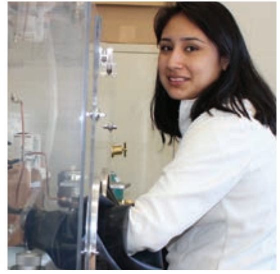

materials &ENGINEERING science

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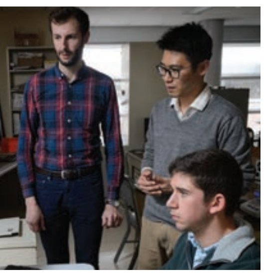

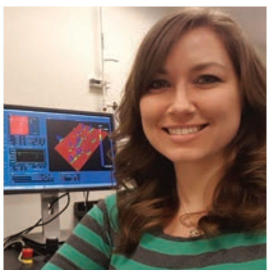

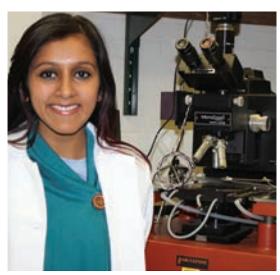

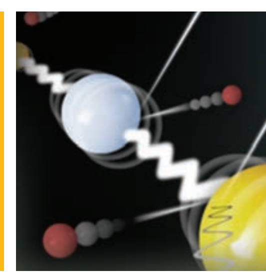

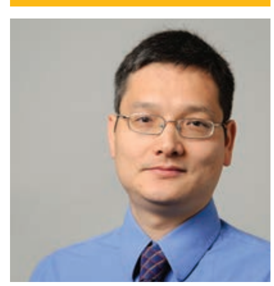

UCONN
SCHOOL OF ENGINEERING

A WORD FROM THE DEPARTMENT HEAD

This is an exciting time at UConn, with an increased focus on industry collaboration and expanded technical resources. This year, our faculty, students, and alumni are on the brink of breakthrough discoveries. From pioneering materials for deep space travel, to improving the lives of millions who suffer from osteoarthritis, our researchers strive to uphold the superior quality of education and research opportunities available.

After a rigorous internal search our esteemed colleague Professor Radenka Maric is newly appointed as the Vice President for Research. UConn officials noted: “Professor Maric’s very impressive record as a researcher, strong leadership qualities, highly collaborative approach, and the energy and comprehensive vision she has for the role of the VPR combined to make her an ideal choice for this important position”. We wish Dr. Maric well and we look forward to working with her in her new capacity.

There have been significant investments related to materials characterization. I am pleased to announce that the new UConn – FEI Center for Advanced Microscopy and Materials Analysis is now open. Thanks to an impressive investment from FEI/Thermo Fisher Scientific, the new center, valued at over $25 million, is one of the most advanced electron microscopy facilities in the world. It features 12 state-of-the-art microscopes, including leading-edge scanning electron microscopes, transmission electron microscopes and focused ion beam microscopes, with sophisticated capabilities to characterize a broad range of novel materials. This includes advanced instruments such as the Titan Themis and Verios 460L, as well as access to on-site FEI support to ensure the most effective and efficient use of the technology.

In addition to materials characterization, we have developed advanced manufacturing capabilities which will be housed in the brand new Innovation Partnership Building, a $200 million investment. These include additive manufacturing of metals and polymers, cutting edge thermo-mechanical and thermo-chemical measurement equipment, several rheometers, process simulation tools, supplemented with and a wide variety of imaging techniques.

Our distinguished faculty are making excellent progress. Assistant Professor Seok-Woo Lee was awarded an Early Career Faculty award by NASA for his research into a bulk-scale novel intermetallic compounds which exhibit superelastic deformation and ultra-high strength. This leads to unusually high actuation power per volume, 10~1000 times larger than most actuator materials, as well as cryogenic linear shape memory effects. With the award, Dr. Lee and his team seek to develop a small-volume, high-precision and mechanically-robust cryogenic linear actuator that can operate in deep cold space. Professor Rampi Ramprasad’s team has been awarded a second Multidisciplinary University Research Initiative (MURI) award by the Department of Defense for “Tracking, Diagnosing, and Impeding Dielectric Breakdown in Polymers.” This program concerns the behavior of insulators when exposed to high electric fields.

In other news, our students and alumni are surpassing all expectations. Undergraduate researcher Andrew Nguyen, in conjunction with Professor Mei Wei’s lab, is on the verge of creating biodegradable scaffolds capable of inducing regeneration of damaged tissue in arthritic joints. And alumna Jacquelynn Garofano, senior research scientist at UTRC and ranked twice as one of Connecticut’s “Forty Under 40” outstanding young professionals, was honored by delivering the key note speech at this year’s Society of Women Engineers (SWE) Northeast Regional Conference. Her inspiring message to women engineers and young professionals can be found on page 19.

In recent years, UConn has developed an impressive array of advanced technologies in manufacturing and manufacturing processes, and we are actively looking for academic and industrial collaborators to best make use of these resources. In addition, our faculty, staff, and students are on the cutting edge of progressive research that will affect the lives of millions. UConn is ready to form strong collaborations with colleagues in academia and industry. We welcome you to read our 2017 MSE newsletter.

With my best regards,
S. Pamir Alpay

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

Please direct any questions or comments to engr-mse-info@365.uconn.edu.

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Heike Brueckner

KEEP IN TOUCH

To stay informed about ongoing news and events happening at UConn’s Materials Science and Engineering Department, visit our website regularly: www.MSE.engr.uconn.edu

www.facebook.com/UConnMSE

UConn Materials Science & Engineering Alumni Group

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New Material Promises Benefits to Deep Space Travel

UConn MSE researcher Seok-Woo Lee has developed a new material designed to address some of the challenges to deep space travel by changing shape at very low temperatures.

Exploring beyond our solar system requires traveling enormous distances. The nearest star system to ours – Alpha Centauri – is 4.37 light years away, or 25 trillion miles; and distant star systems will take hundreds or thousands of years to reach, even in the best of circumstances. So scientists who want to send unmanned probes to another star system must create some innovative technologies that can outlive them.

Lee, who recently received an Early Career Faculty grant from NASA, is working on one such technology. In collaboration with researchers at Iowa State University, Ames Laboratory and at Colorado State University, he has developed a shape memory material (called $ThCr_2Si_2$-type intermetallic compounds) that can help in deep space travel by changing shape at low temperatures.

Shape memory materials can be deformed into one shape, but return to their original shape when exposed to a specific temperature, usually at high heats. Lee's material, a solution-grown crystal, works at colder temperatures.

"What we're creating is a shape memory material that can return to its original shape when exposed to temperatures as low as 50 kelvins, or right around -370 degrees Fahrenheit," says Lee, a Pratt & Whitney assistant professor of materials science and engineering. "A material returning to its original shape at such a low temperature could have some interesting benefits for space travel, such as acting as an on/off switch."

Lee and his graduate students, John Sypek and Keith Dusoe, are developing mechanical actuators that will work together with this material in the cold of space. Once a vessel leaves our solar system, the temperature drops below 50 kelvins, which will cause the shape memory material to deform and will activate the actuator, which in turn will power down the vessel. With minimal gravity in deep space, the vessel will continue in a set direction for hundreds of years, slowly making its way to its target while depowered.

If the vessel arrives at a new solar system, even the very distant heat at the edges of a star's reach will activate the shape memory material, which would return to its original shape.

The shape change would push the actuator, which would power up the vessel's power source and allow the unmanned vessel to begin recording and transmitting data back to Earth – long after the scientists who launched the vessel have died.

