INSTITUTE OF MATERIALS SCIENCE

IMS 2021 Newsletter

UCONN
UNIVERSITY OF CONNECTICUT

INSTITUTE OF MATERIALS SCIENCE

IMS Newsletter Production

Director
Dr. Steven L. Suib

Associate Director
Dr. Rainer Hebert

IMS Polymer Program
Dr. Luyi Sun, Director

Materials Science and Engineering Department
Dr. Bryan Huey, Department Head

IMS Industrial Affiliates Program
Dr. Paul Nahass, Director
Dr. Hatice Bodugoz-Senturk, Associate Director

IMS Contributing Writers
Kaitlyn Cullen
Osker Dahabsu
Rhonda Ward

Additional Contributions
Hartford Business Journal
Ohio State University, MSE Department
Raytheon Technologies
UConn Communications
UConn IPB Tech Park
UConn Materials Science and Engineering Dept.
UConn Office of the Vice President for Research
UConn School of Engineering
UConn Today

Design and Layout
Rhonda Ward

Institute of Materials Science
97 North Eagleville Road, Unit 3136
Storrs, CT 06269-3136
Phone: (860) 486-4623
Fax: (860) 486-4745

On the Cover:

Top row (l-r):
Custom-fit mask frames are delivered to to the UConn Health intensive care unit; Dr. Kelly Burke is one of three recipients of the NSF CAREER Award for 2020; UConn hand sanitizer produced by the Fraunhöfer USA Center for Energy Innovation

Second row (l-r):
UConn broke ground on Science 1, the future home of IMS; Dr. Cato Laurencin was one of two IMS members to receive the Convergence Award for Research in Interdisciplinary Centers (CARIC); Ph.D. Student Erin Curry accepting the Physics Department Teaching Award

Third row (l-r):
Drs. Yang Qin, Xueju "Sophie" Wang, and Yi Zhang joined the IMS as faculty members

Fourth row:
Dr. Yuanyuan Zhu was awarded funding from the American Chemical Society (ACS)

Fifth row:
We remember the contributions of Dr. Harris Marcus, former Director of IMS, who passed away in January 2021

IN THIS ISSUE

MESSAGE FROM THE DIRECTOR

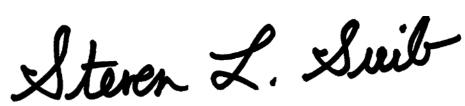
Greetings from the Institute of Materials Science!

We hope that all is well with you and your families during these difficult times. The pandemic has complicated all of our lives at work and home. Several people in IMS have been working the front lines concerning new ways to measure COVID-19, on potential cures, and treatments. Our labs re-opened under restrictions of using PPE and social distancing. Staff members continue working hard to make sure that problems are solved, facilities remain open and accessible, and that normal day-to-day operations continue as much as possible. We are currently operating at about a 90% level with hope to return to pre-pandemic conditions soon.

There have been lots of excellent happenings in IMS this past year. We thank Laura Pinatti and Shari Masinda for their excellent work and wish them all the best in their retirement. At the same time we welcomed Kayla Burgess as our new grants and contracts specialist. Yang Qin (Chemical and Biomolecular Engineering), Sophie Wang (Materials Science and Engineering), and Yi Zhang (Biomedical Engineering) are three new faculty members that were recruited and bring to UConn outstanding research programs. The last steel beam of our new home in Science 1 was signed and installed June 17, 2021 with a move-in date of August 2022. We are all very excited about this new facility which will serve IMS, MSE, and the University community.

We are thankful for the excellent treatment afforded us by University administration during these difficult times, especially by our Provost Carl Lejuez whose support, insight, and experience have been on display in our External Advisory Board meetings and at the Annual Meeting of the Industrial Affiliates Program.

You can read about more outstanding contributions of our Staff, Faculty, and Students in this issue of IMS News. As always, we wish you the best and hope to see you soon.



Steven L. Suib, Director
Institute of Materials Science

IMS Members Respond to the COVID-19 Pandemic

Institute of Materials Science

As the reality of the COVID-19 pandemic became clear beginning in March of 2020, IMS was forced to shutter operations until safety standards could be established and implemented. Our staff began telecommuting to keep administrative tasks on target but laboratories remained closed pending those safety policies.

In the face of personal protective equipment (PPE) shortages for frontline healthcare workers and ventilators for coronavirus patients during the initial outbreak, IMS faculty members stepped up in creative ways. They worked to design custom-fitting masks, developed a prototype for an emergency-use ventilator, and produced hand sanitizer.

Dr. Jeffrey McCutcheon, in collaboration with the Fraunhöfer Center, led a team developing a prototype of an emergency ventilator that could be produced by Connecticut manufacturers to help ease the anticipated shortage of the devices as the novel coronavirus continued to spread across the state.

As a first step, the team built a prototype of the ventilator using a number of plastic parts. A second generation model was recently completed that is made out of aluminum.

McCutcheon's hope was that the prototype used parts that would be easy to make by Connecticut manufacturers working in metal or machinery.

"It's a clever, simple approach to produce a rapidly deployable emergency ventilator. If the health care professionals in the state or region see a shortage coming based on the models of ICU admittance, they could use these and not start from scratch."

Dr. Cato Laurencin was first to point out the racial disparity in deaths from the virus. A review of public health data through the first few weeks of the COVID-19 pandemic found disproportionate infection and mortality rates in Connecticut's minority populations, particularly among Blacks.

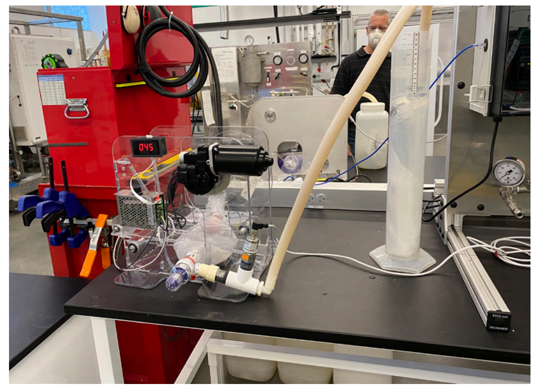
"We had the first peer-reviewed, published study that really stated that," said Dr. Laurencin, CEO of the Connecticut Convergence Institute for Translation in Regenerative Engineering at UConn Health and lead author. "Also, we're very proud that we pushed the state to move forward in terms of getting the data. Once they got the data and saw all the data, they realized that this was important to place on the state website for all to see." Not long after the release of Dr. Laurencin's findings, the nation began to wake up to the reality of the disparities.

Working with the Fraunhöfer USA Center for Energy Innovation, located in the Innovation Partnership Building at UConn's Tech Park, chemical engineering doctoral student Noah Ferguson led a project that produced Husky Hand Sanitizer for distribution to local facilities and charities. The hand sanitizer was produced to World Health Organization (WHO) specifications.

The Connecticut Convergence Institute for Translation in Regenerative Engineering developed a method to fabricate custom-fit mask frames and exoskeletons to give conventional masks the optimal protective qualities of N95 respirators.

"We use a combination of facial recognition software and 3D printing to create the exact dimensions and make the perfect size," says Dr. Cato T. Laurencin, the Institute's CEO. "It's very difficult to make one-size fits all, and one size shouldn't fit all."

IMS is proud of our faculty, students, and staff. We salute them for rising to the challenges presented by the coronavirus pandemic.



The second generation prototype of the emergency ventilator.

Amir Seyedsalehi, a graduate research assistant in the Connecticut Convergence Institute for Translation in Regenerative Engineering, delivers custom-fit mask frames to the UConn Health intensive care unit, with nurse manager Patricia Hurley (left) and assistant nurse manager Crystall Coe (right). (Photo by Godwin Dzidotor)

UConn hand sanitizer is being produced by the Fraunhöfer USA Center for Energy Innovation.

Construction Kicks Off on UConn's Transformational New Science Quad, Future Home of IMS

UConn Today

An architect's conception of what the Northwest Science Quad will look like from above once construction is completed. (Courtesy of Payette)

A transformational science complex that ties together UConn's research expansion, academic vision, and culture of innovation is taking shape on the Storrs campus with the recent start of construction at the site.

The Northwest Science Quad, a complex that includes a 198,000-square-foot modern research facility and related amenities, is a cornerstone of the Next Generation Connecticut program adopted by the Connecticut General Assembly in 2013 to expand research and education in STEM fields (science, technology, engineering and math).

In addition to construction of a new building to be known as Science 1, the Northwest Science Quad project includes a Supplemental Utility Plant (SUP), a passive open space corridor running east to west through the property, an extension of the existing utility tunnel and associated parking.

If all remains on schedule, the research labs and other facilities inside the high-tech building would be ready to use by fall 2022.

"This project is a crucial step forward in the state's investment in UConn as an engine for innovation and economic development in Connecticut," says Carl W. Lejuez, UConn's provost and executive vice president for academic affairs. "It also builds on one of President Katsouleas's key priorities to boost entrepreneurship and research funding. I am excited to see these new facilities start to take shape and enhance the resources available to our faculty, staff, and students to advance Connecticut as a leading hub of STEM innovation."

The Science 1 building will be one of UConn's largest and most technologically advanced facilities and will house research, teaching and core laboratories; a 240-seat active-learning room to engage students more dynamically than traditional lecture halls; along with faculty offices, public spaces including a new cafe, administrative support offices, and informal gathering spaces.

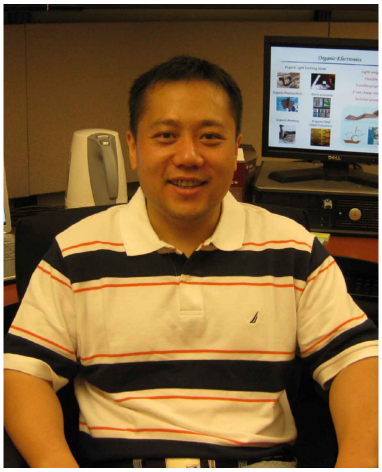
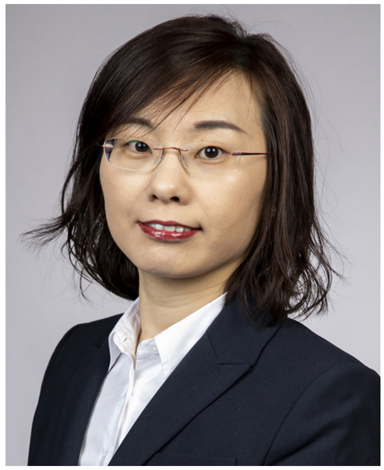
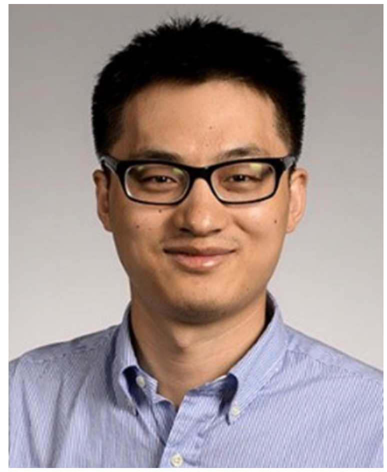
The building's labs include traditional "wet" labs with chemicals, liquids, and other substances used for testing and analysis; along with "dry" labs where computer-generated models are created using computers for investigating a wide array of material science applications. It also includes a "clean room" designed to support specialized scientific research in a tightly controlled environment where contamination is minimized to protect the work by filtering airborne dust or other particulates from within the room.

"The plans for labs in Science 1 will bring to the forefront state-of-the-art facilities for interdisciplinary teaching, research, and outreach," says Steven L. Suib, UConn Board of Trustees Distinguished Professor in Chemistry and Director of the Institute of Materials Science, the largest UConn academic enterprise that will move from the nearby Gant Science Complex to the new building.

"The new interactive learning room will be used by many on campus," Suib says. "Several core lab facilities will also allow researchers to carry out new research, sensitive projects, and provide opportunities for large multi-disciplinary activities with considerable outreach to researchers from industry as well as government labs."

IMS Welcomes New Faculty Members

Institute of Materials Science

(l-r) Drs. Yang Qin, Xueju "Sophie" Wang, and Yi Zhang

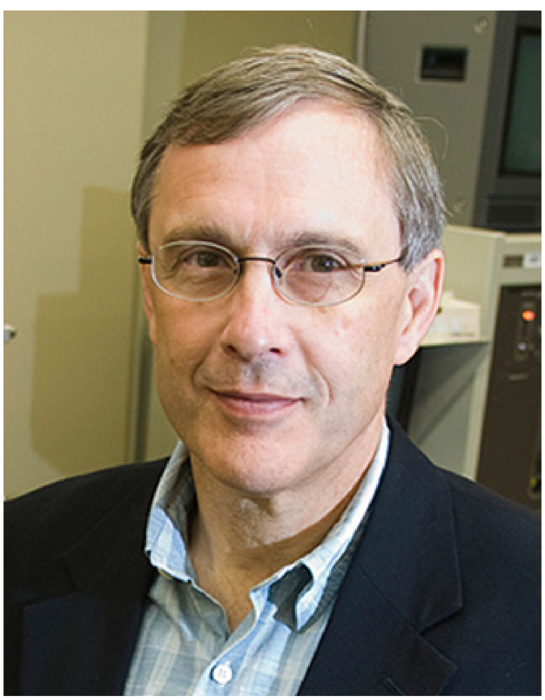
Dr. Yang Qin earned his Ph.D. from Rutgers University. His academic home is the Department of Chemical and Biomolecular Engineering. Dr. Qin's research interests focus on design and synthesis of conjugated organic and polymeric materials, organic/inorganic hybrid materials, and their applications in energy and environment.

Dr. Sophie Wang holds a Ph.D. from Georgia Institute of Technology. Her research interests include soft/active/smart materials, nanomechanics and micromechanics of advanced materials, energy storage and conversion, flexible/stretchable/bio-integrated electronics, and in-situ/environmental operando experimental techniques. Dr. Wang is a faculty member of the Materials Science and Engineering Department.

Dr. Yi Zhang received his Ph.D. from Georgia Institute of Technology and is a member of UConn's Department of Biomedical Engineering. His research interests include soft materials, bioelectronics and biosensors, colloids and interfacial science.

IMS Director's Research Featured in *The Economist*

Institute of Materials Science



IMS Director, Dr. Steven L. Suib

Imagine being able to create water from thin air. The ramifications for desert communities would be enormous. IMS Director Dr. Steven L. Suib has found a way to do just that by employing adsorption, a process by which water molecules are captured from air with less than 100% humidity and attached to the surface of a solid material allowing the water to be collected, absorbed, and stored. This research is the subject of an article in the January 11, 2020 edition of *The Economist*.

Dr. Suib's research investigates the water sorption characteristic of birnessite (i.e. a layered structure manganese dioxide, or MnO2) from both thermodynamic and kinetic perspectives. According to the research, MnO2 is widely found in nature and possesses layered and tunnel structures that can adsorb between 4.8% and 16.2% of atmospheric water. Birnessite MnO2 is a better potential alternative material for water harvesting as it displays a layered structure with cations and water molecules intercalated. More importantly, MnO2 features solar absorptivity and can convert solar to thermal energy. The abundance of natural birnessite and the ability to create it artificially also make it a cheaper candidate for water harvesting applications.

Dr. Suib outlines his research in a paper, "Water Harvesting from the Atmosphere in Arid Areas with Manganese Dioxide", published in *Environmental Science and Technology Letters*, a publication of the American Chemical Society in its December 19, 2019 issue.

