalination plant. (Getty Images)

More than 300 million people around the world rely on desalinated water for part or all of their daily needs — a demand that will only grow with larger populations and improved standards of living.

Accessing the oceans for drinking water, however, requires desalination technologies that are complicated and expensive.

In the current issue of *Science*, researchers at the University of Connecticut offer a new approach to manufacturing a key facet of the process — the membranes integral to desalination. Using an additive manufacturing approach that employs electrospraying, UConn scientists were able to create ultra-thin, ultra-smooth polyamide membranes that are less prone to fouling and may require less power to move water through them.

The most commonly used technology for desalination is reverse osmosis, a process in which seawater is forced through a membrane capable of removing salts and many other molecule contaminants. Conventional approaches to making reverse osmosis membranes have not changed in nearly 40 years.

"Today's membranes for reverse osmosis are not made in a way that allows their properties to be controlled," says Jeffrey McCutcheon, study author and UConn School of Engineering's Al Geib Professor of Environmental Engineering Research and Education. "Our approach uses an 'additive' technique that allows for control of a membrane's fundamental properties such as thickness and roughness, which is currently impossible using conventional methods."

While the use of reverse osmosis continues to rise around the world, many of its drawbacks, which include high-energy consumption and a propensity for membranes to foul, continue to plague the industry.

The traditional approach to making these membranes is known as interfacial polymerization. This method relies on a self-ter-

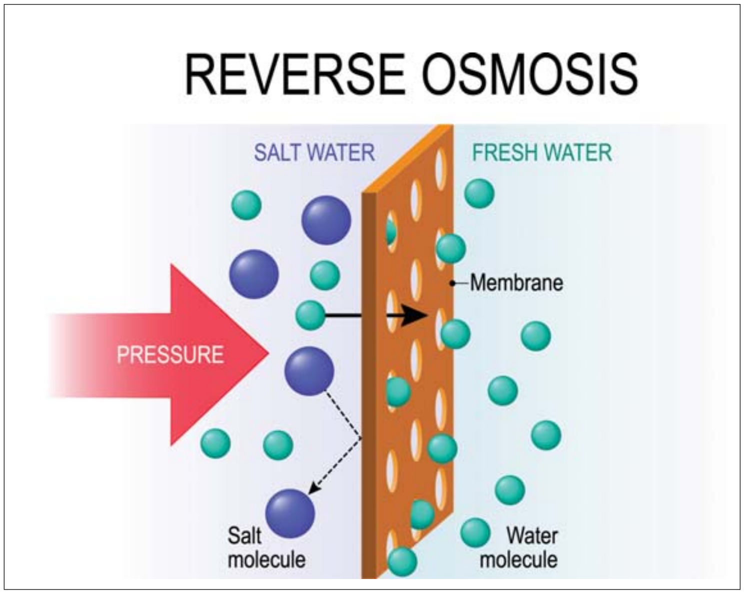


Illustration depicting the process of reverse osmosis. (iStock/Getty Images Plus)

minating reaction between an aqueous phase amine and an organic phase acid chloride monomer. The resulting polyamide films — exceedingly thin, highly selective, and permeable to water — became the gold standard membrane for reverse osmosis.

However, as the field has advanced, the need to better control this reaction to allow for membranes of varying thickness and roughness to optimize water flow and reduce fouling has become more pressing.

UConn's method provides a superior level of control over the thickness and roughness of the polyamide membrane, says McCutcheon.

Unlike conventional additive manufacturing, which uses lasers to fuse layers of fine metal powder into a solid object, direct write technology uses semisolid metal 'ink' that is extruded from a nozzle.

Typical polyamide membranes have a thickness between 100 and 200 nanometers (nm) that cannot be controlled. UConn's electrospray method allows for the controlled creation of membranes as thin as 15 nm and the capacity to control membrane thickness in 4 nm increments, a level of specificity not seen before in this area. Likewise, typical reverse osmosis membranes have a roughness of over 80 nm. UConn researchers were able to create membranes with roughness as low as 2 nm.

"Our printing approach to making polyamide membranes has the additional benefit of being scalable," McCutcheon says. "Much like electrospinning has seen dramatic improvements in roll-to-roll processing, electrospraying can be scaled with relative ease."

"Our printing approach to making polyamide membranes has the additional benefit of being scalable. Much like electrospinning has seen dramatic improvements in roll-to-roll processing, electrospraying can be scaled with relative ease."

~Dr. Jeffrey McCutcheon
Associate Professor
Executive Director, Fraunhofer USA
Center for Energy Innovation

The authors also say this type of manufacturing could save on chemical consumption as traditional chemical baths are not needed as part of the membrane fabrication process.

"In the lab, we use 95 percent less chemical volume making membranes by printing when compared to conventional interfacial polymerization," says McCutcheon. "These benefits would be magnified in large-scale membrane manufacturing and make the process more 'green' than it has been for the past 40 years."

This innovative approach is not limited to desalination and could lead to better membranes for other separation processes, says McCutcheon, who also serves as the executive director of the Fraunhofer USA Center for Energy Innovation at UConn, which develops new applied membrane technologies. "In fact, we hope that this method will enable new materials to be considered for a myriad of membrane separation processes, perhaps in processes where those materials were not, or could not, be used before."

In addition to McCutcheon, the study authors included Maqsud Chowdhury, a recent Ph.D. graduate in chemical engineering, and the paper's lead author; James Steffes, a current Ph.D. student; and Bryan Huey, the department head and a professor of materials science and engineering.

"Our approach uses an 'additive' technique that allows for control of a membrane's fundamental properties such as thickness and roughness, which is currently impossible using conventional methods."

~Dr. Jeffrey McCutcheon
Associate Professor
Executive Director, Fraunhofer USA
Center for Energy Innovation

Artificial Skin Could Give Superhuman Perception

by Kristen Cole - UConn Communications

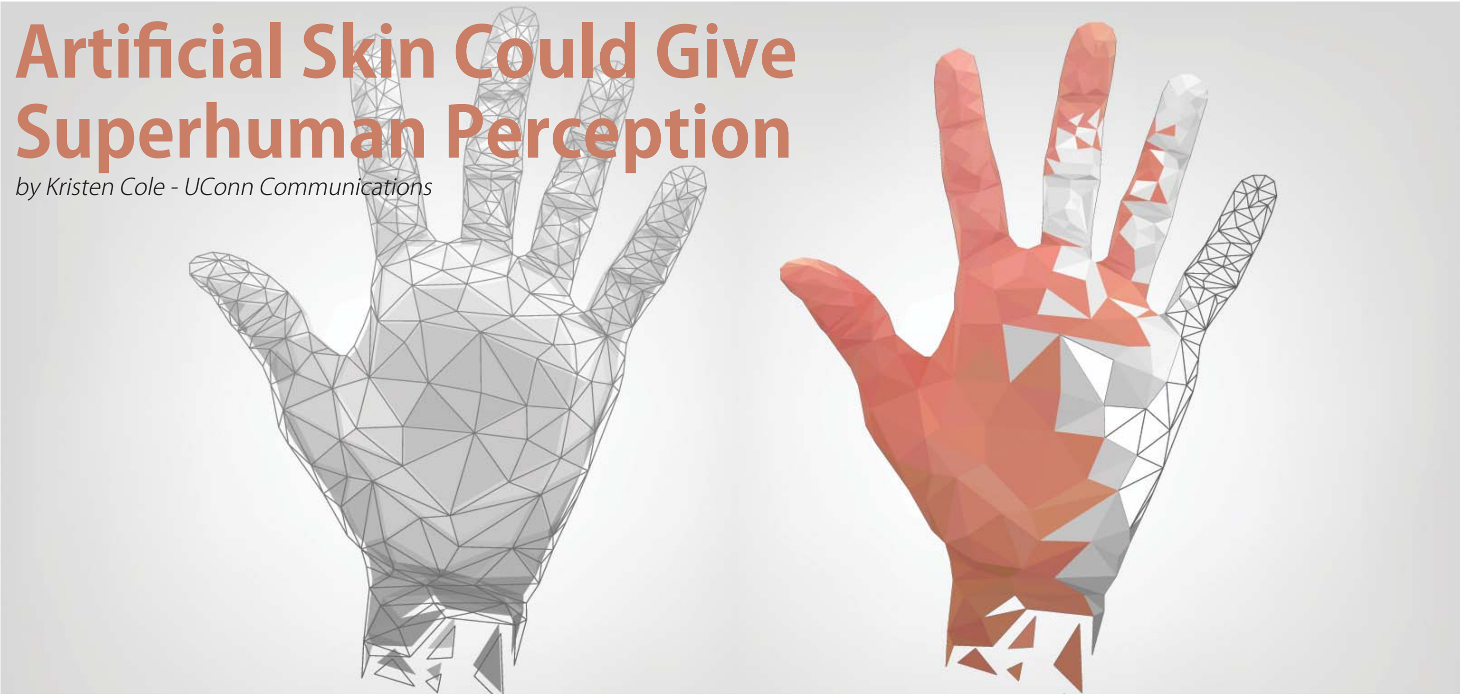


Image by iStock Photo

A new type of sensor could lead to artificial skin that someday helps burn victims ‘feel’ and safeguards the rest of us, UConn researchers suggest in a forthcoming paper in *Advanced Materials*.

Our skin’s ability to perceive pressure, heat, cold and vibration is a critical safety function that most people take for granted. However, burn victims, those with prosthetic limbs, and others who have lost skin sensitivity for one reason or another, can’t take it for granted, and often injure themselves unintentionally.

Chemists Islam Mosa from UConn, and James Rusling from UConn and UConn Health, along with University of Toronto engineer Abdelsalam Ahmed, wanted to create a sensor that can mimic the sensing properties of skin. Such a sensor would need to be able to detect pressure, temperature and vibration. Perhaps, though, it could do other things too, the researchers thought.

“It would be very cool if [our sensor] had abilities human skin does not; for example, the ability to detect magnetic fields, sound waves, and abnormal behaviors,” said Mosa.

Mosa and his colleagues created such a sensor with a silicone tube wrapped in a copper wire and filled with a special fluid made of tiny particles of iron oxide just one billionth of a meter long, called nanoparticles. The nanoparticles rub around the inside of the silicone tube and create an electric current. The copper wire surrounding the silicone tube picks up the current as a signal. When this tube is bumped by something experiencing pressure, the nanoparticles move and the electric signal changes. Sound waves also create waves in the nanoparticle fluid, and the electric signal changes in a different way than when the tube is bumped.

The researchers found that magnetic fields alter the signal too, in a way distinct from pressure or sound waves. Even a person moving around while carrying the sensor changes the electrical current, and the team found they could distinguish between the electrical signals caused by walking, running, jumping, and swimming.

Metal skin might sound like a superhero power, but this skin would not make the wearer Colossus from the X-Men. Rather, Mosa and his colleagues hope it could help burn victims “feel” again, and perhaps act as an early warning for workers exposed to dangerously high magnetic fields. Because the rubber exterior is completely sealed and waterproof, it could also serve as a wearable monitor to alert parents if their child fell into deep water in a pool, for example.

> “It would be very cool if [our sensor] had abilities human skin does not; for example the ability to detect magnetic fields, sound waves and abnormal behavior.”
>
> ~Islam Mosa
> Ph.D. Student, James Rusling Group

“The inspiration was to make something durable that would last for a very long time, and could detect multiple hazards,” Mosa says. The team has yet to test the sensor for its response to heat and cold, but they suspect it will work for those as well. The next step is to make the sensor in a flat configuration, more like skin, and see if it still works.

Among the authors of the paper are Esraa Elsanadidy and Mohamed Sharafeldin from UConn, Islam Hassan from McMaster University, and Professor Shenqiang Ren from State University of New York at Buffalo.

IMS Faculty Members Among Group Chosen to Lead GAANN Awards Enabling School of Engineering to Hire Up To 30 Ph.D. Students

by Eli Freund - School of Engineering


Dr. Kelly Burke


Dr. John Chandy


Dr. Tim Vadas


Dr. Sanguthevar Rajasekaran


Dr. Arash Zaghi

Following a nationally competitive application process, faculty members from the University of Connecticut's School of Engineering successfully secured four multi-year Graduate Assistance in Areas of National Need (GAANN) awards from the U.S. Department of Education, each for approximately $1 million. The number of awards given to the School represent around 5.5 percent of the total given across the country in 2018.

"With these new GAANN awards, we will have the opportunity to bring in extremely talented students in areas of high need, hel push new discovery and, in turn, fuel economic progress in our state and beyond."

~Dr. Kazem Kazerounian
Dean, School of Engineering

Over the next three years, the awards will provide prestigious fellowship opportunities to around 30 top-quality Ph.D. students in disciplines ranging from cybersecurity, artificial intelligence, big data, and biopolymer to resiliency and robustness of infrastructures, creating crucial knowledge generation and workforce development to the state and the country.

The purpose of the GAANN program is to strengthen graduate research, training, and scholarship, as well as expand access to graduate study. Domestic students with demonstrated financial need and outstanding academic credentials are provided funding to pursue a Ph.D., according to the GAANN website. In addition to this year's four awards, the University's engineering faculty have received 13 other GAANN awards since 2009.

According to UConn Engineering Dean Kazem Kazerounian, these prestigious awards will allow the School to attract top-quality graduate students who will work in cutting-edge research with the School's most talented faculty members:

"High quality graduate students are crucial for our research efforts, helping us to advance some of the world's toughest engineering challenges," Kazerounian said. "With these new GAANN awards, we will have the opportunity to bring in extremely talented students in areas of high need, help push new discovery and, in turn, fuel economic progress in our state and beyond."