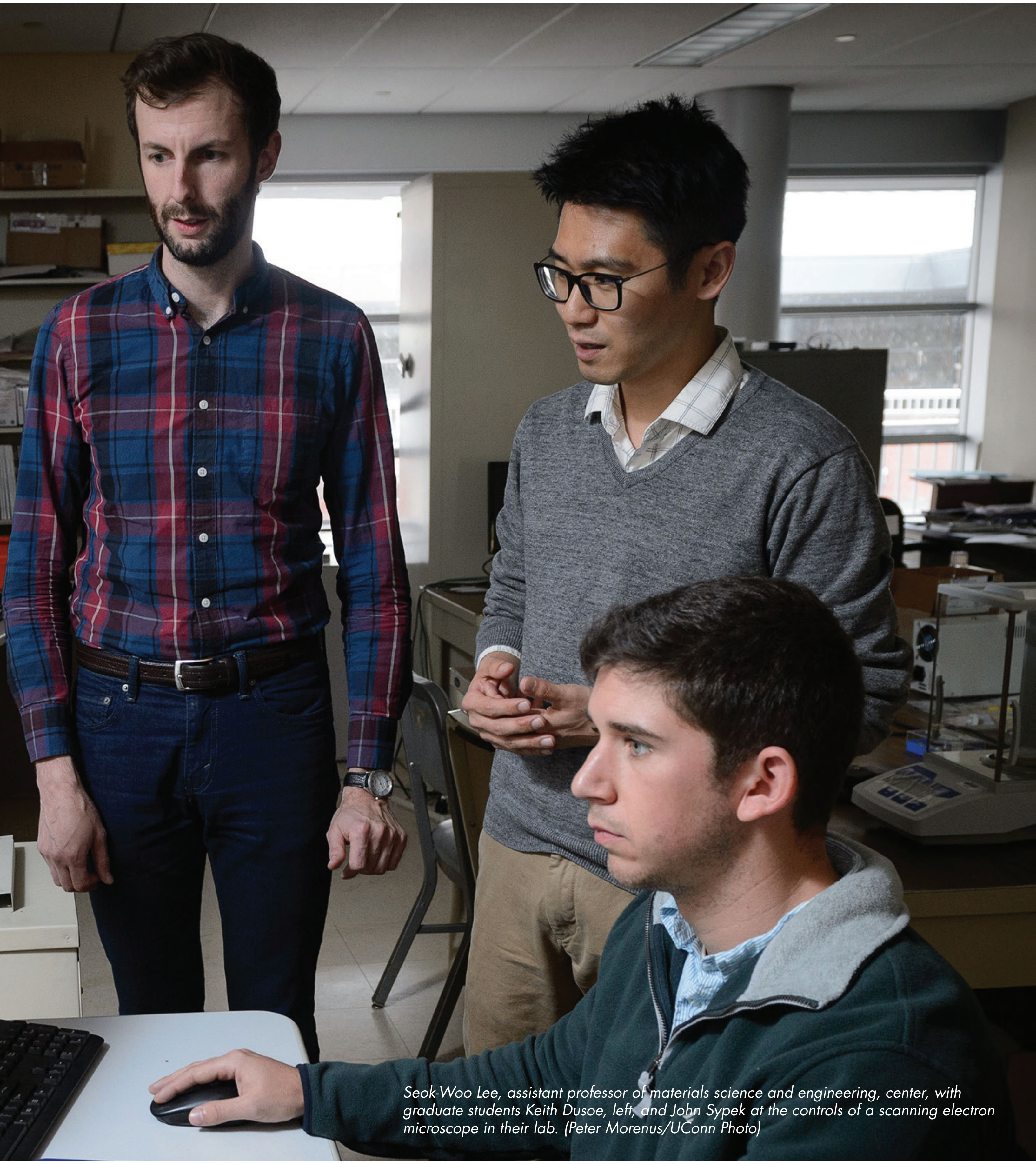
Lee says one of the reasons the low temperature at which the material activates is so important is that it means a vessel can switch on further from a star, where there's less debris and less chance the vessel will be damaged while powered down.

Another potential use for the shape memory material is to control telescopes in space. Lee says the material can be manipulated accurately enough to control a telescopic aperture. Since telescopes have to focus on stars so far away, the amount of light the lens lets in must be incredibly precise.

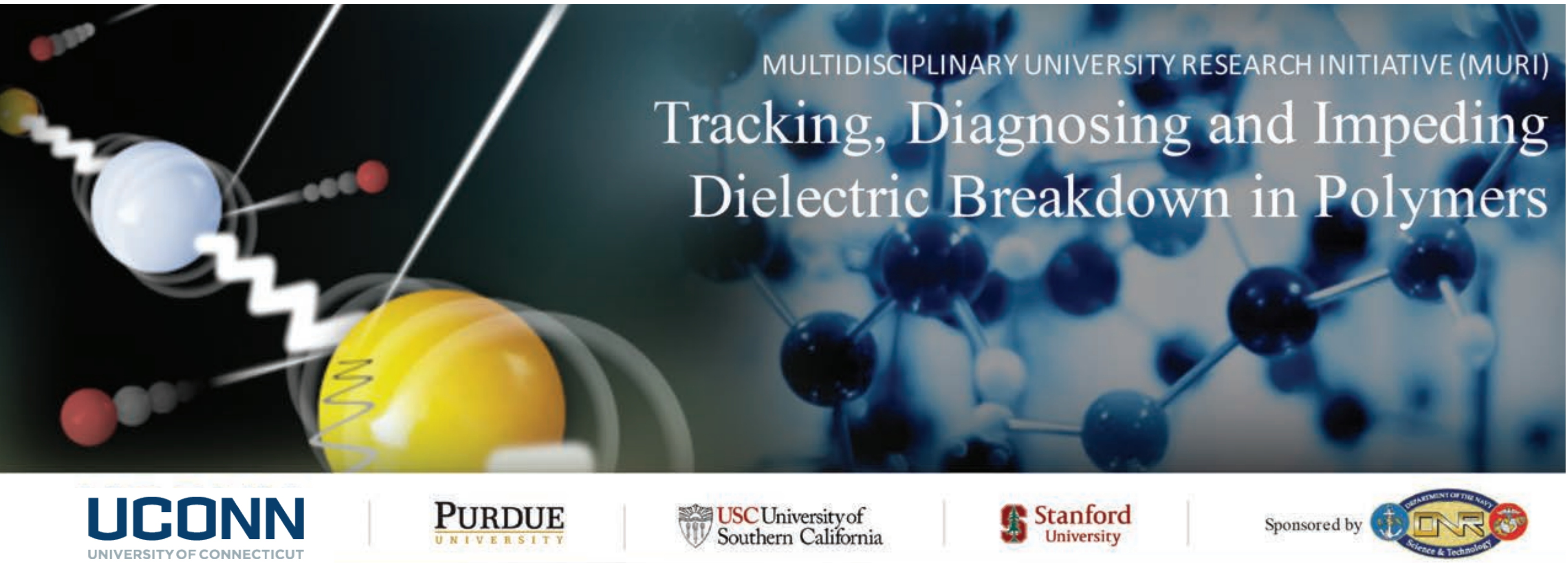
"By controlling the temperature around the shape memory material, we can manipulate the lens of a telescope to within a few angstroms," Lee said. An angstrom is a unit of measurement so small, a human hair is 500,000 angstroms thick.

Lee and his team are working to discover other uses for the new shape memory material.

by Josh Garvey, SoE


Seok-Woo Lee, assistant professor of materials science and engineering, center, with graduate students Keith Dusoe, left, and John Sypek at the controls of a scanning electron microscope in their lab. (Peter Morenus/UConn Photo)

MSE Researcher Awarded Millions in Funding by the DOD



Artistic rendition of dielectric breakdown. (Image Courtesy: Chiho Kim)

A team led by UConn MSE Professor Rampi Ramprasad has been awarded a multi-million-dollar Multidisciplinary University Research Initiative (MURI) grant by the Department of Defense for their research titled "Tracking, Diagnosing, and Impeding Dielectric Breakdown in Polymers."

As part of the MURI award, the team of researchers from UConn and other universities will learn how insulating materials exposed to very high electric fields break down. The award grants a total of $4.5 million over three years, with an additional $3 million possible after review.

"This program is about understanding how insulators behave when exposed to high electric fields," said Ramprasad, professor of materials science and engineering. "If you want to design materials that are tolerant to enormous electric fields, you must first understand how they fail."

In addition to Professor Ramprasad, the UConn researchers on this project include Yang Cao, an associate professor of electrical engineering, and Gregory Sotzing, a professor of chemistry. Researchers from Purdue University, Stanford University, and the University of Southern California are also involved in this project.

With the recent funding, the MURI team will study the response of a variety of polymeric materials to very strong electric fields. Using experimental, computational, and data-driven methods, they will see how the field affects the material over a wide range of length scales, ranging from sub-nanometers to microns. Learning how insulators break down could eventually lead to increased efficiency for a number of important military and civilian technologies, according to Professor Ramprasad.

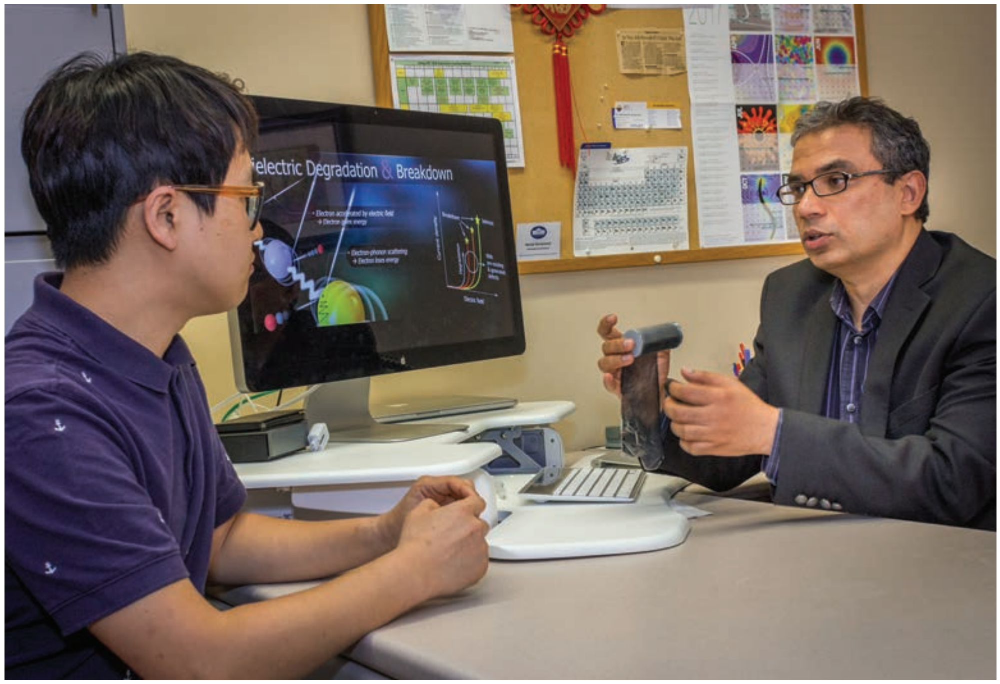
Professor Ramprasad and his collaborators have previously received another MURI award from the Department of Defense. The focus of that award was the computation-guided development of new polymer dielectrics for advanced electrostatic energy storage. The project is aligned with the White House Materials Genome Initiative (MGI) launched by President Obama in 2011 "to help businesses discover, develop, and deploy new materials twice as fast."

