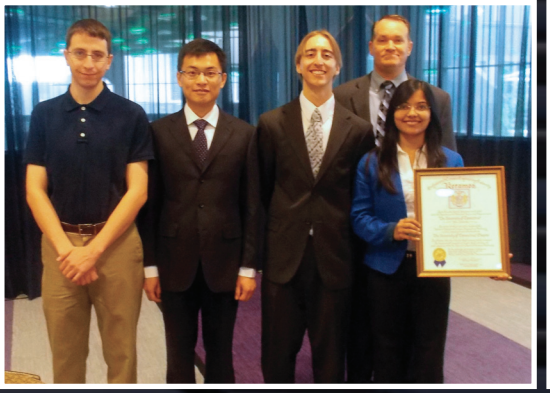
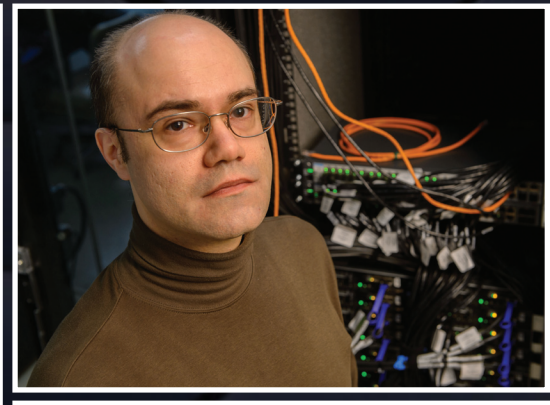
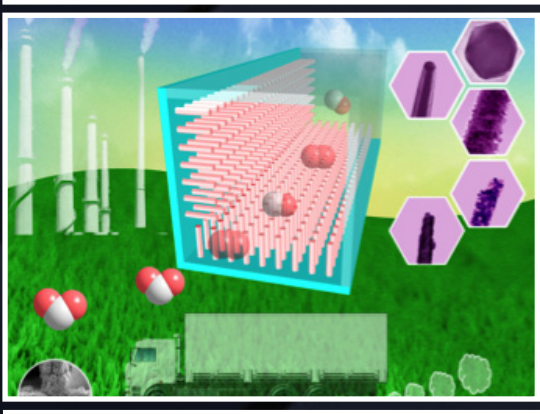


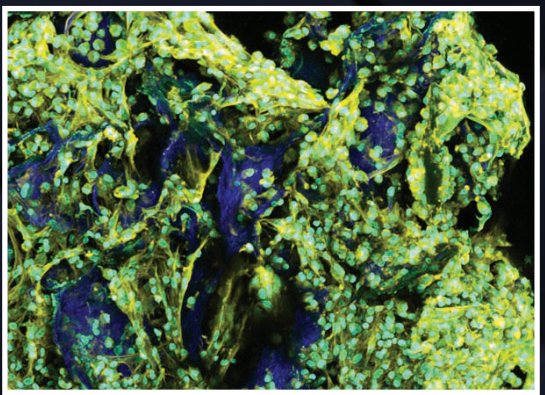
MATERIALS SCIENCE & ENGINEERING

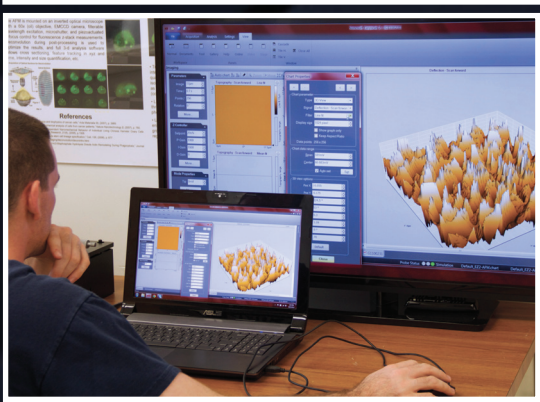
Spring 2014

UCONN









This newsletter is published for the alumni, faculty, students, corporate supporters and friends of the Department of Materials Science & Engineering at the University of Connecticut. Comments about the magazine, articles, letters, or address corrections may be sent to mseinfo@engr.uconn.edu.

INSIDE

ARTICLES BY:
Giorgina Paiella

GRAPHIC DESIGN:
Heike Brueckner

PHOTOGRAPHY:
Peter Morenus, UCONN Communications, Heike Brueckner, and others.

Cover Image Credits

1. UConn Extension 4-H Program in Litchfield County visited the Center for Clean Energy Engineering on Sunday, February 9th. Presentations on clean and sustainable energy, lab demos on fuel cell technology and polymers, and a tour of the center were given.
2. Keramos student chapter leaders Matthew Janish, Chen Jiang, Alan Harris, Dr. Hilmas (President of Keramos National Board of Directors), and Sapna Gupta at the MS&T Conference in Montreal, Canada.
3. Governor Malloy at the final approval of *Next Generation Connecticut* legislation at UConn.
4. Governor Malloy with Materials Science & Engineering students at the final approval of *Next Generation Connecticut* legislation at UConn.
5. Dr. Serge Nakhmanson
6. 3D Configurated Metal Oxide Nano-array based Monolithic Catalysts invented in Prof. Pu-Xian Gao's Nanomaterials Science Laboratory (NSL).
7. Lab manager Adam Wentworth operating the atomic force microscope (AFM).
8. Progenitor Cells seeded on a scaffold for bone tissue engineering developed in Dr. Mei Wei's laboratory.
9. Alumna Dr. Jacquelynn Garofano as featured in Connecticut Magazine's "40 Under 40" article in January 2013.

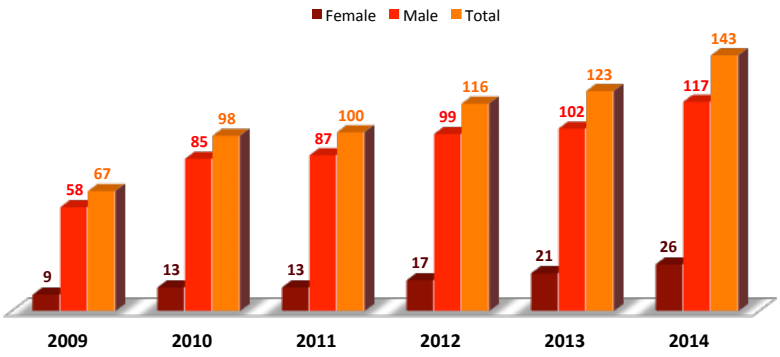
A Word from the Department Head

The past few months have brought exciting changes to the Department of Materials Science and Engineering by way of laboratory upgrades, innovative research, new faculty additions, and student group outreach.

We have experienced significant growth in the number of bright minds that will join our department. Over a period of about two months, our total undergraduate enrollment has increased to 143 students after hovering around 120 for the past three years. This expansion is a result of increased outreach and recruitment of students through media outlets, including email and a promotional video, to promote the hands-on experience, job opportunities, and top-rate faculty that a University of Connecticut MSE education has to offer.