Dr. Anson Ma Receives USDA Grant to Fund Research into 3D Printing

School of Engineering

Dr. Anson Ma

Armed with a four-year, $470,000 grant from USDA's National Institute of Food and Agriculture, National Science Foundation (NSF) SHAP3D Center Site Director and Associate Professor of Chemical Engineering and Polymers Anson Ma—and his collaborator, Qian Yang, Assistant Professor of Computer Science and Engineering—are working on creating pulse-based food products with novel textures and customized nutritional profiles using machine learning and a specially designed 3D printer.

Pulses, which encompass all edible seeds in the legume family—including chickpeas, dry beans, lentils, and more—are seen as viable nutritional sources, as they are high in protein, complex carbohydrates, and low in calories and fat. During the next four years, the two researchers will work in conjunction with the U.S. Army Combat Capabilities Development Command (CCDC) Soldier Center (Natick, MA) to test their methods and results.

Ma and Yang will use UConn's state-of-the-art pilot scale HuskyJet 3D printer housed at UConn's Innovation Partnership Building. The versatile printer has a number of applications, which range from regular graphics on paper, to creating flexible electronics, medicinal tablets, and green parts for ceramics and metals. The printer was funded by UConn's Academic Plan and has already been leveraged for a number of projects, including projects funded by the NSF SHAP3D center and a federally funded project from NextFlex – America's Flexible Hybrid Electronics Manufacturing Innovation Institute – both of which UConn is a founding academic member.

CCDC-Soldier Center will provide expertise in food 3D printing and nutritional solutions. Food is unlike other material used in 3D printing, it is a uniquely complex non-linear material. CCDC-Soldier Center maintains 3D food prints with the capabilities and knowledge to characterize food matrices, conduct shelf-stability testing, evaluate sensory characteristics and perform nutritional and food microbiological analysis.

A number of societal benefits will be realized through this project. First, the ability to produce food that will meet an individual's energy and nutrient needs, as well as flavor and texture preferences, and will help promote a healthier lifestyle. Second, by making the 3D printing technology more accessible, consumers will be able to experiment with different food forms at home, fostering creativity in the younger generations and changing their relationships with pulse-based products. Third, 3D food printers can function as standalone food production systems that could be used in disaster relief situations and austere environments. Lastly, the 3D food printing technology developed in this project can potentially be adapted for using a wide variety of sustainable feedstock materials.

Dr. Thomas Seery Serves Up a Special Course on Wine

Excerpted from a story from the Chronicle (of Eastern Connecticut)

Dr. Thomas Seery

It's a big world out there when it comes to wine, the libation made from fruit of the vine.

Enter Thomas Seery, professor at the University of Connecticut, who teaches a class on "Understanding Wine Chemistry." Seery lands in the right place at the right time when he makes his connections. He's been teaching this class in Shanghai in the summers. Through a series of fortunate events, including passport control, meeting wives of professors and a group of scholars coming to UConn, Seery brings his interests in wine to the college community and beyond.

Throughout my Zoom interview, I heard words like tannins, retronasal, terpene and umami. Umami is a category of taste in food. I thought there were only four basic tastes, but there are more. It's related to the flavor of glutamates.

The syllabus for a semester of Seery's class included the physical chemistry of water/alcohol mixtures, understanding the fermentation process, the intricate and complex process of how fruit is grown (think how, where, amount of rain, sun and other elemental influences, how skins, seeds and stems contribute to the flavor, how yeasts act in the fermentation process, and so much more).

Is the taste astringent? Pungent? How about taste sensations? Does the tongue agree with the nose? How does the mouth feel? What is the bouquet/smell in the glass that is (only) a third full? These questions are addressed through the class.

And in case you were wondering, no, there is no tasting allowed in class since it is typically taught to undergraduates.

Dr. Bryan Huey is Digging Into a More Cost-Effective Solar Technology

School of Engineering

Solar panel technology has seemingly boomed over the last 20 years, but when you dig into the numbers, only six percent of U.S. homes have panels installed on their roofs. The prevailing material used in solar cells is silicon, which is easy to manufacture and lasts decades, but the cost has remained high. University of Connecticut Materials Science and Engineering Department Head Bryan Huey and his postdoc Jingfeng Song have produced some compelling research reported in the journal *Nature Communications* that could lead to another lesser-known material to come to market at a fraction of the price.

MSE Department Head, Dr. Bryan Huey

The material, known as hybrid perovskites (HPs), can be manufactured into a thin film that is 200 times thinner than a conventional silicon cell but is just as efficient.

The biggest problem, says Huey, is their longevity does not yet match silicon cells, which are the prevailing material used in solar cells.

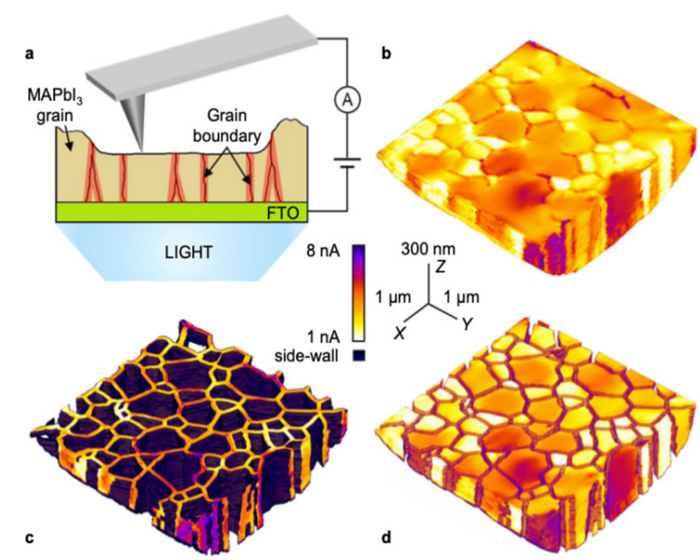
"The primary limitation thus far is that their lifetime cannot yet compete with modern silicon cells, especially because the perovskites are highly sensitive to humidity. From an engineering perspective, that ought to be solvable—we also needed to figure out how to protect silicon from humidity, and now those panels can be warrantied to still produce 80% of their installed efficiency after 25 years. Current targets are for 50 years," Huey said.

"Imagine any other technology being able to keep working so well after so long. If the perovskite thin film's cells can survive even to just 5-10 years, they'll begin to displace silicon panels due to cost advantages."

"Imagine any other technology being able to keep working so well after so long."

~Dr. Bryan Huey

To help accelerate the technology to market, Huey and his team have spent the past several years developing a unique method of 3D mapping called tomographic atomic force microscopy (T-AFM). In this technique, which uses a super-hard tip to scrape away and map the layers of the material, researchers were able to study the grain boundaries of the material, which had previously only been studied at the surface.



Some of the visuals captured by Dr. Huey and his team of crucial grain boundaries. (Courtesy of Dr. Bryan Huey)

Huey said that studying the grain boundaries beneath the initial surface allows scientists to understand the functionality of energy generation more accurately.

"Surprisingly, we found a new type of grain boundary, which is almost indistinguishable from the other interfaces at the top surface. After digging into the HP thin film, these interfaces behave as if there is no grain boundary at all. They don't provide any particular advantage compared to the adjacent grains, and indeed photo-generated electron and holes carriers are almost free to travel across them, instead of channeling along them. Without our T-AFM advances at UConn, thanks to an NSF grant along with support from the SOE and IMS, we'd all still be guessing at what lies beneath the surface."

With this new research out, Huey hopes that scientists and manufacturers use this new knowledge to make HP technology more accessible to the consumer. Next he hopes to turn his attention to another piece of the puzzle—solar cell degradation.

continued on next page

Dr. Bryan Huey is Digging Into a More Cost-Effective Solar Technology

continued from previous page

"Specific to Hybrid Perovskites, our results may guide the efforts of film manufacturing, and device design, to either leverage or suppress the properties of the two distinct grain boundary types we've resolved. While we continue to develop the method and apply it to several fundamental problems in materials science, we are also specifically focusing on solar cell degradation, one of the greatest remaining roadblocks for HP films before they can really compete in the over $100 Billion solar panel market. Tune back again soon– we're just beginning to scratch the surface."

Professors Yuanyuan Zhou and Nitin Padture from the School of Engineering at Brown University, who collaborated with the team at UConn on this research, said that these findings can have a ripple effect on the industry.

"The tomographic AFM technique has the unique capability of revealing 3D buried microstructures at the nanoscale during perovskite device operation and degradation. This is extremely helpful for scientists and engineers to develop more robust hybrid perovskites devices in the future," said Zhou and Padture.

Dr. Yuanyuan Zhu Receives funding from American Chemical Society

Institute of Materials Science

Dr. Yuanyuan Zhu

Institute of Materials Science Assistant Professor, Dr. Yuanyuan Zhu, was awarded funding from the American Chemical Society Petroleum Research Fund for her project titled "Structural Basis for the Optimal Promotor Concentration and Distribution of Metal-Promoted Oxide Catalysts for Selective Oxidation of Alkane".

Alkane dehydrogenation through catalytic selective oxidation has become increasingly important to modern petroleum refining and petroleum chemistry. In particular, the oxidative dehydrogenation (ODH) of light alkanes into olefins, which is essential to the production of high-value petrochemicals, such as ethylene, as well as the understanding of heterogeneous catalysis. According to Dr. Zhu's proposal, "As the catalytic reaction is expected to convert a stable starting molecule into a less stable one at a relatively low temperature without combustion, high selectivity and stability, as well as activity, are desired in ODH catalysts." However, Dr. Zhu states, "Conversion to high-value petrochemicals like ethylene poses a dual challenge for heterogeneous catalysis: the catalyst must be capable of activating the first C-H bond of highly saturated alkane while maintaining a high selectivity. Most oxidation catalysts developed so far can't achieve both." Dr. Zhu's research looks to establish a clear structural picture of some of the best alkane oxidation catalysts. She proposes that this research will assist in solving that catalyst design problem.

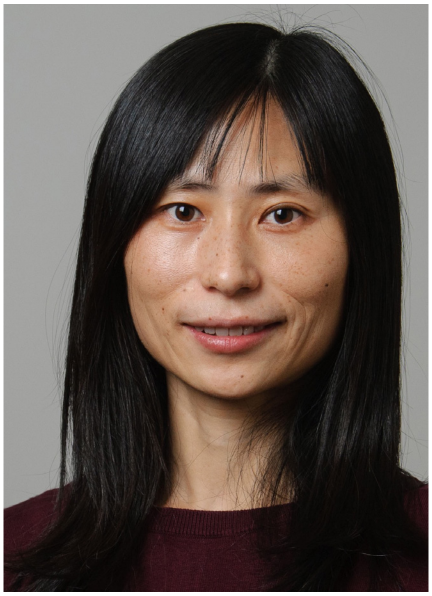
Through the use of advanced analytical and in-situ environmental scanning transmission electron microscopy (STEM), Dr. Zhu looks to fill in the knowledge gaps between the commonly accepted "molecular" view and the lacking "structural" view of the prototypical alkane selective oxidation catalyst Nb-NiO. In particular, "we seek to establish a clear microstructural picture of the Nb-promoted NiO selective oxidation catalyst. Our work will emphasize the effective Nb-NiO phase stoichiometry and particle size, the Nb concentration variations in depth from the surface, the uniformity of Nb distributions, and the response of these characteristics under ethane ODH reaction conditions." Dr. Zhu continues, "The main objective of the research will be to gain experimental insight into the structural properties of Nb-promoted NiO ODH catalysts and to explore fundamental correlations with physical properties and the catalytic performance in selective oxidation of light alkanes." Dr. Zhu hypothesizes, "that the structural (including chemical) basis of these nanocatalysts at the particle, surface-facet, and atomic-scale levels plays an essential role in determining the nature and the abundance of selective active sites."

> "The main objective of the research will be to gain experimental insight into the structural properties of Nb-promoted NiO ODH catalysts and to explore fundamental correlations with physical properties and the catalytic performance in selective oxidation of light alkanes."
>
> ~Dr. Yuanyuan Zhu

In addition to Dr. Zhu's background researching the development of novel scanning transmission electron microscopy techniques, she is currently the Director of the DENSsolutions Center for IN-siTu/Operando Electron Microscopy (InToEM) at the University of Connecticut (UConn). She looks to utilize her experience, as well as the latest generation in-situ/operando (S) TEM NanoReactor at the UConn Tech Park, to pursue this project which will proposedly "establish a comprehensive understanding of the structural properties of a prototypical selective oxidation catalyst: Nb-promoted NiO nanoparticles." From this research Dr. Zhu expects, "the fundamental insights we gain to provide guidance for the design of next-generation selective oxidation catalysts with enhanced olefin yield."

Dr. Xiuling Lu Invents Nanoparticle for Overcoming Leukemia Treatment Resistance

UConn Today



Dr. Xiuling Lu

UConn associate professor of pharmaceutics Xiuling Lu, along with professor of chemistry Rajeswari M. Kasi, was part of a team that recently published a paper in *Nature Cell Biology* finding a commonly used chemotherapy drug may be repurposed as a treatment for resurgent or chemotherapy-resistant leukemia.

One of the largest problems with cancer treatment is the development of resistance to anticancer therapies. Few FDA-approved products directly target leukemia stem cells, which cause treatment-resistant relapses. The only known method to combat their presence is stem cell transplantation.

Leukemia, a cancer of the early blood-forming cells, or stem cells, presents unique treatment challenges due to its nature. The disease affects bone marrow, which produces blood cells. Most often, leukemia is a cancer of the white blood cells. The first step of treatment is to use chemotherapy to kill the cancerous white blood cells, but if the leukemia stem cells in the bone marrow persist, the cancer may relapse in a therapy-resistant form. Fifteen to 20% of child and up to two thirds of adult leukemia patients experience relapse. Adults who relapse face a less-than 30% five-year survival rate. For children the five-year survival rate after relapse is around two thirds. When relapse occurs, chemotherapy does not improve the prognosis for these patients.

There is a critical need for scientists to develop a therapy that can more effectively target chemotherapy-resistant cells.

There are two cellular pathways, Wnt–β-catenin and PI3K–Akt, which play a key role in stem cell regulation and tumor regenesis. Cooperative activation of the Wnt– β-catenin and PI3K–Akt pathways drives self-renewal of cells that results in leukemic transformation, giving rise to cancer relapse. Previous studies have worked on targeting elements of these pathways individually, which has had limited success and often results in the growth of chemo-resistant clones.

The researchers screened hundreds of drugs to find one that may inhibit this interaction. They identified a commonly used chemotherapy drug, doxorubicin as the most viable target. While this drug is highly toxic and usually used with caution in clinical settings, the team found when used in multiple, low doses, it disrupts the Wnt–β-catenin and PI3K–Akt pathways' interaction, while potentially reducing toxicity.

Lu's lab contributed a nanoparticle which allowed the drug to be injected safely and released sustainably over time, a key to the experiment's success. The nanoparticle encasing doxorubicin enables slow release of the drug to the bone marrow to reduce the Akt-activated β-catenin levels in chemo-resistant leukemic stem cells and reduce the tumorigenic activity. In low doses, doxorubicin stimulated the immune system while typical clinical doses are immunosuppressive, inhibiting healthy immune cells.

Lu is the CEO of Nami Therapeutics, a startup which designs nanoparticles for drug delivery in a variety of clinical contexts including cancer treatment and vaccine delivery.

Because of its rate of drug release, Lu's patented nanoparticle was more effective than both a solution of the pure drug and a liposomal doxorubicin, the only commercially available version of a nanoparticle carrying doxorubicin.

"It's exciting that the whole research team identified this new mechanism to effectively inhibit leukemia stem cells," Lu says. "We are happy to see that our proprietary nanoparticle delivery system has such potential to help patients."

By using low, but more sustained, doses of this drug, leukemia-initiating activity of cancerous stem cells was effectively inhibited.

"It's exciting that the whole research team identified this new mechanism to effectively inhibit leukemia stem cells."