Last year, Professor Ramprasad attended the 5-year anniversary event of the MGI at the White House, in which several MGI accomplishments were highlighted, including the UConn-led MURI effort. "It is an honor to be a part of our polymer discovery effort," Professor Ramprasad says. For him, the previous MURI project was an extraordinary learning experience, providing an in-depth view of the many aspects and challenges involved in the path from fundamental science, to validation, to real-world applications.

"The applications could be insulation that you find in electronic devices, electric cables, and most importantly, insulation in capacitor dielectrics," Ramprasad said in a *UConn Today* article. "Capacitors are used in many applications, and the Navy is interested in electrostatic energy storage and high energy density capacitors."

Professor Ramprasad explains capacitors using electric and hybrid vehicles as an example: "Capacitors are often used in conjunction with batteries in electric and hybrid electric vehicles. A capacitor can hold less energy overall than a battery, but it can charge and discharge its energy much faster, which makes it useful for capturing and releasing energy quickly," he told *UConn Today*.

However, one of the limiting factors in how much electrical energy a capacitor can store is the point at which the insulator breaks down and gets irreversibly transformed to a conductor. In other words, too much energy in the electric field will cause the insulator to fail.



Research Associate Chiho Kim (left), and Professor Rampi Ramprasad discuss a capacitor. (Christopher LaRosa/UConn Photo)

Understanding how the insulator in a capacitor breaks down will eventually lead to materials that can result in more efficient and long-lasting capacitors capable of storing more energy than is possible today. These materials will lower the weight and increase the efficiency and effective range of an electric or hybrid vehicle. The military is interested, for similar reasons, in lowering the weight of electric and hybrid vehicles, as well as in the development of reliable all-electric ships. Professor Ramprasad looks forward to working on the new MURI project with his collaborators, students, and postdocs.

The Ramprasad group studies and designs materials on the computer—virtually—using fundamental theories, such as quantum mechanics, and data-driven methods, such as machine learning. These methods accelerate significantly the design and discovery of new application-specific materials by virtually screening thousands of new materials even before they are actually made, and provide guidance for the specific types of materials that should be made and tested. This type of activity, which would have been viewed as "science fiction" just a few decades ago, is rapidly becoming a prominent sub-field of materials science here at UConn and around the world.

"We have come up with several new polymers which did not exist before but appear to be very suitable and very promising for capacitor-based energy storage applications," Professor Ramprasad explains. Their work has been summarized in articles in *Advanced Materials*, under the title "Rational Co-Design of Polymer Dielectrics for Energy Storage," and in *Progress in Materials Science*, under the title " Advanced Polymer Dielectrics for High Energy Density Applications."

A recent addition to his computational toolkit arsenal is "machine learning," a branch of artificial intelligence that is concerned with how we can create a computer system that can automatically and progressively learn and improve through experience. "Within the context of materials science, such a paradigm can help transform the discovery process, and make it far more efficient, by using available materials data and new data that can be intentionally created in a careful manner, e.g., using quantum mechanics," Professor Ramprasad explains.

Recently, Professor Ramprasad, Fellow of the American Physical Society and an elected member of the Connecticut Academy of Science and Engineering, received a significant grant from Toyota Research Institute to accelerate the design and discovery of advanced polymeric battery materials using artificial intelligence and machine learning methods. He is the recipient of the Alexander von Humboldt Fellowship, the Max Planck Society Fellowship for Distinguished Scientists, the United Technologies Corporation Professorship for Engineering Innovation, and most recently, the UConn Centennial Term Professorship.

New Vice President for Research Seeks to Grow UConn's Enterprise with an Inclusive Approach

MSE Professor Radenka Maric, newly appointed vice president for research at UConn and UConn Health, intends to grow the university's research enterprise by implementing a vision that focuses on increasing strategic connections within and beyond the university walls.

"Collaboration is going to become the model of the future for scientists", Maric explains. "I want to bring more faculty, companies, and foundations together on collaborative projects to grow UConn's capabilities and increase our chances of receiving substantial funding for cutting-edge research. We cannot do that alone."

Maric wants to build on the momentum she has already seen at UConn since coming to the university in 2010 through the Eminent Faculty Initiative in Sustainable Energy program. Increased focus on partnerships with industry leaders in UConn's areas of strength, additional entrepreneurial training for faculty and students that leads to startup creation, and bigger emphasis on large-scale, multi-institution grants all provide an excellent foundation for improving and promoting UConn's status as a top public research university, says Maric.

She has identified several key initiatives to carry out her ambitious mission including efforts that:

- Utilize emerging data on federal funding priorities to align and promote UConn research capacity and increase UConn's research competiveness based on these trends.
- Enable and empower faculty to focus on large-scale global research opportunities with corporate and foundation partners.
- Convene cross disciplinary research teams able to target and cultivate relationships with other academic institutions, national labs, industry, and government partners to build new comprehensive strategic partnerships.
- Facilitate strong communications, dialogue, and coordination to foster an exciting intellectual environment that will support new engagement among different schools.
- Increase external promotions that demonstrate the unique value and capacity of UConn research, with particular emphasis in areas of interest to funding agencies, foundations, and industry.
- Provide faculty with access to industry mentors, information about market opportunities, and seed funding to align their academic research projects with industry priorities and increase the quantity of UConn inventions.

Maric began her research career at the Japan Fine Ceramics Center where she managed technology development for fuel cells, electronics, and biomaterials applications. From there she moved across the world to the U.S. to work in the private sector at nGimat Corporation (formerly known as Micro Coating Technologies), a leading manufacturer and innovator of engineered thin films and nanopowder technologies. After five years with nGimat, she took on a leadership role at the National Research Council of Canada's Institute for Fuel Cell Innovation. There she led efforts to develop a breakthrough thin film deposition technology that enables next generation semiconductor and advanced fuel cell materials production at significantly reduced costs and enhanced performance. In addition to her current responsibilities at UConn, she is also the founder of a biotech startup based on her research.

Maric has already had an impact at UConn, both in her role as CT Clean Energy Fund Professor of Sustainable Energy and executive director of UConn's Innovation Partnership Building (IPB).

Her ability to build fundamental and applied research and technology commercialization capabilities with a keen eye towards government, industry, and academic interests has been instrumental to the $132 million Innovation Partnership Building. Her leadership on this large-scale project has already leveraged more than $80 million in industry and federal agency projects. The IPB is scheduled to open its doors to industry and academic researchers in the fall of 2017. As VPR, the IPB will remain within the scope of Maric's responsibilities and extends her ability to connect UConn with startups and industry leaders.

In addition to being responsible for managing successful partnerships with General Electric, Comcast, UTC Aerospace, Pratt and Whitney, and Eversource that are key to the IPB, Maric has a history of creating collaborations between UConn and industry, such as sponsored projects with United Technologies Research Center, Sonalysts, Proton OnSite, NGK Spark Plugs, Advent Technologies, Cabot, and Danbury-based Fuel Cell Energy.

"Connecticut has made a massive investment in UConn aimed at building infrastructure, improving education, and training the states' future workforce. UConn's research enterprise is a critically important part of making sure this happens," says Maric. "It helps drive Connecticut's innovation economy by

Dr. Radenka Maric speaks to a group of faculty and students from UConn's School of Dental Medicine. (Taylor Hudak/UConn Photo)

forging important partnerships, commercializing life-saving technologies, supporting entrepreneurship, and preparing talented graduates for high-wage jobs."

Maric earned her B.S. in materials science from the University of Belgrade, and her M.S. and Ph.D. in materials science and energy from the University of Kyoto. Her research interests include nanomaterials and thin films, the effect of structure, defects, and microstructure on transport and electrical properties of surfaces and interfaces. In particular, she is interested in developing novel materials for fuel cells, batteries, and biomaterials. Maric has been invited to give keynote addresses at numerous international conferences, was named Woman of Innovation by the Connecticut Technology Council in 2016, and was selected to be a Fulbright Scholar at Politecnico Di Milano in Italy in 2016-2017. She has authored over 100 journal publications, and holds four patents.

By Jessica McBride, Office of the Vice President for Research

MSE Professor Puxian Gao Achieves Professional Milestone

"My goal is always to try to make and promote better science and technology that can benefit our community and society at large."