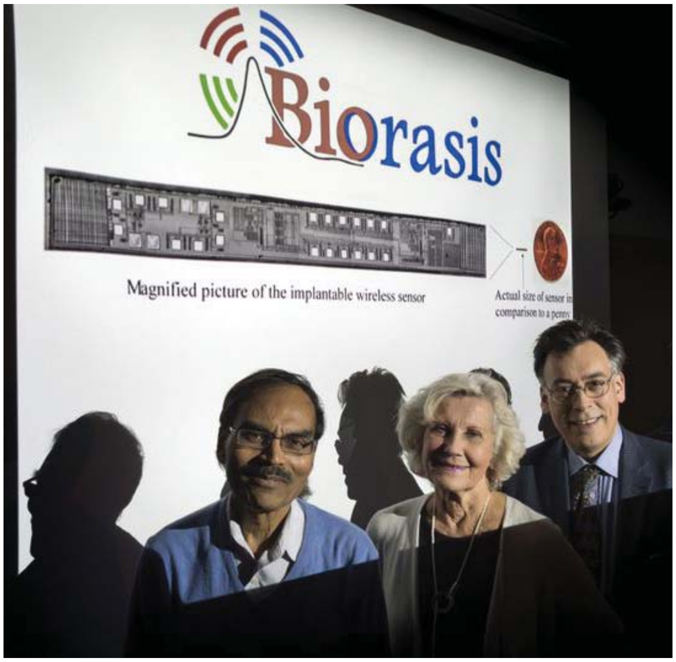
The five faculty members, from four different departments, who will lead each GAANN award are: Dr. Kelly Burke, Chemical and Biomolecular Engineering; Dr. John Chandy, Electrical and Computer Engineering; Dr. Arash Zaghi and Dr. Tim Vadas of Civil and Environmental Engineering; and Dr. Sanguthevar Rajasekaran, Computer Science and Engineering. Drs. Burke and Zaghi are also members of IMS. In addition to working within their respective departments, all of these grants will involve faculty crossing disciplines, which will expose graduate students to a unique multi-disciplinary research environment.

"High quality graduate students are crucial for our research efforts, helping us to advance some of the world's toughest engineering challenges."

~Dr. Kazem Kazerounian
Dean, School of Engineering

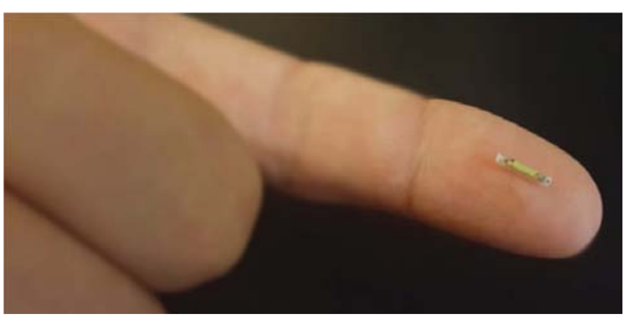
Biorasis, Co-Founded by IMS Members, Receives $3M from Helmsley Charitable Trust

by Jessica McBride - Office of the Vice President for Research



Drs. Faquir Jain (l), Ilze Krisst; and Fotios Papadimitrakopoulos (r) co-founders of Biorasis

Biorasis, a life sciences company developing the smallest non-surgically implantable continuous glucose monitoring system, received $3 million in non-dilutive funding from The Leona M. and Harry B. Helmsley Charitable Trust. As part of the agreement, the Helmsley Trust will provide funding to support pre-clinical advancement of Biorasis' technology. The partnership is structured as a program-related investment (PRI) in the form of a loan to Biorasis.



Glucowizzard, 24/7 continuous glucose monitoring implant. (Biorasis Photo)

Invented by UConn professors Faquir Jain, Ilze Krisst, and Fotios Papadimitrakopoulos, Biorasis' technology responds to significant clinical and societal needs. Diabetes affects 30 million Americans, or one in 10, and creates numerous secondary complications including blindness, heart disease, and stroke. With one in every four Americans being pre-diabetic, innovative solutions to combat the diabetes epidemic continue to represent a major challenge for the U.S. healthcare system.

"We are excited and honored to be working with the Helmsley Charitable Trust, an organization dedicated to bringing new technologies and therapies to people with Type 1 diabetes," says Fotios Papadimitrakopoulos, a UConn professor of chemistry and co-founder of Biorasis. "We look forward to our combined efforts to improve the lives of many who suffer from this debilitating disease."

Type 1 diabetes (T1D) patients need a long-term, reliable, and cost-effective continuous glucose monitoring system to effectively manage their condition. Biorasis is developing Glucowizzard, the smallest and most accurate, minimally invasive biosensor.

Glucowizzard eliminates painful finger pricking and provides real-time glucose monitoring for managing diabetes and enabling patients to improve their eating habits. The device also eliminates open wounds and permits diabetics to swim, run, and maintain an active lifestyle.

"This new Helmsley Charitable Trust funding fills a critical need in financing that will enable Biorasis to move our technology forward to be ready for clinical trials," says Ilze Krisst, chief operating officer of Biorasis.

> "...this new funding will build upon years of consistent, non-dilutive funding from federal and state agencies, foundations and private sources."
>
> ~Dr. Faquir Jain
> Professor of Electrical
> and Computer Engineering
> Co-Founder of Biorasis

"It is also important to note that this new funding will build upon years of consistent non-dilutive funding from federal and state agencies, foundations and private sources. Most recently, funding has been received by the National Institutes of Health, the National Science Foundation, JDRF, the Center for the Advancement of Science in Space, the U.S. Army as well as the Mass Challenge Diamond Award," says Faquir Jain, a UConn professor of electrical and computer engineering and co-founder of Biorasis.

Biorasis is located at UConn's Technology Incubation Program (TIP) in Farmington, CT. The company plans to leverage funding from the Helmsley Charitable Trust to translate Glucowizzard to humans via FDA's Early Feasibility Study-IDE (Individual Device Exemption).

Dr. Anson Ma to Lead UConn Site of SHAP3D Joining UMass Lowell and Georgia Tech on 3D Printing Research Supported by NSF

by Anna Zarra Aldrich - Office of the Vice President for Research

UConn, University of Massachusetts Lowell (UMass Lowell), and Georgia Institute of Technology (Georgia Tech) announced a collaboration to establish the Center for Science of Heterogeneous Additive Printing of 3D Materials (SHAP3D), a National Science Foundation (NSF) Industry-University Cooperative Research Center (IUCRC), to address emerging challenges of additive manufacturing, also commonly referred to as 3D printing.

Dr. Anson Ma

IUCRCs bridge the gap between early academic research and commercial readiness, supporting use-inspired research leading to new knowledge, technological capabilities and downstream commercial applications of these technologies.

"This Center will address the grand challenges that prevent the entire 3D printing field from moving forward," says Joey Mead, Distinguished University Professor and David and Frances Pernick Nanotechnology Professor in the Department of Plastics Engineering at UMass Lowell. Mead serves as the center director of SHAP3D.

"Our vision is to establish a synergistic national network of excellence in additive manufacturing knowledge, experience and facilities that will add value to the additive manufacturing industry, which is expected to top $20 billion within the next five years."

The three universities, each serving as a site, are working cooperatively as SHAP3D, one of nearly 75 IUCRCs nationwide, to conduct pre-competitive research that will guide future technologies in 3D printing. The NSF funding supports the partnership, universities provide the research infrastructure and talent, and industry partners provide research funding and guide university researchers on industrially relevant projects. All members vote on the research areas the center should pursue, and research is conducted at university sites.

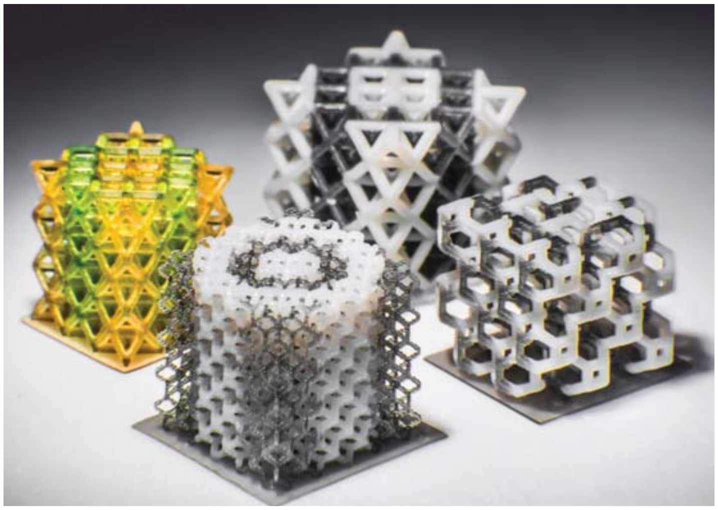
The NSF's IUCRC program enables industrially relevant, pre-competitive research via multi-member, sustained partnerships among industry, academe, and government. NSF supports the development and evolution of IUCRCs, providing a financial and procedural framework for membership and operations in addition to best practices learned over decades of fostering public-private partnerships that provide significant value to the nation, industry and university faculty and students. There are currently about 70 centers and over 800 unique members nationwide.

While the new joint center will cover many facets of 3D printing, from materials development and new printer design to modeling and applications, each site focuses on specific areas based on their strength and works collaboratively with other sites.

The UConn center site is primarily focused on 3D printing applications for aerospace, shipbuilding and biomedical applications since these industries all have a strong foothold in Connecticut. The UML site, based on its renowned plastic engineering program, focuses on developing new printing and processing methods as well as developing new polymer feedstocks for future 3D printing. Georgia Tech focuses on developing new functional materials and hybrid printing technologies and studying design methodology.

"We're trying to set up an ecosystem where we can all work together to solve fundamental research questions that are both intellectually stimulating and technologically relevant to the additive manufacturing field."

~Dr. Anson Ma
Associate Professor of Chemical and Biomolecular Engineering



Multi-material micro-lattice polymeric structures fabricated using 3D printing. (Kavin Kowsari/UConn Photo)

“We’re trying to set up an ecosystem where we can all work together to solve fundamental research questions that are both intellectually stimulating and technologically relevant to the additive manufacturing field,” says Anson Ma, an associate professor in UConn’s Department of Chemical and Biomedical Engineering and IMS Polymer Program and the site director at UConn.

Rainer Hebert, an associate professor from the Department of Materials Science and Engineering, serves as the site co-director.

The IUCRC brings together large companies, small businesses, startups and government agencies in a collaborative research ecosystem.

“We’re trying to be as inclusive as possible because this is a relatively new field, and the research and development landscape is changing at amazing speed,” says Christopher Hansen, an associate professor in UML’s mechanical engineering department and the site director at UML.

Currently, 14 companies have committed to join the center, which will provide $2.25 million for SHAP3D to conduct precompetitive research.

“By working with industry partners, university researchers can focus on topics with great commercial potential and create more practical uses for 3D printing,” says H. Jerry Qi, the Georgia Tech site director and a professor at the George W. Woodruff School of Mechanical Engineering. “The center will also serve as a training ground for next-generation leaders in additive manufacturing and provide a talent pipeline to industry.”

> “By working with industry partners, university researchers can focus on topics with great commercial potential and create more practical uses for 3D printing.”
>
> ~Dr. Anson Ma
> Associate Professor of Chemical and Biomolecular Engineering

“This new center is really exciting and we’re so glad NSF supports our vision and is willing to fund it,” says Mead. “The whole is larger than the sum of its parts, so we are looking forward to expanding this center to include more universities, industry partners and government agencies.”

IMS**QUICK**FACTS

Research Funding FY 2018-2019

$7.4M New Awards
$5.7M Federal
$1.4M Non-Federal
$0.3M Internally Funded

Mobile Sense Technologies Wins U.S. Patent, $225K from NSF

by Jessica McBride - Office of the Vice President for Research

Justin Chickles, CEO/Co-Founder of Mobile Sense Technologies

Mobile Sense Technologies, Inc. (Mobile Sense) announced it was issued an additional patent from the U.S. Patent and Trademark Office (USPTO), bringing the company's issued patent portfolio total to 12.

Located at UConn's Technology Incubation Program facility in Farmington, Connecticut, Mobile Sense Technologies also recently won $225,000 from the National Science Foundation's Small Business Research Innovation (SBIR) program.

The startup continues to expand development of its wearable technology to detect arrhythmias for use in a broader population. Co-founder and a UConn professor of biomedical engineering, Ki Chon, Ph.D., pioneered the patent portfolio and leads algorithm development.

"Mobile Sense Technologies and their continued progress show what can be achieved when industry and academia come together to move technologies forward."

~Dr. Radenka Maric
Vice President for Research, UConn

Mobile Sense is building foundational technology enabling off-the-chest wearables for long-term management of cardiac arrhythmias. The traditional cardiac monitoring market relies on seeing a specialist known as an electrophysiologist to make a diagnosis. Mobile Sense enables users to do a first pass screen of their own cardiac signals using smartwatch technology, with the possibility for long-term monitoring on the upper arm as prescribed by a cardiologist.

This Phase I funding will allow Mobile Sense to further optimize their technology for commercial use. The primary goal of the proposal is to understand how electromyogram (EMG) physiological interference from the bicep and tricep muscles can be registered without inaccurately appearing in the electrocardiogram (ECG) signal on the arm, as well as to embed motion and noise cancellation into Mobile Sense's armband-based device.

"We're thrilled about these two major milestones – winning additional protection for our novel technology and receiving additional non-dilutive funding to continue to commercialize it," says Justin Chickles, CEO, and co-founder. "This type of progress brings us that much closer to a viable product that can provide physicians with critical information and patients with improved quality of life."

Arrhythmias are one of the leading causes of strokes and affect 120 million people worldwide. In the United States, six million people are affected; two million of whom are identifiable and symptomatic.