~Dr. Xiuling Lu

The researchers demonstrated clinical relevance by transplanting patient leukemic cells into mice and observing that low-dose doxorubicin's ability to disrupt these cells. Patient sample transplants with therapy-resistant leukemia stem cells rapidly developed leukemia. But the low-dose doxorubicin nanoparticle treatment improved survival by reducing the presence of leukemia stem cells.

Lu says the next steps for this research is to further validate the now-patented method and nanoparticle and eventually bring it into clinical usage. Lu and her collaborator, Rajeswari Kasi, also have two pending patents on copolymer-nanoparticles for drug delivery and methods for treating chemo-resistant cancer-initiating cells.

UConn, Army Research Lab Collaborate on New Portable, Renewable Energy Technology

UConn Today

Dr. S. Pamir Alpay

UConn's Associate Dean for Research and Industrial Partnerships, S. Pamir Alpay, and Yomery Espinal '18 Ph.D. (ENG) have published a paper on a novel portable pyroelectric technology in *Cell Reports Physical Science* with support from the Army Research Laboratory.

Pyroelectric energy research is focused on how to generate energy from heat that would otherwise be wasted in a catalytic chemical reaction.

When pyroelectric materials are heated, their polarization changes, leading to an electron flow that generates energy. These materials are commonly used in household devices like motion sensor lights, which detect body heat to determine when someone is near.

Anytime there is a catalytic reaction, heat is generated. These devices harness that heat and use it as energy. For example, a combustion engine in a car produces heat that, with this kind of technology, could be used to power the electrical functions of the car that otherwise rely on battery power.

The Army Research Lab (ARL) is particularly interested in this technology because it can provide more power with less weight, which is important for soldiers carrying heavy bags.

While scientists have been experimenting with pyroelectric power for decades, the technology proposed in this paper is completely novel.

"Something like that doesn't exist," Alpay says. "It would give you the opportunity to recover some things that just go to waste."

The technology proposed in this publication is portable and has an extended lifetime. It uses on-chip combustion of methanol, a high-energy fuel, to harness energy from the reaction. The pyroelectric material converts waste heat from the reaction to usable power. Vapor of a high-energy fuel, in this case methanol, is combusted on a thin, 440 nanometer film on platinized silicon wafers. The device converts the heat from this reaction into pyroelectric power.

Nanostructured iridium oxide is the top electrode and combustion catalyst. Iridium is a dense, corrosion and heat-resistant metal making it an excellent candidate for this application. Iridium oxide is first activated at temperatures as low as 105 degrees Celsius and fully catalyzes methanol to carbon dioxide at 120 degrees Celsius.

This is an advantage compared to platinum-based catalysts, which do not achieve full conversion until 150 degrees Celsius. This means less heat must be applied to the device for it to be fully effective.

This on-chip combustion technology has a 90% combustion efficiency rate.

This technology would be significantly more powerful than lithium-ion batteries, the common rechargeable batteries used in electronics. The energy density of methanol is 22 times greater than a lithium-ion battery.

While this study only provided researchers with a preliminary version of this technology, it can have far-reaching applications.

Pyroelectric power is a clean alternative to fossil fuels and nuclear energy, which still constitute more than 80% of the United States's power. Thus, this technology has broad energy applications on large and small scales.

Dr. Yomery Espinal

Brendan Hanrahan, Ph.D., a staff materials engineer at ARL, led this effort on ARL's side of the partnership. Hanrahan operated as a critical hinge to bring the ARL and UConn researchers together for this project.

Espinal earned her Ph.D. at UConn and was awarded the Bridge to the Doctorate Fellowship in 2013, which supports members of underrepresented groups in STEM. She began working at the Army Research Lab with Hanrahan during her time in the program and spent two years there. Immediately after graduation, she was offered a position with the Defense Advanced Research Projects Agency (DARPA).

Over the past few years, UConn and ARL have fostered a productive partnership that will likely continue for years to come. "The key to our successful collaboration is that we play off each other's strengths," says Dr. Hanrahan,. "Without one another [Alpay's] theories would remain theories and we're just shooting in the dark. So that's why it's such a great partnership."

MSE Professor's Research is More Than What Meets the Eye

Materials Science and Engineering Department

Dr. Seok-Woo Lee

Many of the materials that UConn MSE Assistant Professor Seok-Woo Lee works with in his research are invisible to the naked eye. In order to even see them, an electron microscope is required. Some samples are more than 100 times thinner than a human hair. Despite this, the nanomaterials that Lee researches are crucial to producing mechanically robust devices and structures.

According to Lee, creating resilient small materials is important for smaller machines.

"In order to develop a mechanically reliable robot or machine at the nano-/micro-meter scale, we need to know how to create a strong and tough 'small' material," Lee said. His research group is working on understanding how characteristics of materials can influence mechanical behaviors of substances including metals, ceramics, intermetallic compounds, and polymers.

One such way to control mechanical behavior is reducing the size of materials. As a material's size decreases from macro to nano-/micro-meter scales, it usually becomes much stronger and tougher. However, this can change as temperatures become more extreme. Part of Lee's research involves exposing micromaterials such as metals to very cold temperatures, where they become brittle and fracture easily. Lee is attempting to find a way to avoid this.

It is important to understand how materials may respond in extremely cold environments for applications such as the vacuum of space. One example is called a cryogenic shape memory material, which can recover its original shape even after being largely deformed. The process of recovering its shape by expanding or contracting can be used to create mechanical motion.

"This long-range motion can turn on an electrical switch for a cold, dormant satellite in deep space once it meets a heat source such as a star. Also, this material can be used to move a mechanical component to control a robotic arm or telescope lens that is used under cold environments such as the shadow area of the moon," Lee said.

Although Lee is dedicated to his research, he mainly sees himself as a teacher.

"Teaching is very important to me because I have always believed that I am basically a teacher. Once a student receives a good lecture, they can remember what they learn for a longer time," Lee said.

Lee has received multiple awards for his teaching, including the UConn Mentorship Excellence Award in 2019 and UConn MSE Teaching Excellence of the year in 2017 and 2018. Lee is proud of being recognized for educating.

Lee has both undergraduate and graduate students, and over time, he has learned that they both require different approaches. According to him, the major difference is independence when it comes to performing research.

"A graduate student can design and perform experiments by themselves. However, I usually assign a simple and relatively straightforward research topic to undergraduate students because they are very busy due to their classes. I usually give step-by-step instructions to an undergraduate student, then they can learn the details of the research even without much prior experience," said Lee. The graduate students Lee works with handle the microscopic material that he researches and are able to "pull and push a sample with an extremely precise control of force," Lee said. An electron microscope has to be used in order to see these samples, as they are too small to be visible in a regular optical microscope.

continued on next page

MSE Professor's Research is More Than What Meets the Eye

continued from previous page

According to Lee, it is fun for him to work with the three undergraduates and five graduate students who are part of his research group. He feels his MSE students should be especially proud of their major.

"I want to tell our MSE students that their decision to study MSE is a great choice. More and more I see that technological breakthroughs require the development of new advanced materials. Creating high-performance engineering devices such as micro-processors, airplanes, satellites, etc. requires sophisticated materials design and processing. Because of this, studying MSE becomes more important in overcoming our technological limits. So, I really think they should be proud to be MSE majors," Lee said.

In addition to his work with students, Lee also collaborates with other faculty members on research. One such project is a cold spray project for the US Army, which he is working on with MSE professors Avinash Dongare, Mark Aindow, and Harold Brody. Lee enjoys these collaborations, which helped influence his decision to come to UConn.

"I chose UConn because of great people here. All of the faculty and students I met during the interview were very nice and friendly to me. I always believe that working with wonderful people is very important, and I thought (and still think) that those people are here at UConn," said Lee.

Lee discovered materials science when he was in high school. He always wanted to combine his love of physics and chemistry with "making something useful," which was fulfilled by materials science and engineering.

"I found that materials science and engineering is the best program because I can do both science and engineering! Also, I always wondered how matter was formed after the beginning of the universe, and I thought that it would be wonderful if I could design and create a special matter under my own control," Lee said.

This interest followed Lee to his current career, and he is optimistic about his students also being a part of the MSE field.

"They can use this knowledge of materials to improve our world," Lee said.

IMS Associate Director Hebert Leads Successful Research Collaboration Between UConn MSE and Industry

Materials Science and Engineering Department

IMS Associate Director, Dr. Rainer Hebert

MSE professor Rainer Hebert recently led a study in collaboration with the Collins Aerospace Center for Advanced Materials at the UConn Tech Park. Collaborating partners also included Pratt & Whitney, Schlumberger Reservoir Completions Technology Center, and UTC Additive Manufacturing Center of Excellence. The study, entitled "Novel Al-X alloys with improved hardness," centers on high-strength aluminum-based materials for use in 3-D printing, an additive manufacturing process.

This research is of strong interest to the aerospace industry because materials such as aluminum that are light and strong are used to manufacture small aircraft parts with complex geometries that are difficult to produce with traditional manufacturing.

"Working with Collins and Pratt & Whitney helped us remain focused on the end goal of aerospace applications, and their input is invaluable for bridging the gap from fundamental research to applications," Hebert said.

The Collins Aerospace Center, established in 2016 and directed by MSE professor Pamir Alpay, is the result of continuing collaboration between UConn and Collins Aerospace, one of the world's largest suppliers of technologically advanced aerospace and defense products. The center offers funding for studies that focus on areas related to materials development and characterization. It also provides an opportunity for firsthand interactions with an industrial partner whose technologies are used in advanced aerospace and defense applications.

This study is one of several related to 3-D printing that UConn MSE has conducted with the help of the Collins Center. Hebert expects that more collaborations will occur.

"We will continue on this trajectory and have new initiatives underway to collaborate with industry," Hebert said.

Dr. Richard Parnas Retires

Institute of Materials Science

Dr. Richard Parnas

After 19 years as a faculty member of the Institute of Materials Science Polymer Program and Chemical and Biomolecular Engineering Department, Professor Richard Parnas retired in August 2020 from the University of Connecticut.

Dr. Parnas summarized his career choices over the past 30 years stating, “My career was shaped by my desire to create environmentally responsible materials and energy solutions”. His words and resume both reflect his passion to helping the environment. Since completing his bachelor’s degree, Dr. Parnas has worked for big industry, government, and academia on a variety of projects relating to environmental issues.

After completing his bachelor’s degree in chemical engineering at MIT, Dr. Parnas joined Exxon Research & Engineering in Florham Park, NJ. There he worked on his first environmentally friendly project, coal gasification. He helped engineer a proposed plant for Europe that would convert coal into methane at the rate of 30,000 tons per day. Although the project never came to fruition, this was the first of many environmental projects. Exxon’s abandonment of the project led Dr. Parnas to return to school. He completed his master’s degree, and later his Ph.D., at U.C.L.A.

Upon completion of graduate school, he spent 10 years in the polymers division at the National Institute of Standards and Technology (NIST), first as a chemical engineer, then as a composites group leader. His research was based around manufacturing technology. The main focus was to create new lighter weight materials for cars in an effort to increase gas mileage and reduce CO_2 production. While at NIST, Dr. Parnas met Prof. Anthony DiBenedetto of the IMS Polymer Program while hosting an international meeting on composites processing, initiating his association with and eventual move to join IMS.

In 2001, Dr. Parnas was hired by IMS as a faculty member of the Polymer Program. His initial research interest was polymer composites and renewable polymers created from plant protein. Starting in 2005, Dr. Parnas became involved with a number of aspects of the world of biofuels. This changed his research direction and ultimately his career path. He ran the annual Biofuels and Sustainable Energy Symposiums at UConn from 2005 to 2010. These events were key to opening communications between state representatives, local industry professionals, and scientists from the university. It enabled discussions regarding the technical components, policies, and financial aspects of energy. The conference included as many as 300 participants, including 25 state and federal representatives such as Rosa DeLauro and John Larson.

In 2007, an undergraduate asked Dr. Parnas for help with a biofuels project. This simple question led Dr. Parnas down a path to three patents, the creation of a business, and eventually a new career. The original project led the student to a Ph.D. and a faculty position at Oregon State University.

A collaboration with IMS Director Steven Suib and other University faculty landed a 1.2 million dollar Department of Energy grant to support biofuels research at UConn. This was a stepping stone to Dr. Parnas’s research. The funding increased the research staff, enabling publications and further supporting his reputation in the field. He was elected to the Connecticut Academy of Science & Engineering in 2013. After seven patents, he was also inducted into the UConn chapter of the National Academy of Inventors in 2019. During this time, he developed a novel transesterification reactor for the efficient conversion of triglycerides to biodiesel. The reactor was patent worthy and a key component to his future company. In 2018, after 11 years of research and three U.S. patents, Dr. Parnas created REA Resource Recovery Systems, LLC. The company processes brown grease, sourced from wastewater treatment plants, into biodiesel. The end result is less waste and reduced carbon emissions. This benefits the company, local government, and our mother earth.

> “My career was shaped by my desire to create environmentally responsible materials and energy solutions.”
>
> ~Dr. Richard Parnas

In addition to education and research, Dr. Parnas spent five years as the faculty director for UConn’s EcoHouse, one of the learning communities on the Storrs campus. Participating students dedicate their time to a variety of environmental issues, such as sustainable energy, farming, and government policies. At the UConn Spring Valley Student Farm, students grow food for dining services at the Storrs campus. They learn about both farming and selling their products. A team of engineering students also worked on solar energy, both photovoltaic and thermal, to support the farm. As faculty director, Dr. Parnas was able to help students bring their specific set of skills and interests to the learning community.

Dr. Parnas’s lasting contributions to the University are tremendous, setting a tone for engaging students and inspiring interest in the ways that modern science interfaces with our ecological footprint. Helping to educate hundreds of students and introducing dozens to the wonderful world of scientific research, many UConn undergraduate engineers and chemists received their first experience in a scientific setting under the advisement of Dr. Parnas. This experience helped pave their paths to a career or graduate school.

Quantum Effect Triggers Unusual Material Expansion

UConn Today

Dr. Jason Hancock

You know how you leave space in a water bottle before you pop it in the freezer—to accommodate the fact that water expands as it freezes? Most metal parts in airplanes face the more common opposite problem. At high altitudes (and low temperatures) they shrink. To keep such shrinkage from causing major disasters, engineers make airplanes out of composites or alloys, mixing materials that have opposite expansion properties to balance one another out.

New research conducted in part at UConn and the U.S. Department of Energy's Brookhaven National Laboratory may bring a whole new class of chemical elements into this materials science balancing act.

As described in a paper just published on March 26 in *Physical Review Letters*, scientists used x-rays at Brookhaven's National Synchrotron Light Source II (NSLS-II)—a U.S. Department of Energy Office of Science user facility—and two other synchrotron research facilities to explore an unusual metal that expands dramatically at low temperature. The experiments on samarium sulfide doped with some impurities revealed details about the material's atomic-level structure and the electron-based origins of its "negative thermal expansion."

This work opens avenues for designing new materials where the degree of expansion can be precisely tuned by tweaking the chemical recipe. It also suggests a few related materials that could be explored for metal-mixing applications.