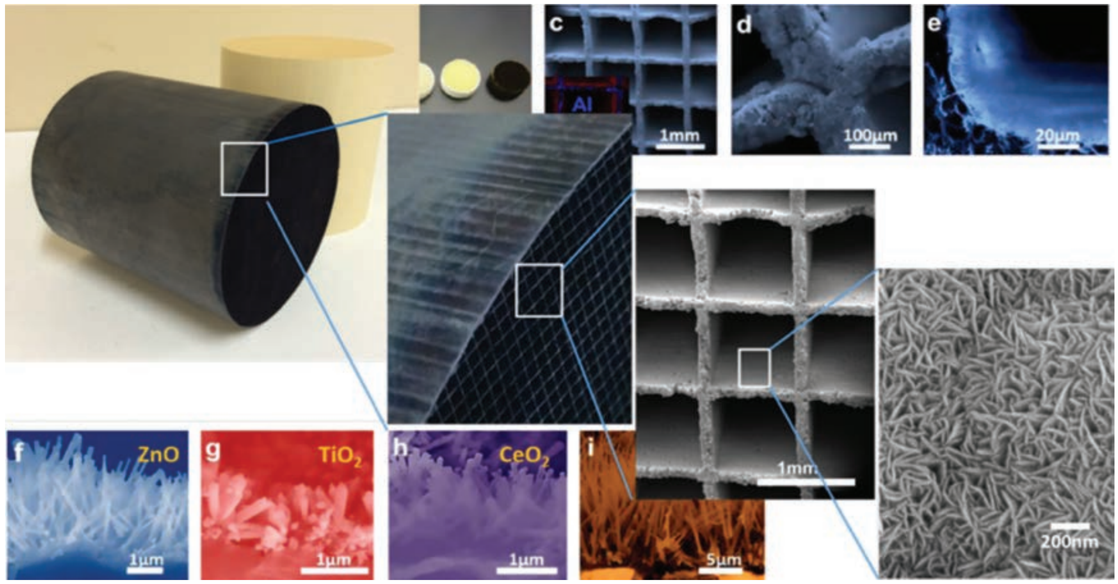


Figure 1. Above, an image of Professor Puxian Gao's research: Ø4.66"x4" nano-array integrated diesel oxidation catalytic converter fabricated at UConn Nanomaterials Science Laboratory. (Inset colored SEM images adapted from Nano Energy, 2013, 2, 873.)

MSE Professor Puxian Gao was inducted to the Connecticut Academy of Science and Engineering (CASE) in 2017 for "seminal contribution to the fundamental understanding of engineered nanomaterials assembly and scalable manufacturing," among other achievements. CASE reputedly admits a limited number of new members each year on the basis of a few criteria, including scientific distinction, unusual accomplishments in new and developing fields of science and technology, and peer recommendations.

The CASE 2017 new member publication lists his admirable professional work, which includes nanomaterials science and engineering for energy, environment and biomedical applications.

"There were a few notable aspects that I am especially proud of on the work we have done in the past decade," Professor Gao says in regards to his recent induction. "In the field of nanomaterials science and engineering, we have founded and gained quite a unique and in-depth fundamental understanding of engineered nanomaterials assembly and scalable manufacturing." Guided by these understandings, Gao and his team have successfully established nanostructure array integrated catalysis and sensing technology paradigm for various mobile and stationary energy systems. "As such, we have pioneered the research and development of nano-array based catalytic converters and harsh environmental sensors."

Professor Puxian Gao

In the past ten years, Professor Gao's research group has been focusing on bridging nanomaterials science and engineering with practical applications in energy and environmental catalysis, sensors and related electronics and optoelectronics, fire security and energy sources, bio-nano interfaces, and scalable nanomanufacturing.

"In the practical Nanotechnology Research and Development, we have been working on the following directions: 1) Nano-array based catalytic converters for emission control in stationary and mobile sources; 2) Harsh environmental nano-array sensors for advanced energy systems; 3) Full-spectrum nanostructured films as smart sensors and energy harvesters; and 4) Conformal 3D nanostructured film manufacturing," he explains. "Our latest research effort includes hierarchical nanomaterials assembly and manufacturing, nano-array based catalytic converters and harsh environmental sensors for advanced mobile and stationary energy systems."

"Their research is interdisciplinary, involving various subjects in materials science and engineering, chemistry, physics, chemical engineering, mechanical engineering, and electrical engineering. "I have been working with students and postdocs from different backgrounds and majors, and collaborating with scientists and engineers from universities, national labs, and industries," Gao says.

As a member of CASE, Professor Gao is dedicated to serving the community with advancements in science and engineering.

“My goal is always to try to make and promote better science and technology that can benefit our community and society at large,” Professor Gao says. “In becoming a CASE member, I am entitled with pride and responsibility in helping advance science and technology and promoting societal awareness in science and engineering.” The induction means it is now Professor Gao’s responsibility to help fulfill the mission of the Academy, which entails providing information and advice on science and technology to the government, industry and people of Connecticut, and encouraging youth’s interest in science, engineering, and technology.

“The induction to a significant extent is a nice recognition of my research at UConn, thanks to my past and current students, postdocs, and collaborators,” he says. “This will motivate me and my team moving forward, making more scientific advancements and technological breakthroughs in the near future.”

The Connecticut Academy of Science and Engineering is a private, nonprofit, public-service institution patterned after the National Academy of Sciences. The Academy identifies and studies issues and technological advances that are or should be of concern to the people of Connecticut, and provides unbiased, expert advice on science- and technology-related issues to state government and other Connecticut institutions, as stated on their website. Candidates for membership should be recognized by associates for professional integrity, as well as for accomplishments in science or engineering.

SENIOR DESIGN DAY 2017

Congratulations to our graduating MSE seniors who presented their Senior Design projects at Gampel Pavilion. As part of the annual MSE Senior Design judging process, students presented 15 Senior Design projects, showcasing the analytical and practical skills they gained from the program. Of the 15 presenting teams, three were selected for monetary awards. A total of $3,500 was distributed among first, second, and third place winners.

1st Prize

Characterization of Tensile Mechanical Properties of Biodegradable Polymers

by Jarred Correia, Alexis Jensen, Jessica LeClerc, Michael Murelli, Zachary Kerschner

Industry Sponsor: Medtronic

Industry Advisor: Darlene Nebinger, Dr. Gerald Hodgkinson, Michael Morsches, Jack Kennedy

Faculty Advisor: Prof. Rainer Hebert

2nd Prize

Accelerated Aging and Failure Analysis of Polymer-based Adhesive

by Dion Buterbaugh, Chris Didero-Gonzalez, Aaron Gladstein, Jay Latimer

Industry Sponsor: Pratt & Whitney

Industry Advisor: John Harner

Faculty Advisor: Prof. Serge Nakhmanson

3rd Prize

In Space Manufacturing and Reclamation

by Asa Army, Alexander Kadov, Spencer Palmer, Jonathan Rasimas, Beau Tetreault, and ME and EE students Tyler Young (EE) and Stephen Hawes (ME)

Industry Sponsor: NASA

Industry Advisor: Tracy Gill, Dr. Tracie Prater

Faculty Advisor: Adam Wentworth, Prof. Rainer Hebert

OTHER CAPSTONE DESIGN PROJECTS:

Design of a Method for Improving Mixing and Homogeneity of Polyethylene Cable Insulation

by Josiah Morgan, Ashleigh Scahill, Tochukwu Nioku, Owen Casey

Industry Sponsor: Marmon Innovation

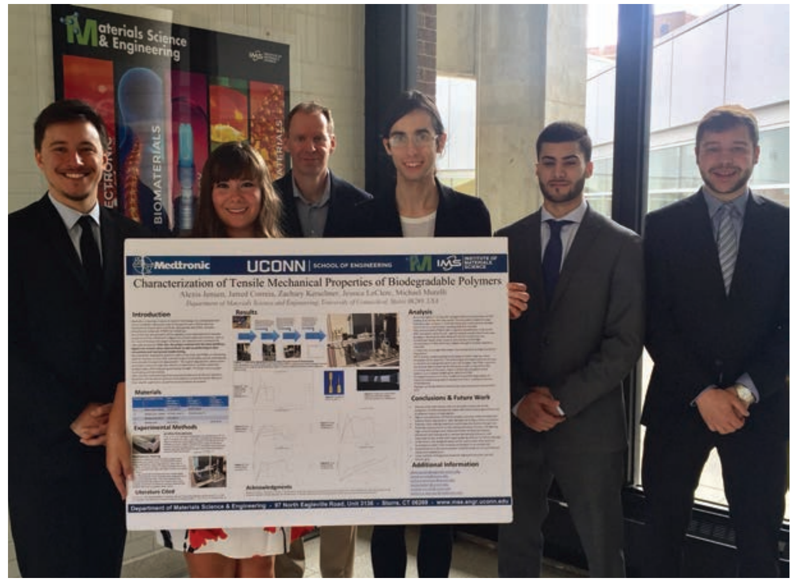
Industry Advisor: Dan Masakowski

Faculty Advisor: Prof. George Rossetti

Ulbrich Commercially Pure Titanium Alpha Case Analysis
by Sam Guerra, Matthew McKenna, Andrew Boucher, Zach Florio
Industry Sponsor: Ulbrich Stainless Steels & Special Metals, Inc.
Industry Advisor: Sean Ketchum
Faculty Advisor: Prof. Mark Aindow

Recrystallization During Continuous Annealing of 300 Series Stainless Steel
by Joshua Motley, Matthew Kall, Nils Jonsson
Industry Sponsor: Ulbrich Stainless Steels & Special Metals, Inc.
Industry Advisor: Will Keenan, Sean Ketchum
Faculty Advisor: Prof. Harold Brody