To accompany our growing numbers, our undergraduate laboratories have received upgrades in the form of new equipment and enhanced software. These facility enhancements, in addition to hands-on laboratory courses, provide our undergraduates with a state-of-the art, interactive education.

UNDERGRADUATE STUDENTS



MSE students are more involved in the department, the campus community, and the world beyond UConn than ever before. In addition to the ongoing community outreach efforts of groups like Material Advantage, we also saw the creation of UConn's own chapter of Keramos, the National Professional Ceramic Engineering Fraternity.

We also welcome Dr. Manoj Kumar Mahapatra and Dr. Diane Van Scoter to the department as Assistant Professors-in-Residence.

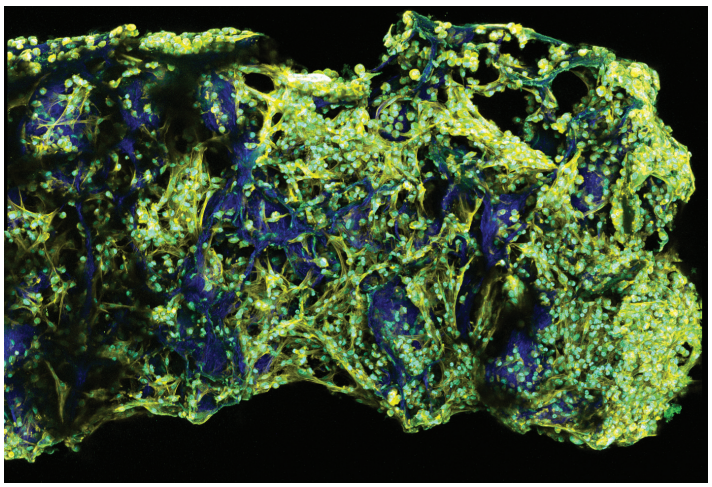
S. Pamir Alpay

"Visualizing Osteogenesis In Vivo Within a Cell–Scaffold Construct for Bone Tissue Engineering Using Two-Photon Microscopy" Contributes Cover Image to *Tissue Engineering C*

Max M. Villa, Ph.D. Student

MSE Ph.D. student Max Villa (M.S.), in conjunction with Dr. Liping Wang (M.D.), Dr. Jianping Huang (M.S.), Dr. David W. Rowe (M.D.), and MSE Professor and Associate Dean for Research and Graduate Education Dr. Mei Wei, have jointly published an article in the biomedical journal *Tissue Engineering*. The multidisciplinary journal features innovative research and applications of tissue growth and regeneration, uniting the principles of engineering and life sciences within the realm of tissue development and regenerative medicine.

The article, "Visualizing Osteogenesis In Vivo Within a Cell–Scaffold Construct for Bone Tissue Engineering Using Two-Photon Microscopy" was featured in the Part C: Methods section of the November 2013 section of *Tissue Engineering*. An optical section of a mouse skull revealing osteoprogenitor cells acquired during a live animal imaging session utilizing two-photon microscopy was featured on the cover.



Progenitor Cells seeded on a scaffold for bone tissue engineering developed in Dr. Mei Wei's laboratory.

The research project and paper focus on cell-based bone tissue engineering. While bone can regenerate itself in the case of small fractures, a more severe bone injury requires a bone graft. Presently, the best available graft is a patient's own bone, but if a patient is missing a significant amount of bone, this method simply does not supply enough to fill the void.

Cell-based bone tissue engineering has the potential to address this shortage of bone graft material, as it employs a biomaterial scaffold carrying progenitor cells that will regenerate new bone at the site of injury. However, numerous obstacles currently prevent the application of cell-based bone tissue engineering. It is not fully understood how the process works, and it is challenging to use this approach to reliably heal large defects. It is also difficult to observe this complex repair process inside a scaffold after it has been implanted.

In the paper, the authors detail a method for visualizing seeded progenitor and resident host cells as they create new bone inside of a living animal. They use genetically engineered animals that contain bone cells labeled with fluorescent proteins, which allows researchers to track bone cells in the implant. For the group, combining this labeling approach with their model allows the 3D tracking of any protein or cell of interest within a live animal and in a cell-biomaterial construct for tissue engineering. This method is also conducive to tracking the progression of repair in the same animal, allowing researchers to connect the steps of the complex regeneration process and visualize it as it develops over time.

Max Villa (M.S.), lead author of the paper, is pursuing doctoral research in bone regeneration in the Wei Laboratory. His research focuses on scaffold design and testing as well as two-photon live animal imaging.

He states of the research findings:"Just as the telescope allowed us to see new things for the first time and to ask new questions, this technique allows us to dig deeper into what contributes to successful bone tissue engineering. This methodology should deepen our understanding of this process, ultimately leading to safer and more effective tissue engineering therapies."

The full article can be accessed at:
http://online.liebertpub.com/doi/pdfplus/10.1089/ten.tec.2012.0490.

MSE Students Meet Governor Malloy at *Next Generation Connecticut* Celebration

On October 21, Governor Malloy visited UConn's Storrs campus to celebrate the final approval of *Next Generation Connecticut* legislation.

Approved by both the state legislature and Malloy this past June, the plan involves a total commitment of $1.77 billion, including $1.54 billion from the state, to expand innovation, research, and educational opportunities in the science, technology, math, and engineering (STEM) fields at UConn over the span of the next decade.

Goals of the initiative include the hiring of 259 new faculty members, of which 200 will be in the STEM disciplines, enrollment of an additional 6,580 undergraduate students, and construction of new STEM facilities and laboratories on the Storrs, Greater Hartford, and Stamford campuses. The plan is expected to attract $270 million in research dollars, $527 million in new business activity, support 4,050 permanent jobs, and increase the number of STEM graduates by 47%.

(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.

> "Somebody had to think about the future of Connecticut."

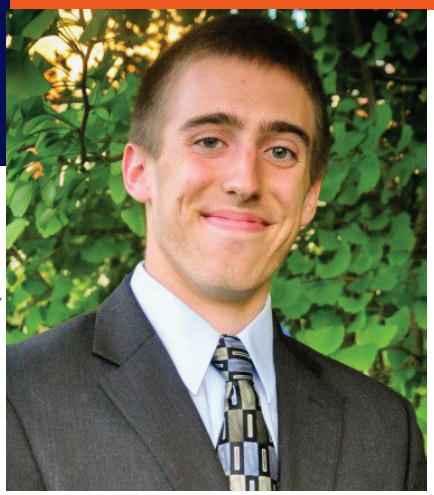
(From right to left) Rheanna Ward, Nathan Martin, Zachary Thatcher, showing Governor Dannel P. Malloy a ceramic foam space shuttle tile.

"Somebody had to think about the future of Connecticut," Malloy commented on the legislation. One of the most ambitious state investments in innovation, research, and education in the nation, *Next Generation* will create historic economic and educational growth for the university and the state of Connecticut, positioning UConn as a leading research institution and reinvigorating the state economy through technological innovation.