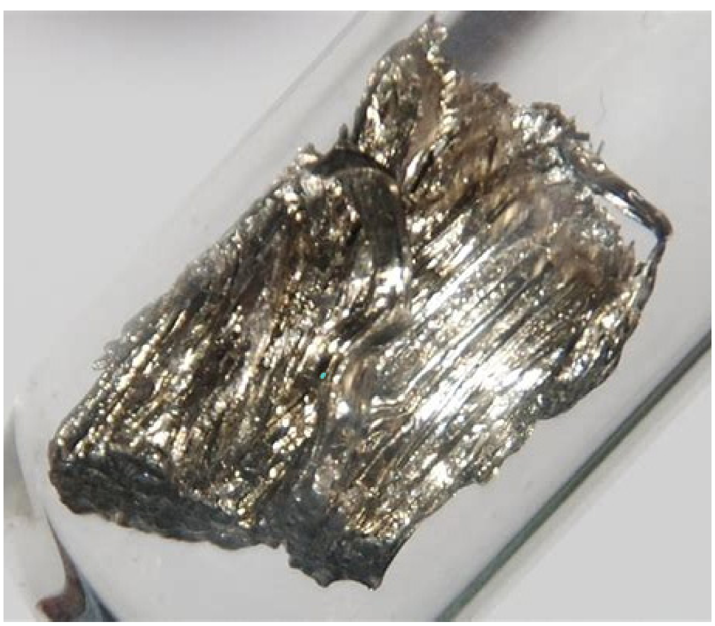


Image of samarium (Wikipedia)

"In practical applications, whether an airplane or an electronic device, you want to make alloys of materials with these opposite properties—things that expand on one side and shrink on the other when they cool down, so in total it stays the same," explained Daniel Mazzone, the paper's lead author and a postdoctoral fellow at NSLS-II and Brookhaven Lab's Condensed Matter Physics and Materials Science Department.

But materials that mimic water's expansion when chilled are few and far between. And while the expansion of freezing water is well understood, the dramatic expansion of samarium sulfide had never been explained.

This samarium-based compound (specifically samarium sulfide with some yttrium atoms taking the place of a few samarium atoms) reveals competing electronic phases (somewhat analogous to the solid, liquid, and gaseous phases of water). Depending on external conditions such as temperature and pressure, electrons in the material can do different things. In some cases, the material is a gold-colored metal through which electrons can move freely—a conductor. In other conditions, it's a black-colored semiconductor, allowing only some electrons to flow.

> "This work connects negative thermal expansion to the Kondo effect, potentially guiding new materials discovery efforts in the context of moment screening in rare-earth systems."
>
> ~Dr. Jason Hancock

The golden metallic state is the one that expands dramatically when chilled, making it an extremely unusual metal. Mazzone and his colleagues, including UConn physics professor Jason Hancock, an expert in materials with negative thermal expansion (that is, materials that expand when cold and shrink when warm), turned to x-rays and theoretical descriptions of the electrons' behavior to figure out why.

> The basic idea behind the Kondo effect is that electrons will interact with magnetic impurities in a material, aligning their own spins in the opposite direction of the larger magnetic particle to "screen out," or cancel, its magnetism.

The element samarium

At NSLS-II's Pair Distribution Function (PDF) beamline, the scientists conducted diffraction experiments. They placed samples of their samarium metal in the beam of NSLS-II's x-rays and measured how the x-rays bounced off atoms making up the material's crystal structure.

The team also used x-rays at the SOLEIL synchrotron in France and Spring-8 synchrotron in Japan to take a detailed look at what electrons were doing in the material at different stages of the temperature-induced transition.

"These 'x-ray absorption spectroscopy' experiments can track whether electrons are moving into or out of the outermost 'shell' of electrons around the samarium atoms," explained co-corresponding author Ignace Jarrige, physicist at NSLS-II.

If you think back to one of the basics of chemistry, you might remember that atoms with unfilled outer shells tend to be the most reactive. Samarium's outer shell is just under half full.

The electron-tracking x-ray experiments revealed that electrons flowing through the samarium-sulfide metal were moving into that outer shell around each samarium atom. As each atom's electron cloud grew to accommodate the extra electrons, the entire material expanded.

But the scientists still had to explain the behavior based on physics theories. With the help of Maxim Dzero, a professor at Kent State University, they were able to explain the effect with the so-called Kondo effect, named after physicist Jun Kondo.

The basic idea behind the Kondo effect is that electrons will interact with magnetic impurities in a material, aligning their own spins in the opposite direction of the larger magnetic particle to "screen out," or cancel, its magnetism.

In the samarium-sulfide material, Dzero explained, the almost-half-full outer shell of each samarium atom acts as a tiny magnetic impurity pointing in a certain direction. "And because you have a metal, you also find free electrons that can approach and cancel out these little magnetic moments," Dzero said.

"This work connects negative thermal expansion to the Kondo effect, potentially guiding new materials discovery efforts in the context of moment screening in rare-earth systems," said UConn's Hancock.

It's unusual for the Kondo effect to cause electrons to fill the outermost shell. More often, they go the other way—leaving the shell—which arises from a delicate energy balance dictated by basic quantum mechanical rules. These rules suggest that compounds incorporating two other elements in the same region of the periodic table—the breakout section that contains the "transition elements"—might also attract extra electrons.

"In most of these elements, because of the way the outer shell fills up following the rules of quantum mechanics, it is more energetically favorable for electrons to move out of the shell, but for a couple of these materials, the electrons can move in," Jarrige said. In addition to samarium (Sm), the other two are thulium (Tm) and ytterbium (Yb).

This work opens avenues for designing new materials where the degree of expansion can be precisely tuned by tweaking the chemical recipe.

It would be worth exploring compounds containing these other elements as additional possible ingredients for creating materials that expand upon cooling, Jarrige noted.

Finally, the scientists noted that the extent of the negative thermal expansion in samarium sulfide can be tuned by varying the concentration of impurities.

"This tunability makes this material very valuable for engineering expansion-balanced alloys," Mazzone said.

"The application of highly developed many-body theory modeling was an important part of the work to identify the connection between the magnetic state of this material and its volume expansion," said Hancock. "This collaboration between Kent State, UConn, Brookhaven Lab, partner synchrotrons, and synthesis groups in Japan could potentially guide new materials discovery efforts that make use of the unusual properties of these rare-earth materials."

Dr. Thanh Nguyen's Group Develops New Technique to Heal Broken Bones

UConn Today

Healing broken bones could get easier with a device that provides both a scaffold for the bone to grow on and electrical stimulation to urge it forward, University of Connecticut engineers reported on June 27, 2020 in the *Journal of Nano Energy*.

Although minor bone breaks usually heal on their own, large fractures with shattered or missing chunks of bone are more difficult to repair. Applying a tiny electrical field to the site of the fracture to mimic the body's natural electrical field helps the cells regenerate. But the medical devices that do this are usually bulky, rely on electrical wires or toxic batteries, require invasive removal surgery, and can't do much for serious injuries.

Now, a group of biomedical engineers from UConn have developed a scaffold of non-toxic polymer that also generates a controllable electrical field to encourage bone growth. The scaffold helps the body bridge large fractures. Although many scientists are exploring the use of scaffolding to encourage bone growth, pairing it with electrical stimulation is new.

The team demonstrated the device in mice with skull fractures.

The electrical voltage the scaffold generates is very small, just a few millivolts. And uniquely for this type of device, the voltage is generated via remotely-controlled ultrasound. The ultrasound vibrates the polymer scaffolding, which then creates an electrical field (materials that create electricity from vibration, or vice versa, are called piezoelectric). To help heal a thigh fracture, for example, the polymer scaffold can be implanted across the broken bone. Later, the person with the broken bone can wave the ultrasound wand over their own thigh themselves. No need for batteries, and no need for invasive removal surgery once the bone is healed.

"The electrical field relates to the natural signal generated by your body at the injury location. We can sustain that voltage, on demand and reversible, for however long is needed using ultrasound," says UConn biomedical engineer Thanh Nguyen. The piezoelectric polymer Nguyen and his colleagues use to build the scaffold is called poly(L-lactic acid), or PLLA. In addition to being non-toxic and piezoelectric, PLLA gradually dissolves in the body over time, disappearing as the new bone grows.

"The electric field created by the piezoelectric PLLA scaffold seems to attract bone cells to the site of the fracture, and promote stem cells to evolve into bone cells. This technology can possibly be combined with other factors to facilitate regeneration of other tissues, like cartilage, muscles, or nerves," says Ritopa Das, a graduate student in Nguyen group and the first author of the published paper.

Currently, Nguyen and his colleagues are working to make the polymer more favorable to bone growth, so that it heals a large fracture more quickly. They are also trying to understand why electrical fields encourage bone growth at all. Bone itself is somewhat piezoelectric, generating a surface charge when the bone is stressed by everyday life activities. That surface charge encourages more bone to grow. But scientists don't know whether it's because it helps cells stick to the surface of the bone, or whether it makes the cells themselves more active.

"Once we understand the mechanism, we can devise a better way to improve the material and the whole approach of tissue stimulation," Nguyen says.

Healing broken bones could get easier, thanks to research being done by UConn biomedical engineers (Getty Images).

In Memoriam: Former IMS Director Dr. Harris L. Marcus

Institute of Materials Science

Dr. Harris L. Marcus, former IMS Director

Former IMS Director, Dr. Harris Marcus, passed away on January 14, 2021. Dr. Marcus earned his B.S. from Purdue University and a Ph.D. from Northwestern University. He served as Professor of Mechanical Engineering and Materials Science and Engineering at the University of Texas at Austin from 1975 to 1995 after a career in industry that included positions at Texas Instruments and Rockwell Science Center. He joined the UConn faculty in 1995 as Director of IMS.

During his tenure as Director of IMS, Dr. Marcus dramatically increased the infrastructure for research within IMS through the acquisition of major instrumentation for both soft and hard materials, and by rigorously recruiting excellent faculty members and graduate students to the University. His efforts led to significantly greater partnerships with industry and federal/state agencies for extramural support for research and development.

Dr. Marcus's career was marked by numerous awards for excellence including the Von Karman Memorial Special Award for Outstanding Contributions to Aerospace and Structural Materials Technology in Past Decade, the Purdue University Distinguished Engineering Alumnus Award, Northwestern University Alumni Association Award of Merit, and induction in the Connecticut Academy of Science and Engineering. He had well over 300 peer-reviewed publications.

Current IMS Director, Dr. Steven L. Suib, said in his remembrance of Dr. Marcus, "Dr. Harris Marcus was Director of IMS for 18 years. He was always interested in research and enthusiastically discussed his ideas with everyone. He made people laugh and was fun to be around. We will miss him dearly."

Dr. Marcus was preceded in death by his wife, Leona Marcus. He is survived by his son, Leland Marcus, his daughter, Dr. M'Risa Mendelsohn, his son-in-law Michael Mendelsohn, and his granddaughter, Samantha Mendelsohn.

In Memoriam: Dr. John E. Morral

Excerpted from Ohio State University, Department of Materials Science and Engineering

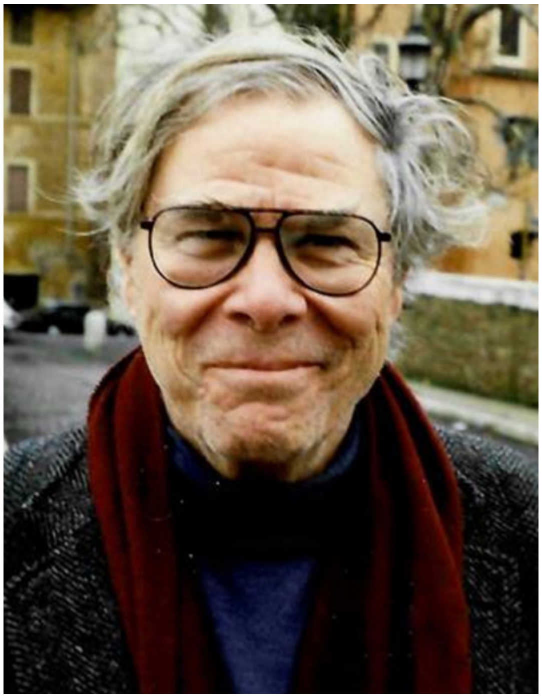
Dr. John E. Morral

John Eric Morral, age 81, passed away unexpectedly on Monday, December 21, 2020. He was born in Kokomo, Indiana on August 3, 1939 to Rolf and Lillie Morral. He was also preceded in death by his sister Sandra Pinkham. John received his undergraduate and Master of Science degrees in Metallurgical Engineering from The Ohio State University, graduating in 1965. He completed his doctoral work at the Massachusetts Institute of Technology, receiving his Ph.D. in 1969. He joined the University of Connecticut in 1971 and became a full professor and chair of his department. Within a week of his retirement in 2003, he was recruited to be chair of OSU's Material Science and Engineering Department. He retired from OSU in 2012, becoming an emeritus professor. John continued his professional work as Editor-in-Chief of the *Journal of Phase Equilibria and Diffusion*. John was the recipient of numerous awards for his many scientific contributions. He was named a Fellow of ASM International in 1995; named a Distinguished Alumnus of the OSU College of Engineering in 1995; elected a member of the Connecticut Academy of Science and Engineering in 2003; honored with a TMS Honorary Symposium in 2004; received an American Competitiveness and Innovation Fellow Award, NSF Division of Materials Research in 2009; received a Distinguished Scientist/Engineer Award, TMS Division of Materials Processing and Manufacturing in 2012; and awarded the J. Willard Gibbs Phase Equilibria Award in 2017.

John will be deeply missed by his loving wife of 42 years Dorothy "Dot" Morral; children Peter (Bronwin) Morral, Ingrid Morral (Patrick Quesenberry), Kenneth Cammarato, and Cheryl (Jerry) Wolters; grandchildren Natalie and William Morral; siblings Frank (Linda) Morral, Ann (Matthew) Sandor, Harriet (Jim) Perkins; brother-in-law Galen Pinkham; and numerous nieces and nephews.

In Memoriam: Dr. James Galligan

Institute of Materials Science



Dr. James Galligan

Dr. James Galligan, Professor Emeritus of Metallurgy (currently Materials Science and Engineering) passed away on September 7, 2020, at the age of 89.

He was born in Far Rockaway, NY, to the late John A. and Teresa (Martin) Galligan and raised in Woodmere, NY. He earned his undergraduate degree from Brooklyn Polytechnic Institute, his master's degree from the University of Illinois, and his Ph.D. in Metallurgical Engineering from the University of California at Berkley. He was a Professor at Columbia University and the University of Connecticut, where he retired after 30 years. Over his career, he mentored numerous students earning their Ph.D. degrees. Dr. Galligan was awarded the prestigious Humboldt Research Award in 1986 from the Humboldt Foundation, Bohn, Germany, in recognition of his research and teaching accomplishments.

Dr. Theodoulos Kattamis, Professor of Materials Science and Engineering, was a close, personal friend of Dr. Galligan. He recounted how Dr. Galligan was instrumental in the transition of the Metallurgy Department to, eventually, the Materials Science and Engineering Department in keeping with changing trends.

"A few years after joining the Department he thought it was time for us to follow the majority of Metallurgy Departments that changed their names to Materials Science and Engineering. Unfortunately, it took many years to change the name to Metallurgy and Materials Science and only in 2002 the name Materials Science and Engineering was finally adopted," Dr. Kattamis recalled.

Speaking further of the keen foresight of Dr. Galligan, Dr. Kattamis noted, "From the late seventies he understood that the viability of the then graduate Department (Metallurgy) would be guaranteed only if an undergraduate program were added, too. He started advocating for this change, which was much later embraced by Owen Devereux, and it eventually became a reality. Finally, he promoted the Engineering/Physics double major which was instituted in the mid 1990's."

Dr. Galligan's family remembers that his love of learning did not stop in the classroom. He enjoyed reading, sometimes juggling multiple books at a time. He loved the New York Times, and solved the crossword puzzles every day, never using anything but an ink pen. He was a supporter of the arts, especially the Manhattan Theatre Club, and an avid gardener. They also remember him as a staunch, liberal Democrat who was active during the civil rights movements of the 1960s and throughout his life.

We take this space to honor the hundreds of thousands of lives lost to the coronavirus. To the families of those we've lost, we have mourned, and continue to mourn, with you.