Mobile Sense aims to expand the diagnosis of patients with arrhythmias that are random onset and/or asymptomatic through long-term, non-invasive health monitoring.

"This type of progress brings us that much closer to a viable product that can provide physicians with critical information and patients with improved quality of life."

~Justin Chickles
CEO and Co-Founder
Mobile Sense Technologies

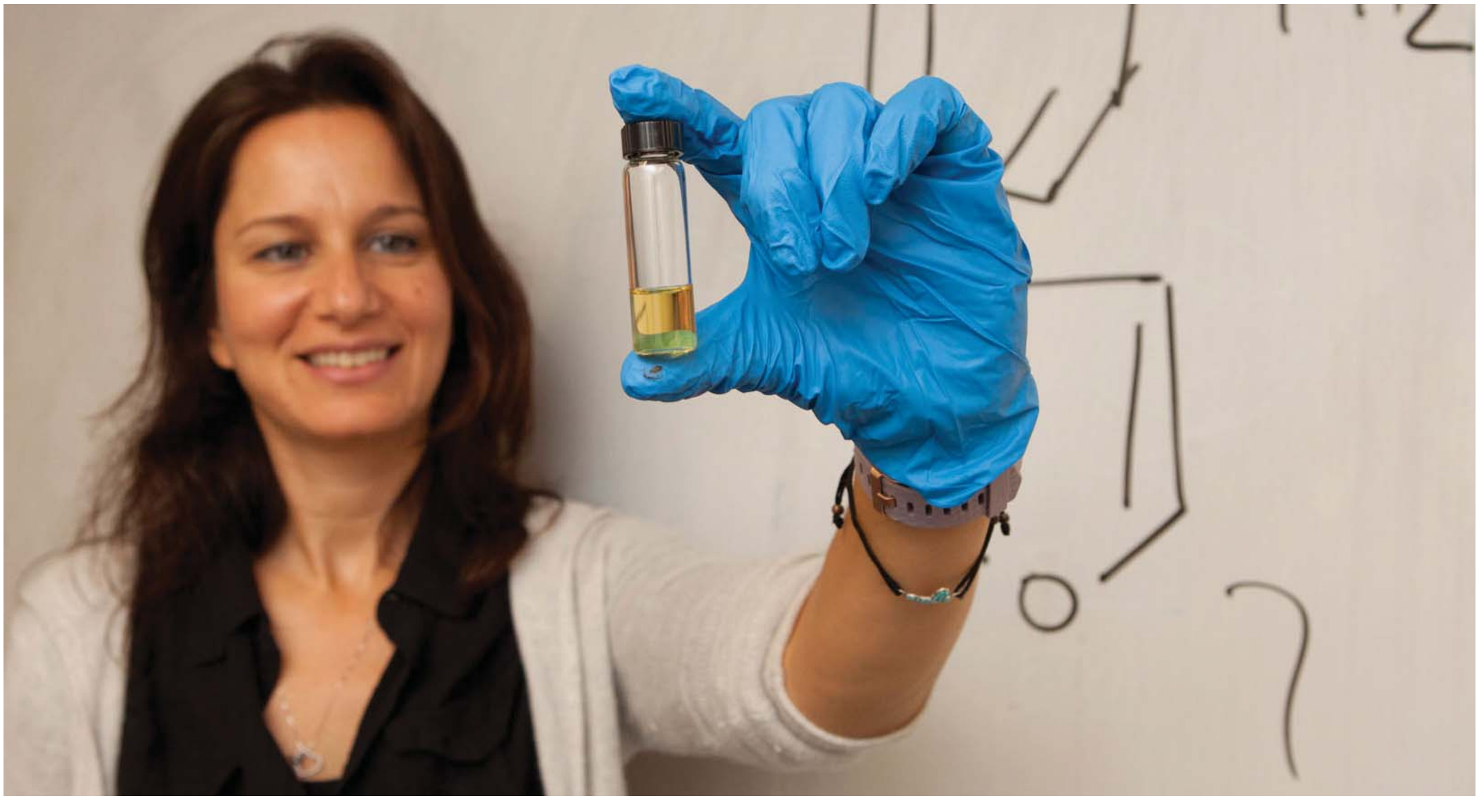
Mobile Sense also enrolled patients at a clinical study at the University of Massachusetts Memorial Medical Center by lead investigator Dr. Timothy Fitzgibbons with input from co-inventor and Section Chief, Connected Cardiovascular Healthcare, Dr. David McManus. The National Institutes for Health Small Business Innovation Research program is funding this study.

"Mobile Sense Technologies and their continued progress show what can be achieved when industry and academia come together to move technologies forward," says Radenka Maric, UConn vice president for research. "The combination of top researchers, experienced business experts, and the entrepreneurial ecosystem fostered at UConn can lead to solutions for the health of our citizens as well as our economy."

Prototype of Mobile Sense Technologies' wearable device to detect arrhythmias. (Photo courtesy of Mobile Sense Technologies)

Fine Tuning the Manufacturing Process of Specialized Catalysts

by Anna Zarra Aldrich - Office of the Vice President for Research



UConn engineer Julia Valla is developing hollow molecules with tunable properties for use in energy storage, drug discovery, gas storage, and more. (Thomas Hurlbut Photography)

Julia Valla, an assistant professor of chemical and biomolecular engineering, has received a $227,000 grant from the National Science Foundation for a project to develop hollow molecules with tunable properties. She is working with Vijay John, a professor at Tulane University.

In nature, reactions occur as a cascade wherein the product of one chemical reaction provides the materials or catalyst needed for the next one.

This project seeks to develop a manufacturing process to produce novel hollow particles with controllable properties and functions for various catalytic applications in energy storage, drug delivery, gas sensing, and more.

One of the primary challenges faced in the advancement of nanoscale technology is producing sufficient quantities of materials to allow the technology to be produced and commercialized.

Valla and John propose to create these molecules through an aerosol process, a well-known technique for rapidly producing functional inorganic molecules.

The aim of this research is to gain a better understanding of the steps involved in the aerosol-based manufacturing method.

Once more is known about this process, Valla and John hope to be able to tweak the steps and conditions involved to produce molecules with specific characteristics. For instance, the researchers want to investigative how things like the thickness of the shell surrounding the hollow molecule and the molecule's porosity can affect its functionality as a catalyst.

The researchers hypothesize that they can change the chemistry within the droplet during the manufacturing process, altering these properties but also creating the possibility of adding active sites for catalysts in the particles.

One important application Valla and John will test in this study is how these particles could be used to remove the harmful chemical compounds, trichloroethylene and perchloroethylene, from the environment. Those compounds are among the most common pollutants at industrial sites.

Trichloroethylene and perchloroethylene are used for a variety of chemical operations from dry cleaning to metal degreasing. They contaminate groundwater, stick around in our ecosystem for a long time, and can have serious toxic and carcinogenic properties that pose health threats to humans.

Dr. Maria Chrysochoou Begins Historic Appointment as First Female Head of Civil and Environmental Engineering Department

by Eli Freund - School of Engineering

Dr. Maria Chrysochoou

In June of 2018, the School of Engineering announced the appointment of Dr. Maria Chrysochoou, a talented scientist, teacher, and academic leader, to the position of department head for the Civil and Environmental Engineering Department (CEE). Dr. Chrysochoou assumed the role at the beginning of the Spring Semester 2019, becoming the first female department head in the School of Engineering's 102-year history.

For nearly a decade prior to Dr. Chrysochoou's appointment, the department was in the capable hands of Dr. Amvrossios Bagtzoglou. During his tenure, the CEE department increased the number of faculty by nearly 40%, recorded a 318% increase in research expenditures (largest departmental increase during that period), and has seen its student population in the Environmental Engineering program become a majority female.

Dr. Chrysochoou has been director of the Environmental Engineering Program since 2015, has been a faculty member in the CEE department since 2007, and received her Ph.D. in environmental engineering from the Stevens Institute of Technology in 2006.

In addition to serving as department head for the Environmental Engineering Department, Dr. Chrysochoou is director of the Connecticut Brownfields Initiative, an interdisciplinary training program launched in 2017, which teaches students how to transform polluted and abandoned property into valuable land. Students in the program work directly with Connecticut cities and towns to revitalize and restore properties, gaining experience while supporting local communities.

She is a member of the American Society of Civil Engineers (ASCE) Geoenvironmental Committee, serves as a subject-matter expert for the Federal Highway Administration, and was named a Marie Curie Fellow in 2013. She received the U.S. Environmental Protection Agency's People, Prosperity, and the Planet Award in 2012 for her and her team's use of local byproducts to stabilize soils against erosion in Nicaragua.

Dr. Chrysochoou's appointment comes on the heels of the School of Engineering's push over the past several years to increase female representation in engineering, a field where women are severely underrepresented. While a Washington Post survey identified UConn as the top public institution in the country for closing the engineering gender gap with regard to engineering students, nationwide female engineering students comprise only about 21 percent of the undergraduate population. UConn's engineering student population is 38 percent above the national average.

MSE Faculty Member Selected for Heat Treat Today 40 Under 40 List

by Marlese Lessing - Materials Science and Engineering

Dr. Lesley Frame

MSE faculty member, Lesley Frame, was named a member of *Heat Treat Today's* "40 Under 40 Class of 2018" for her research on heat treating, metallurgy, and thermal manufacturing processes.

Dr. Frame previously worked as an associate professor at the University of Bridgeport and as Director of Product Development at Thermatool Corporation in East Haven, Connecticut. She has conducted research on solar thermal devices as a Research Professor at the Arizona Research Institute for Solar Energy (ARISE) and on residual stress relaxation using x-ray diffraction and neutron diffraction as a Fulbright Scholar at Cardiff University and the Rutherford Appleton Laboratory.

Her current research examines the relationship between thermomechanical processing, microstructural changes, and residual stresses. While at Thermatool Corporation, her research included collaborations with Worcester Polytechnic Institute's Center for Heat Treat Excellence focusing on carbide formation during induction tempering of alloy steels. She joined UConn's faculty team earlier this fall.

Her previous accomplishments include the Bronze Medal Award from ASM International, an Award of Achievement from the American Society for Testing and Materials (ASTM), and the President's Award from Thermatool Corporation.

Dr. S. Pamir Alpay (right) accepts his Fellow of the Society award from the ACerS President Michael Alexander (left) at the Society's annual banquet

Professor S. Pamir Alpay Elected ACerS Fellow

by Marlese Lessing - Materials Science and Engineering

Materials Science and Engineering professor, Dr. S. Pamir Alpay, who is also Executive Director of the Innovation Partnership Building at UConn Tech Park, was named a Fellow of the American Ceramic Society (ACerS), a distinguishing honor given to individuals who have impacted the ceramics engineering industry through scholarship and enterprise.

Alpay received the honor at the ACerS Annual Honor and Awards Banquet, in Columbus, Ohio in October 2018. His research in ceramics involves multiscale modeling, electrothermic heating and cooling, HVAC systems, dielectrically tunable oxides and other practical applications of ceramic materials.

The ACerS Fellowship is one of the many honors Professor Alpay has received this year. He was named General Electric Endowed Professor in Advanced Manufacturing by the UConn Board of Trustees for his extensive work with industry partner collaboration. He also was awarded the UConn American Association of University Professors 2018 Excellence in Research & Creativity: Career Award for his continued scholastic service.

Professor Mei Wei Named as School of Engineering Centennial Term Professor

by Marlese Lessing - Materials Science and Engineering

Dr. Mei Wei

MSE professor, Mei Wei, has been named a UConn School of Engineering Centennial Term Professor, an honor given to professors who have had an exceptional impact on teaching, leadership, academic achievement and continued excellence within the School of Engineering. The professorship was established through an anonymous $1 million donation.

"It is my great honor to receive the award," Dr. Wei said. "I sincerely thank Professor Bryan Huey, MSE Department Head, for his nomination and support, and the evaluation committee for recognition of my achievement."

An accomplished engineer and researcher, Dr. Wei has won numerous awards for her continued work with bioresorbable bone fixation composites, biomimetic coatings, tissue engineering scaffolds, and nanoworm-based cancer treatment.

In 2007, Dr. Wei was named as one of the 2007 Women of Innovation by The Connecticut Technology Council for her leadership and service as a role model to future female leaders in the field of STEM. In 2013, she was elected into the Connecticut Academy of Science and Engineering (CASE), and also became Associate Dean for Research and Graduate Education at the School of Engineering. She was appointed as the Associate Editor of Journal of Biomedical Materials Research Part A in 2015, and won an award from INSIGHT Into Diversity, a magazine focused on connecting business leaders with diverse staff and researchers. In 2017, Dr. Wei was also named a Fellow of American Institute for Medical and Biological Engineering (AIMBE).

The daughter of materials science and engineering professors, Dr. Wei pursued her love of the subject early on, and earned her Ph.D. from the University of New South Wales, Australia, in 1998. She joined the MSE Department in 2002 as an assistant professor, before being promoted to full professor in 2012. Her lab, which focuses on tissue repair biomaterials, employs and incorporates students, collaborators, and industry partners from multiple backgrounds and fields of study, including biology, materials science, mechanical engineering, pharmacy, and polymer science.

This is the second time an MSE professor has been given the Centennial Professorship, with Professor Rampi Ramprasad receiving the honor in 2016.

Dr. Cato T. Laurencin Receives 2019 AAAS Philip Hauge Abelson Prize

from UConn Communications

Dr. Cato T. Laurencin, founding director of the Institute for Regenerative Engineering and the 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 (AAAS).

An eminent 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. Inspired by the late Philip Hauge Abelson, long-time senior adviser to AAAS, editor of Science and President of the Carnegie Institution of Washington, the prize is given annually to either a public servant in recognition of sustained exceptional contributions to advancing science, or to a scientist whose career has been distinguished both for scientific achievement and for other notable services to the scientific community.