Adhesion Readiness for Anodized Aluminum, Plexiglas, and Composites
by Andrew Jeffery, Alexander Berry, Zach Thatcher, Leopoldo Valencia
Industry Sponsor: Sikorsky
Industry Advisor: Dr. Xiamoei Yu, Lauren Salisbury, Brian Rothermich
Faculty Advisor: Prof. Avinash Dongare



The Senior Design winning team. (From left to right) Zachary Kerschner, Alexis Jensen, Associate Professor Rainer Hebert (advisor), Jessica LeClerc, Jarred Correia, Michael Murelli

Performance Testing of TEC Cables
by Ryan Chapman, Emily Shallo, Brendan McLarty, Michael Martin
Industry Sponsor: Rockbestos Surprenant Cable Company
Industry Advisor: Scott Magner, Jason Vilakis
Faculty Advisor: Prof. Bryan Huey

Cryogenic Processing of Ti-6Al-4V
by Amanda Giroux, Alexander Kinstler, Jordan Kovacs, Brendan Hans, Kevin Tran
Industry Sponsor: UTC Aerospace Systems
Industry Advisor: Sergey Mironets
Faculty Advisor: Prof. Seok-Woo Lee

Characterization of Ceramic Zeolite Membrane for Water Desalination
by Benjamin Thieken, Fresia Morales, Jonathan White
Industry Sponsor: KX Technology
Industry Advisor: Bruce Taylor, William Li, Dr. Frank Brigano, Natasha Balkcom
Faculty Advisor: Prof. Steven Suib

Pump Cover & Solenoid Assembly Design
by Cameron Hansel, Jacob Mount, Mwamburi Mkaya
Industry Sponsor: Stanadyne
Industry Advisor: Fred Golja, Ed Goetsch, Steve Tsuji
Faculty Advisor: Prof. C. Barry Carter

Pratt & Whitney Sustainable Design
by Kevin Gryk, John Persico, Brian Keane, Mohamad Daeipour
Industry Sponsor: Pratt & Whitney Design
Industry Advisor: Dr. Amra Peles
Faculty Advisor: Prof. Ramamurthy Ramprasad

Chromate Conversion Coatings on Aluminum 2024
by Alyssa Denno, Benjamin Hyde, Jack Morley, Ryan Shiring
Industry Sponsor: Pratt & Whitney Electro-Chemical
Industry Advisor: Dr. Promila Bhatia
Faculty Advisor: Prof. Prabakhar Singh

Advanced Adhesive Bonding
by Justin Webster, Nathaniel Santos
Industry Sponsor: ASML
Industry Advisor: Dr. Andrew Judge
Faculty Advisor: Prof. Pamir Alpay

Annealing Furnaces
by Matthew McKinne, Nathan Eichacker, Matthew Lundin
Industry Sponsor: Ulbrich Stainless Steels & Special Metals, Inc.
Industry Advisor: Jonathan Garhart, Tim Fekete, Bill Fallon
Faculty Advisor: Prof. Mark Aindow

Educating
The Next Generation of Engineers

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

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

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

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

Materials Science & Engineering

University of Connecticut
Department of Materials Science & Engineering
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Storrs, CT 06269-3136

www.mse.engr.uconn.edu

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

UCONN | SCHOOL OF ENGINEERING

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Congratulations to the Class of 2017!

BACHELOR OF SCIENCE GRADUATES

Asa Samuel Army
Alexander Gordon Berry
Andrew Taylor Boucher
Dion Jon Buterbaugh
Ryan McGuire Chapman
Jarred Michael Correia
Mohamad Reza Daeipour
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Matthew Emile Kall
Brian Keane
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Michael David Martin
Brendan James McLarty
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Joshua Jonathon Motley
Jacob Mount
Michael James Murelli
John Carmen Persico
Jonathan D Rasimas
Emily Cara Shallo
Ryan Sullivan Shiring
Beau Kimball Tetreault
Zachary Alan Thatcher
Benjamin Francis Thieken
Kevin James Tran
Leopoldo Valencia Jr.
Justin Paul Webster
Jonathan David White

MASTER OF SCIENCE GRADUATES

William Castle, Major Advisor: Bryan Huey
Noveen Delaram, Major Advisor: Eric Jordan
Kathryn Read, Major Advisor: Bryan Huey
Weyshla Rodriguez, Major Advisor: Prabhakar Singh
Anamica Saha, Major Advisor: Pamir Alpay
Gyuho Song, Major Advisor: Seok-Woo Lee
Ethan Weikleenget, Major Advisor: Bryan Huey

MASTER OF ENGINEERING GRADUATES

Ryan Noraas, Major Advisor: Bryan Huey
Scott Storms, Major Advisor: Bryan Huey
Timothy Winfield, Major Advisor: Bryan Huey

PH.D. GRADUATES

Kan Fu
Major Advisor: Bryan Willis
Doctoral Dissertation: Integration of Biomolecular Recognition Elements with Solid-State Devices

Matthew Janish
Major Advisor: C. Barry Carter
Doctoral Dissertation: In-situ TEM Lithiation of Alternative Battery Electrode Materials

Hamidreza Khassaf
Major Advisor: Pamir Alpay
Doctoral Dissertation: Combined Intrinsic Caloric Effects in Ferroelectrics

Hui-Jan Lin
Major Advisor: Puxian Gao
Doctoral Dissertation: Ga_2O_3 Nanorod-based High Temperature Gas Sensors: A 3-D Nano-Architecture and Mechanism Study

Arun Kumar Mannodi Kanakkithodi
Major Advisor: Rampi Ramprasad
Doctoral Dissertation: Rational Design of Polymer Dielectrics: An Application of Density Functional Theory and Machine Learning

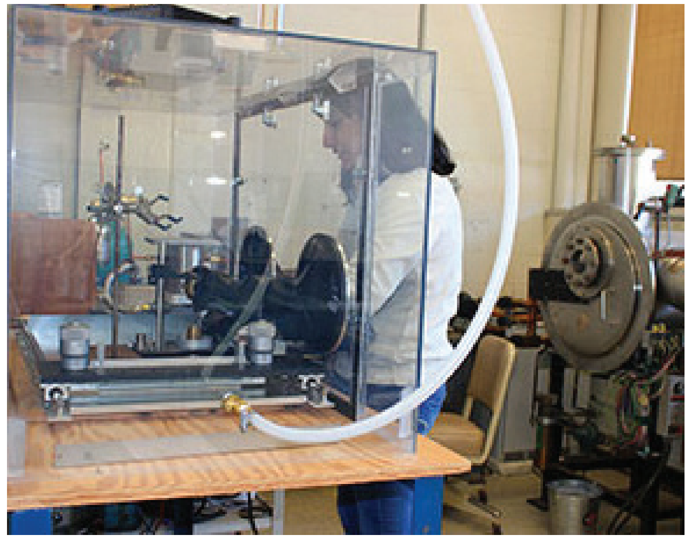
Austin McDannald
Major Advisor: Menka Jain
Doctoral Dissertation: Investigations on Magnetoelectric Bulk and Nanocomposite Materials

Linghan Ye
Major Advisor: Bryan Huey
Doctoral Dissertation: Nanoscale Domain Mapping on $BiFeO_3$ and PZT Thin Films by Piezo Force Microscopy

Michael Zilm
Major Advisor: Mei Wei
Doctoral Dissertation: Magnetic Materials for Biomedical Applications

MSE: An Ideal Major for Claudia Chavez

"The work of materials science engineers affects us every day, even though people may not realize it. Now, I am more aware of the importance of materials because it has allowed humanity to advance to where we are now."



Claudia is measuring the flow rate of titanium powder using a flowmeter tunnel in Dr. Rainer Hebert's lab. They are working on testing the effects of humidity on flow rate.

What do the development of metal casings for handheld devices and prosthetic limbs have in common? For Claudia Chavez, rising seventh semester Materials Science and Engineering major, they represent just two of the vastly numerous ways materials science engineers can utilize their knowledge.

Growing up, Claudia's favorite subjects at school were math and chemistry, and she became curious about how things were made. When she was younger, Claudia wanted to become a math teacher because she loved the subject. After a guidance counselor suggested she major in engineering, Claudia entered UConn as a Biomedical Engineering major in 2014, and began to learn more about the different fields the School of Engineering offers. Ultimately, Claudia fell in love with the school, and with MSE.

"UConn has a great engineering program that offers 12 different engineering majors," Claudia explains. "I chose MSE because it involves applying my favorite school subjects, math and chemistry, to the real world, and MSE majors can use their knowledge almost everywhere. For example, materials science engineers are needed by Apple to test and develop new phone materials that will not wear out, and they are needed by medical scientists when developing new prosthetics or when growing bones," she says.

Claudia, who focuses on metallurgy, recently started working as a student researcher in Associate Professor Rainer Hebert's lab, where she conducts experiments to measure the flow rate of titanium powder using a flowmeter tunnel. "I do the experiment in a closed environment because we are currently testing the effects of humidity on flow rate," Claudia explains. In order to create the humidity inside the box, argon gas must be blown into a closed container filled with distilled water that is concurrently heated by a hot plate. "In the end, this creates steam that is lead into the box which is ultimately humidity," she says. She has not yet decided whether she wants to pursue a Master's degree straight after graduating or get started in industry. However, she wants to investigate biomaterials in the future.