As scientists, we believe in the power of tested scientific data to move the world toward an end to the COVID-19 pandemic.

Dr. Alpay Named UConn Board of Trustees Distinguished Professor

Excerpted from a story from the School of Engineering

Dr. S. Pamir Alpay

Dr. S. Pamir Alpay, Associate Dean for Research and Industrial Partnerships, was named a Board of Trustees Distinguished Professor, after a vote by the trustees. The award recognizes faculty who have achieved exceptional distinction in scholarship, teaching, and service and has been awarded annually since 1998.

In addition to serving as associate dean, Alpay is the General Electric Professor in Advanced Manufacturing in the Department of Materials Science and Engineering and the Executive Director of UConn Tech Park, where he serves as UConn's chief ambassador to industry and government agencies in building industry-responsive and economically important initiatives based on UConn's strengths in applied research. In this role, he has excelled in outreach, having hosted workshops and symposia connecting over 500 professionals and government leaders on current topics ranging from sustainability, cybersecurity, energy, advanced manufacturing and support for small/medium size businesses.

UConn Health's Dr. Cato Laurencin Honored for Promotion of Justice, Equity

Excerpted from a story from UConn Today

Dr. Cato Laurencin

On Monday, August 24, the Association of American Medical Colleges (AAMC) announced University of Connecticut Professor Cato T. Laurencin as the recipient of the 2020 Herbert W. Nickens Award.

The award is bestowed on an individual who has made monumental contributions to promoting justice in medical education and health care equity throughout the nation. Laurencin received the prestigious award in November during the virtual AAMC annual meeting, where he gave a presentation entitled "Black Lives Matter in Science, Engineering, and Medicine."

"Connecticut applauds and congratulates Dr. Laurencin for his lifelong dedication to the betterment of society and science. His work in support of humanity is exemplified by his recent title of Healthcare Hero by Connecticut Magazine, and now in receiving the AAMC's Herbert W. Nickens Award," said Connecticut Governor Ned Lamont.

Dr. Luyi Sun Named a 2020 M1 Mentor by Connecticut Convergence Institute for Translation in Regenerative Engineering

Institute of Materials Science

The Presidential M1 Mentorship Award Program was established to create a national model for best practices in mentorship and formalize mentorship as an academic discipline. The award seeks to establish a cadre of accomplished UConn faculty who will deliver mentorship to racially and ethnically underrepresented individuals along the biomedical science pipeline.

Dr. Luyi Sun, Director of the IMS Polymer Program, and Professor of Chemical and Biomolecular Engineering was named a 2020 recipient of the M1 Mentorship Award.

Funding for the Presidential M1 Mentorship Award Program covers up to 25% of protected time for mentoring activities, including mentorship of individual students as well as participation in the development and execution of various mentorship initiatives. In addition, up to $5,000 will be allocated to the development of new and innovative initiatives focused on student-related activities that promote their academic growth and increase the number of students in the pipeline.

Dr. Luyi Sun, IMS Polymer Program Director

IMS Director Honored for Excellence in Review

Institute of Materials Science

IMS Director Dr. Steven L. Suib has been honored by the journal *Industrial & Engineering Chemical Research for Excellence in Review*. Over 6,000 international scientists volunteer to review submissions to the journal annually. Their advice and suggestions allow authors and editors to improve manuscripts to communicate advances in chemical research. "We are grateful for the time, experience, and expertise our reviewers provide to keep I&EC Research at the forefront of chemical engineering research," the journal noted in announcing the 2020 awardees.

While the award honors reviewers for the previous 12-month period, Dr. Suib, a Board of Trustees Distinguished Professor of Chemistry, has served as a reviewer for over 10 years. "It is useful to know that the reviews were considered of value," Dr. Suib says.

Dr. Suib is renowned for his work in synthesis by molecular design of environmentally friendly catalysts, surfaces, ceramics, adhesives and other materials as well as the characterization of the structural, surface, bulk, optical, magnetic, electronic, morphologic and thermal properties of them. He recently launched an online and distance learning, 12-credit advanced engineering certificate course in Advanced Materials Characterization.

IMS Director, Dr. Steven L. Suib

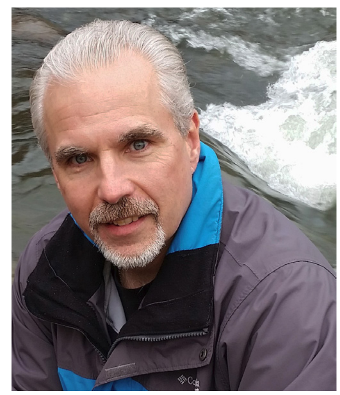
Dr. J. Evan Ward Awarded 2020 Microbiome Research Seed Grant

Institute of Materials Science

Dr. J. Evan Ward, IMS faculty member and professor and department head of the Marine Sciences Department at UConn Avery Point, has been awarded a 2020 Microbiome Research Seed Grant.

The UConn Microbiome Research Seed Grant program, offered through the Office of the Vice President for Research, is able to provide up to $50,000 to UConn faculty to support innovative and collaborative research proposals that will lead to new proposals for extramural funding in microbiome research.

Dr. Ward was recognized for his research entitled *The Effect of a Common Anthropogenic Pollutant on the Microbiome of an Ecologically and Commercially Important Bivalve*. Co-PIs for the project are Drs. Penny Vlahos and Lisa Nigro, professors in the Marine Sciences Department.



Dr. J. Evan Ward

Dr. Ying Li is Recipient of Air Force Office of Scientific Research YIP Award

Institute of Materials Science

Plastic is an essential part of everyday life, from water bottles to packaging to technical molded parts for specialized equipment. With its inherent durability and resistance to water, it is one of the most common materials used today.

Assistant professor in the Department of Mechanical Engineering at the University of Connecticut, Ying Li has received a prestigious Young Investigator award from the U.S. Air Force Office of Scientific Research (AFOSR) to develop the next generation of cutting-edge thermoset plastics using artificial intelligence technology. As part of the award, Li will receive $450,000 from AFOSR to conduct his research.

Dr. Ying Li

Dr. Suib Named Fellow of American Academy for the Advancement of Science

Excerpted from a story from UConn Today

Six researchers from the University of Connecticut and UConn Health were named as Fellows of the American Association for the Advancement of Science (AAAS) this year. Election as an AAAS Fellow is an honor bestowed upon AAAS members by their peers.

UConn Institute for Materials Science Director Steven L. Suib was elected for his contributions to ceramics, catalysts, surfaces and other materials of industrial significance. He says he is proud "to be recognized for fundamental work that is recognized as having practical significance."

IMS Director Dr. Steven L. Suib

Dr. Radenka Maric Honored with 2020 Women in Business Award from Hartford Business Journal

Excerpted from a story from UConn Today

Dr. Radenka Maric

CBE Professor and UConn Vice President for Research, Innovation, and Entrepreneurship, Dr. Radenka Maric, has been recognized by the Hartford Business Journal with a 2020 Women in Business Award.

Before becoming an educational leader, champion of research, and a familiar presence at UConn, Radenka Maric worked as an engineer developing hydrogen fuel-cell innovation and clean energy.

Her many responsibilities today include managing a staff of 250 and overseeing UConn's $260 million in research programs both in Storrs and at UConn Health. She also leads the Innovation Partnership Building at UConn Tech Park, the University's center for academic-industry collaboration, and the Technology Incubation Program (TIP) that launches and supports startups.

Maric attributes her career success to a lifelong love of science. Born in the former Yugoslavia, she developed interest in technology and clean energy as a child. She graduated from Belgrade University and then went to Japan, where the advancement of clean energy technology was a national priority. After spending 12 years at the University of Kyoto working on hydrogen fuel-cell innovation, she moved to the U.S. in 2001. She served as head of the Institute for Fuel Cell Innovation at the National Research Council Canada in Vancouver before joining UConn in 2010.

UConn's CCEI, Alumni, and Affiliates Honored with 2020 CT Entrepreneur Awards

Excerpted from a story from UConn Today

Dr. Armin Rad

Dr. Leila Daneshmandi

Dr. Xiuling Lu

UConn's Connecticut Center for Entrepreneurship and Innovation, or CCEI, was a big winner in this year's Connecticut Entrepreneur Awards, taking home top honors with recognition as the 2020 Community Promoter of the Year.

This year's awards, held virtually for the first time, honored 24 winners and 68 runners-up – 15 categories featured winners selected through community voting, while nine winners – including CCEI – were selected by panels of more than two dozen expert judges from outside of Connecticut who evaluated the finalists.

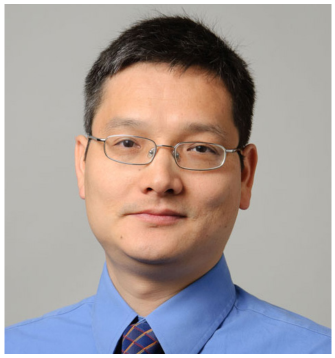
In addition to CCEI, UConn-affiliated judged winners and runners-up included the following IMS affiliated persons or programs:

- Winner, Entrepreneur of the Year: Scalable Venture – Armin Rad '19 Ph.D. and Leila Daneshmandi '20 Ph.D., Encapsulate
- Honorable Mention, Venture of the Year: Pre-Revenue – Encapsulate (Armin Rad '19 Ph.D. and Leila Daneshmandi '20 Ph.D.)
- Honorable Mention, Venture of the Year: Pre-Revenue – Nami Therapeutics (Professor Xiuling Lu, UConn School of Pharmacy)

Two IMS Faculty Members Receive Convergence Awards for Research in Interdisciplinary Centers

Excerpted from a story from UConn Today

Dr. Cato Laurencin



Dr. Pu-Xian Gao

IMS faculty members Dr. Cato Laurencin and Dr. Pu-Xian Gao were awarded the Convergence Award for Research in Interdisciplinary Centers (CARIC). The award is an initiative of the Office of the Vice President for Research (OVPR) that supports the development of collaborative interdisciplinary teams to bid for major federally funded initiatives, such as research centers. CARIC provides funding for planning, outreach to strategic partners, and proof-of-concept research activities that will prepare the team to bid competitively for these prestigious federal awards.

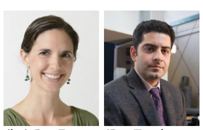
Dr. Gao's award will support his research project entitled "Mapping Catalytic Energy Transformations: Convergence of Nanoarray Catalysis, In Situ Microscopy, and Data Science."

Dr. Laurencin's award will support the "Convergence Center for Regenerative Engineering – A Science and Technology Center."

IMMP Funding Awarded to IMS Faculty Members

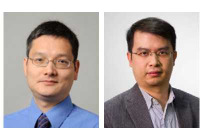
Institute of Materials Science

Eleven IMS faculty members have been the awarded IMS Interdisciplinary Multi-Investigator Materials Proposal (IMMP) award. With seed funds from OVPR, Provost, CLAS, SoE, and IMS, the IMS IMMP Award is a competitive process that provides up to three years of funding for research projects that have at least two investigators, preferably from separate units. The proposed work must be materials related and interdisciplinary.



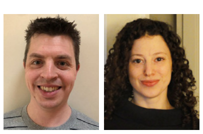
(l-r) Dr. Frame/Dr. Zaghi

Dr. Lesley Frame (MSE) and Dr. Arash Esmaili Zaghi (CEE) were awarded funding in support of the collaborative project entitled "Prediction of Bridge Performance Degradation due to Corrosion, Material Loss, and Microstructural Changes using Experiment, Field Samples, and 3D Scanning."



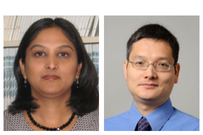
(l-r) Dr. Gao/Dr. Zheng

Dr. Puxian Gao (MSE) and Dr. Guoan Zheng (BME) have received funding for their collaboative project "Correlative In Situ Microscppy Study of nanomaterial Etching Dynamics for Advanced Energy and Optoelectronics Materials."



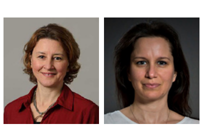
(l-r) Dr. Hohman/Dr. Ostroff

Dr. J. Nathan Hohman (CHEM) and Dr. Linnaea Ostroff (PNB) have received funding for their collaboration entitled "Mind-Capture Materials: Customized Supports for Tissue Slices."



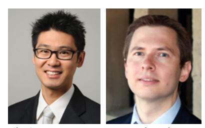
(l-r) Dr. Jain/Dr. Gao

Dr. Menka Jain (PHYS) and Dr. Puxian Gao (MSE) are collaborating on a research project entitled "Experimental and Theoretical Investigations on Oxide Materials for Multiferroics and Magnetocaloric Applications."



(l-r) Dr. Jankovic/Dr. Valla

Dr. Jasna Jankovic (MSE) and Dr. Ioulia Valla (CBE) are collaborating on the project titled "From Waste Plastics to Fuel Cell Catalysts" to develop approaches to utilize plastic waste to fabricate components for clean energy devices, such as fuel cells.

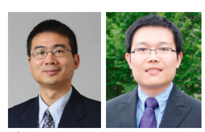


(l-r) Dr. Lee/Dr. Sochnikov

Dr. Seok-Woo Lee (MSE) and Dr. Ilya Sochnikov (PHYS) will work together on a research project entitled "Cryogenic Nano-Electro-Magneto-Mechanical Measurement for Strain Engineering Study on Advanced Functional and Quantum materials."

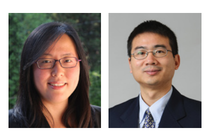
(l-r) Dr. Ortalan/Dr. Cakmak

Dr. Volkan Ortalan (MSE) and Dr. Miko Cakmak (Purdue University) have received funding to collaborate on a research project entiled "Unraveling Polymer Dynamics by In Situ Transmission Electron Microscopy."



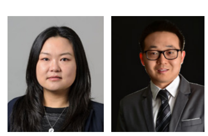
(l-r) Dr. Sun/Dr. Li

Dr. Luyi Sun (CBE) and Dr. Ying Li (ME) are collaborating on a project entitled "Mechanics-Guided Design of Multi-Functional Stretchable Nanocomposite Hydrogels."



(l-r) Dr. Zhang/Dr. Sun

Dr. Dianyun Zhang (ME) and Dr. Luyi Sun (CBE) are collaborating on the research project entitled ""Mechanics-Guided Design of Multi-Functional and Multi-Stimuli Responsive Stretchable Composites via a Controlled Self-Folding Process."



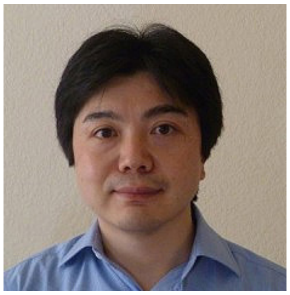
(l-r) Dr. Zhu/Dr. Ding

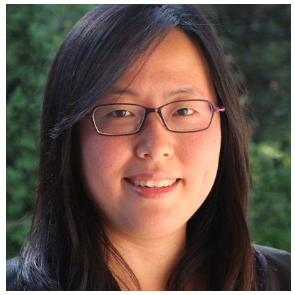
Dr. Yuanyuan Zhu (MSE) and Dr. Caiwen Ding (CSE) are collaborating on a research project entitled "Reliable and Efficient Feature Analysis in Electron Micrographs."

IMS Faculty Members Win Prestigious Research Award

Institute of Materials Science


Dr. Kelly Burke


Dr. Kazunori Hoshino


Dr. Dianyun Zhang

Three IMS faculty members have been selected to receive National Science Foundation Faculty Early Career Development Program (CAREER) awards. The CAREER award supports early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization. Activities pursued by early-career faculty should build a firm foundation for a lifetime of leadership in integrating education and research.