"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."

Dr. Cato Laurencin

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 designed to fix bone to soft tissue. These screws are used in at least 25 percent of the more than 500,000 anterior cruciate ligament (ACL) reconstruction surgeries performed worldwide each year.

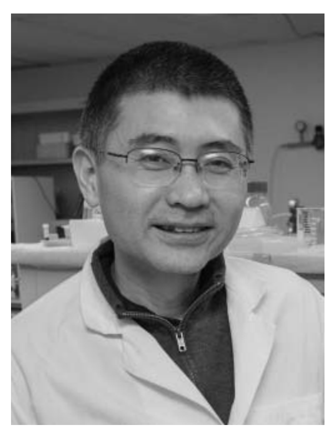
Laurencin has received many other awards, including the National Medal of Technology and Innovation and the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring from former President Obama. He is a peer-elected member of the National Academy of Engineering and the National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

Dr. Yu Lei Appointed to Centennial Term Professorship

from the Chemical and Biomolecular Engineering Department

Professor Yu Lei has been chosen for appointment to a Centennial Term Professorship in the School of Engineering. The Centennial Term Professorships, established through an anonymous donation of $1 million, are aimed at recognizing outstanding faculty members who have left a lasting impact on the School of Engineering through leadership and innovation in teaching, research, mentorship, engagement, and institution building.

After receiving his Ph.D. in 2004 from the University of California-Riverside, Dr. Lei joined UConn's Chemical and Biomolecular Engineering Department in 2006. He is a well-acknowledged expert in the areas of chemical and biological sensors. The primary goal of his research is to develop novel, simple, cost-effective, ultrasensitive, and universal (bio) sensor and/or nanomaterial-based sensor platforms for the detection of biological and chemical species, which combine the principles of chemical engineering, nanotechnology and molecular biology for homeland security, environmental, energy and biomedical monitoring.



Dr. Yu Lei

Dr. Lei is an elected Fellow of American Institute of Medical and Biological Engineering (AIMBE) and an elected member of the Connecticut Academy of Science and Engineering (CASE). He is a licensed Professional Engineer (P.E.) in Chemical Engineering and was a recipient of UConn School of Engineering Dean's Excellence Award in 2016. Dr. Lei has over 140 peer-reviewed journal publications, three invited book chapters, and more than 10 patents/disclosures.

IMS Faculty Members

Biomedical Engineering

Dr. Ki Chon
Dr. Alix Deymier
Dr. Martin Han
Dr. Kazunori Hoshino
Dr. Cato T. Laurencin
Dr. Tannin Schmidt
Dr. Sina Shahbazmohamadi
Dr. Wendy Vanden Berg-Foels

Chemical & Biomolecular Engineering

Dr. George M. Bollas
Dr. Kelly A. Burke
Dr. Cato T. Laurencin
Dr. Yu Lei
Dr. Anson W. K. Ma
Dr. Jeffrey R. McCutcheon
Dr. William Mustain
Dr. Mu-Ping Nieh
Dr. Richard S. Parnas
Dr. Leslie Shor
Dr. Luyi M. Sun
Dr. Julia A. Valla

Chemistry

Dr. Douglas H. Adamson
Dr. Alfredo Angeles-Boza
Dr. Alexandru D. Asandei
Dr. William F. Bailey
Dr. José Gascón
Dr. Jie He
Dr. J. Nathan Hohman
Dr. Rajeswari Kasi
Dr. Challa Vijaya Kumar
Dr. Yao Lin
Dr. Tomoyasu Mani
Dr. Fotios Papadimitrakopoulos
Dr. Eugene Pinkhassik
Dr. Rebecca Quardokus
Dr. Jessica Rouge
Dr. James F. Rusling
Dr. Thomas A. P. Seery
Dr. Gregory Sotzing
Dr. Steven L. Suib
Dr. Jing Zhao

Civil & Environmental Engineering

Dr. Maria Chrysochoou
Dr. Shinae Jang
Dr. Jeong-Ho Kim
Dr. Baikun Li
Dr. Ramesh Malla
Dr. Kay Wille
Dr. Arash E. Zaghi
Dr. Wei Zhang

Electrical & Computer Engineering

Dr. Rajeev Bansal
Dr. Necmi Biyikli
Dr. Yang Cao
Dr. Ali Gokirmak
Dr. Faquir C. Jain
Dr. Helena Silva

Marine Sciences

Dr. Heidi M. Dierssen

Materials Science & Engineering

Dr. Mark Aindow
Dr. S. Pamir Alpay
Dr. Harold D. Brody
Dr. Avinash M. Dongare
Dr. Lesley Frame
Dr. Pu-Xian Gao
Dr. Rainer J. Hebert
Dr. Bryan D. Huey
Dr. Jasna Jankovic
Dr. Theodore Z. Kattamis
Dr. Cato T. Laurencin
Dr. Seok-Woo Lee
Dr. Radenka Maric
Dr. Serge M. Nakhmanson
Dr. Volkan Ortalan
Dr. George A. Rossetti Jr.
Dr. Stefan Schafföner
Dr. Mei Wei
Dr. Yuanyuan Zhu

Mechanical Engineering

Dr. Baki Cetegen
Dr. Xu Chen
Dr. Wilson K. S. Chiu
Dr. Robert X. Gao
Dr. Kazem Kazerounian
Dr. Leila Ladani
Dr. Ying Li
Dr. George Lykotrafitis
Dr. Thanh D. Nguyen
Dr. Julian A. Norato
Dr. Ugur Pasaogullari
Dr. David M. Pierce
Dr. Anna Tarakanova
Dr. Savas Tasoglu
Dr. Dianyun Zhang

Molecular & Cell Biology

Dr. James L. Cole
Dr. Kenneth M. Noll
Dr. Victoria L. Robinson
Dr. Carolyn M. Teschke

Nutritional Sciences

Dr. Yangchao Luo

Pathobiology

Dr. Mazhar I. Khan

Pharmaceutical Sciences

Dr. Robin H. Bogner
Dr. Diane J. Burgess
Dr. Bodhisattwa Chaudhuri
Dr. Debra A. Kendall
Dr. Xiuling Lu

Physics

Dr. Elena E. Dormidontova
Dr. Niloy Dutta
Dr. Gayanath W. Fernando
Dr. George Nicholas Gibson
Dr. Phillip L. Gould
Dr. Douglas S. Hamilton
Dr. Jason Hancock
Dr. Menka Jain
Dr. Richard T. Jones
Dr. Jeffrey S. Schweitzer
Dr. Boris Sinkovic
Dr. Barrett O. Wells

Plant Science & Landscape Architecture

Dr. Cristian P. Schulthess

UConn Health

Dr. Douglas J. Adams
Dr. A. Jon Goldberg
Dr. J. Robert Kelly
Dr. Yusuf Khan
Dr. Liisa Tiina Kuhn
Dr. Sangamesh Kumbar
Dr. Cato T. Laurencin
Dr. Wai Hong (Kevin) Lo
Dr. Lakshmi S. Nair
Dr. Syam Nukavarapu

Emeritus/Retired Faculty

Dr. Thomas Anderson
Dr. James P. Bell
Dr. Philip E. Best
Dr. Robert R. Birge
Dr. Joseph I. Budnick
Dr. C. Barry Carter
Dr. Anthony DiBenedetto
Dr. Harry Frank
Dr. James Galligan
Dr. Norman Garrick
Dr. Maurice Gell
Dr. Douglas S. Hamilton
Dr. William Hines
Dr. Eric H. Jordan
Dr. Devendra Kalonia
Dr. Lawrence A. Kappers
Dr. Quentin Kessel
Dr. James Knox
Dr. Harris L. Marcus
Dr. Matthew Mashikian
Dr. Robert Northrop
Dr. Arthur McEvily
Dr. Douglas Pease
Dr. Donald Potter
Dr. Wolf-Dieter Reiter
Dr. Dan A. Scola
Dr. Montgomery T. Shaw
Dr. Winthrop W. Smith
Dr. William C. Stwalley
Dr. Chong Sook P. Sung
Dr. Geoff Taylor

IMS resident faculty are indicated in bold

Making Research Connections at UConn

by Carson Stifel - Office of the Vice President for Research

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. (Carson Stifel/UConn Photo)

Riley Blumenfield, a materials science and engineering 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 did not 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.

"My main goal for the future stems from an obsession with Spider-Man. I want to invent the web fluid he uses! 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."

~Riley Blumenfield
Materials Science and
Engineering Student

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

Blumenfield works closely with 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. During fall semester 2018, Blumenfield helped create thin films of the polymers for mechanical testing, for spring semester 2019 she will study how the polymer degrades in in vitro conditions.

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

Organized through a collaboration between UConn's Office of First Year Programs, Learning Communities & Academic Achievement Center and the Office of Undergraduate Research, the annual Research Connections event, held October 17, 2018, exposes first and second year students to undergraduate research by engaging in meaningful interactions with faculty, staff, graduate students, peers and other key partners.

Blumenfield credits finding her research experience to the Research Connections event. For her, Research Connections helped make the process of finding a research opportunity less intimidating and more accessible.

"It can be intimidating to request a meeting with a professor you would like to work with, so knowing that someone is actively recruiting undergraduates is reassuring."

Blumenfield's plans for the future include continuing to employ regenerative engineering to find innovative technologies.

"My main goal for the future stems from an obsession with Spider-Man. I want to invent the web fluid he uses! 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."

Polymer Program Ph.D. Student Sneh Sinha Gives Presentation at American Chemical Society National Meeting

from the Institute of Materials Science

Graduate Student Sneh Sinha

Sneh Sinha, a fifth-year Polymer Program graduate student, works with conductive polymers in the Sotzing Research Group. Sinha was selected to give a presentation as part of the Excellence in Graduate Polymer Research Symposium at the American Chemical Society national meeting this spring. A panel of judges, from academia and industry, selected a limited number of students for this honor.

Sinha gave a presentation discussing polymer-based wearable electronics, which are being synthesized in Professor Gregory Sotzing's research laboratory. Conductive polymers, such as poly (3,4-ethylenedioxythiophene): poly (styrene sulfonate) ("PEDOT:PSS"), are known to be conductors of both ionic and electric currents. PEDOT:PSS has been used in applications such as organic transistors, optoelectronic devices, and photovoltaic devices. In collaboration with Professor Yang Cao's group, the Sotzing lab has been testing the polymer for wearable electronics, with applications such as antenna and Doppler radar. With Professor Ki Chon's group, a prototype shirt was also developed with PEDOT:PSS electrodes for measuring ECG signal under exercise.

Sinha will complete his dissertation spring 2019 and pursue a career in industry.

IMS QUICK FACTS

Students

150 Graduate Students

Alumni

972 Alumni/345 Live in Connecticut

Building a Research Career at UConn

by Anna Zarra Aldrich - Office of the Vice President for Research

Pierre Fils, a first-year graduate student on the Ph.D. track in structural engineering. (Carson Stifel/UConn Photo)

Sometimes walking into a professor's office can launch a student on an incredible research track. Pierre Fils, a first-year graduate student on the Ph.D. track in structural engineering, had that experience his junior year when he met with his Design of Steel Structures professor, Arash Zaghi. Fils was immediately intrigued by the structural engineering research being conducted by Zaghi.

"I went in thinking I would just talk about the class, but I left with an unofficial mentor," Fils says. Zaghi, along with Sarira Motaref, an assistant professor in residence, is indeed now Fils' mentor for his Ph.D. work.

Fils is studying the structure of homes in Haiti. He hopes to determine how they could be built to be more resistant to earthquakes like the catastrophe in 2010 that brought down hundreds of thousands of buildings, displacing millions of survivors.

Fils got his start in research early on by utilizing the connections available to undergrads at UConn. As a member of the EcoHouse learning community, he was able to see first-hand what research looks like.

> "I went in thinking I would just talk about the class, but I left with an unofficial mentor."
>
> ~Pierre Fils
> First-Year Ph.D. Student in
> Structural Engineering

"I kind of had this perception that researchers were a little weird, but once I got to know Professor Parnas, I got to see what a cool person he was," Fils says, referring to Dr. Richard Parnas, Faculty Director of EcoHouse. "That was my introduction to research and I thought 'this is cool'."

During the summer of his freshman year, Fils received a McNair Fellowship to pursue research working with molecular and cellular biology Assistant Professor Jonathan Klassen studying the symbiotic relationship between ants and various fungi.

"I was still interested in research, but I was looking for something that would be more my niche," Fils says.

In the summer after his junior year, Fils found a project that made him realize how perfect and exciting research is for him. He worked at the Climate Change Science Institute at Oak Ridge National Laboratory in Knoxville, Tennessee studying climate-impacted buildings. More specifically his post was "Assessing the optimality of ASHRAE climate zones using high resolution meteorological data sets."

"That opportunity completely flipped the switch for me when it came to research," Fils says. "I was engaged in the idea of 'let's learn something new, let's create some new knowledge and let's figure out how it is that we can do these things that nobody knows about'."

> "That opportunity completely flipped the switch for me when it came to research. I was engaged in the idea of 'let's learn something new, let's create some new knowledge and let's figure out how it is that we can do these things that nobody knows about."
>
> ~Pierre Fils
> First-Year Ph.D. Student in
> Structural Engineering

Fils credits his learning communities (EcoHouse and ScHOLA2RS House), the Louis Stokes Alliance for Minority Participation and being a Student Support Services student for the success that he has experienced thus far.