"I think that it would be cool to help scientists grow new limbs from cells," she says. "The new limb would need to have the same or greater strength than a human arm, would need to be flexible, and would need to be compatible with a human's body."

As a co-vice-president of UConn Engineering Ambassadors (EA), an international network of college students who are dedicated to inspiring the next generation of engineers by reaching out to middle school and high school students in the Connecticut area, Claudia helps plan the weekly meetings. She also participates in EA's presentation team (PT) by traveling to schools throughout Connecticut and giving presentations on how their current school subjects (Algebra, Physics, Chemistry, and more) are being applied in the real world, to help get students interested in the STEM field through presentations and demonstrations.

"I think that joining PT has been one of my greatest decisions after coming to UConn," Claudia says. "I love seeing the kids get excited about the topics. They are eager to ask questions and enjoy the activities that we do."

Claudia emphasizes that MSE is important because its applications are all around. "The work of materials science engineers affects us every day, even though people may not realize it," she explains. "Now, I am more aware of the importance of materials because it has allowed humanity to advance to where we are now."

Aside from EA, Claudia is a member of Alpha Phi Omega (APO), a co-ed service fraternity, and serves as a Husky Ambassador with Husky-for-a-Day, where she helps motivate potential UConn students to attend the university by showing them the campus and taking them to classes, in addition to maintaining her standing on the Dean's List. With so much on her plate, Claudia has much to look forward to.

"I would say that I am proud of myself for making it this far. My major has its challenges but I have managed to make it through. I am also thankful for what I have been given because I know that not everyone gets to have an education."

MSE Undergraduate is Close to Treating a Very Common Disease

"There's just so much to gain from doing research, and I would encourage any MSE student to pursue research during his or her undergraduate career."

More than 30 million people suffer from osteoarthritis in the United States, a conservative estimate of the disease that degrades tissue in articular joints. Andrew Nguyen, seventh-semester undergraduate MSE major, is working on creating biodegradable templates (scaffolds) that would be able to induce regeneration of damaged tissue in these joints.

Andrew works in Professor Mei Wei's lab with Ph.D. student Drew Clearfield and fellow undergraduate Simon Du on the research. Their purpose is to create scaffolds for joint tissue regeneration that will eventually be implemented in a person's body to mimic the complex structure, composition, and function of native cartilage tissue. His research won second place in the Undergraduate Poster Competition at the 2016 National Materials Science & Technology (MS&T) conference in Salt Lake City, Utah.

"I am motivated to work and research in this field because I know that the research is ground-breaking and will eventually be used to further advancements in medicine and regenerative engineering," Andrew explains. "Knowing that the research that I do can eventually be used to improve the lives of those who suffer from osteoarthritis is very exciting and makes me want to work even harder."

Aside from fabricating multi-zonal scaffolds, the group is also planning to conduct cell culture analyses and growth factor studies at the UConn Health Center with their scaffolds. "We are working with the Rowe Laboratory to study the differentiation of chondrocytes and bone marrow stromal cells in our multizonal scaffolds using cells with fluorescent reporter genes," Andrew says.

"Additionally, we have another undergraduate student in our lab who is working on conjugating chondrogenic and osteogenic growth factors to the different compartments in our scaffolds. The goal is to see if we can deliver zone-specific growth factors that enhance the differentiation of seeded progenitor cells." Since these are essentially biomaterials, it is important that they test the scaffolds using real cells and see how they react within the scaffolds.

"We chose to create anisotropic scaffolds because they mimic the actual structure of functional tissue, which is ideal. Since then, we've progressed further along in this field to the point where we have finalized our fabrication protocols and multizonal scaffold designs to fabricate these anisotropic scaffolds easily in high volume," he explains.

In addition to this research, Andrew is about to be published as a third co-author in Dr. Wei and Drew Clearfield's paper, Biomimetic Multidirectional Scaffolds for Zonal Cartilage and Osteochondral Tissue Engineering though Freeze Casting Routes in the *Acta Biomaterialia* for his work on an independent research project conducted last year. "In my independent

Andrew Nguyen, MSE undergraduate, works with a freeze-casting assembly dubbed the 'Freeze-Castinator 2000,' which consists of a liquid nitrogen cooling bath and temperature controller used to fabricate our multi-zonal scaffolds.

research project, I conjugated a fluorophore called fluorescein isothiocyanate (FITC) onto a glycosaminoglycan in our scaffolds called hyaluronic acid (HyA)," he says. "Our goal was to track its qualitative distribution throughout the scaffold through confocal scanning laser microscopy." He's also been awarded the Academic Innovation Keys Scholarship and Harry and Beatrice Mansley-Peter and Anastasia Hardy Scholarship from the UConn School of Engineering.

Since he began his research in Professor Mei Wei's lab his third semester at UConn, Andrew has been curious to learn more about the field of Materials Science, not just Biomaterials, and to get hands-on engineering experience where he could apply what he learned in academic coursework to real-life. "There's just so much to gain from doing research, and I would encourage any MSE student to pursue research during his or her undergraduate career," he says. Some of the skills Andrew has gained include learning how to conduct independent research projects, utilizing characterization equipment like the SEM, TGA, and DMA, writing technical reports, and giving professional presentations on his work.

Aside from research, there is plenty to be learned from the many materials science and engineering classes offered to undergraduates. "I'd have to say Applied Thermodynamics of Materials taught by Dr. Brody is the most valuable class that I've taken thus far in MSE," Andrew says. "Dr. Brody taught me the underlying principles of how the laws of thermodynamics govern the behavior and properties of materials, but I also learned that in order to be a successful future engineer, both your effort and teamwork with your collaborators are equally important to succeed."

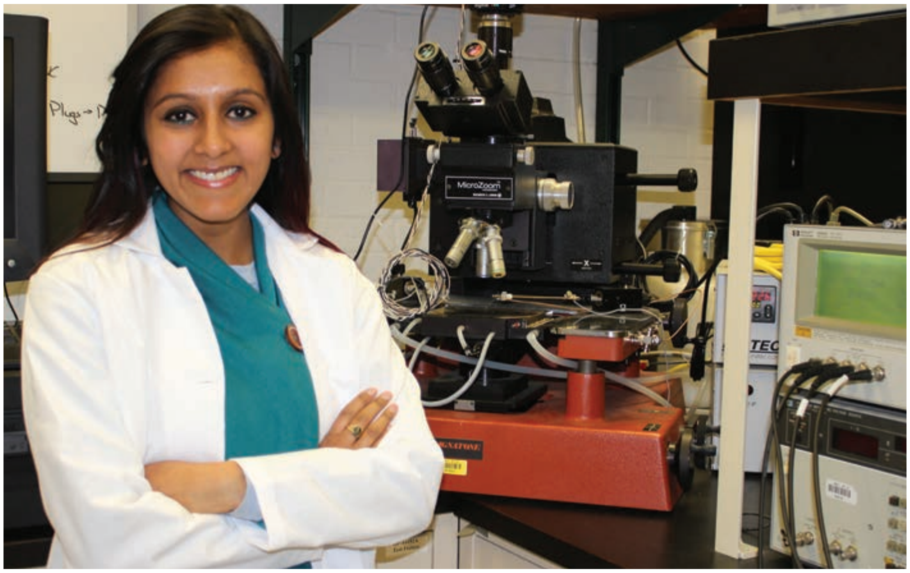
It was the group effort ultimately that made the class so valuable to Andrew. "Through the many nights of staying up past 2:00 a.m. in ITE to work on our projects, helping each other when we struggled to overcome difficult concepts, seeing how everything we'd been learning in our previous classes ties together and is utilized in more advanced applications, and the feeling of accomplishment when we all finally made it through was so gratifying and has allowed me to become close to many of my peers in the MSE community," Andrew explains.

At UConn, Andrew is also the Academic Chairholder of Alpha Beta Epsilon, an academic sciences fraternity. "I am in charge of organizing and facilitating academic events for this entire organization such as professor seminars, academic trips to research facilities, professional development workshops, and industry professional panels." He is also involved with UConn Material Advantage, where he participates in engineering outreach events to elementary schools, industry tours, and volunteer opportunities.

As for his future, Andrew is thinking of working in industry after graduating in May 2018. "I'd like to keep my options open, but am leaning toward industry to be able to utilize the education that I've gained here in engineering applications at a company setting," he says. "I would love to gain more knowledge and experience in other fields of MSE such as metals, failure analysis, and additive manufacturing processes in the aerospace industry."

Graduate Student Tulsi Patel Shares Three Defining Moments at UConn

"The addition of state-of-the-art microscopy and construction of a new Tech Park allows growth in industry-university partnerships and enables cutting-edge research to be conducted on campus."



Ph.D. student Tulsi Patel stands beside a probe station connected to a ferroelectric test system that measures polarization-electric field (P-E) hysteresis loops.

In the future of aerospace engineering, it may be more efficient to 3D print structural components. Materials Science and Engineering Ph.D. student Tulsi Patel is ahead of the game investigating how to combine different materials in an additive manufacturing environment.