Dr. Kelly Burke, assistant professor of chemical and biomolecular engineering, will receive $582,469 over five years to investigate new polymers that are compatible with human cells and can be used to surround cells for laboratory culture in three-dimensional (3D) gels. The knowledge of cell behavior gained from this CAREER project can help discover and validate therapies for diseases such as fibrosis, a pathology characterized by excess scarring, and can contribute to new materials for regenerative medicine.

Dr. Kazunori Hoshino, assistant professor of biomedical engineering, was selected to receive the National Science Foundation Faculty Early Career Development Program (CAREER) award. Dr. Hoshino will receive $500,000 over five years to obtain a spatio-temporally-resolved, whole-body 3D map of the elastic modulus of healthy and abnormal zebrafish embryos, which will be used to quantitatively profile their growth and pathology. A better understanding of embryonic structural development will promote studies in developmental biology and biomedical sciences.

Dr. Dianyun Zhang, assistant professor of mechanical engineering, will receive $550,000 over five years to develop physics based models to create an in-depth understanding of defects and variability arising from manufacturing processes, and will elucidate the correlation between the constituent properties, processing conditions, and structural performance. The lack of robust modeling tools makes the composite manufacturers heavily reliant on trial-and-error approaches to minimize part variability, resulting in high manufacturing costs and limiting innovations for new process and part designs.

Dr. Anson Ma Named a 2020 Air Force Research Lab Summer Faculty Fellow

UConn Tech Park


Dr. Anson Ma

NSF SHAP3D Center Site Director, Professor Anson Ma, has received a prestigious 2020 summer faculty fellowship from the Air Force Research Lab (AFRL) Materials and Manufacturing Directorate. The fellowship is sponsored by the Air Force Office of Scientific Research (AFOSR) with the objectives of enhancing the research interests and capabilities of faculty fellows, elevating the awareness in the U.S. academic community of Air Force research needs, and stimulating professional relationships between the faculty fellows and Air Force researchers.

With the support of this fellowship, Ma and his Ph.D. student, Ethan Chadwick, will be working with researchers at the Wright Patterson Air Force Base on the topic of additive manufacturing, or 3D printing. "I am honored to receive this recognition. My student and I are very excited about the opportunity to interact and work closely with AFRL researchers and other fellowship recipients who are leading experts in their respective research fields," Ma said.

Ma is the founding Site Director of the NSF SHAP3D center for additive manufacturing at UConn. His research group focuses on understanding fluid dynamics (rheology) and advancing additive manufacturing technologies. Ma has received many accolades, including a National Science Foundation (NSF) CAREER award, Arthur B. Metzner Award from the Society of Rheology, and faculty awards from TA Instruments, 3M, and the American Association of University Professors (AAUP)-UConn Chapter.

IMS Faculty Members

Biomedical Engineering

Dr. Yupeng Chen
Dr. Ki Chon
Dr. Alix Deymier
Dr. Bin Feng
Dr. Martin Han
Dr. Kazunori Hoshino
Dr. Cato T. Laurencin
Dr. Tannin Schmidt
Dr. Sina Shahbazmohamadi
Dr. Wendy Vanden Berg-Foels
Dr. Yi Zhang
Dr. Guoan Zheng

Chemical & Biomolecular Engineering

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

Chemistry

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

Civil & Environmental Engineering

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

Electrical & Computer Engineering

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

Marine Sciences

Dr. Heidi M. Dierssen
Dr. J. Evan Ward

Materials Science & Engineering

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

Mechanical Engineering

Dr. Baki Cetegen
Dr. Xu Chen
Dr. Wilson K. S. Chiu
Dr. Farhar Imani
Dr. Kazem Kazerounian
Dr. Ying Li
Dr. George Lykotrafitis
Dr. Thanh D. Nguyen
Dr. Julián A. Norato
Dr. Ugur Pasaogullari
Dr. David M. Pierce
Dr. Anna Tarakanova
Dr. Savas Tasoglu
Dr. Dianyun Zhang

Molecular & Cell Biology

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

Nutritional Sciences

Dr. Yangchao Luo

Pathobiology

Dr. Mazhar I. Khan

Pharmaceutical Sciences

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

Physics

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

Physiology & Neurobiology

Dr. Linnaea Ostroff

Plant Science & Landscape Architecture

Dr. Cristian P. Schulthess

UConn Health

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

Emeritus/Retired Faculty

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

IMS resident faculty are indicated in bold

MSE Graduate Student Develops Novel Hybrid Convolution Neural Network

Materials Science and Engineering Department

MSE Graduate Student Rajat Sainju

Rajat Sainju, a third-year MSE doctoral student, has quite literally broken the mold of typical semantic segmentation for electron microscopy images, a technique that his research group has since applied in the development of computer vision-based algorithms for microscopy data. The opportunity to work in this new field would not have been possible without the support of his advisor, assistant professor Yuanyuan Zhu, and the MSE department. In fact, Rajat found the resources existing within UConn MSE to be crucial in guiding him toward his career goals, providing him with access to many renowned academics and a dedicated staff, and with opportunities to present and discuss his ongoing research in a highly collaborative, engaging environment. Utilizing these resources, Rajat co-authored one of the top 100 most downloaded materials science papers published in *Scientific Reports* in 2019.

The paper, entitled, "*Deep Learning for Semantic Segmentation of Defects in Advanced STEM Images in Steels*," focuses on the development and application of deep learning-based semantic segmentation algorithms, which can be used to automatically identify and segment nanoscale crystallographic defects in electron micrographs. Semantic segmentation involves the process of assigning each object – a type of defect in this case – to a corresponding class. The algorithm is able to make a prediction of all pixels that represent or belong to an object. Depending on the type of material, the defect type, and the number of defects, labeling each pixel manually in an image can take hours, even for seasoned researchers.

In this particular study, however, Rajat worked with his collaborators to develop a new convolution neural network architecture 'DefectSegNet,' which is now able to learn and identify any type of defect (such as dislocation lines, precipitates, and voids in steels) from a set of very small yet high-quality Scanning Transmission Electron Microscopy (STEM) images. When compared to the manual quantification of defect metrics, the prediction of defect-maps by DefectSegNet is significantly faster, and can now be completed reliably within seconds. These automated image analysis capabilities were demonstrated using micrographs acquired on HT-9 martensitic steel.

Rajat's paper on DefectSegNet has become the foundation of his future research. The lessons learned while demonstrating the feasibility of deep learning-based semantic segmentation for identifying defects that form under a complex-contrast mechanism have also opened exciting avenues for other applications of computer vision to S/TEM-image processing.

His current research focuses on the development of computer vision-based algorithms for automated high throughput analysis of images. Specifically, he seeks to understand material dynamics by combining in-situ environmental S/TEM and deep learning-based analysis. Depending on the experimental conditions and the information that needs to be extracted, a given project may include solving a combination of vision-based challenges such as object defection, object tracking, semantic, and instance segmentation. This can be used to better understand the fundamental processes and reactions within materials, like redox reactions, defect motion, catalysis, and phase transformations to name a few. These scientific tools contribute to reliable extraction of statistically significant, high-quality information from microscopy data. The implementation of deep learning algorithms removes human subjectivity, making the measurements robust, reliable, replicable, and comparable. Being able to take advantage of such algorithms will "save a lot of human hours."

"The bigger picture is to understand the material dynamics and behavior under various conditions." Rajat says of his work when applied to the real world, "Our hope is to create a positive impact through fundamental research on the lives of as many people as possible." The driving force behind his work is to continue developing such tools, and he aims to make them accessible to people across different fields. Building these image-processing tools is not limited to the materials science domain, but can also be applied to medical images, robotics, and satellite imagery, among other things. With this in mind, Rajat hopes to attain a job as a researcher in academia sometime soon.

He thanks his advisor, Dr. Yuanyuan Zhu, for helping him to get this far. "She is a great role model with an infectious passion for materials science," he says. Her vision for the future of in-situ electron microscopy and the integration of deep learning/computer vision for the advancement of microscopy has deeply influenced his research. "Becoming a scientist requires a broad range of scientific skills, critical thinking, imagination, integrity, independence, and of course, a very supportive mentor. By providing an environment of growth, Professor Zhu has helped me to acquire those skills and build an aptitude for scientific discovery."

MSE Graduate Student Discovers Career Path During Difficult Times

Materials Science and Engineering Department

MSE graduate student Marco Echeverria

Third year MSE graduate student Marco Echeverria spent a second highly productive summer at the Lawrence Livermore National Laboratory (LLNL).

Echeverria says his research focused on using simulations to model the generation of metal ejecta from high-energy experiments with metals and lasers.

"The focus of the simulation effort is to provide an atomistic insight on the process, and to study the microstructural and defects effects on the ejecta formation. Results such as strength values, dominant dislocation types and free surface morphology can be then used in higher length-scale simulations, such as continuum mechanics, to fill the gaps these models have due to their larger scale"

LLNL physicist Alison Saunders, Echeverria's internship supervisor, said that gaining a better understanding of ejecta interactions has a broad range of applications including spacecraft shielding, cold-spray welding, additive manufacturing and understanding material strength at small scales.

These findings will contribute to LLNL's primary responsibility of ensuring the safety, security and reliability of the United States' nuclear deterrent. The research laboratory is focused on using applied scientific and engineering advancements to support breakthroughs in counterterrorism, nonproliferation, defense and intelligence, energy and environmental security; a few of the many ways in which work such as Echeverria's can improve the world beyond the laboratory.

Echeverria likes that his work with LLNL is now a direct component to his Ph.D. research. "My (Ph.D.) work focuses on the behavior of materials under extreme environments, such as laser excited shock loading and piston loading. The ejecta studies with LLNL are another type of outcome in similarly extreme mechanical environments, so it all fits together well."

At UConn Echeverria works under the guidance and advice of MSE Associate Professor Avinash M. Dongare, principal investigator of the Dongare Computational Materials and Mechanics research group. Echeverria says that Professor Dongare recommended he attend the 2019 Stewardship Science Academic Programs (SSAP) conference in Albuquerque where he connected with scientists from LLNL. Marco's graduate research at UConn is part of the Center for Research Excellence on Dynamically Deformed Solids (CREDDS) that is funded by the Department of Energy's National Nuclear Security Administration (DOE/NNSA).

Dongare notes, "One of the top priorities of CREDDS is the ability of the students to engage with NNSA labs. Marco has been a success story for the center wherein he has worked with the scientists at LLNL to build a strong direction for his Ph.D. research. This is truly impressive for a graduate student."

Echeverria was one of millions of American students who found their academics restructured by COVID-19. Despite a shift to virtual research jeopardizing positions in most laboratories, Echeverria was able to obtain a completely remote internship.

Ph.D. Student Erin Curry Wins Physics Department Teaching Award

Department of Physics

Physics Ph.D. student, Erin Curry, accepting her award.

IMS/Physics Ph.D. student, Erin Curry, is a recipient of the Marshall Walker Outstanding Teaching Assistant Award in the Department of Physics. Erin was cited for her excellent service as a teaching assistant during the development of active learning "studio" style physics instruction. This innovative curricular overhaul combines research-supported practice of combining laboratory, lecture, and discussion in a new setting, presenting a strong break from the traditional, lecture hall plus lab approach of decades past.

Erin, who is advised by IMS faculty member Dr. Jason Hancock, was cited for her contributions in creating and developing original "tutorial" exercises in Spring 2019 Phys 1601: Fundamentals of Physics for Physics Majors and again as an instructor of record in Fall 2019 Phys 1501: Physics for Engineers. Tutorials are problem sets deliberately constructed to serve specific learning goals and a popular and effective new element of the studio physics in addition to the traditional lecture and laboratory components.

Congratulations to the 2020 MSE Senior Design Project Winners!

Materials Science and Engineering Department

On May 1st, 2020, 13 teams of MSE seniors virtually presented their Senior Design Projects for the annual Senior Design Day. These capstone projects, each sponsored by industry, state, or federal grants, demonstrate the engineering skills students have learned throughout their undergraduate careers. This includes the principles of design, how ethics affect engineering decisions, how professionals communicate ideas, and the day-to-day implications of intellectual property. The students research a problem, brainstorm potential solutions, and travel to the sponsoring company's site to learn more about them and the project. Throughout the two-semester project timeline, student teams maintain contact with their industrial and faculty mentors, continually reevaluate their designs, write progress and final reports, and give presentations summarizing their outcomes.

The top three Senior Design projects were awarded by a team of industry judges and alumni, as summarized below:

Lauren Heaven, Lockheed-Martin, Sikorsky
Rheanna Ward, Lockheed-Martin, Sikorsky
Vincent Palumbo, Mott Corporation
Truman Strodel, Pratt & Whitney

As department head Bryan Huey notes, "The winning projects and students represent just a few examples of the knowledge, skills, creativity, poise, and determination which our MSE graduates carry to the next stage in their careers."

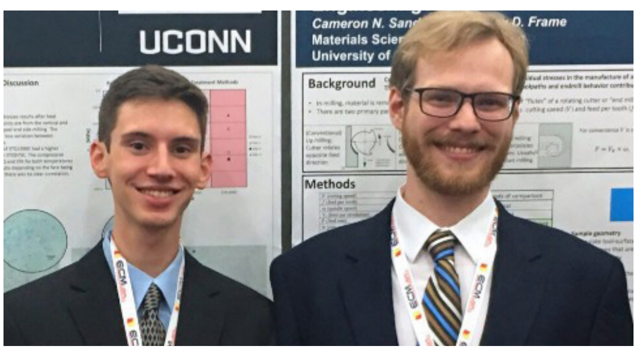
(Left to Right:) Christopher Choi, Riley Blumenfield, and Aidan Walsh

1st Place ($400): *Preparation Of 3D Printed Plastic Components For Waterborne Environments*

By Riley Blumenfield, Christopher Choi, and Aidan Walsh

Sponsored by: Naval Undersea Warfare Center
Sponsor Advisor: James LeBlanc
Faculty Advisor: Rainer Hebert

This project focuses on finding a 3D printable material with high mechanical properties and UV resistance, as well as a coating that prevents significant degradation of mechanical properties during exposure to seawater.



Kevin Sala (l) and Cameron Sanders

2nd Place ($300): *Controlling Residual Stresses In Alpha Beta Titanium During Manufacturing*

By Kevin Sala and Cameron Sanders

Sponsored by: Pratt & Whitney
Industry Advisor: Vasisht Venkatesh
Faculty Advisor: Lesley Frame

This project focuses on a better understanding of the surface and subsurface residual stresses and microstructural damages that occur during machining of titanium alloys as well as the design of manufacturing processes that limit the residual stresses and subsurface damage.

Katelyn White (l) and Eric Krementowski

3rd Place ($200): *Optimization Of Adhesion Between Kapton Tape And EPR In Motor Lead Extension Cables For Use In Electric Submersible Pump Cables*

By Eric Krementowski and Katelyn White

Sponsored by: Marmon Utility Co.
Industry Advisors: Michael Norton, Dan Masakowski
Faculty Advisor: Bryan Huey

This project focuses on assessing the adhesion between Kapton® tape and EPDM rubber of Chemlok® 250, Chemlok® 6150, 3M® 4799, and 3M® Primer 94 with 3M® 9485PC adhesive tape with a T-peel test in order to identify the optimal adhesive, prioritizing adhesion strength while considering ease of use and safety issues.

MSE Publication is one of the Top 100 Most Downloaded Papers on Physics

Materials Science and Engineering Department

MSE Ph.D. Graduate, Dr. Ayana Ghosh

MSE graduate student Dennis Trujillo

MSE Ph.D. graduate, Dr. Ayana Ghosh, and MSE graduate studet, Dennis Trujillo, co-authored a research paper with MSE faculty members S. Pamir Alpay and Serge M. Nakhmanson that has become one of the top 100 most downloaded papers on physics published in 2019, according to a list compiled by *Scientific Reports*. The paper is entitled "Electronic and Magnetic Properties of Lanthanum and Strontium Doped Bismuth Ferrite: A First-Principles Study."