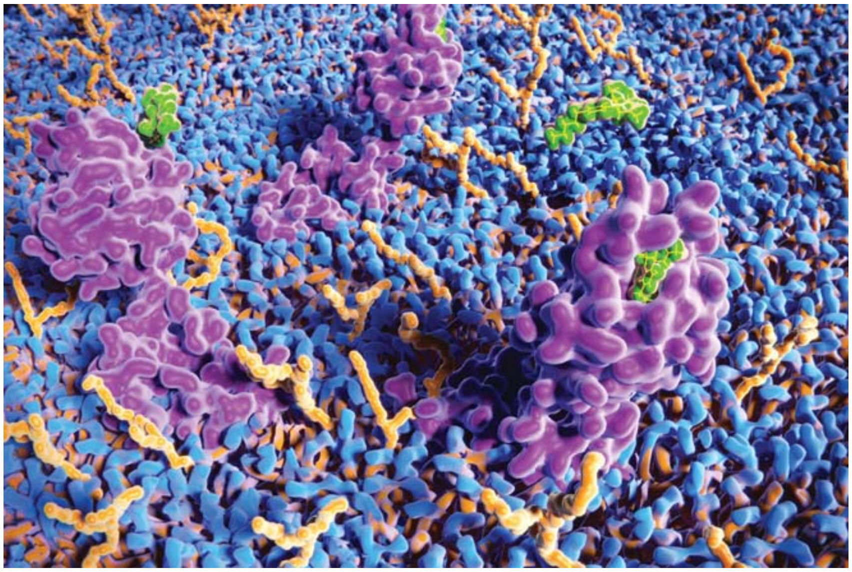
"I would like to attribute my growth to the many connections I have made here at UConn," Fils says. "They've really pushed me to go beyond my comfort zone and to find other opportunities and allow magic to happen."

Fils encourages any students who want to get involved in research to contact professors and find a mentor to help them get where they want to be.

"Undergraduate research is so important, especially if you want to go to grad school. [You'll be] showing them that you already have the experience and that you can work independently," Fils says. "You don't need to know all the answers to the questions, or even the right questions for that matter, so long as you're willing to learn."

The Blitz of Neuroscience

by Kim Krieger - UConn Communications



An illustration showing THC binding to cannabinoid receptors. Tetrahydrocannabinol (THC, green molecules) is the main psychoactive constituent of cannabis. (Getty Images)

UConn neuroscience students presented research on mouse motivation, broken cannabinoid receptors, and aged bladders at the annual Graduate Student Neuroscience Datablitz in October 2018.

> Drugs that block brain cells from clearing away dopamine can reverse chemically induced lack of motivation.

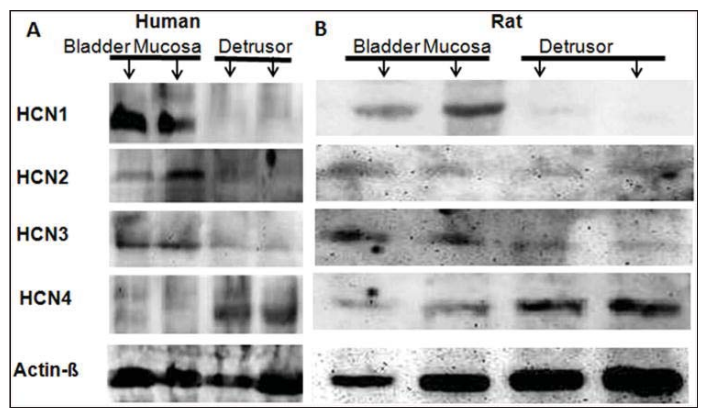
The event brings together neuroscience researchers from across departments and campuses to discuss mutual interests and take in a keynote speech, given this year by Kay Tye from MIT. The datablitz, in which several lucky graduate students get to present fast-moving summaries of their research to a live audience and then take questions, is always a highlight of the event.

Rachel Dopart from UConn pharmacist Debra Kendall's lab discussed her work exploring how cannabinoid-1 receptors – that is, the places in the body that bind to the active ingredients in natural and synthetic marijuana, as well as similar compounds made by our own bodies – work, and sometimes don't. She showed a map of all the places in the body that have cannabinoid-1 receptors (basically, everywhere), and how various mutations might disrupt how they function.

Cara Hardy, a graduate student at UConn Health working with urogynecologist, Phil Smith, and Director of the Center on Aging, George Kuchel, presented intriguing evidence that old bladders may not be entirely responsible for urinary incontinence. The brain probably has something to do with it too, and good communication and feedback between the bladder and brain may be key. Hardy also told us more about male mice's pee patterns than we had ever thought to ask: "Male mouse voiding looks like a Jackson Pollock painting," she said. "Spatters everywhere."

Mice played a starring role in the next two talks from members of the psychology lab of Professor John Salamone. Rather than art, they demonstrated motivation, or the lack of it.

Ph.D. student Jen-Hau Yang explained that lack of motivation is a serious problem that occurs in many mental disorders. He set up an experiment to show that mice with normal motivation will work very hard to get a good reward, in this case a milkshake. However, if you dose that mouse with haloperidol, a drug that blocks the effects of dopamine, it will not work nearly as hard for that milkshake. Mice with a certain human-like variation of the COMT gene also had a harder time pushing themselves to get that tasty shake.



Renee Rotolo, also a Ph.D. student, explored a different side of motivation, demonstrating that drugs that block brain cells from clearing away dopamine can reverse chemically induced lack of motivation. Rotolo uses lisdexamfetamine, but other drugs with similar effects include cocaine and others known to have a high potential for abuse. Rotolo is now looking at drugs that produce this reaction selectively in certain brain receptors not associated with addiction and psychosis.

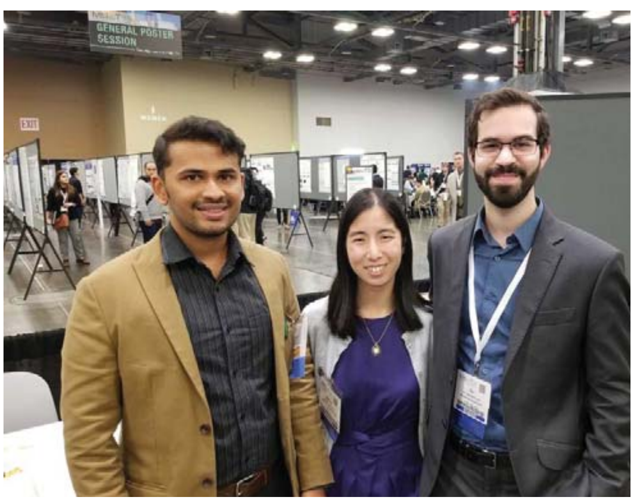
The annual neuroscience event happens in Storrs every year in the autumn, and is one of several opportunities at UConn for researchers with ties to neuroscience to present their work and meet with their peers who may be in other departments or campuses but may do synergistic work.

2018 ASM Conference Allows MSE Undergraduates to Meet and Compete

by Marlese Lessing - Materials Science and Engineering

Zach Putney throws his ceramic frisbee at the Keramos Ceramic Disc Golf Competition.

The 2018 Materials Science and Technology (MS&T) Conference in Columbus, Ohio brought thousands of scientists and innovators from around the globe to celebrate and collaborate on the latest breakthroughs in materials science. Perhaps most excited of all were 10 UConn MSE undergraduates who attended the event both to represent UConn and to take part in the myriad of activities the conference offered. This included Kenna Ritter, Hetal Patel, Grace Quinlan, Iwona Wrobel, Michelle Such, Zach Putney, Joe Tracey, Jordan Gomes, Alex Perkins, and Justin Hewitt.



Kenna Ritter with other ASM Student Board of Trustees members Aadithya Jeyaranjan (UCF) and Eli Vandersluis (Ryerson University), after a long day of organizing and leading.

Senior Kenna Ritter, President of the UConn Materials Advantage chapter and member of the ASM International Student Board of Trustees, helped draft plans for the student board to provide more resources to MSE students who are part of ASM International. She also helped organize the 2018 Domesday Competition, which invited students from several prestigious universities to bring their best 'dome'—a structure built to withstand compression. Points are also awarded for aesthetics, durability, design, and other criteria. UConn's Justin Hewitt, Jordan Gomes, Iwona Wrobel and Zach Putney all took part with their polymer-based structure.

Joe Tracey and Hetal Patel competed in the Undergraduate Speaking Competition and the Poster Presentation Competition, respectively. These contests reward the presenter for the scientific content, public performance, and the author's composition skills. The Keramos Ceramic Mug Drop, for which Alex Perkins and Grace Quinlan made (and sacrificed) ceramic mugs, tests ceramics skills by dropping lab-designed and crafted mugs from progressively greater heights. Until they break....

The Keramos Ceramic Frisbee Competition, however, is where UConn truly shone. Michelle Such's midnight-dark frisbee won first place for the Aesthetics competition among all of the universities competing at this annual MSE conference. This was followed by the ceramic Frisbee toss, judged on a strange combination of resilience and aim, in which Zach Putney, among others, naturally competed since he is also a member of UConn's ultimate Frisbee club.

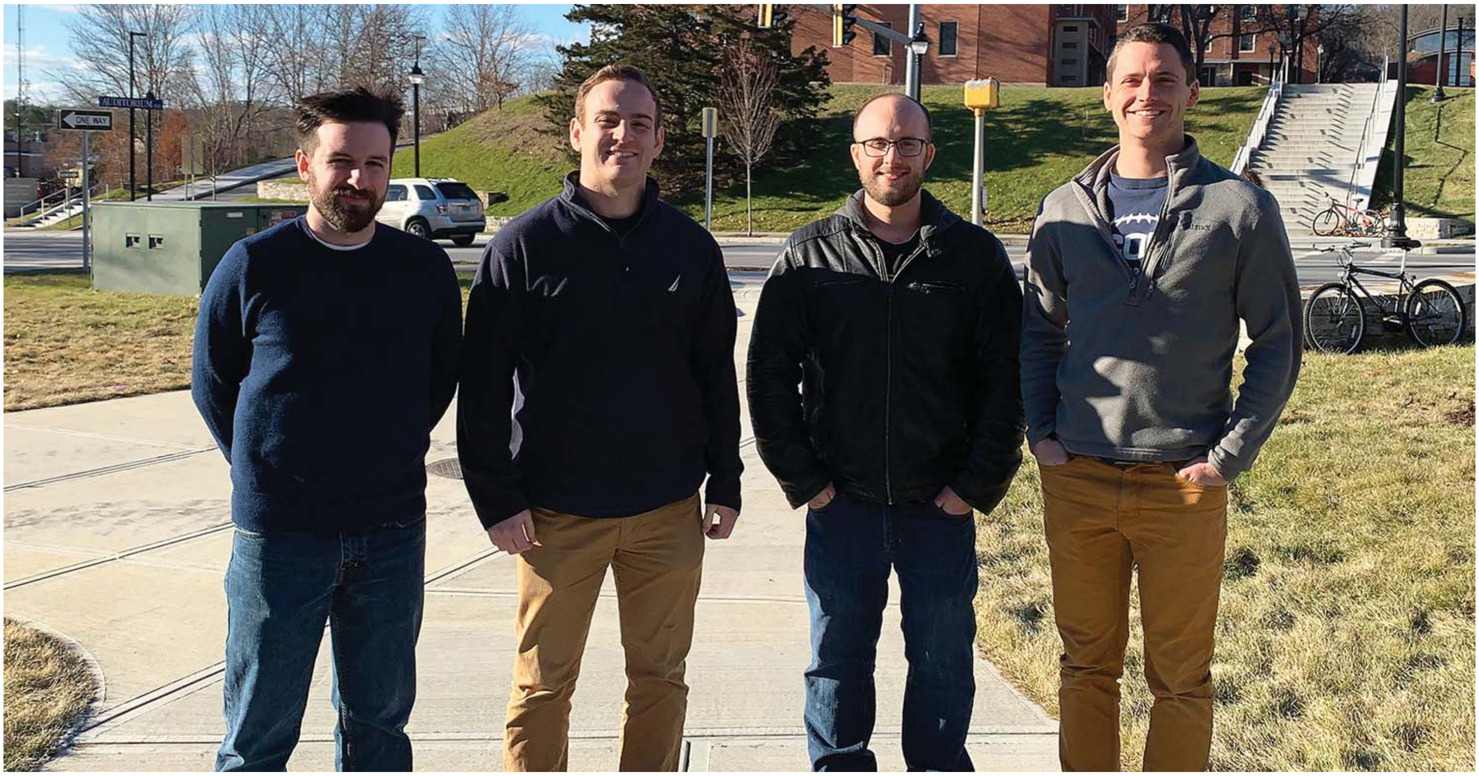
Grace Quinlan and Alex Perkins pose with their ceramic mug before the Mug Drop Competition, ready to see how well it can withstand the plunge.

"UConn MSE has a proud history of our students winning recognition at MS&T and other scientific conferences," says Department Head Bryan Huey. "We are very pleased to cosponsor this annual undergraduate delegation, especially since the officers and members of Materials Advantage work so hard year-round with outreach, recruiting, programming, and social events. "

As one of the four major annual meetings for the MSE community worldwide, UConn's undergraduate delegates also mingled with like-minded engineers, faculty, and students from all corners of the globe. Conferences like these enable engineers to learn how others tackle academic and real-world problems, network with each other, and gain leadership skills.

MSE Graduate Students Show off Presentations at Grad Student Speaking Contest

by Marlese Lessing - Materials Science and Engineering



Competitors for the 2018 Graduate Student Speaking Competition stand by the Gant Science Complex. From left to right: Benjamin Bedard, Thomas Moran, Tyler Flanagan and Douglas Hendrix. (UConn photo/Stefan Schafföner)

Materials Science and Engineering (MSE) graduate students let their communication and presentation skills shine at the 2018 Fall Graduate Student Speaking Competition on November 16. Four students, Benjamin Bedard, Douglas Hendrix, Thomas Moran, and Tyler Flanagan, were selected by the MSE Graduate Committee to participate in the annual contest, which is part of the MSE Seminar Series.