As an undergraduate in chemical engineering, Tulsi Patel, currently a graduate student in Dr. Rainer Hebert's lab, was interested in alternative energies, which eventually led her to work on dye-sensitized solar cells for her Master's thesis. Now, her interests have shifted to additive manufacturing, commonly known as 3D printing.

"My Ph.D. research focuses on multi-material additive manufacturing of metals and ceramics for aerospace applications," Tulsi explains. "Specifically, I work on inkjet printing ferroelectric ceramics on conventional aerospace alloys to one day pave a path to integrated functionality in structural components."

The goal is to print functional elements, such as sensors, actuators, and active cooling, directly on and into the aerospace part, during the additive manufacturing process. The materials she is currently investigating are lead zirconate titanate (PZT) and barium titanate (BTO) for the ferroelectric ceramic, and Inconel 718 as the aerospace alloy.

When asked why she chose UConn's Department of Materials Science and Engineering, Tulsi lauds the MSE laboratories and facilities, which advance the caliber of research being conducted. "The addition of state-of-the-art microscopy and construction of a new Tech Park allows growth in industry-university partnerships and enables cutting-edge research to be conducted on campus. This contributes to the variety of research projects available and the many job opportunities for graduating students," she says. "A major focus of this Tech Park is additive manufacturing and I have the opportunity to contribute to this effort as a graduate student."

However, having completed both her B.S. and M.S. at UConn, her love for the school goes beyond its technological capacities. "As an avid fan and Connecticut native, I would not have the opportunity to see UConn basketball from the front rows of the student section elsewhere," she says.

Additionally, she thanks her advisors, Associate Professor and Director of the Additive Manufacturing Innovation Center Rainer Hebert, and MSE Department Head Professor Pamir Alpay. "They have been great mentors to me thus far in my Ph.D. and have fully supported my research interests. I have also gotten equally great mentorship from other MSE faculty members, both in and out of the classroom, as well as faculty from other departments who have aided my research work."

Of her years as a graduate student, Tulsi has experienced three significant, defining moments. First, she had the opportunity to spend a year in Italy as part of a dual-degree Master's MSE program between UConn and Politecnico di Milano, where she worked in Fabio Di Fonzo's lab. "Not only did I grow the most as a person and researcher during this time, but it was also the first time I developed an interest for materials science and engineering and decided to further pursue the field," she explains.

The second experience involved spending two years visiting a local technical high school as part of the NSF GK-12 fellowship. "I developed valuable teaching skills and had the opportunity to encourage the next generation to pursue engineering."

Lastly, while Tulsi spent last summer in South Korea as a NSF EAPSI fellow, she learned more about additive manufacturing technologies and their profound effect around the world. "Overall, I am so grateful for all the opportunities I have gotten as a student at UConn," she says.

As a NSF GK-12 fellow, Tulsi received a prestigious two-year fellowship that required her to visit a local technical high school on a weekly basis. "The objective of this fellowship was to conduct innovative research and communicate science and research to a broader audience." Her duties included creating and executing lesson plans for high school students, and encouraging them to pursue STEM fields.

"Specifically, I visited physics and CADD classes at E.C. Goodwin Technical High School, and some projects I executed include: building a Moon Buggy (NASA competition), Rube Goldberg device, wind turbines, prosthetic legs, balloon-powered cars, bridges, and rollercoasters. Moreover, it was a wonderful opportunity that enabled me to grow as a researcher and give back to the community."

Tulsi looks forward to graduating in December 2018, and her future career goals entail working as a research scientist at either a national laboratory or in industry and contributing to the advancement of additive manufacturing. "UConn MSE has helped me work toward these goals with the many collaborations I have had for my research projects and the network I have created."

Alumnus Neal Magdefrau, Ph.D., stands next to one of the desktop SEMs that his company, Electron Microscopy Innovative Technologies, LLC, rents out.

Alumnus Neal Magdefrau Shares His Journey From Ph.D. to Business Owner

Neal Magdefrau, Materials Science and Engineering alum, was inspired to enter the field to design new materials for golf equipment. Instead, he earned a Ph.D., became a research scientist at one of United States' premier engineering research companies, and started a business.

"I've been at United Technologies Research Center (UTRC) full-time for just over ten years," Neal says. He currently works as a staff engineer and research scientist in the Measurement Science Group at UTRC, where he's responsible for running and maintaining the electron microscopy labs. "I started working at UTRC as an undergraduate intern, and then decided to work there full-time after receiving my Master's degree in 2006." He continued to pursue his Ph.D. part-time while working at UTRC.

After working in Dr. Mark Aindow's lab as an undergraduate, Neal wanted to keep working in the lab as a graduate student, with Dr. Aindow as his advisor. His Master's degree was focused on characterization of amorphous aluminum alloy powders. "At the time, there was a large DARPA (Defense Advanced Research Projects Agency) program called 'Structural Amorphous Materials' that we were working on for Pratt & Whitney," Neal says.

The project was focused on producing high strength nanocrystalline aluminum alloys by canning and extruding amorphous aluminum alloy precursor powders, and Neal wanted to understand the starting powder chemistry, morphology and crystallinity in more detail.

"Most of my work was based on Al-Y-Ni-Gd systems, and while these starting powder materials were predicted to be amorphous, very often we found that during the gas atomization process used to produce the powder, crystallization would occur." There were also difficulties controlling the heat transfer in the scale up of the extrusion process.

His doctorate work involved high resolution electron microscopy and spectroscopy to understand oxidation and reaction layer products for Solid Oxide Fuel Cell (SOFC) interconnects. "Dr. Aindow and I wrote a DOE proposal that enabled us to generate a set of experiments which gave the SOFC community a more informed picture of what the mechanisms and reactions are that actually limit the life of SOFCs," he recalls. "In all of my studies, at UConn I was always most interested in how to use the latest characterization tools to study different materials."

Neal's desire to study various materials has led him to his current position at UTRC. "My job at UTRC is what I would consider very applied scientific research and often times is also highly proprietary," he explains. A drawback to the realm of highly proprietary applied scientific research is that the general scientific community outside of UTC does not immediately benefit from his work, or know what research he is doing. That doesn't make his work any less fulfilling, though. "Any time you're working on developing a new material that can cut down the weight of a component by a third or improve efficiency there is always a sense that you're doing something impactful for society."

Interestingly, Neal initially went into the field of materials science and engineering because of golf. "I'm an avid golfer and I thought it would be great to be able to design new materials for golf equipment," he says. "I was offered the opportunity to work for Adams Golf, which is one of the major golf companies in the U.S., but ultimately I decided to stay in Connecticut to be closer to friends and family."

Instead, he started a business in 2014, which was established to give companies better access to high-end characterization equipment. "While full size electron microscopes are getting more and more powerful, many companies are focused on creating fully capable tabletop electron microscopes," Neal explains. "These microscopes first came out as 'learning tools' mostly for high schools and colleges, but the introduction of chemical analysis capability to these tabletop electron microscopes made them very powerful."

Neal's company rents out these highly functioning portable tabletop Scanning Electron Microscopes (SEMs) to businesses that may have a short-term need or cannot afford to purchase a system of their own. "Many of our customers will rent for a month or more, but we also have customers who will come into our local office and use one of our microscopes there. In the two and half years we've been in business, we've delivered microscopes all over the country," he says. The company, Electron Microscopy Innovative Technologies, LLC, allows smaller technology companies to have access to equipment that they likely wouldn't have been able to afford previously.

Although he did not enroll in any business classes at UConn, Neal learned many skills from his MSE courses that helped him become an entrepreneur. "First, in order to succeed in the technology industry, you need to be laser focused on a very specific industry need," Neal explains. "UConn MSE gave me the technical tools and rigor to be able to grow into a technical expert in this field." He adds that the smaller class size contributed to his ability to communicate effectively with others, which is a key component to running a business.

Between UTRC and Electron Microscopy Innovative Technologies, Neal is constantly utilizing and building upon his MSE education. "My time is split between managing and working on materials development programs and providing failure analysis support for different business units in the corporation. Some days I spend a lot of time in the lab and others I spend doing project management type work." He prefers being in the lab.

Finally, Neal strongly urges anyone who has an interest in science coming out of high school to look at Materials Science as a career choice. "As technology in the next century progresses, there are two main components which are likely to advance most modern technologies: one is the improvement of software that goes into many of our electronics, but the second piece of the puzzle is creating new materials to continue to push the boundaries of technology," he explains. "There is no shortage of career opportunities in the field of Materials Science and that isn't likely to change in the foreseeable future."

MSE Alumna Jacquelynn Garofano Explains Her Multi-Faceted Spectrum of Success

"Materials science was an attractive field of study because it's so broad and diverse with types of materials and applications."

As a Senior Research Scientist at UTRC and one of Connecticut's "Forty Under 40" outstanding young professionals for 2013 (*Connecticut Magazine*) and 2015 (*Hartford Business Journal*), MSE alumna Dr. Jacquelynn (Jackie) Garofano, has earned honors and recognition as both an educator and researcher. At the 2017 Society of Women Engineers (SWE) Northeast Regional Conference at UConn, Dr. Garofano gave the morning keynote address, sharing some insight from her own achievements with more than 400 collegiate and professional young women engineers in attendance.