The study focuses on using first-principles theory to investigate the effect of A-site dopant (lanthanum and strontium) on the changes in the electronic and magnetic properties of bismuth ferrite (BFO), which is a well-studied multiferroic material. The correlation between these properties of transition-metal oxide materials such as BFO has many technological applications, including tunable multifunctional spintronics, magnetoelectric random access memory devices, and various kinds of electronic sensors and optoelectronic devices. Since BFO thin films exhibit low electrical resistivity which limits its application in designing novel multifunctional non-volatile random access memory devices, the research featured in the paper contributes towards understanding how dopants like lanthanum and strontium can help overcome these shortcomings.

The research was performed in collaboration with Honchul Choi and Jian-Xin Zhu, both scientists from the Theoretical Division of Los Alamos National Laboratory (LANL). This collaboration grew from a mutual interest in working on a perovskite material such as BFO, as well as Ghosh's visits to LANL in 2017 when she was hired as a graduate research intern. Both Ghosh and Trujillo are currently also working on other projects and publications together.

On being a part of one of the top 100 most downloaded papers on physics, Ghosh said, "It is good to know that this paper is well-received by the research community and gaining attention. It will be great to see a few extensions of this research in the future as well."

Trujillo said, "It was amazing to be recognized for our work and to see that people were interested in our research. It validates the hopes we have from the beginning of any project that our work will be well received and have some impact on the community."

"Both Professor Nakhmanson and I have enjoyed working on this project with Ayana and Dennis who have done a great job with the calculations, the analysis, and the presentations of the results," Alpay said.

Congratulations Graduates!

IMS congratulates our 2020 graduates. Our graduates have worked hard over several years preparing to contribute to the future of materials science in industry, academia, and government. We wish all of them all the best as they begin their careers.

Dr. Matthew Baczkowski, Ph.D.

Exploration of Conjugated Polymers and Electroactive Small Molecules within Electrochromic Devices

Advisor: Dr. Gregory Sotzing

Dr. Reuben Bosire, Ph.D.

Functional Polymeric Materials: Exploiting Self-assembly Using Thermotropic and Lyotropic Liquid Crystals Within Random and Block Copolymer Framework

Advisor: Dr. Rajeswari Kasi

Dr. Elizabeth Brown, Ph.D.

Graphene as a 2D Surfactant: Influence on Emulsion and Composite Morphology and Properties

Advisor: Dr. Douglas Adamson

Dr. Feiyang Chen, Ph.D.

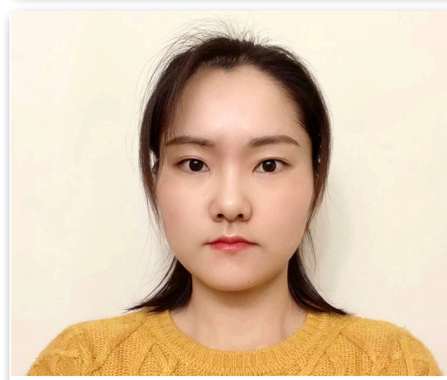
Graphene Stabilized Water-in-Oil Emulsion: From Liquid to Solid Application

Advisor: Dr. Douglas Adamson

Dr. Mohamad Daeipour, Ph.D.

Design and Calibration of an End Chilled Benchmark Casting Process

Advisor: Dr. Serge Nakhmanson



Dr. Yanliu Dang, Ph.D.

Design, Synthesis and Characterization of Metal Oxide/Phosphide-Based Catalysts for Energy Applications

Advisor: Dr. Steven L. Suib

continued on next page

Congratulations Graduates

Dr. Bahareh Deljoo, Ph.D.

Effect of Process Conditions on Phase Stability and Morphology in Manganese Oxide Nano-materials

Advisor: Dr. Mark Aindow

Dr. Stephen Ekatan, Ph.D.

Material Properties of Complex Synthetic Macromolecules Containing Secondary Structures

Advisor: Dr. Yao Lin

Dr. Ayana Ghosh, Ph.D.

Predicting Materials Behavior with Atomistic Simulations and Machine Learning

Advisors: Dr. Serge Nakhmanson

Dr. Danielle Heichel, Ph.D.

Design and Synthesis of Silk Fibroin Conjugates for Cell and Tissue Interfaces

Advisor: Dr. Kelly Burke

Dr. Taoran "Martin" Hui, Ph.D.

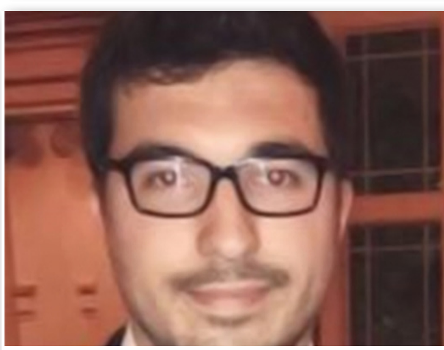
Kenetic Study of Surfactant-Free Graphene Exfoliation and its Applications in Conductive Film

Advisor: Dr. Douglas Adamson

Dr. Jindong Huo, Ph.D.

Multiphysics Modeling of Arc Plasma and Arc Root Instability in Plasma-Solid Interaction

Advisor: Dr. Yang Cao



Dr. Lukasz Kuna, Ph.D.

Mesoscale Studies of Nanostructured Multi-Functional Materials.

Advisor: Dr. Serge Nakhmanson

Dr. Dongwook Kwak, Ph.D.

Functional Nanomaterials for Energy and Sensor Applications

Advisor: Dr. Radenka Maric

Dr. Chris Monteleone, Ph.D.

Design of Materials and Processing Methods for High Temperature Composites

Advisor: Dr. Steven L. Suib

Dr. Dennis Ndaya, Ph.D.

New Platform of Functional Liquid Crystalline Co-polymers: Synthesis, Morphology, Properties, and Applications

Advisor: Dr. Rajeswari Kasi

Dr. Megan Puglia, Ph.D.

Stirred not Shaken: Functional, Biological, Two-dimensional Materials

Advisor: Dr. Challa V. Kumar

Dr. Armin Rad, Ph.D.

Lipid Nanodiscs: A Universal Platform for Cancer Therapy

Advisor: Dr. Mu-Ping Nieh

Dr. Deepthi Varghese, Ph.D.

Harnessing the Potential of Polymer Graphene Composites for Filtration and Energy Storage

Advisor: Dr. Douglas Adamson

Dr. Ngoc Chau Vy, Ph.D.

Controlling Dispersity of Polymer Brushes for Salt-Selective and Biologically Relevant Applications

Advisor: Dr. Douglas Adamson

Dr. Shawn Ward, Ph.D.

Self Assembly and Design: Two-dimensional Surfactants and Polymer Interfaces

Advisor: Dr. Douglas Adamson

Dr. Brandon Williams, Ph.D.

Nanostructured Flame Retardant Coatings

Advisor: Dr. Luyi Sun

Best Wishes to All of Our 2020 Graduates From Everyone at IMS

IMS INSTITUTE OF MATERIALS SCIENCE

EIRC Alumna Mona Ghassemi is Recipient of 2020 NSF CAREER Award and 2020 AFOSR Young Investigator Award

Institute of Materials Science

IMS Alumna, Dr. Mona Ghassemi

Dr. Mona Ghassemi, an IMS Alumna, is a recipient of the prestigious 2020 National Science Foundation (NSF) CAREER Award and the 2020 Air Force Office of Scientific Research (AFOSR) Young Invistigator Research Program (YIP) Award. Dr. Ghassemi was a post-doctoral fellow at the IMS Electrical Insulation Research Center (EIRC) from 2015 to 2017 working in the fields of streamer modeling for a Department of Defense (DOD)-funded subsea oil and gas electrification project as well as arc gas dynamic computation for General Electric with fruitful research outcomes of multiple joint publications with her advisor, Dr. Yang Cao at *IEEE Transactions*.

Since August 2017, Dr. Ghassemi has been an assistant professor at the Bradley Department of Electrical and Computer Engineering at Virginia Polytechnic Institute and State University. Her research interests include electrical insulation materials and systems, high voltage/field technology, multiphysics modeling, plasma science, electromagnetic transients in power systems, and power system analysis and modeling.

Initial Struggles Led to Lessons for IMS Polymer Program Graduate Dr. Deepthi Varghese

Institute of Materials Science

IMS Alumna, Dr. Deepthi Varghese

After completing a Master's Degree in Biochemistry from St. Josephs Arts & Science College in Bangalore, India, Deepthi Varghese joined the UConn Chemistry graduate program in the fall semester of 2014. After hearing brief research presentations from the chemistry departmental faculty, she became interested in Polymer Science with Prof. Douglas Adamson, an unexpected diversion from her initial plans for a career in biochemistry into a field in which she had no experience.

Although the lack of experience created a steep learning curve, Deepthi embraced this new research direction. While she faced challenges during the first two years, looking back, Deepthi says that she "gained far more knowledge than expected, including polymer science, electro chemistry, and setting up scientific research laboratories."

Deepthi also struggled with many challenges regarding science including the fact that experiments are more likely to fail than succeed; science takes far more time than initially expected; and there is never enough time to accomplish everything. Lessons like this can be applied to all aspects of life, business, and art, as well as science.

In addition to the science, Deepthi has increased her knowledge of communications, independent learning, and keeping an open her mind to feedback from all sources. She realized that you never know who will have valuable knowledge.

MSE Alumna Jacquelynn Garofano Honored by Society of Women Engineers

Materials Science and Engineering Department

MSE alumna, Dr. Jacquelynn Garofano

Jacquelynn Garofano used to suffer from impostor syndrome.

You wouldn't know it today – she speaks with the poise and confidence you'd expect from someone with her credentials – but it wasn't always that way. Early in her career, she felt overloaded, overwhelmed and filled with self-doubt. At one point she found herself on her mother's couch and in the midst of an anxiety attack. It was both a low point and a lesson in disguise.

"'No' is a full sentence. I had to learn that because I was taking on so much," Garofano said.

In the years since, she has found her voice and her power – she holds a Ph.D., leads a career development program for engineers and is a self-styled "STEMinist" – and she mentors others to help them do the same.

Garofano is among four Raytheon Technologies engineers being honored at the 2020 Society of Women Engineers awards for their contributions to the field. The organization, a nonprofit that advocates for women in engineering and technology, is also honoring 37 women across Raytheon Technologies' four businesses with a Patent Recognition Award, presented to members who were awarded a patent within the previous 10 years.

Here, the four major award winners share their advice for aspiring leaders.

Garofano was the first in her family to go to college. Her physics professor, Christine Broadbridge, inspired her to pursue a doctorate in materials science and engineering.

"She was leading a materials research lab. I had no idea what that was. I didn't know what I was walking into," said Garofano. "I had the access and opportunity and just the gumption, I think, even 20 years ago, to say 'What do you do? How can I get involved?'"

Since then, Garofano has found joy and success through seeking out connections within Raytheon Technologies as well as outside the company: allies, advisers, peers, people she's mentored. That has led her to the best job she's ever had – leading the Margaret Ingels Engineering Development Program at Raytheon Technologies, where she cultivates the next generation of engineers.

"I want to be for someone what Christine was for me," Garofano said.

"Find people of like mind and like energy, and surround yourself with those people."

~Dr. Jacquelynn Garofano

Garofano, who was honored with a Spark Award from the Society of Women Engineers (SWE) for contributing to the advancement of women by mentoring, encourages young women to build a community of their own.

"Find people of like mind and like energy, and surround yourself with those people," she said.

UConn Startup Wins NASA Award to Advance Artificial Retina to Help Patients Regain Sight

UConn Today

Nicole Wagner, CEO of UConn TIP company LambdaVision, works in the lab at the Cell and Genome Sciences Building in Farmington. (Peter Morenus/UConn Photo)

LambdaVision, an innovative biotech founded on UConn technology, along with implementation partner, Space Tango, has been selected by NASA for a $5 million award. This new funding will support LambdaVision's development of the first protein-based artificial retina to restore meaningful vision for patients who are blind or have lost significant sight due to advanced retinitis pigmentosa (RP), with follow-on applications in age-related macular degeneration (AMD), the leading cause of blindness for adults over 55 years old. As part of this award, LambdaVision and Space Tango will explore the benefits of microgravity for producing the startup's artificial retina on the International Space Station (ISS) U.S. National Laboratory located in low-Earth orbit (LEO).

LambdaVision Inc. was based on research by Robert Birge, Ph.D., professor emeritus in UConn's Department of Chemistry. He first considered using the light-activated protein, bacteriorhodopsin, more than 15 years ago to correct age-related blindness and inherited retinal disorders. Today, the company is commercializing its technology at UConn's Technology Incubation Program (TIP) in the hopes of restoring vision for millions of patients with a retinal implant that utilizes this protein. LambdaVision's protein-based artificial retina naturally mimics the light-absorbing properties of human photoreceptors and is capable of activating the degenerative retinas of blind patients.

"We are grateful to UConn for the continued support we've received as we develop this technology," says Jordan Greco, Ph.D., chief scientific officer of LambdaVision and UConn alum. "Partnering with Space Tango and working closely with NASA continues to be an impactful experience that is providing new insight in the development of our artificial retina, and we are confident that this work will one day benefit patients who have lost their sight. It is also our hope that LambdaVision's work will inspire new research and commercial product development that can help foster a thriving low-Earth orbit economy."

The new NASA award will cover a series of flights to the ISS over three years to evaluate and improve on-orbit production processes, and to produce artificial retinas that will then be evaluated on Earth for the potential to restore vision to patients suffering from retinal degenerative diseases. Once validated, this process could also provide the foundation for a number of products that could be manufactured in space with clinical benefit to patients and process improvement across technology industries on Earth.

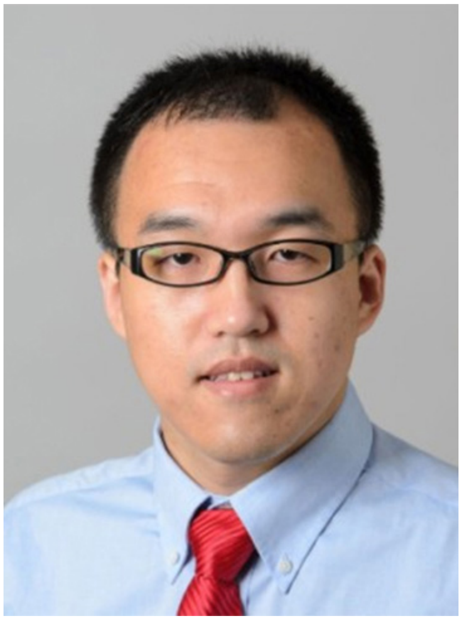
LambdaVision's implantable technology is produced through a layer-by-layer manufacturing process that ensures the artificial retina is dense enough to absorb appropriate amounts of light. While layer-by-layer production processes are used on Earth for multiple applications, LambdaVision researchers believe that production in microgravity may reduce the amount of materials required to produce the artificial retina, lower costs, and accelerate production time for future pre-clinical and clinical efforts.

Exploring production of the artificial retina for a rare disease before moving to diseases which affect a significantly larger portion of the population, such as AMD, provides several strategic advantages toward the creation of a new LEO biomedical sector. These include more manageable production volumes required to supply clinical trials, and a step-wise transition to commercial production volumes and scale required for future applications reaching a larger patient population. Upon finalization of optimal production processes and pre-clinical studies, LambdaVision intends to initiate clinical trials for the treatment of advanced RP.