> "The quality of all four of the presentations impressed me the most. Each speaker succinctly described their research, made it interesting to the audience, and answered questions with authority."
>
> ~Dr. Bryan Huey
> Department Head
> Materials Science and
> Engineering Department

Each graduate student had 12 minutes to present his topic, with time given for questions from the judging panel afterwards. The graduate students were evaluated on the quality of their presentation, scientific and engineering merit, originality, and other criteria by a panel of three faculty members and two graduate students.

Douglas Hendrix, an MSE Ph.D. student who graduated from UConn in 2015, emerged victorious, taking first place with his presentation on "Characterization of Dispersion Quality of Nanoparticles in Cementitious Materials." He is currently studying the effects of nano-sized particles in cement, co-advised by Professor Bryan Huey, the department head of MSE, and Associate Professor Kay Wille from the Department of Civil and Environmental Engineering.

"The quality of all four of the presentations impressed me the most. Each speaker succinctly described their research, made it interesting to the audience, and answered questions with authority," Professor Huey said. "In fact, these talks would fit in perfectly at any major materials conference, and thus set a great example to the students in the audience. I'm especially pleased for Doug whose work is inherently interdisciplinary, as is much of what we do in MSE."

POLYMER PROGRAM SEMINARS

Spring Semester 2019

"The Mechanical Side of Artificial Intelligence"
***Professor Robert Wood**, Harvard University*

"Next Generation Membranes Through Polymer Self-Assembly"
***Professor Ayse Asatekin,** Tufts University*

"Hydrogen-Bonding Polymers in Water and Mixed/Hydrated Salt Solvents: From Drug Delivery to Thermal Energy Storage"
***Professor Svetlana Sukhishvili,** Texas A&M University*

"Synchrotron X-ray Scattering and Spectroscopy Applied to Soft Matter"
***Professor Atsushi Takahara,** Kyushu University*

"Viscoelasticity with Twist-Tie Knots in Liquid Crystalline Polymer"
***Professor Steve Lustig,** Northeastern University*

"Instability and Explosion of Electrified Drops: EHD Tip and Equatorial Streaming"
***Professor Osman Basaran,** Purdue University*

"Carbon and Multifunctional Fibers, and Nanocomposites"
***Professor Satish Kumar,** Georgia Institute of Technology*

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UConn Research Project Goes to International Space Station

by Jessica McBride - Office of the Vice President for Research

An experiment devised by researchers at UConn startup LambdaVision was launched into space March 2, 2019. (Leonello Calvetti/Science Photo Library/Getty Images)

An experiment devised by researchers at UConn startup LambdaVision was launched into space last year.

The company's robotic system for manufacturing films that could cure blindness was taken to the International Space Station (ISS) U.S. National Laboratory by the SpaceX Dragon spacecraft, which launched December 5, 2018, from Launch Complex 40 at Cape Canaveral Air Force Station.

The experiment is one of a diverse group of research investigations brought to the orbiting research platform aboard the Dragon spacecraft. With more than 20 payloads, including the one from LambdaVision, the mission represented the largest number of payloads ever delivered to the ISS National Lab during a single launch.

LambdaVision Inc. was founded based on research by Professor Emeritus Robert Birge from UConn's Department of Chemistry. He first considered using bacteriorhodopsin, a light-activated protein, more than 15 years ago to correct age-related blindness. Today, the company is commercializing its technology in the hopes of restoring vision for millions of patients suffering from retinitis pigmentosa and age-related macular degeneration.

LambdaVision's retinal implant is similar to a contact lens that is surgically placed in the back of the eye to convert light into energy. The implant does not need hardware or electrodes to send electrical pulses into the eye. Instead, the bacteriorhodopsin-coated membrane replaces native photoreceptor cells in the retina to restore vision.

LambdaVision President and CEO Nicole Wagner purifying the protein for use in the retinal implant. (Peter Morenus/UConn Photo)

The LambdaVision payload, one of 20 payloads on the 16th resupply mission to the International Space Station U.S. National Laboratory. (Courtesy of LambdaVision)

The company is led by UConn alumni and former students in Birge's research group, Dr. Nicole Wagner '07 (CLAS), '13 Ph.D., and Dr. Jordan Greco '10 (CLAS), '15 Ph.D.

"Our preliminary animal studies show that the protein-based implant is capable of stimulating the retina," Wagner says. "When the protein absorbs light, it sends signals to the remaining neural circuitry of the retina, which allows it to communicate with the brain. We expect a similar outcome in human patients."

Currently, LambdaVision manufactures its prosthetics at its headquarters at UConn's Technology Incubation Program facility in Farmington, Connecticut. Producing the flexible, tiny films is a time-consuming process – on this planet, at least.

On Earth, it takes LambdaVision approximately five days for each of its three robotic stations to produce an implant. The process involves a series of alternating dipping steps, which are subject to the effects of gravity. Once complete the process results in a membrane approximately 60 micrometers (one-millionth of a meter) thick.

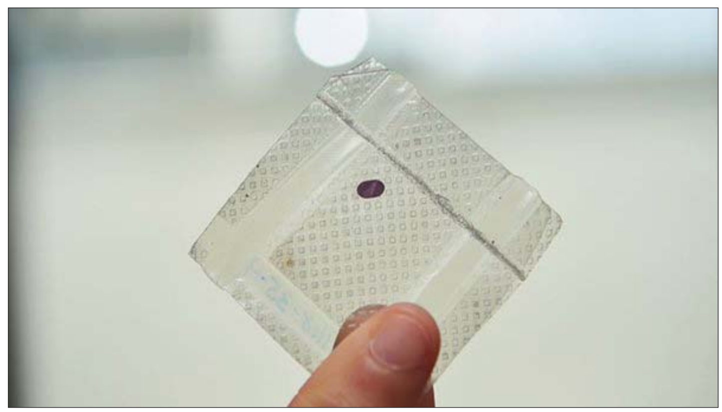
"If successful, we think it could ultimately help us generate more stable films with better performance and accelerate our time to market."

~Dr. Jordan Greco
Chief Scientific Officer
LambdaVision

In the weightless conditions of the International Space Station, LambdaVision anticipates producing a more homogeneous and stable film. If successful, Wagner and Greco anticipate they can generate a similar signal with fewer layers of protein. This would drastically decrease the time for manufacturing, and save on the cost of materials.

"On Earth, issues like sedimentation of solutions and surface tension can interfere with the homogeneity and stability of the thin films, but in microgravity these issues are minimized," says Greco. "We are manufacturing them now in microgravity as an experiment; however, if successful, we think it could ultimately help us generate more stable films with better performance, and accelerate our time to market."

LambdaVision was selected for this highly competitive opportunity as part of the company's experience in the startup accelerator MassChallenge in 2016, when the researchers received the CASIS-Boeing Award, along with a share of $500,000 in funding. Since its incorporation in 2009, LambdaVision has raised nearly $3 million from state, local, and federal grants, including support from Connecticut Innovations, CASIS-Boeing, and the National Science Foundation.



LambdaVision's tiny protein-based retinal implant. The implant is the small purple dot, which is about the size of a paper hole punch. (Peter Morenus/UConn Photo)

Wagner estimates the total value of the MassChallenge prize to be approximately $7 million in resources.

To ensure that the complicated space experiments go smoothly, LambdaVision was assisted by Space Tango, a Lexington, Kentucky-based company. LambdaVision miniaturized the dipping setup and prepared it for space travel. Space Tango initiated and controlled the software to run LambdaVision's experiment from Earth. The experiment was scheduled to run for approximately six weeks in space before being transported back to Earth.

Birge, Wagner, and Greco hope this experiment will represent another step closer to a cure for the millions of people suffering from age-related blindness.

"We've met a lot of people who are suffering or have family members who have these diseases, and we work hard every day to develop a viable treatment option that can improve their quality of life," says Greco. "We're continually encouraged by our preliminary results. We anticipate being at the steps of the clinic by the end of 2020."

Prior to the launch of their technology into space, Wagner thought back on the technology's roots in Storrs and the local support that has helped LambdaVision succeed.

"This all started in Dr. Birge's laboratory on North Eagleville Road in Storrs," she says. "Since then, UConn has been incredibly supportive in the development of our technology, providing access to top tier scientists, facilities, and resources."

"We could have relocated out of state, but we chose to keep our company in Connecticut in Farmington, which gave us access to other innovation hubs in New York and Massachusetts," she continued, "Connecticut also has talented employees and resources like Connecticut Innovations to help us get the technology off the ground – no pun intended."

Alumna Alexandra Merkouriou Talks Outreach, Career, and Semiconductors

by Marlese Lessing - Materials Science and Engineering

MSE alumna Alexandra Merkouriou, Development Engineer at M Cubed Technologies

After graduating with a B.S. from the materials science and engineering program at UConn in 2015, Alexandra Merkouriou went on to complete the Edison Engineering Development Program at GE Industrial Solutions. She currently works at M Cubed Technologies making silicon carbide ceramic composites for the semiconductor industry and has returned to UConn part time as a graduate student to pursue her M.S. in materials science and engineering. She accredits her success and passion for materials science to her professors here at UConn and her colleagues at her current workplace. Alexandra was recently invited to join the MSE Industrial Advisory Board.

What projects do you currently have running?
I am working on a new product introduction for a product that will help create higher density flash memory. This product is a great opportunity not only to work with the custom to develop a successful design, but also to push the boundaries of precision manufacturing.

I am also developing a diamond silicon carbide material called Thermadite. I am fortunate enough to be working on characterization of a new formulation of Thermadite. I hope that soon after that work is completed, we will be able to introduce it into the industry slowly. It is really great to see my research applied in the industry almost as soon as I discover something new.

My master's project is through my company, which is great, and very busy. It is a balance of working and researching. My thesis is due at the end of the year, so it is very much crunch time for me right now.

What inspired you to join the MSE Industrial Advisory Board?
Professor Bryan Huey invited me to the Industrial Advisory Board earlier last year. I had participated briefly in some Industrial Advisory Board student feedback meetings as an undergrad and I was honored to be able to be part of the committee. Our goal is to help guide the Materials Science and Engineering program and provide insight into current and future industry needs and expectations. 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 continue that work and also to give back to the program (UConn MSE) that has gotten me to where I am today.

How did you first get into materials science and engineering?
In high school, I found out about UConn's Explore Engineering program over the summer. It was a weeklong program where they introduced me to all the different fields of engineering offered here at UConn, and 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, I knew I had to do that right away. After talking to Professor Huey, who ran the demo, I worked in his lab during my undergraduate career.

> "I loved teaching younger kids abou the world of engineering and STEM, and showing them the opportunities available to them as scientists and engineers."
>
> ~Alexandra Merkouriou
> Materials Science and Engineering Alumna

What experience do you think has influenced you the most at the University?
I was part of UConn Material Advantage, an outreach club that talks to high school and middle students about engineering and the sciences. I loved teaching younger kids about the world

Alexandra Merkouriou (sixth from the left) meets with former Governor Malloy to celebrate the final approval of Next Generation Connecticut legislation in Oct. 2013. MSE students were excited to meet Malloy and conducted experiments in magnetic levitation using ceramic superconductors produced in MSE undergraduate labs. (From left to right) Zachary Thatcher, Nathan Martin, Rheanna Ward, Governor Dannel P. Malloy, Alexander Reardon, Alexandra Merkouriou, Nicholas Poulos, Steven Onorato, Dr. Bryan Huey, Terry Ng

of engineering and STEM, and showing them the opportunities available to them as scientists and engineers. I started in my freshman year, and I was lucky enough to be elected President for my last two years until I graduated. I saw this position as a way to help members make connections and networking collaborations that could help them with their future careers. My hope was to communicate all the things I wish I had known going into engineering – like when, how and where to look for internships or undergraduate research, how to make a resume and what to expect from an interview.

One experience that was very important to me was tutoring two seniors at South Windsor High School in materials science and engineering for a STEM competition they were competing in. 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.

Who helped influence your path at the Department?
There are so many professors that helped me get to where I am now. Working with Professor Pamir Alpay was great. I met him through Material Advantage because he was the department head at the time. He helped guide me through the program and opened up so many opportunities in terms of my career.

Dr. Daniel Goberman taught the first materials class I ever took and showed me that materials science can always be exciting. He works at Pratt and Whitney Research Center. He did an excellent job of introducing us to materials science and telling us why it matters, how it influences our lives and peoples' lives, and how we can change the world that way.

Even though some of my classes were not easy, I use what I learn in them every day at my job in M Cubed Technologies. Professor Brody taught two of the hardest classes in the MSE course set, thermodynamics and materials transport. He also did a fantastic job of connecting it to industry and market needs. Professor Aindow in my senior year also gave a phenomenal class on materials characterization. As a materials engineer, it is so important to know the tools you have at your disposal. It has had such a huge impact on my work.

What advice would you give to yourself from four years ago?
Make mistakes now. It is ok to fail; it is ok to change your mind. UConn has a huge support system to help you when you fall. I am using everything I learned from my mistakes and failures in college, and the support system at the MSE department helped me pick myself up again and go back at it. It is such a huge booster to have something like that, but it is one of those things that you don't realize you have until it's gone.

In sum, how do you think the MSE department helped you to your current career?
The department has been my home throughout my undergraduate 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. They were a phenomenal support system, all the professors, all the office staff. When I come back here, it's a sense of freedom. I know there are people who are here who will let you try just about anything. It has been such an encouraging environment.

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"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."

~Alexandra Merkouriou
Materials Science and Engineering Alumna

From Undecided to Dean of Engineering

by Eli Freund - School of Engineering

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

Dr. Janet Callahan, Dean of Engineering at Michigan Technological University, arrived at the University of Connecticut as a sophomore transfer student, undecided in major. A decade later, she had three degrees from UConn, and a clear career path. "It's normal not to know what you will settle on as your major," Callahan noted. "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."