The ceremonial bill signing and press conference were held in the Information Technologies (ITE) Building. Also in attendance were state legislators, UConn President Susan Herbst, and various members of the engineering community. Engineering professors conducted virtual reality demonstrations for Governor Malloy following the ceremony. Department of Materials Science and Engineering (MSE) students were excited to meet Malloy and conducted experiments in magnetic levitation using ceramic superconductors produced in MSE undergraduate labs.

Dr. Bryan Huey, Materials Science and Engineering (MSE) Professor and Director of Graduate Studies, stated, "We certainly enjoyed having the opportunity to tell the Governor about materials science and demonstrate a few examples of advanced materials. The *Next Generation* investment will help us meet the needs of the state and region for even more MSE graduates."

Undergraduate Daniel Violette Awarded the *James B. Willett Educational Memorial Scholarship Award*



The Department of Material Science and Engineering is pleased to announce that UConn senior Daniel Violette (Engineering Physics) has been awarded the James B. Willett Educational Memorial Scholarship Award, a prestigious accomplishment awarded on behalf of the Universities Space Research Association (USRA).

Founded in 1969, USRA's mission is to advance the space-related sciences and exploration by way of innovative research, technology, and educational programs. Through its member institutions, USRA promotes cooperation and collaboration among universities, research organizations, and the United States government with the goal of increasing knowledge in space science and exploration. All USRA scholarships are awarded to students who have exhibited career interests in science or engineering, with a particular focus on either space research or space science education.

The James B. Willett Educational Memorial Scholarship Award honors the late Dr. James B. Willett. A native of Lexington, Kentucky, Willett received his B.S. degree in physics and astronomy from the University of Kentucky in 1962 and continued on to earn a Ph.D. in physics from Indiana University in 1969. He was an accomplished astrophysicist who collaborated with USRA through his work at the Jet Propulsion Laboratory and NASA headquarters. The award consists of a letter of recognition from the organization and a check for $1,500.

With the encouragement of Dr. Harold Brody, Distinguished Professor of Materials Science and Engineering, Violette applied to the scholarship by way of the USRA's website. The scholarship committee was impressed with Violette's application, namely his scholastic records, letter detailing his educational and career goals, and supplementing letters of recommendation. He was selected as the recipient of the scholarship from a large pool of applicants and a highly competitive selection process.

Congratulations to Daniel Violette on his accomplishment! The department wishes him all the best in his future academic and career endeavors.

UConn Material Advantage Tours *Laser Joining Technologies*

(From left to right) Lauren Salisbury, Gregory Castator, Alexandra Merkouriou, Brenden Mil-Homens, Katerine Urena-Pimentel, Ben Thieken, and James Lee

UConn members of Material Advantage had the unique opportunity to tour *Laser Joining Technologies* in conjunction with the ASM Hartford chapter.

The informative and educational tour of the company's facilities in East Granby, Connecticut allowed students to view laser welding and electron beam welding systems. Such systems are utilized in a variety of fields and applications, including medical devices, wind turbines, and pistol manufacturing. The additive manufacturing, also known as 3D printing, facility was undergoing quality control inspections at the time of the tour, but the group hopes to organize another trip to view this futuristic technology.

Material Advantage would like to thank Matt Francoeur and John Lucas for a fantastic tour and their willingness to answer student questions.

The Material Advantage Student Program is an organization for students who want to optimize their Materials Engineering experience. For a single, low membership fee, Material Advantage provides access to several distinguished engineering societies, including The American Ceramic Society and The Materials Information Society.

The UConn chapter of Material Advantage is one of the most active and successful chapters in the nation, garnering the prestigious "Chapter of Excellence" award from 2008-2010, in addition to the "World Materials Day Outreach Award" for each of the past eight years. The chapter focuses on outreach and membership development, featuring activities such as panel discussions on future career options in the field and local outreach among K-12 students.

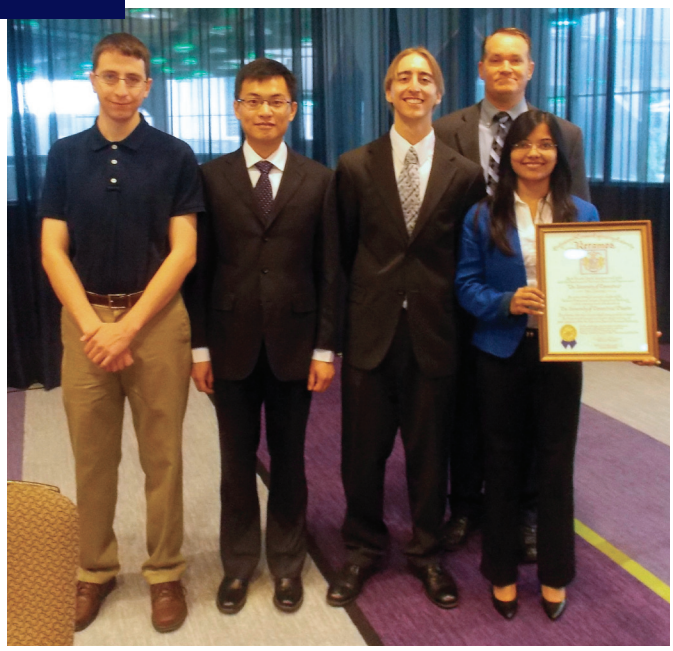
Keramos Chapter Founded at UConn

Ms. Sapna Gupta, a Materials Science and Engineering (MSE) graduate student, has founded a University of Connecticut chapter of Keramos with the support of her team leaders and chapter advisor Professor Prabhakar Singh. The chapter was formally announced during the Materials Science and Technology (MS&T '13) conference in Montreal, Canada.

Keramos, the National Professional Ceramic Engineering Fraternity, aims to stimulate scholarship, character, and development in students while promoting interest in the professional aspects of ceramic engineering, technology, and science. There are currently 12 student chapters across the country actively promoting the ideals of Keramos and ceramic engineering.

Ms. Gupta is a Ph.D. candidate in the MSE Department and Center for Clean Energy Engineering who worked with the Keramos Board of Directors to create a UConn Keramos chapter. She is pursuing research toward the development of clean and efficient energy systems, with a focus on high temperature ceramic materials and the development of advanced concepts and designs for new processes. Ms. Gupta presently works on the development and characterization of advanced ionically, electronically, and mixed conducting ceramic oxides for applications in high temperature electrochemical systems under the supervision of Professor Prabhakar Singh, Director of the Center for Clean Energy Engineering and Fraunhofer Center for Energy Innovation. Ms. Gupta is also a current finance committee chair of The American Ceramic Society (ACerS) President's Council of Student Advisors (PCSA) and was recently invited to the ACerS New England section meeting to provide a brief introduction on PCSA goals and activities.