"As we explore the seemingly immense ways in which microgravity can benefit the development and production of a wide range of products, our long-term collaboration with LambdaVision continues to provide us with valuable learnings that might one day help some patients regain sight and may also lead to other important production discoveries," says Twyman Clements, co-founder and chief executive officer of Space Tango.

2020 Graduate Dr. Dongliang “Moses” Wang is a Postdoctoral Researcher at Biorasis

Institute of Materials Science



Dr. Dongliang “Moses” Wang

After completing a master’s degree in Materials Science from the University of Pennsylvania, Dongliang “Moses” Wang joined the IMS Polymer Program as a Ph.D. student in the fall of 2014. Under the guidance of Dr. Fotios Papadimitrakopoulos, he learned the advanced knowledge of polymer materials, the development of biosensors and the interdisciplinary nature of today’s scientific problems. According to Moses, one of the many benefits of the UConn graduate school is the connections with researchers from various disciplines. Those connections were valuable for his scientific research and helped him succeed in the development of advanced glucose biosensors for diabetes patients.

In addition to the academic resources, Moses was amazed at the diversity of culture found on the UConn campus. He appreciated the opportunity to meet people from all over the world and enjoyed learning about various traditions, philosophies, and stories. One American tradition Moses discovered was baseball. He is now a supporter of the Boston Red Sox. He also enjoyed the beautiful scenery and rolling hills of New England.

After completing his Ph.D. in Polymer Science, Moses began his postdoctoral research scientist position with the UConn-born biotech company, Biorasis.

2020 Graduate Dr. Chris Monteleone is Using His Talents at Rolls Royce High Temperature Composites Lab

Institute of Materials Science

Dr. Chris Monteleone

Dr. Chris Monteleone completed his final defense and Ph.D. in Materials Science in May 2020. Chris began his education in UConn’s Chemical Engineering undergraduate program in 2010. During his sophomore year he was offered a research position in the ceramic’s laboratory of Dr. Steven L. Suib. The lab’s focus is coatings deposited by chemical vapor deposition for composites. Interest in these materials and processing led Chris to pursue minor degrees in both Chemistry and Materials Science & Engineering.

Chris was encouraged to leave UConn for graduate school, however after some investigating, he realized his current lab was conducting cutting edge research that was unmatched and could lead him to a career. He remained at UConn to complete his Ph.D. in Materials Science. Chris’s thesis title was, “Design of Materials and Processing Methods for High Temperature Composites.”

Chris said he’s “grateful for the support he received at both IMS and Chemistry.” The open collaborative attitude helped him grow as a scientist and make achievements that might otherwise be impossible. Outside of research, Chris was offered an opportunity helping the mechanical testing and microscopy labs at IMS. This gave him experience in both professional communications and writing technical reports, excellent preparation for an industrial position.

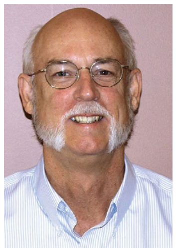
Chris recently began his career as a Materials Engineer at the Rolls Royce High Temperature Composites lab in Cypress, California.

IMS Industrial Affiliates Program is Business Forward in the Age of COVID-19

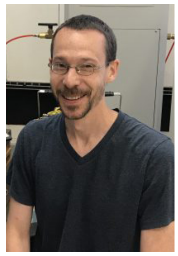
Institute of Materials Science

Dr. Paul Nahass

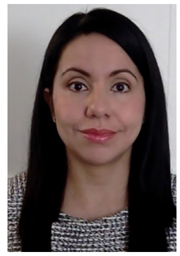
Dr. Hatice Bodugoz-Senturk



Dr. Roger Ristau

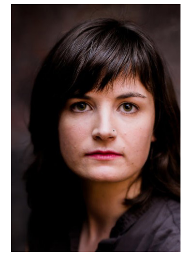


Dr. Nicholas Eddy



Dr. Daniela Morales

Dr. Dennis Ndaya



Dr. Capri Price

Dr. Haiyan Tan

The turmoil of the COVID-19 pandemic beginning in March 2020 resulted in the temporary shutdown of all UConn labs. IAP staff telecommuted during this time, completing reports and providing support to the extent possible. IAP, following State of Connecticut, UConn and IMS guidelines, safely reopened labs in May and June 2020. Since then, we have been taking company requests as usual, with slightly longer lead-times on some projects (typically three weeks), mainly due to limitations on the number of persons allowed in laboratories and reduced frequency of mail deliveries. As member companies ramped back up, we were able to return to a normal volume of requests.

As we have not been able to accommodate in person visitors, we have done most meetings virtually, and have used Zoom, Teams, and Webex. We have performed many project reviews online that we might have otherwise done in person. Our team came up with numerous innovative ways to accommodate these changes, for example, electron microscopy projects have had companies tune in virtually for a live session.

While we have not done much traveling to visit companies, we have had numerous introductory meetings and virtual tours of our industry partners' facilities. Even in the face of a pandemic, we were proud to welcome two new IAP Member companies: Nanoscale Components and Fluoropolymer Resources.

IAP has continued to expand its collaboration with UConn faculty and labs outside IMS, employing new capabilities to support company projects. During 2020, faculty have been adjusting to teaching remotely, but we have embarked on successful projects with. As in the past, IAP continued to collaborate with IMS faculty for the projects that could benefit from their expertise. Below are the examples of faculty collaborations.

IMS Core Faculty Project Examples:

- Douglas Adamson: Anionic Polymerization, Electrical Conductivity
- Yang Cao and Electrical Insulation Research Center (EIRC): Electrical Insulation Characterization
- Lesley Frame: Microstructure Analysis of Metals, Corrosion, Metal Fatigue and Failure
- Bryan Huey: Atomic Force Microscopy of Polymers, Piezoelectric Behavior of Materials
- Rajeswari Kasi: Polymer Chemical Characterization and Synthesis
- Seok-Woo Lee: Nano-indentation
- Anson Ma: Rheological Properties of Liquids and Solids
- Mu-Ping Nieh: Dynamic Light Scattering, X-ray Scattering of Polymers
- Montgomery Shaw: Polymer Fatigue, Rheology
- Luyi Sun: Microstructure Analysis of Polymers,
- Steven L. Suib: X-ray Photoelectron Spectroscopy (XPS), Auger, Secondary Ion Mass Spectroscopy (SIMS), battery characterization

IMS Non-Resident Faculty and Labs:

- Jeremy Balsbaugh (Proteomics & Metabolomics): Chemical Characterization by LCMS
- Liisa Kuhn (BME): X-ray Radiography for Biomaterials
- Challa V. Kumar (CHEM): Zeta Potential
- Jeffrey McCutcheon (CBE): Membrane and Filtration Efficacy
- Chris O'Connell (Advanced Light Microscopy): Confocal Microscopy, Fluorescence of Optical Fiber
- Sina Shabhazmohamadi (BME, REFINE Lab): X-ray Computed tomography, He-FIB
- Leslie Shor (CBE): In Vitro Characterization of Biomaterials
- Barrett Wells (PHYS): Optical Film Growth
- Kay Wille (CEE): High-load Mechanical Testing
- Dianyun Zhang (ME): Properties, Modeling of Composites
- Center for Environmental Sciences and Engineering: Inductively Coupled Plasma, Liquid Chromatography

The 2020 IAP Annual Meeting was cancelled, of course. Understanding the desire by our members and industry partners to keep current on analytical capabilities, IAP began planning for online webinars targeting specific analytical techniques. We have held these webinars monthly since October, with very robust attendance.

Preparations for a Virtual IAP Annual Meeting are in the works for June 2021, complete with faculty research presentations, lab tours, and student posters. Stay tuned, as the agenda should be released shortly.

Dr. Laura Pinatti retired in May 2020 and Dr. Dennis Ndaya joined the IMS technical staff as manager of the Polymer Thermal Analysis lab in June 2020.

Dr. Ndaya earned his B.Sc. in Chemistry and M.Sc. in Environmental Chemistry from the University of Nairobi, in Kenya, and his PGD in Chemistry and Physics Education from Moi University in Kenya. He completed his Ph.D. in Polymer Chemistry at UConn in 2019.

He brings his polymer research skills, including material selection, design, formulation, synthesis, and characterization to the Industrial Affiliates Program, the IMS industry outreach program.

Dr. Laura Pinatti Retires

Institute of Materials Science

Dr. Laura Pinatti

Dr. Laura Pinatti, manager of the IMS Thermal Analysis Laboratory, is soft-spoken and avoids the spotlight but she is also funny and caring, devoted to family, and amazing at her job. After 20 years working for the IMS Industrial Affiliates Program, Laura retired at the end of April. IMS News reached out to Dr. Pinatti with a few questions.

How did you come to the sciences and, specifically, analysis and characterization?
When the job for a research assistant in the thermal lab opened up in 2000 I jumped at the opportunity. My youngest had just turned 5 and it was time to get back to work. I couldn't have found a better place to spend the next 20 years.

What did you like most about your job in IMS?
Working for IMS and for the IAP has been challenging and stimulating with always something new to keep it interesting. I loved working with our team to define and solve the ever-increasing complexity of issues that industry continue to face.

You've retired in the age of coronavirus where we are working and socializing remotely. Of course there are plans to celebrate you when it is safe, but does having such a major event in these times feel different than what you expected?
Retiring when everything is shut down is obviously not how I expected to say goodbye. I would have liked to shake some hands and share some hugs.

How will you remember your time in IMS?
I, of course, also enjoyed meeting and working with all the graduate students over the years. Getting to know them, working with them on the instruments and learning about their research added a whole new layer of enjoyment to my life at IMS. But what I am going to miss most is chatting with the friendly faces in the halls and offices throughout IMS.

Do you have any special plans for your retirement years?
I am looking forward to a no-obligation, nowhere-to-be sort of retirement. My priority is my family and my health and some road trips to new places now and then.

Dr. Dennis Ndaya Joins IMS

Institute of Materials Science

Dr. Dennis Ndaya

On June 5, Dr. Dennis Ndaya became the new manager of the Thermal Analysis Laboratory, replacing Dr. Laura Pinatti who retired in May.

Dr. Ndaya earned his Ph.D. in chemistry from UConn in December 2019 under the advisemnt of Dr. Rajeswari Kasi. He received his M.Sc. in environmental chemistry from the University of Nairobi, Kenya.

His research has been published in such journals as International Journal of Pharmaceutics and Polymer Chemistry. Additionally, he has presented his research at the American Chemical Society where he received the Distinguished Poster Award in August 2015.

Dr. Ndaya's research interests include synthetic methods, structural characterization, and thermal-mechanical analysis and microscopy. He has served on the IMS Safety Committee, and has served as a student mentor to high school, undergraduate, and graduate students on a variety of research projects, as well as serving as Head of the Department of Physical and Biological Sciences for the Pumwani Girls High School in Kenya.

Shari Masinda Retires

Institute of Materials Science

Mrs. Shari Masinda

After 13 years in the Institute of Materials Science (IMS) and 17 years at UConn, Shari Masinda has retired. She began working for the university's Small Business Development Centers, then transitioned to IMS as an administrative assistant for the Industrial Affiliates Program (IAP). Shari ended her UConn career as a financial assistant in IMS. Asked what she felt was the best part of her job, Shari said it was the people.

"The best part is interacting with people; staff, students and faculty. I feel that the students are our future and it is incredibly important to be supportive while they're here. I like finding out where they are from and where they hope to go after graduating. I've found that the faculty are so interesting and devoted to their research. I am truly impressed by the dedication to research—trying to improve our lives through science and innovation, so cool."

In the next phase of her life, Shari looks forward to a time when she and her husband can travel together and she hopes to work more on photography. She also plans more volunteer work. "Most of all, I am looking for the gift of time — time to look at the color in an autumn leaf and feel sun on my face. I think I will have more appreciation for everything when I have the luxury of time."

IMS Welcomes Kayla Burgess

Institute of Materials Science

Ms. Kayla Burgess

On January 4th, 2021, Ms. Kayla Burgess joined the IMS professional team as a Grants and Contracts Specialist, taking over the pre-award administration process. We are excited to welcome her.

Kayla brings a financial background in both the public and private sector. After receiving her Bachelor of Arts in Economics and Bachelor of Arts in Political Science from the University of Connecticut, Kayla began her career in banking. She managed two branch offices before shifting her focus to public finance in 2015 when she started at UConn's Office of Budget and Planning. As a budget analyst, Kayla analyzed and monitored annual operating budgets and requests for her portfolio which included various academic and administrative departments.

Kayla has also been involved in various town and non-profit organizations, including the Putnam Rotary, Putnam Business Association, and Dyer Manor Fire District. She enjoys traveling and spending quality time with her husband and two young daughters.

INSTITUTE OF MATERIALS SCIENCE

IMS Administrative Staff

Kayla Burgess
Grants and Contracts Specialist

Kaitlyn Cullen
Administrative Assistant to the Director

Osker Dahabsu
Administrative Assistant
IMS Polymer Program

Brianna Demers
Finance Director

Nancy Kellerann
Purchasing

Lena Mastrangelo
Financial Assistant

Maria Mejias
Administrative Assistant
IMS Central Office

Joshua Strecker
Infrastructure

Rhonda Ward
Administrative Assistant
IMS Industrial Affiliates Program

IMS Scientific and Technical Staff

Mr. Matthew Beebe
Machinist

Dr. Hatice Bodugoz-Senturk
Associate Director
IMS Industrial Affiliates Program

Dr. Nicholas Eddy
Mechanical Testing Lab

Dr. Daniela Morales
X-ray Lab

Dr. Paul Nahass
Director
IMS Industrial Affiliates Program

Dr. Dennis Ndaya
Thermal Analysis Lab

Dr. Capri Price
GCMS Lab

Dr. Roger Ristau
Manager, Center for Advanced Microscopy and Materials Analysis (CAMMA)

Ms. Joanne Ronzello
Electrical Insulation Research Center Lab

Dr. Haiyan Tan
Microscopy Specialist

Dr. Lichun Zhang
SEM Lab

UCONN

IMS External Advisory Board

Jack Crane
CONNSTEP, Inc.

Ted W. Deisenroth
BASF Corporation

Matthew Dougherty
United Technologies
Electronic Controls

Richard M. Kellett
Ensign-Bickford
Aerospace & Defense

Joseph Kozakiewicz
Retired - 2020
Cytec Industries, Inc.

Joseph Krzyzaniak
Pfizer Inc.

Carmen Molina-Rios
State of Connecticut
Department of Economic and
Community Development

Richard Muisener
Evonik Corporation

David Pappas
Duracell Research and
Development

Francis Preli
Pratt & Whitney Aerospace

Karl M. Prewo
Innovatech LLC

Richard Price
Thermo Fisher Scientific

Joseph Puglisi
Rogers Corporation

Leah Reimer
Cantor Colburn LLP

Mark Roby
Retired - 2020
Hyalex Orthopedics

John A. Sharon
Raytheon Technologies
Research Center

William Tredway
Raytheon Technologies
Research Center

UCONN
UNIVERSITY OF CONNECTICUT

Support the Institute of Materials Science

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

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

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

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

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

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

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

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

Please make checks payable to The UConn Foundation
and indicate the fund(s) of your choice in the memo line.

Mail payment to:
Steven L. Suib, Director
Institute of Materials Science
University of Connecticut
97 North Eagleville Road, Unit 3136
Storrs, CT 06269-3136

Alumni, we would love to hear from you!

Send us your highlights, news stories, updates, research information, and photos. We would like to feature you in our next publication.

Please send email to: IMSnews@uconn.edu

Or mail to:
Institute of Materials Science
University of Connecticut
97 North Eagleville Road, Unit 3136
Storrs, CT 06269-3136