During that first year at UConn, Callahan took courses in alignment with a vague notion of being "pre-med" and then selected chemical engineering, which resonated with her, having a parent who was an engineer.

> "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."
>
> ~Dr. Janet Callahan
> Dean of Engineering
> Michigan Technological University

By her senior year, her pre-med route had led to her taking all the prerequisite courses except Introduction to Engineering. In her last semester, she learned that taking this introductory course was still an expectation, but with a great deal more persuasion, she was able to avert disaster:

"I had been called to a meeting with the head of Chemical Engineering, who explained that I had to take Introduction to Engineering (a first-year course) in order to graduate. I remember asking him, 'Why, what knowledge is in this course that I need to learn as a graduating senior?' I just kept asking about what it was that taking the course would teach me. After a long half-hour with me, the department head signed the paperwork to waive the course completely."

After learning that she was on-track to graduate on time, Callahan started planning her post-graduation steps. She never intended to launch herself headfirst into a career in academia, and had plans to enter the workforce.

As fate would have it, a chance encounter with a UConn Engineering professor, Dr. Donald Potter, pivoted her trajectory towards the academic world:

"In my last semester as an undergraduate, Dr. Potter spied me one day crossing campus, returning from an on-campus interview and stopped to chat with me. He asked when I was graduating, and what my plans were. And he went on to introduce the idea of graduate school," Callahan said.

During that conversation, he convinced her to delay her plans to enter industry and get a Master's in metallurgy. When she entered graduate school, she did not intend to get a Ph.D., but fate intervened again:

"I didn't actually set out to earn my Ph.D., but after about a year in graduate school, I realized how much I liked to do independent research," Callahan said.

While in graduate school, she took all the opportunities presented to her, which included learning a third language: "I wanted to exercise another part of my brain."

She remembers her advisor discovering after about a year, that she had been taking coursework in Italian, and asking her about it. "He was fine with it, just curious about my motivation. Ironically, a year later, he sent me to present my research at a conference at Riva del Garda, in northern Italy!"

After leaving UConn, she went on to do post-doctoral work in Melbourne, Australia, become a faculty member in the Materials Science and Engineering Department at Georgia Tech, held various leadership roles at Boise State University, and eventually arrived at Michigan Technological University, where she was appointed Dean of Engineering earlier this year.

As Dean at Michigan Tech, where the mascot is also a husky, Callahan has the important responsibility of leading the academic and research mission of the college. She also has the distinction of being the first female dean of engineering at Michigan Tech. According to the American Society of Engineering Education, there are 368 engineering deans in the U.S., with only 17 percent of those deans being female.

Callahan is proud to serve as a role model for women looking to go into academia, and into academic leadership:

"My personal message to women is that engineering is a place where we certainly belong. Academia— being a professor—we belong there too. While getting an engineering degree, and a Ph.D., and seeking an academic career is hard work —well it turns out that for people who like hard work, and solving problems, it's a great career. And so why not choose a career where you can make a difference in the world, which is what engineers do?" Callahan said.

Moreover, to this day, 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:

> "It was at UConn that I learned the huge value of being with colleagues who love problem-solving, design, laughter, and teamwork."
>
> ~Dr. Janet Callahan
> Dean of Engineering
> Michigan Technological University

"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. "It was at UConn that I learned the huge value of being with colleagues who love problem-solving, design, laughter, and teamwork. [callout] I am still in touch to this day with my graduate school friends, and with my doctoral mentor. For alumni who may read this—keep in touch with your home department and with your colleagues—these are your life-long allies."

Dr. Janet Callahan with MSE Graduate Students after 2017 Seminar at UConn

UConn NAi Fellows (l-r): Dr. Cato T. Laurencin, Dr. Lakshmi Nair, Dr. Pramod K. Srivastava, Dr. Steven L. Suib

UConn Joins National Academy of Inventors' Global Academic Inventor Network

by Jessica McBride - Office of the Vice President for Research

UConn has joined the National Academy of Inventors' (NAI) Global Academic Inventor Network (GAIN), an international mentoring platform exclusively for academic inventors.

> "The launch of GAIN by the NAI is timely as a global invention community is essential to drive 21st century innovation."
>
> ~Dr. Lakshmi Nair
> President, UConn Chapter of NAI

"UConn is committed to empowering our faculty and students to capitalize on innovative university research by developing new technologies and products, and entering into economic partnerships with public and private entities," says Radenka Maric, Vice President for Research and UConn's member representative to NAI. "This expansion of the NAI provides even greater opportunity to identify global partners, move technologies developed in UConn labs closer to market, and bolster the University's strong history of innovation."

UConn is among the NAI Chapters who will receive exclusive priority access to join GAIN. Following the initial launch stage, the NAI will open the platform to the entire NAI community.

The UConn NAI chapter was established in September 2017, a result of the efforts and prodigious invention history of three distinguished researchers who are NAI Fellows. To receive this distinction from NAI, a researcher must be named inventor on patent(s) issued by the United States Patent and Trademark Office (USPTO) and must be affiliated with a university, non-profit research institute, or other academic entity.

"UConn has a wonderful history of inventorship and mentorship, and the goals of GAIN are consistent with our UConn NAI Chapter's goals. We look forward to working with the National Academy of Inventors on this and other new initiatives," says Cato T. Laurencin, M.D., Ph.D., President of UConn's NAI chapter.

Currently, UConn is home to four NAI Fellows:

- Cato T. Laurencin, founder and President of the UConn Chapter of the National Academy of Inventors became the first UConn NAI Fellow in 2013. Laurencin is well known for his pioneering work in the field of regenerative engineering and is an elected member of both the National Academy of Engineering and the National Academy of Medicine, and recipient of the National Medal of Technology and Innovation and the Connecticut Medal of Technology.
- In 2015, Dr. Pramod K. Srivastava, who is recognized globally for his groundbreaking discoveries in cancer immunotherapy, was named an NAI Fellow.

> "UConn is committed to empowering our faculty and students to capitalize on innovative university research by developing new technologies and products, and entering into economic partnerships with public and private entities."
>
> ~Dr. Radenka Maric
> Vice President for Research

- Lakshmi Nair, Ph.D., vice president of the UConn Chapter of NAI was inducted in 2016. Her work in regenerative biomaterials to enhance tissue repair and regeneration has resulted in many novel and valuable discoveries.

- Board of Trustees Distinguished Professor of Chemistry Steven L. Suib, Ph.D., was inducted in 2017 for his pioneering work in solid-state chemistry and the synthesis of novel materials with a strong environmental focus.

"The launch of GAIN by the NAI is timely as a global invention community is essential to drive 21st century innovation," says Nair.

UConn faculty generate an average of 80 invention disclosures a year, and UConn has been issued over 600 total U.S. patents since tracking began. An average of 15 agreements aimed at commercializing UConn technologies are executed annually. The UConn Chapter of the NAI supports these activities through educational and networking events. For instance, on November 19, 2018, the Chapter hosted Drew Hirschfeld, Commissioner for Patents of the USPTO. Faculty, students, and technology professionals were invited to attend and learn more about the patent process.

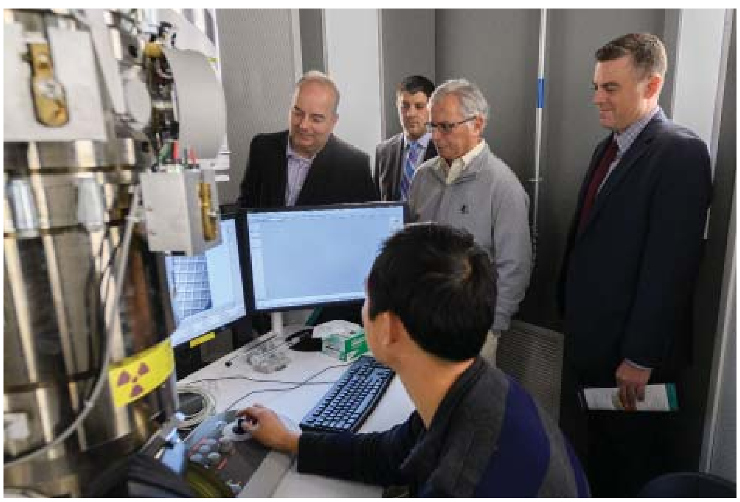
UConn is a proud member of the NAI, whose mission is to recognize a spirit of innovation within the academic community and nurture that spirit among the next generation of inventors.

"It is our hope that this network will ease the process for emerging inventors as they take an initial idea through the entire discovery process, and then licensing and commercializing that technology for the benefit of society," says Paul R. Sanberg, Ph.D., president of the NAI.

GAIN will help connect experienced inventors with those seeking guidance on patents and commercialization of new technologies.

State Legislators Visit UConn Innovation Partnership Building

by Melanie Noble - Innovation Partnership Building



Legislators view the Titan Themis at the Innovation Partnership Building (IPB) on Dec. 10, 2018. (Peter Morenus/UConn Photo)

Legislators tour the Innovation Partnership Building (IPB) on Dec. 10, 2018. (Peter Morenus/UConn Photo)

Returning and newly elected state legislators met with University officials at the Innovation Partnership Building (IPB) to tour the unparalleled facility and discuss many of UConn's core research and educational programs. The tour group included Senator-Elect Dan Champagne, Representative-Elect Gary Turco, Representative Chris Ziogas, Representative-Elect Jason Doucette, and Representative Greg Haddad.

Pamir Alpay, Executive Director of IPB, led the group on a building tour highlighting key research areas, specialty equipment, and how IPB activities impact and support the state's economic development. Legislators got a firsthand look at the Advanced Characterization Lab, which houses 11 electron microscopes in addition to X-ray equipment and optical microscopes. Pictured above, microscopy specialist Haiyan Tan demonstrated one of the most sophisticated and powerful electron microscopes in the world, the Titan Themis, which is capable of analyzing samples at the atomic level.

Legislators also visited the Proof of Concept Center and Connecticut Manufacturing Simulation Center to hear about those programs, which seek to assist small Connecticut companies in developing and improving their manufacturing processes.

At their last stop in the IPB labs, the Additive Manufacturing Center, legislators viewed room-sized metal 3D printers and state-of-the-art materials testing equipment. They learned about its capabilities, features, and uses.

Meet Industrial Affiliates Program Lab Managers Dr. Laura Pinatti and Dr. Nicholas Eddy

from the Institute of Materials Science

Dr. Laura Pinatti, Thermal Analysis Lab Manager

How did you come to be interested in materials characterization?
I was synthesizing new polymers both as a graduate student and as a research scientist at American Cyanamid. Nothing was more satisfying than running the characterization techniques to verify the properties of my reactions and using the data to determine the next step.

What instrumentation does your lab house and what are some of the new capabilities (equipment or techniques) of these instruments?
The thermal lab is fully equipped with instrumentation to measure weight loss, phase transitions, and mechanical and rheological properties of both liquid and solid samples from sub-ambient to high temperatures. We also have instrumentation to measure particle size, surface area, contact angles and surface tension.

What types of projects do you typically work on for industry partners?
Typical requests involve the use of thermal analysis instruments to identify sources of issues that a member may be having with a material or a process. The instruments in the thermal lab are used for polymer identification, to study the effect of different heat treatments, the degradation behavior and the mechanical behavior, all of which can be a source of material failure. We usually compare a good to a failed material. I provide a thorough report describing the equipment and experimental method, data analysis with tables and graphs and an explanation of the results and what they mean in relation to the problem as described.

Give an example of a particularly interesting project that resulted in very useful results for the company or how you worked with other IMS labs to solve a company's problems.
A recent project involved the sole use of the differential scanning calorimetry (DSC) to validate a material for use in the aerospace industry. The material had to meet a very specific requirement for melting behavior. Samples that had been subjected to different heat treatments were analyzed and the results used in the final design of the material.

What do you most enjoy about the work you perform in the Thermal Analysis Lab?
I enjoy the wide variety of materials and problems that we are asked to solve. I like putting all the data together from the different instruments to create a picture of the problem and then deciding where to go from there.

Dr. Nicholas Eddy, Nuclear Magnetic Resonance Spectroscopy Lab Manager

How did you come to be interested in materials characterization?
I originally trained as an organic chemist where a sizeable portion of the analytical techniques involved characterization of molecules and materials. The group that I worked in at the time did work with the local Haz-Mat unit as part of University service, and so I dealt with anything ranging from drug related residues to explosives to federal cases for characterizing unknown hazardous materials. What stuck through my tenure with that program was that characterization was a sort of puzzle to solve by taking all of the pieces from different techniques and putting it into a more complete picture of molecular and macromolecular structure.

What instrumentation does your lab house and what are some of the new capabilities (equipment or techniques) of these instruments?
The UConn/Thermo Fisher Scientific Center for Advanced Microscopy and Materials Analysis (CAMMA) has nine electron microscopes, including examples of the SEM, TEM and Dual Beam FIB types. These tools range from the basic to the highest resolution available today. The wide range of capability means that "no job is too big or too small" for the electron microscopes in terms of imaging, chemical analysis and sample modification.

What types of projects do you typically work on for industry partners?
One of the needs of customers we see a lot is process qualification. When an existing process no longer works up to spec or a new process is being developed, we can analyze the product and point out problems or recommend improvements. Often these analyses require looking at the material at the microscopic or even atomic scale to detect the root issue.

Give an example of a particularly interesting project that resulted in very useful results for the company or how you worked with other IMS labs to solve a company's problems.
One memorable job was an extensive analysis of the failure of an armored cable used in deep-sea oil exploration. The evidence uncovered by the microscopes of CAMMA suggested that the cable had undergone mechanical trauma beyond that normally expected. These damaged sites then experienced an accelerated rate of corrosion from the highly aggressive service environment. Other experts within IMS were able to confirm the actual corrosion process.