She hopes to use the chapter as a platform to encourage and promote involvement and participation of students and faculty members from diverse backgrounds with the common goal of encouraging the future growth of Keramos and The American Ceramic Society. She states,



(From left to right) Matthew Janish, Chen Jiang, Alan Harris, Dr. Hilmas (President of Keramos National Board of Directors), and Sapna Gupta at the MS&T Conference in Montreal, Canada

"I am very proud to be a part of the ACerS, Keramos and PCSA. My desire is to contribute to the advancement of science and technology through research, development, and education, thereby serving mankind."

Congratulations and best of luck to the chapter! The leadership positions for the organization are as follows:

President: Sapna Gupta
Vice President: Austin McDannald
Treasurer: Nasser Khakpash
Secretary: Alan Harris
Herald: Chen Jiang

For more information on Keramos, visit http://ceramics.org/classes/keramos. Contact Sapna Gupta for UConn Keramos chapter details and information on how to become a member.

Other Materials Science Student Societies

Alpha Sigma Mu

Alpha Sigma Mu is an international professional and academic honors society for materials science and engineering students. Membership is by invitation only to the top 25% of juniors, seniors, and graduate students. http://alphasigmamu.engr.uconn.edu/index.html

Material Advantage

The Material Advantage Student Program is an organization for students who want to make the most of their materials education. Material Advantage provides access to distinguished materials science and engineering societies (ACerS, AIST, ASM International, and TMS). http://ucma.engr.uconn.edu/index.html

Materials Research Society (MRS)

The Materials Research Society (MRS) is a group of over 16,000 materials researchers from academia, industry, and government. Membership grants access to journal article databases and monthly publications regarding the latest developments in the field as well as extensive networking opportunities. http://mrs.engr.uconn.edu/index.html

UCONN MSE Department Contributes to Green Campus Initiatives

Initially founded as the Connecticut Global Fuel Cell Center in 2001, the Center for Clean Energy Engineering (C2E2) has played a key role in sustainability at the University of Connecticut. The Center's green campus ventures include a variety of projects, including carbon capture, natural resource conservation, power management, smart power transmission, fuel cells, and solar and wind energy.

This past July heralded the official launch by Governor Dannel Malloy of the Fraunhofer Center for Energy Innovation (CEI) at UConn, with the goal of accelerating statewide, national, and global adoption and deployment of cost-effective, sustainable energy technologies. The Center was established through a partnership among UConn, the State of Connecticut Department of Energy and Environmental Protection, and Fraunhofer USA (U.S. subsidiary of Fraunhofer-Gesellschaft, Europe's largest applied R&D organization). The Fraunhofer Center is one of only seven Fraunhofer research centers in the nation, focusing on advanced technologies pertaining to energy storage, fuel cells, in-stream hydro, and power management and distribution. Currently located in Depot Campus, there are plans to relocate the Fraunhofer Center to the UConn Technology Park once it opens.

In August, C2E2 also received $2.14 million in state funding to create an independent microgrid system with the goal of enhancing UConn's ability to provide power to the surrounding community in storm-related emergencies. UConn was one of nine grant recipients chosen from more than 20 institutional and municipal applicants to receive this award. The microgrid will allow core Depot Campus buildings to stay operational when the state faces major storm-related outages and will provide warming centers for the public.

The Department of Materials Science and Engineering (MSE) is heavily engaged in C2E2 efforts, with many MSE affiliated faculty involved in research and engineering at the Center. Professor Prabhakar Singh is the Center Director and United Technologies Corporation (UTC) Endowed Chair Professor of Fuel Cell Technology in the MSE department at UConn. Professor Singh conducts research in high temperature energy systems with a focus on systems efficiency, long term operation, and functional and structural materials for aggressive environments. His research interests also include solid- liquid- gas interactions, clean and efficient electrochemical energy conversion, and storage systems including advanced fuel cells, clean combustion, concentrated solar thermal storage, hydrocarbon processing and utilization, high temperature coatings, and novel synthesis techniques. Professor Singh's current research programs include the quantification of oxide vaporization in humidified environments, accelerated corrosion under dual atmosphere exposure conditions, electrode-electrolyte interface degradation under electrolysis conditions, and enzymatic sulfur cleanup from bio-derived fuels and carbon capture utilizing a solid- liquid agglomerated adsorbent.

Professor Radenka Maric, CT Clean Energy Fund Professor of Sustainable Energy, also contributes to sustainable campus efforts. Dr. Maric holds appointments in both the MSE and Chemical and Biomolecular Engineering (CBE) Departments. Her research focuses on the development of improved materials and processing techniques for the manufacture of fuel cells as well as innovative processing of materials using reactive spray deposition technology (RSDT). Professor Maric has concentrated on the investigation of a wide variety of electrode processes, with particular emphasis on the study and modification of electrode surfaces in order to achieve the formation of new thin film materials with interesting and useful properties. She also studies the impact of the processing conditions on electrode surface characteristics and other electrochemical reactions. The focus of this work has also been to develop a deeper understanding of electrochemical reaction kinetics and mechanisms. Her current research engages with fuel cells and batteries, hydrogen generation, nanomaterials and thin film coating, ceramic processing, electrochemical sensors, and gasification and biofuels.

Another key member of MSE at the Center for Clean Energy Engineering is Professor Manoj Mahapatra, who is completing his research in advanced functional materials development for applications in clean and efficient solid oxide fuel cell power systems, oxygen transport membranes for oxycombustion, and reliable seals for high temperature large scale stationary energy storage. In September 2013, Professor Mahapatra joined the team as an Assistant Professor-in-Residence. Professor Mahapatra also teaches MSE 4034, Corrosion Environmental Protection, in the Master's of Engineering program.

MSE Industrial Advisory Board Meeting

The UConn MSE Industrial Advisory Board convened for a meeting. The Industrial Advisory Board, comprised of seven industry partners, works to augment the visibility of the Department of Materials Science and Engineering on the university, state, and national scale. In attendance were members of the board, MSE faculty members, and student organization chapter representatives.

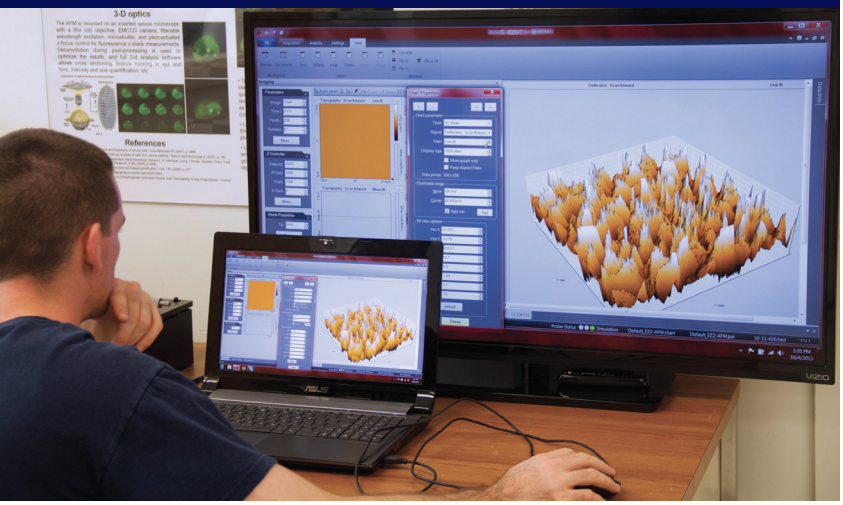
MSE Department Head Dr. Pamir Alpay provided a report detailing a current overview of the department. MSE currently has 16 full-time faculty members, 143 undergraduate students, and 80 graduate students, including 62 full-time Ph.D. students. The Capstone Senior Design Projects have also been assigned, with 26 students participating.