The theme of the Society of Women Engineers Regional Conference was Spectrum of Success, focusing on the diversity in engineering from the collegiate to professional level, and the spectrum of women that are a part of SWE. During Dr. Garofano's keynote she shared her thoughts on defining her own spectrum of success, which is multi-faceted: personal, academic, professional and philanthropic.

As a first-generation college graduate, Jackie encouraged attendees to remember that it is not "where you start, but how high you aim," and that success is characterized by the value you put on your achievements.

"My academic and professional career has been marked by numerous honors and achievements that have been amplified by my passion for philanthropy and community service," Jackie says. "I shared with the audience my story as an example of a professional woman scientist who has a distinctive spectrum of success which is not solely based on technical accomplishments."

Indeed, Jackie's achievements are numerous. As an undergraduate physics major at Southern Connecticut State University (SCSU), she had the opportunity to participate in materials research through the Research Experience for Undergraduates (REU) program in conjunction with Yale University. Initially, Jackie wanted to study astrophysics and work for NASA. However, after having the opportunity to engage in research through REU, she "became fascinated with phenomena on the opposite end of the size spectrum," she says. Her research interest shifted from cosmic-level astrophysics to micro- and nanoscale research.

"Materials science was an attractive field of study because it's so broad and diverse with types of materials and applications." MSE turned out to be a perfect fit for Jackie's interests and abilities. At UConn, Jackie was actively involved in the Materials Research Society and Materials Advantage organizations, and she received numerous honors. Among them the Outstanding Woman Scholar Academic Achievement Award (2009), presented by UConn's Graduate School, the MSE program's Outstanding Graduate Student award (2010) and induction into UConn's Alpha Sigma Mu honor society (2010).

While pursuing her doctorate she also worked part-time as an Education and Outreach Coordinator for the Center for Research on Interface Structures and Phenomena (CRISP). At CRISP, Jackie organized professional development workshops for educators, coordinated the NSF-sponsored REU summer program, which she had participated in as an undergraduate, and assisted with the program's website.

In 2011, while she was pursuing her Ph.D. in MSE, her advisor Professor Mark Aindow nominated her for a Connecticut Technology Council Women of Innovation award, with a dual, independent nomination from her undergraduate Physics Professor Christine Broadbridge at SCSU for her work done with CRISP. She was one of 10 women to be honored with an award, and was presented the Collegian Innovation and Leadership award in recognition of exceptional academic achievement or inventiveness in technology, science, or engineering. Her Master's thesis research focused on high-resolution electron microscopy characterization of laser-processed Ni-based superalloys, and her doctoral dissertation research involved microstructural characterization to study the phase evolution and homogeneity of magnesia/yttria nanocomposites for optical components.

Jackie joined United Technologies Research Center (UTRC) in September 2011 as a Senior Research Scientist.

"At UTRC, we ensure UTC's technological advantage in the market and solve the toughest scientific challenges for our business unit customers," she says. "During my tenure at UTRC in the Measurement Science Group, I have worked on many diverse projects and programs to develop new technologies for UTC's aerospace and building industries." Her most recent research has focused on combinatorial high throughput experimentation, coupled with materials informatics approaches, for advanced materials development (including additive manufacturing) and corrosion mitigation.

In late 2015, MSE Department Head Professor Pamir Alpay reached out to Jackie to inquire if she would be interested in an adjunct professor position, teaching a section of MSE 2101: Materials Science and Engineering I (for non-MSE majors) in the Spring 2016.

"I also had the opportunity to teach a graduate course MSE 5001: Principles of Materials Engineering in Fall 2016. My appointment as an adjunct professor has not included research; however, I do find myself missing the days of conducting applied research as a graduate student – and even more so now that the university has established the UConn-FEI Center for Advanced Microscopy and Materials Analysis."

Although she is not conducting her own research for MSE anymore, Jackie does enjoy seeing all of the amazing research that UConn students and faculty are involved in and hearing about it first-hand from her students.

For current students, Jackie shares a few words of advice: "It's about the journey, not the destination," she quotes. "Life is unpredictable and we aren't certain about what may happen. For myself, I don't have expectations of what could be because I'd rather not set myself up for disappointment when things that I want or expect to happen don't. Instead, I aspire to greatness. I want to be able to look back on my life and my career and know that I've made a difference."

Dr. Jackie Garofano using white light interferometry, a non-destructive optical technique, to study corrosion pitting phenomena of aluminum alloys at UTRC.

Your Continued Support Helps Produce a Legacy of Research

UConn's MSE department is growing exponentially every year, introducing new machinery, labs, graduate students or faculty that help us produce cutting edge research. Our students, faculty, staff, and alumni continue to make breakthrough contributions facilitated by the educational, outreach, and research efforts of MSE.

MSE is home to almost 100 graduate students and 17 full time faculty performing research in the areas of biomaterials, energy materials, nanomaterials, metallurgy, and electronic materials. We continue to thrive on the contributions of our community.

Please consider donating to the MSE Department as we make strides toward a richer future.

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Alumna Erica Rozzero's Materials Science Foundation Covers Many Bases

"I would advise undergraduates to consider taking a variety of MSE electives, as materials engineering covers a broad range of topics. Having a basic understanding of many of those topics allows you to move both within and between companies and projects, and therefore opens you up to a variety of opportunities."

The saying "Students today, Huskies forever," is more than a mantra for school spirit. To Erica Rozzero (formerly Erica Pehmoeller), Materials Science and Engineering B.S. '12, M.S. '15, it mirrors the idea that her UConn education provides a foundation for her to build on as she continues to learn the nuances of her trade.

As a metallurgical engineer at Electric Boat's Washington, D.C. location, Erica spends most of her time focusing on materials specifications for castings and forgings for the implementation of Technical Publication 0300, a Navy steel base material specification that covers several base material forms. "I work predominantly with the casting and forging vendors wishing to qualify or recertify to the specification," she explains. "Due to the increased size and complexity of the castings and forgings Electric Boat is now trying to procure, qualification is difficult."

The challenge arises in castings and forging with very thick or very thin segments, which present a heat treatment challenge, as under- or over-tempering parts of the piece can easily occur. Additionally, extremely complex castings may have an increased amount of hydrogen within them. "Since hydrogen can cause premature failure, in some cases under loads below the bulk material's yield strength, this is a significant concern," Erica says. She, along with Electric Boat, is working with the vendors to determine if further heat treatment can solve these hydrogen issues, or if new riser designs are necessary for castings of this size and complexity.

Since changes in processing could negatively impact downstream performance, Erica maintains knowledge of a broad range of topics such as casting, forging, welding, and corrosion, so she will know when more information is needed to solve an issue. "My education gave me the materials foundation I needed in order to understand the fundamentals of the base material issues our vendors are seeing," she says.

The ability to produce larger and more complex castings and forgings widens the aperture of American vendor capabilities. "Success with these parts teaches vendors new processing techniques that they can use in other areas of the business," Erica explains. Additionally, these complex forgings and castings often used to be welded assemblies on past classes, and making them into one piece makes them easier to install for the tradesmen welding the boats together.

Though challenging at times, Erica's enthusiasm for her job is evident. "One of my biggest personal goals is to always continue to learn," she says. "Working on the challenges associated with meeting higher base material standards allows me to continually learn more about base material processing, forming, and fabrication."

Erica Rozzero
(formerly Erica Pehmoeller)

Erica graduated from UConn with a B.S. in 2012 and worked on her M.S. part-time, completing it in 2015. As an undergraduate student, she worked in Dr. C. Barry Carter's group, where she learned some of the most valuable skills she utilizes. "I loved working in the MSE labs, whether it was during class or while working for Dr. Carter. The skills I gained using the SEM have allowed me to perform analyses I would be otherwise unable to do," she says.

While she was located in the Connecticut Electric Boat office, Erica was involved with two high school Project Lead the Way programs in Portland and Southington. "I was on both schools' Partnership team, which helped guide future program goals, and I spoke to students from both programs about being an engineer," she says. Project Lead the Way is a national pre-engineering program that allows high school students to learn about various engineering disciplines so that they are better prepared for college engineering classes. Outreach is very important to Erica: "If it weren't for some of the people I was mentored by early in life, I might not have chosen an engineering career path. Because of this, I enjoy working with students so that they can succeed in their careers, whether they chose engineering or another field."

Prior to joining Electric Boat, Erica was an industry advisor while working as a process metallurgist at Ulbrich Stainless Steels & Special Metals. Erica enjoyed working with and mentoring students. "I greatly enjoyed being an industry advisor as it allowed me to work with a student on an issue our company was having," she says. "Mentoring that student and seeing their progression throughout the year through both their presentations and papers was very rewarding."

Though Erica is not currently planning on pursuing a Ph.D., she continues to learn and overcome challenges in her field. "My professional goal is to continually challenge myself and learn more. I find that having this as a goal, in lieu of a particular project or job position, has allowed me to become involved in many interesting projects that I would not have been able to work on if I was following a strict career path," she says.

Erica has some advice to share with students as well: "I would advise undergraduates to consider taking a variety of MSE electives, as materials engineering covers a broad range of topics. Having a basic understanding of many of those topics allows you to move both within and between companies and projects, and therefore opens you up to a variety of opportunities."

While she is currently focused on steel base materials, Erica has also worked on welding, materials development, and new materials joining processes, which she would not have been able to do without a broad foundation from UConn MSE.

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