IMS Industrial Affiliates Program
2019 Annual Meeting
June 11, 2019

FEATURED GUEST SPEAKER:
Dr. John A. Elliott, Provost

Dr. John A. Elliott was appointed interim Provost effective March 2019. He has served as Dean of the School of Business and Auran J. Fox Chair at UConn since 2012. Prior to coming to UConn, he served as the Dean of the Zicklin School of Business at Baruch College, which is part of the City University of New York (CUNY), Vice President of Baruch College, and the Irwin and Arlene Ettinger Professor of Accountancy.

New This Year! Workshops with the Experts

For the first time, IAP will offer 90 minute afternoon workshops as an alternative to the facilities tour. Three concurrent workshops will be offered this year, the purpose of which is to provide an overview of equipment and analytical techniques offered through IAP and present example analyses that may help address questions and challenges our partners are experiencing. Space is limited.

Surface Analytical Techniques

Topics: XPS, SIMS, Auger
Instructor:
Dr. Steven L. Suib
Board of Trustees Distinguished Professor of Chemistry; Director, Institute of Materials Science

Electron Microscopy Techniques

Topics: SEM, EDX, TEM
Instructors:
Dr. Roger Ristau, Manager CAMMA Lab
Dr. Haiyan Tan, Electron Microscopy Research Scientist, CAMMA Lab

X-Ray Spectroscopy Techniques

Topics: X-Ray Diffraction, X-Ray Fluorescence, Small and Wide Angle X-Ray Scattering, X-ray Micro CT Scanning
Instructors:
Dr. Daniela Morales
Dr. Mu-Ping Nieh
Dr. Sina Shahbazmohamadi

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Promoting Inquiry in the Social Sciences: Connecticut's Kid Governor and Connecticut History Day Programs Engage Today's Students

by Kayla M. Pittman - Institute of Materials Science

Inquiry is essential to understanding the world around us. Propelling all academic disciplines forward, inquiry is behind the sciences that drive the discoveries made within the Institute of Materials Science, and the powerful discernment of our collective past as well as its impact on our present and future as conducted by historians. As a historian, I believe in the power of inquiry-based learning experiences in the classroom and work with both the Connecticut's Kid Governor and Connecticut History Day programs to excite Connecticut kids to engage in the Social Sciences and the world around them.

Established in 2015 by the Connecticut Public Affairs Network (CPAN), the Connecticut's Kid Governor program inspires civic action at a young age in Connecticut's elementary schools. Participating fifth grade classrooms engage in a specialized civics education program that focuses on state government, the history and process of voting, citizenship, and civic action. Each classroom has the opportunity to nominate a candidate from their school for Kid Governor as well as vote for one of the seven finalists in the statewide election.

Ms. Kayla M. Pittman, IMS Administrative Assistant

Candidates must create a campaign video describing their platform that includes why they want to run for governor, a community issue they want to address, their leadership qualities, as well as a three-point action plan for engaging their fellow fifth graders across the state to make a difference. Fifth graders from around the state watch and analyze the campaign videos of Kid Governor nominees before casting their ballots. The nominee with the most votes becomes the Governor-Elect inaugurated at the Old State House in Hartford in January.

The Kid Governor serves a one-year term from their office located in Hartford at the Old State House. During their tenure, the Kid Governor maintains a student activism blog, creates videos, attends constituent meetings, and participates in public speaking events at both kid and adult programs throughout the state. This valuable program continues to grow with Oregon and New Hampshire now electing their very own Kid Governors.

Serving as a Kid Governor Advisory Committee member for the last five years, I am so very excited to be a part of this program's continual growth. Last year, 151 classrooms in sixty-five schools across the state participated. Connecticut's 6,400 fifth graders

10-year old Ella Briggs, with her family by her side, is sworn in as Connecticut's fourth Kid Governor while Governor Ned Lamont looks on at right.

registered to vote, representing forty-three towns and cities, nominated thirty-four candidates for governor. The numbers continue to grow with this program expanding beyond the State of Connecticut with both Oregon and New Hampshire electing their very own Kid Governors in 2018 and 2019 respectively.

The following is a list of Connecticut's Kid Governors and their successful campaign platforms:

2019: Current Kid Governor, Ella Briggs's campaign, "Pride·Hope·Love," focuses on LGBTQ youth safety. Governor Briggs and her cabinet will work to fulfill the following three-point action plan over the course of the next year: promote adoptions for LGBTQ homeless youth, train teachers on how to work with LGBTQ youth, and create youth programs for LGBTQ youth and their allies.

2018: Megan K. Kaperowski's campaign, "Stronger than Cancer: Lifting Spirits and Changing Lives" sought to help fellow students understand the realities of cancer as well as find ways to bring cheer and laughter to hospitalized children.

2017: Jessica S. Brocksom's campaign, "Helping Animals, Those Without a Voice" focused on ending animal cruelty and promoting responsible pet ownership. Working with state lawmakers, the Connecticut General Assembly signed into law a bill that allows therapy animals to accompany children testifying in court to be accompanied by their therapy animal. Governor Brocksom also worked with her state representative to create a heat kills program in her town and even advocated for animals on Capitol Hill. The American Society for the Prevention of Cruelty to Animals (ASPCA) named Governor Brocksom the 2017 ASPCA Tommy P. Monahan Kid of the Year Award Winner.

2016: Elena M. Tipton's campaign, "Campaign for Kindness" sought to spread kindness throughout the state. Governor Tipton worked with Connecticut legislatures to declare the 13th of every month Kindness Day. She also fundraised for Buddy Benches on playground with fifteen installed across the state.

Connecticut History Day is another program supported by CPAN working diligently to inspire inquiry and engage students in the Social Sciences. Participating in one of two divisions: Junior (Grades 6-8) and Senior (Grades 9-12) across six regions in Connecticut, students select and research a local, state, national, or world topic in line with the annual theme.

This year students will unpack the theme: *Triumph and Tragedy in History* by performing college-level research as an individual or a team. Students will engage various resources including oral histories, libraries, and archives to understand the various angles of triumph and tragedy in respect to their subject. Driven by their own inquiry, students will explore the nuances presented by this year's theme and will grapple with of various questions such as who does history considered triumphant and who

Connecticut students celebrate 2018 National History Day

makes that judgement? Is one person's triumph another's tragedy and why? Can one suffer both a tragedy and enjoy triumph at the same time?

A final project, presented in one of five ways: an exhibit, paper, theatrical performance, website, or short documentary is the culmination of their work. Professional historians and educators in a series of competitions at the regional and state level then judge this project. Winners at the state level advance to the National History Day competition where they compete against other state winners from across the country at the University of Maryland in mid-June.

On contest day, student passion is infectious and the excitement surrounding their work is palpable. Since I began serving as a Regional Judge in 2015, I am continually awestruck by the standard of work, professionalism, and creativity displayed by Connecticut students. More than once, I have encountered multi-year competitors, which serves as confirmation in my mind of the power of inquiry and its place in our classrooms.

IMS Welcomes Lena Mastrangelo

from the Institute of Materials Science


Ms. Lena Mastrangelo
IMS Financial Assistant

IMS welcomed UConn alumna Ms. Lena Mastrangelo to the administrative staff as a Financial Assistant.

Lena received her Bachelor's Degree in Psychological Sciences and Minor in Criminal Justice from UConn in May of 2018. Immediately after graduation, she went on to work in the College of Liberal Arts and Sciences (CLAS) Business Center for a year and a half providing temporary services. Lena is excited to start this new chapter in the Institute of Materials Science!

Being from the town of Mansfield, UConn was a big part of Lena's upbringing. She spent many days in her childhood getting ice cream at the dairy bar and sledding down Horsebarn Hill.

Outside of UConn, Lena enjoys having new experiences. She loves traveling and searching for great cuisine as well as cooking, drawing, and painting.

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Administrative Assistant
Industrial Affiliates Program

IMS Welcomes Dr. Haiyan Tan

from the Institute of Materials Science

Dr. Haiyan Tan, Research Scientist

Dr. Haiyan Tan has joined the IMS technical staff as a research scientist in the Center for Advanced Microscopy and Materials Analysis (CAMMA) lab at the Innovation Partnerships Building.

Dr. Tan is a senior electron microscopy specialist with expertise in advanced Transmission Electron Microscopy (TEM) metrology, TEM/Scanning Electron Microscopy (SEM)/Focused Ion Beam (FIB) tool operation and automation, and their applications in material science research and the semiconductor industry. His expertise as an addition to our laboratory team is particularly exciting, as the Titan Themis instrument for single atom resolution imaging and elemental analysis was placed in service during 2018.

As TEM/DualBeam application engineer for TEM manufacturer ThermoFisher Scientific (formerly FEI), Dr. Tan trained and supported customers on advanced TEM metrology and established working procedures for various use cases. He also advised strategic semiconductor customers for customized application of eBeam tool automation.

Dr. Tan has held postdoctoral positions with worldwide TEM and material science organizations including Material Measurement Laboratory (MML | NIST, USA), Center for Materials Development and Structural Studies (CEMES | CNRS, France), and Electron Microscopy for Materials Research (EMAT | UA, Belgium). His research covers a broad range of areas including TEM metrology, new material synthesis and characterization, heterostructure, epitaxial growth, conservation of paintings, new semiconductor devices, all-solid-state Li ion battery etc. He has contributed to 40 publications, garnering nearly 1000 citations in international journals.

Poetry Out Loud

by Rhonda Ward - Institute of Materials Science

Ms. Rhonda Ward,
IMS Administrative Assistant

Since her 2017 appointment as poet laureate for the city of New London, CT, IMS administrative assistant, Rhonda Ward, has read her work alongside award winning poet and columnist for *The Nation*, Katha Pollitt, and performed with the full Eastern Connecticut Symphony Orchestra on the stage of New London's Garde Arts Center. She has conducted workshops for the Mashantucket Pequot Tribal Nation in collaboration with grantees of the Connecticut Sea Grant Arts Support Awards Program, and worked extensively with the Connecticut Office of the Arts on various projects. However, if you ask which project she most appreciates, Ms. Ward will tell you about Poetry Out Loud, a national recitation competition created by the National Endowment for the Arts and the Poetry Foundation.

The competition begins at the local level with high schools from each state (plus the District of Columbia, Puerto Rico and the U.S. Virgin Islands) holding recitation contests. Winners from participating high schools advance to state finals and winners at the state level receive $200 and an all-expenses-paid trip to Washington, DC, to compete for the national championship and the first prize of a $20,000 scholarship.

Connecticut provides participating schools the expertise of poets, writers, and performers to work with students in all aspects being judged in the competition including physical presence, voice and articulation, dramatic appropriateness, evidence of understanding and overall performance.

Rhonda Ward (l) with teaching artists and students at East Lyme High School

"In essence, our state offers students a master class in the art of recitation conducted by several of its teaching artists," says Ms. Ward, who recited original poetry and poems of other American poets during the 2019 state finals in March. She has served as a teaching artist for the program for the past two years, conducting workshops in voice and articulation for students throughout the state as well as professional development workshops for their teachers.

"Recitation has become a lost art. I see Poetry Out Loud as an avenue to introduce young people to poetry and the art of recitation in a way that engages them fully," says Ms. Ward. "The thing I love most about Poetry Out Loud, though, is that the students are there because they choose to be there."

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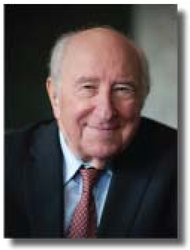

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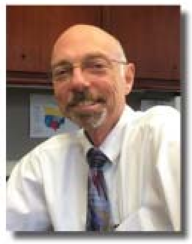

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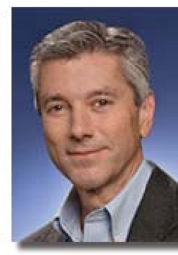

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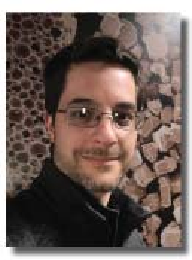

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Support the Institute of Materials Science

For over fifty years, the UConn Institute of Materials Science (IMS) has invested in scientific development within the state, across the nation, and around the globe. Our students, faculty, staff, and alumni continue to make countless contributions made possible by the educational, outreach, and research efforts of IMS. We are home to more than 150 graduate students performing research in our materials science, materials science and engineering, and polymer science programs.

Please consider donating to the institute as we make strides toward a richer future. Your donation to the fund(s) of your choice will directly contribute to our efforts to keep our research infrastructure and graduate education strong.

The Owen F. Devereux MSE Undergraduate Excellence Scholarship (31384)
Funds will be used to provide undergraduate merit based scholarships in honor of Professor Owen F. Devereux to students in the Materials Science and Engineering Program.

IMS Equipment and Maintenance (21753)
This account provides cutting-edge equipment and maintains IMS facilities. IMS houses a wide range of advanced research instruments and facilities.

IMS Polymer Mixture Thermodynamics (20334)
This account supports graduate students and faculty studying polymer mixtures.

An Unrestricted IMS General Fund Account (20312)
This account supports all IMS activities, from maintenance of supplies to industrial collaborations.

Julian F. Johnson Alumni Fellowships Fund (22177)
This account provides fellowships to graduate students in the IMS polymer program. The polymer program is the only center in Connecticut dedicated to research and education in polymer science and engineering and is nationally and internationally recognized for its excellence.

Materials Science and Engineering (MSE) General Fund Account (22165)
This account supports the materials science and engineering program offered by the Department of Materials Science and Engineering. MSE focuses on the production, processing, characterization, selection, design, and modeling of materials.

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