Dr. Steven Suib, Director of the Institute of Materials Science (IMS) and Distinguished Professor of Chemistry, and IMS Associate Director and MSE Professor, Dr. Mark Aindow, reported on the different components of IMS. Dr. Suib also discussed *Next Generation Connecticut* developments, funding opportunities, and the UConn Technology Park.

Dr. Mei Wei, MSE Professor and Associate Dean for Research and Graduate Education, led a question and answer session regarding activities in the School of Engineering. She reported that the SOE is expanding dramatically, with 18 new faculty hired last year and 16 faculty searches planned for this year. The *Next Generation Connecticut* plan to expand undergraduate enrollment in the STEM fields by 50% will also produce hundreds of new jobs at the university.

Faculty research presentations were delivered by MSE Professors Dr. Serge Nakhmanson and Dr. George Rossetti. Dr. Rainer Hebert, MSE Professor and Pratt and Whitney Additive Manufacturing Innovation (AMIC) Director, conducted an AMIC question and answer session. Student representatives of Material Advantage and the Materials Research Society had the opportunity to meet with Industrial Advisory Board Members before the meeting was adjourned.

Undergraduate Laboratory Equipment Upgrade



New and exciting changes have arrived in the Department of Materials Science and Engineering by way of laboratory renovations. Thanks to financial support from both the School of Engineering (SoE) and the Department of Materials Science and Engineering (MSE), the undergraduate teaching laboratories received more than $160,000 for equipment upgrades in the last two years.

The MSE undergraduate labs have been improved upon by the addition of new equipment, including a hydraulic press, band saw, and vacuum oven. A new computer lab boasting a suite of modeling software, including the widely used CES Edupack, will supplement the department's MSE 5320 course, Material Selection and Design.

The new equipment, in addition to three one-credit and one three-credit hands-on laboratory courses, work in tandem to create a truly state-of-the-art education for MSE undergraduate students. Supplementing these courses and new lab equipment is the work of students and faculty members on enhancement of the lab experience. Mr. Adam Wentworth (MSE Lab Manager – UConn MSE B.S., 2009, and MSE M.S., 2011) and Ms. Alexandra Merkouriou (MSE junior), for example, have already developed new lab modules on the synthesis, characterization, and measurement of properties of high-temperature superconducting yttrium barium copper oxide ceramics. "All of our new equipment will expand the opportunities for undergrads to work with all classes of materials, enhancing their hands-on experience in the lab, thus promoting and broadening their materials education," states Ms. Merkouriou.

MSE Department Head S. Pamir Alpay notes the positive effect that such improvements will have both within the Department and the School of Engineering as a whole: "These additional facilities will significantly enhance MSE's capability to support a wide range of senior capstone design projects. The laboratories and equipment will also be made available to students from all departments within the School of Engineering who are working on senior design projects."

Dr. Pamir Alpay Receives *University of Connecticut MSE Award for Teaching Excellence & Outstanding Faculty Advisor Award*

Dr. Pamir Alpay, Department Head and Professor of Materials Science and Engineering, was named a recipient of both the *University of Connecticut Materials Science and Engineering Award for Teaching Excellence* as well as the *Outstanding Faculty Advisor Award.*

The *University of Connecticut Materials Science and Engineering Award for Teaching Excellence as Determined by the Students* is awarded to the MSE faculty member who receives the greatest number of votes from Materials Science and Engineering seniors. The award was created in order to recognize faculty members who have positively influenced MSE students in regard to their academic, research, extracurricular, and personal development. The ballot allows students to reflect upon the teaching excellence that they have encountered over the span of their college experience in the MSE department.

Seniors praised Professor Alpay's strong teaching skills, involvement with students, and maintenance of both respectability and approachability in the classroom environment. In their statements nominating Dr. Alpay for the award, they noted that he is "very understanding with students" and has a "captivating and effective" teaching style.

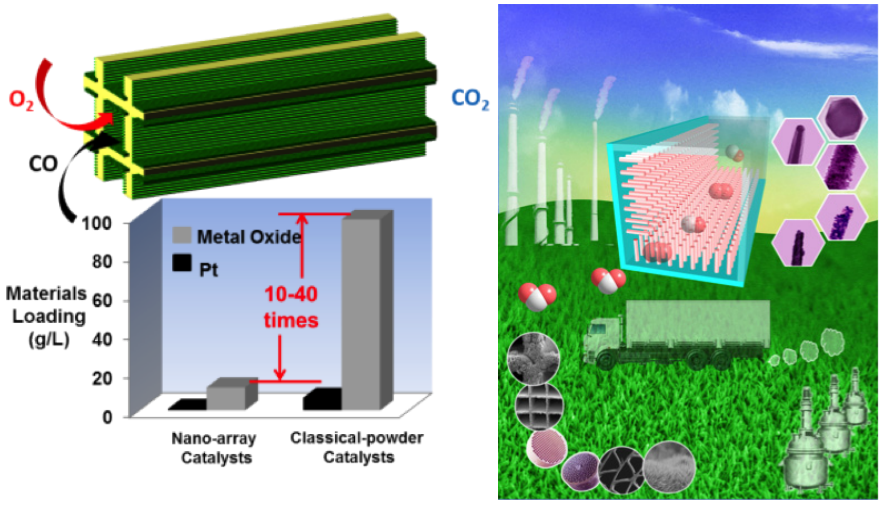
Professor Alpay is also a recipient of an *Outstanding Faculty Advisor Award*. The School of Engineering honored six faculty members for their exceptional dedication to graduate student advising. Dr. Alpay's graduate students have consistently received prestigious awards and honors, including a Science, Mathematics, and Research for Transformation (SMART) award. He has graduated ten Ph.D. students, four M.S. (thesis), and two M.S. (course-based) students. Congratulations to Professor Alpay for his outstanding achievements and contributions to the MSE department as a faculty member and advisor.

Dr. Pu-Xian Gao Awarded NSF Scalable Nanomanufacturing Grant

Dr. Pu-Xian Gao, Associate Professor from the Department of Materials Science and Engineering and the Institute of Materials Science, was awarded a $1.45 million grant from the National Science Foundation (NSF) for his project *SNM: Scalable and Sustainable Hydrothermal Manufacturing of Nano-array based Low Temperature Diesel Oxidation Catalysts*. The project is funded through a third-year NSF program focused on collaborative research and education in the area of scalable nanomanufacturing. The NSF program is both a component of, and response to, the US National Nanotechnology Initiative's (NNI) Sustainable Nanomanufacturing: Creating the Industries of the Future venture. Although many nanofabrication techniques already permit the fabrication of small quantities of nanomaterials and devices, the goal of the program is to overcome the impediments that prevent the low-cost production of useful nanomaterials on a larger, industrially-relevant scale.

For the four-year NSF project, Professor Gao is collaborating with two Mechanical Engineers, Professors Tianfeng Lu and Zhuyin Ren, and a Chemist, Professor Steven Suib, all from the University of Connecticut. Through a complementary combination of experimental and theoretical efforts, the research team aims to understand, design, and develop a new sustainable and scalable manufacturing process for a new class of nanotechnology-enabled catalytic reactors, such as the three-dimensional nanostructure array based catalytic converters (see figures 1 and 2) invented in Professor Gao's Nanomaterials Science Laboratory (NSL).
These new catalytic converters successfully integrate bare monolithic substrates with metal oxide nano-arrays and platinum (Pt) nanoparticles. With a control over the nanostructure size, shape and arrangement, the enabled catalytic devices can significantly reduce Pt and metal oxide usage by 10 to 40 fold compared to typical washcoated powder-form catalysts. The nano-array catalysts also exhibit excellent thermal and mechanical stability in addition to tunable catalytic oxidation performance. These new type of catalytic devices could provide a complementary, and necessary, catalytic after-treatment technology to low-temperature combustion engines, potentially translating to a 30 to 50% fuel savings in comparison with current automotive engines. In addition to the automotive industry, these new catalytic devices could be applied to a range of sectors and industries, including water treatment and the mechanical, chemical, and biotechnology industries.
Professor Gao notes that the project is uniquely designed and positioned to serve as a bridge between catalytic nanomaterials science and engineering research and industrial catalysis for energy and environmental sustainability. The merits associated with the development of a hydrothermal manufacturing process are twofold. On one hand, the energy savings, cost effectiveness, simplicity, and low operation temperatures of the process provide the potential for profitable and advantageous nanomanufacturing apparatus and methods. On the other hand, an understanding of the scientific nature of the hydrothermal process may influence factors such as growth rate, assembled device yield, and batch-to-batch repeatability, which are essential features of a sustainable and scalable manufacturing process. In pursuit of accurate experiment-model correlations, the research team will also address the less understood thermodynamic and transport behaviors in solutions. These research efforts may lead to the predictive control of growth rate and uniformity in the assembly of nanomaterials and device manufacturing process as well as new designs and inventions of scalable nanomanufacturing apparatus and machines.

Professor Gao states: "The aspect of using nanoscale materials and devices to industrially relevant scenarios is in a stage where people look forward to seeing, but still hold certain reservations toward, commercialization. One of the major concerns is the scalability associated with economics. The accomplishments in novel manufacturing techniques and scientific understandings will serve as two important drivers toward sustainable and scalable nanomanufacturing in this project. Another important driver is the collaborative partnership between UConn and several industrial sectors who will provide technical consulting and industrial manufacturing testbeds, which will serve as another key for the eventual success of this project, in order to achieve a scalable prototype of nano-array based catalytic reactors toward commercialization."



(Figure 1 and 2) 3D Configurated Metal Oxide Nano-array based Monolithic Catalysts invented in Prof. Pu-Xian Gao's Nanomaterials Science Laboratory (NSL): Constructed with parallel or honeycomb channels, monolithic devices such as catalysts, filters, and reactors have been utilized for diverse applications, ranging from household water treatment, use in the mechanical, automotive, chemical, and pharmaceutical industries, to the biotechnology industries. The 3D configurated nano-array based monoliths represent a new general strategy to fabricate highly efficient and robust catalysts and reactors for various industrial applications. (Adapted from Y.B. Guo, Z. Ren, et al., Nano Energy, 2013, 2, 873-881. Front cover)

Faculty Feature: Dr. Serge Nakhmanson

What do materials science research and Lewis Carroll's literary works share in common? According to MSE Professor Dr. Serge Nakhmanson, quite a bit.

"To stay current in this field, you have to be quick on your feet, and to get somewhere from where you are, you must move even faster," says Dr. Nakhmanson. It is like the Red Queen's race in Carroll's Through the Looking Glass:

"Well, in our country," said Alice, still panting a little, "you'd generally get to somewhere else — if you run very fast for a long time, as we've been doing."
"A slow sort of country!" said the Queen. "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

He continues, "In order to keep innovating, making discoveries and creating new trends in materials science at a rapid pace, we have to move really fast. Being a scientist himself, Lewis Carroll knew what he was writing about." Such a sentiment echoes the goals of programs like the Materials Genome Initiative, a collaborative government venture aimed at accelerating the discovery, manufacture, and deployment of advanced materials at a fraction of the cost.

Dr. Nakhmanson first joined the UConn MSE department in the winter of 2013 and started teaching as an Associate Professor this past August. Dr. Nakhmanson's research utilizes the principles of solid-state physics, chemistry, and computer science to design and discover advanced multifunctional materials. While he works with laws of quantum mechanics on the length scale of individual atoms and bonds, Nakhmanson also acknowledges the essential collaborations between theorists who develop novel materials concepts and experimentalists who actually grow and characterise these materials. This symbiosis facilitates the exchange of ideas and the flow of information across different disciplines and expertise areas, accelerating the discovery of novel compounds with advanced properties.

Professor Nakhmanson received his Ph.D. in 2001 from Ohio University, where he studied the properties of amorphous materials with first-principles and empirical simulation techniques with Professor David A. Drabold. He then joined Professor Jerry Bernholc at North Carolina State University as a junior post-doctoral fellow to investigate the polar and piezoelectric properties of BN nanotubes and electroactive polymers. In 2004, Dr. Nakhmanson joined Professors David Vanderbilt and Karin Rabe at Rutgers as a senior postdoctoral researcher working on prediction and enhancement of polar properties of functional complex oxide heterostructures.

Prior to joining the UConn MSE Department, Dr. Nakhmanson was a staff member in the Interfacial Materials group of the Materials Science Division at Argonne National Laboratory starting in 2006, where he focused on designing and evaluating new electroactive materials with a variety of computational approaches. His research interests include the development of methodologies for rational design of multifunctional ferroic materials — including complex oxide, polymer and molecular crystal compounds —exploring phase transformations in these materials with the help of quantum mechanical computations to optimize their properties, and mesoscale simulations to study their behavior at long time and extended length scales.

Dr. Nakhmanson's research group currently includes a post-doctoral associate, Dr. Lydie Louis, a graduate student, Krishna Pitike, and an undergraduate student, Lukasz Kuna. The group is also involved in ongoing collaborations with Dr. William Parker and Dr. Shiyuan Gu, Dr. Nakhmanson's postdocs at Argonne.

On joining UConn MSE, Professor Nakhmanson states: "I am very happy to be here, as UConn, and my academic department in particular, provide a perfect match for the work that I do. IMS is a unique structure that unites researchers and professors from multiple departments and disciplines to work together in a transparent fashion. This impresses me very much, as such involved cooperation, rather than competition, is not always the case elsewhere."

More information about Nakhmanson's research can be found on his research group's website: http://satori.ims.uconn.edu/.

"Accelerating Materials Property Predictions Using Machine Learning" Published in *Scientific Reports*

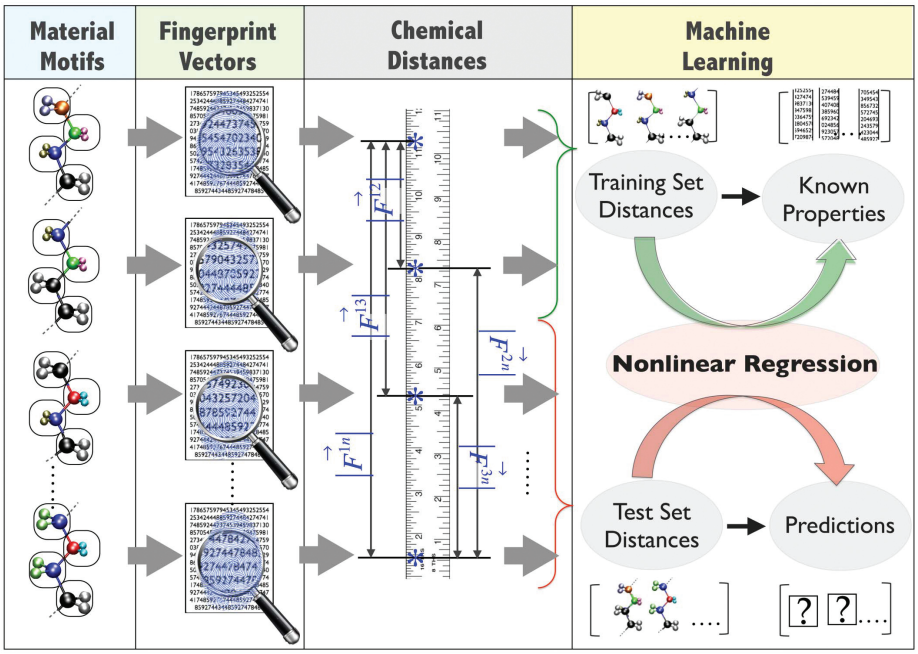
Professor Ramamurthy Ramprasad, postdoctoral fellow Dr. Ghanshyam Pilania, and doctoral candidate Chenchen Wang of Materials Science and Engineering, in conjunction with Professor Sanguthevar Rajasekaran (Computer Science and Engineering) and Dr. Xun Jiang (Ph.D. Statistics 2013), jointly collaborated on a research paper published online on September 30, 2013 in *Scientific Reports*, the open access journal of *Nature*.

The paper, entitled "Accelerating Materials Property Predictions using Machine Learning," details the researchers' findings.

The authors demonstrate that data-driven methods may be used for the rapid prediction of a diverse set of material properties by employing machine learning methods, part of an emerging brand of informatics tools aimed at materials discovery. These findings parallel the goals of the Materials Genome Initiative, a collaborative government venture aimed at accelerating the discovery, manufacture, and deployment of advanced materials at a fraction of the cost. The authors apply this materials property prediction paradigm to a class of polymers, and have identified tin-containing polymers as particularly promising for electronic and energy storage applications.

Professor Ramprasad notes the broad implications of this development in the area of materials discovery. He states: "Although the initial materials dataset that we used were generated using quantum mechanics based modeling, the adopted strategy may be used in conjunction with experimental, empirical or other computational data to enable accelerated materials discovery." Therefore, this concept can be utilized in a wide range of datasets, applications, and disciplines.

The paper is based upon research and work supported by a Multidisciplinary University Research Initiative (MURI) grant. Professor Ramprasad was awarded a MURI grant in July 2010 to guide the design and synthesis of polymeric films for capacitive energy storage. The grant was awarded by the Office of Naval Research with the purpose of supporting teams of researchers investigating high-priority topics that intersect more than one traditional science and engineering discipline.



The machine (or statistical) learning methodology. First, material motifs within a class are reduced to numerical fingerprint vectors. Next, a suitable measure of chemical (dis)similarity, or chemical distance, is used within a learning scheme—in this case, kernel ridge regression—to map the distances to properties.

Professors Mahapatra and Van Scoter Appointed Assistant Professors-in-Residence

The department is pleased to welcome Dr. Mahapatra and Dr. Van Scoter to its teaching faculty.

After graduating with a Ph.D. in Materials Science and Engineering from Virginia Polytechnic Institute and State University in 2009, Dr. Mahapatra has since served as a Postdoctoral Fellow and Assistant Research Professor with the Center for Clean Energy Engineering. Dr. Mahapatra's current research focuses on functional ceramics, glass, and composites for advanced energy applications.

Dr. Van Scoter earned a B. S. and an M.S. in Ceramic Engineering from the University of Washington-Seattle, an M.S. in Operations Research from the Colorado School of Mines, and a Ph.D. in Industrial Engineering from Oregon State University. She has over twenty years of diverse industry experience. Dr. Van Scoter will simultaneously continue her appointment as Co-Director of the Management and Engineering for Manufacturing program.

UConn MSE Alumna Profile: Dr. Jacquelynn Garofano

Dr. Jacquelynn Garofano as featured in Connecticut Magazine's "40 Under 40" article in January 2013.

Name: Dr. Jacquelynn Garofano
Hometown: Milford, CT
Graduating Class: Ph.D. in (Sept) 2011 – Participated in 2012 Commencement

Why did you choose to study at the University of Connecticut?
I chose to attend graduate school at UConn because I wanted to stay in CT and pursue a new discipline. (I studied physics as an undergrad.) I learned about UConn from my undergraduate advisor and she recommended the MSE program and Dr. Aindow to me. I was interested in materials research with a focus on electron microscopy characterization and I knew this was the program I wanted to be in, as it was highly regarded.

What first attracted you to the Materials Science and Engineering (MSE) graduate program?
I studied physics and chemistry as an undergrad. I graduated with a B.S. (Honors) in Physics at Southern CT State University (SCSU). During my undergrad, I started to do research in the lab and it was then that I learned about materials science. Prior to this, I had no idea what materials science and engineering was about. MSE was attractive to me because it was an interdisciplinary field with a lot of breadth. Having studied the fundamental sciences (physics and chemistry), I knew I wanted to venture into a science and engineering discipline that would be challenging and different for my graduate studies.

What was your favorite MSE class and why?
I think that the MSE program has great faculty. I enjoyed all of the classes that I took; most notably, I really enjoyed taking classes with Dr. Alpay – he has a way of making difficult content interesting and comprehensible. If I had to choose, I'd have to say that the "Transmission Electron Microscopy" course taught by Dr. Aindow was my favorite class. I was able to learn much more about TEM which helped to reinforce my research and it had a hands-on (lab) component which I appreciated.

What research, extracurricular activities, internships, or other experiences were you involved with as a student?
At UConn, I founded the Materials Research Society (MRS) University Chapter in 2008 and served as its President for two years (2008 – 2010). I served on the Executive Committee of the Material Advantage Student Chapter for three years (2006 – 2009). Material Advantage was an organization that did a great deal of outreach both on campus and within the local community. I also served as a Chapter Representative on the MSE Faculty-Student Liaison Committee for two years (2007 – 2009).

What work did you complete for your thesis/dissertation?
My expertise is in materials characterization, primarily transmission electron microscopy (TEM). My Master's thesis research focused on high-resolution electron microscopy characterization of laser-processed Ni-based superalloys. My doctoral dissertation research involved microstructural characterization to study the phase evolution and homogeneity of magnesia/yttria nanocomposites for optical components.

What have you been doing since you graduated and how has your materials education influenced your job or other involvements?
I joined United Technologies Research Center in East Hartford in Sept. 2011 (after finishing my Ph.D.). I am a Senior Research Scientist in the Measurement Science group. Working in industry, I am exposed to a lot of different materials and applications, learning new things all the time. While I find that on-the-job training and inquiry is necessary at times, I am still able to leverage my characterization skills/talents (e.g. electron microscopy techniques) and my knowledge of MSE to contribute to projects.

Looking back on your time at UConn, do you have any advice or recommendations for students to have the best experience here?
My advice to students would be to try to gain as much experience as you can: research experiences, extracurricular activities and university service/volunteerism. All will serve you well and will make you an attractive candidate for either graduate studies or entering into the workforce. Networking is important so take advantage of opportunities. Don't be afraid to be inquisitive. Be mindful that it's acceptable, and sometimes better, to say "I don't know" rather than trying to speak to something you are not familiar with.

What are your future academic and career goals?
I've been in the working world for two years so I feel that I am still in the formative years of my career. I think at this point in my life, I'd just like to continue to learn and grow and see where my career will take me.

UConn MSE Alumnus Profile: Shawn Fonseca

Name: Shawn Fonseca
Hometown: Newington, CT
Graduating Class: December 2010

What first attracted you to the Materials Science and Engineering (MSE) major?
As I entered my first day as an engineer at UConn, I quickly realized that I had no idea what engineering was. All I knew was that engineers were good at math, enjoyed physics, and were adept at solving problems. Realizing that there were many types of engineering to choose from instantly increased my stress levels as a freshman. The Engineering 100 course that all freshmen were required to take became a needed resource that I took seriously. I attended every lecture and listened to professors discuss each different type of engineering that was offered and attended as many of the "field trips" to the departments as possible. It just so happened that the Materials Science and Engineering presentation immediately sparked my interest. I quickly realized how influential materials are to our everyday life and future innovations. I realized that materials were the gateway to future solutions and I wanted to learn as much as I could. I also chose to explore Mechanical Engineering and eventually double majored in both MSE and ME.

What was your favorite MSE class and why?
I would have to say that my favorite MSE class came during my graduate work in the MSE program. Of my graduate level classes, I would say that "Transport Phenomena" with Dr. Rossetti was my favorite class. The problem solving I learned in this class seemed so applicable to everyday engineering problems and directly tied in with several Mechanical Engineering concepts that I had learned throughout my undergraduate years.

What research, extracurricular activities, internships, or other experiences were you involved with as a student?
With respect to soccer, I was a member of the Men's Club Soccer Team from Fall 2006 to Spring 2010 where I was President and Captain for the 2008 and 2009 Fall seasons. Following this, I tried out and walked onto the Men's Varsity Soccer team for the Fall 2010 season. I was also a committee member for the Annual Special Olympics Husky Classic for 3 years. For internships, I was able to obtain two summer internships with General Electric located in Plainville, CT. I became a fulltime employee for GE at the same office as a member of their Edison Engineering Development Program (EEDP) in the Summer of 2011.

What work did you complete for your senior design project?
Due to my double major, I was given the opportunity to complete two senior design projects; one for Materials Science and Engineering and one for Mechanical Engineering. Fortunately, I was able to tie both projects together under the same topic provided by General Electric. Serving as the link between the Mechanical and Materials teams, we successfully characterized a ferromagnetic shape memory alloy. Our work showed the material links to the mechanical phenomenon found in the actuating capabilities of the material. Our hard work paid off, as we were awarded first prize in both the Materials Science and Engineering and Mechanical Engineering Senior Design Competitions.

What have you been doing since you graduated and how has your materials education influenced your job or other involvements?
Since graduation, I have been working full time as an engineer at General Electric Industrial Solutions in Plainville, CT working on industrial, commercial, and residential circuit breakers and other electrical distribution products. I recently graduated from the Edison Engineering Development Program and the Advanced Courses in Engineering Programs in August of 2013. My materials background has provided many opportunities with different types of projects throughout these years and always gives me a different perspective on how to solve problems and design unique solutions. Throughout this time, I also worked on my Master's Degree part time in the MSE department, which I completed in August of 2013. My research was focused on calculating the cooling efficiency of perovskite ferroelectric thin films by utilizing them as the medium in the Ericsson and Stirling Refrigeration cycles.

Looking back on your time at UConn, do you have any advice or recommendations for students to have the best experience here?
One piece of advice is to never be shy to ask for help. Find study groups, or locate a mentor or tutor, or (my favorite) establish a relationship with a professor. A class that provides the highest degree of struggle is often the class that you learn the most from. The best advice that I could give to current and prospective students would be to take advantage of all the opportunities that UConn provides academically and socially. Through all the hard work, it is also important to enjoy your life as a college student. Get involved in as many clubs, teams, and groups as you can and meet as many people as possible. This is the best networking opportunity of your life. And of course, it's important to visit Ted's from time to time… it's tradition!

What are your future academic and career goals?
Now that I have completed my Master's Degree, I have the option to continue my education and pursue a PhD, get an MBA so I can learn how to talk the business talk, or focus on my career. At the moment I am focusing on my career, but am keeping my ears and eyes open to a project at work that may provide an opportunity for a doctoral dissertation at UConn. Ultimately, my career goal is to be in my company's technology leadership. In the end, I feel as though my career will dictate my academic goals. I am confident that no matter what path I take, as long as I work hard and continue learning on a daily basis, I will achieve my goals.

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Contact Heike Brueckner at heike@engr.uconn.edu.

University of Connecticut
Department of Materials Science & Engineering
97 North Eagleville Road, Unit 3136
Storrs, CT 06269-3136
Tel: 860.486.9307
Fax: 860.486.4745

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