Institute of Materials Science Newsletter 2023

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On the Cover:

Our cover image is a photomicrograph by graduate student Xueni “Shirley” Huang. Shirley is a student in the Department of Chemistry under the advisement of IMS Director Dr. Steven L. Suib.

IMS News reached out to Shirley about her award-winning microscopic images and her research. Check the interview out on page 31.

Peony, photomicrograph by Xueni “Shirley” Huang

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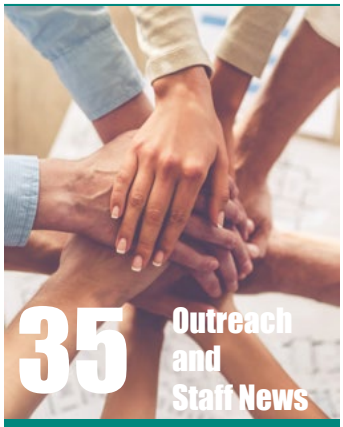


Message from the Director

Steven L. Suib, Director of IMS

Welcome back to *IMS News*. We hope this issue finds you all well and safely navigating our new reality. The past few years have required adjustments for all of us, and everyone here has risen to the challenge.

Our students have worked extremely hard during this time, including during the closure of labs early on. Our faculty members have continued to conduct meaningful research and advise students as they work toward, and achieve, their graduate degrees. Our faculty members also provide good balance as regards educating students about opportunities in industry, academia, and government. Our students continue to be recruited by many of the most well-respected organizations in the science and technology sector as well as organizations on the cutting edge of new technologies.

I want to acknowledge the efforts of our administrative and technical staff members. Because of their hard work and dedication, IMS remains strong and viable.

Our big news for this annual issue is our move from Gant North to Science 1, the new home of IMS. I share my thoughts in an *IMS News* interview where you can also view photos of this amazing new facility. Some key new features include a state-of-the-art clean room; an active learning classroom; consolidated labs for Materials Science and Engineering students; a common area for IMS Core Labs; the NANObyte Café; and many engaging and comfortable spaces for teaching, research, and service. On June 15, 2023, we invite you to join us for the Ribbon Cutting Grand Opening of Science 1. But please feel free to visit us anytime.

We want to thank several industrial and government sponsors for their dedicated support of IMS. We have managed to obtain new instrumentation for many of our Core Labs. The CAMMA microscopy facility is attracting support from all over the Northeast. In addition to academic users, we have welcomed industry partners conducting characterization projects in some of our labs.

In this issue, you will also read about new staff and faculty members. Several of our faculty members have received prestigious awards during this past year or so and these are detailed here. Our students continue to achieve outstanding accomplishments about which we hope you will read with as much pride as we have in sharing them with you.

While our new home is a great place to work, the people inside the building are most important. The people who work and learn in IMS are top notch and you will find just a few stories about their accomplishments in this issue of *IMS News*.

Wishing all of you the best from all of us,

Steven L. Suib

Promotions
Appointments
Honors

Radenka Maric Named 17th UConn President

From UConn Today

Dr. Radenka Maric

Radenka Maric, an acclaimed innovator in clean energy technology whose leadership as a vice president helped propel UConn to new heights in research funding, was selected as the University's 17th president.

Maric served as UConn's interim president prior to the appointment, a period in which she raised its national profile by hosting leaders of several top federal agencies for on-campus visits to demonstrate UConn's successes in various areas of research and academia.

She also brought a highly student-centric focus to her interim presidency and says she will continue and expand those efforts in concert with others at UConn to prioritize student success and inclusion, access to mentoring and life-transformative educational experiences, and their personal and professional fulfillment.

The Board of Trustees unanimously confirmed Maric's appointment, saying she rose to the top of a highly competitive pool of candidates during the national search.

"Being named president of the University of Connecticut is the honor of a lifetime. I am proud and humbled to have your confidence and your trust," Maric told trustees and audience members at Wednesday's meeting. "I will work every day to continue to earn it, as well as that of our students, faculty, staff, alumni, patients, and many supporters."

Read the full story

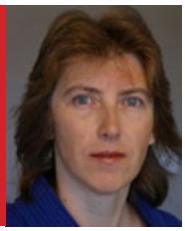
Faculty Promotions

The Office of the Provost announced the award of promotion and/or tenure to 69 faculty across the Storrs and regional campuses. Six IMS faculty members were among them.

IMS Congratulates resident and affiliate faculty members on their 2022/2023 promotions:

Dr. Yupeng Chen
Associate Professor and Tenure
Biomedical Engineering
School of Engineering

Dr. Elena Dormidontova
Professor
Physics
College of Liberal Arts & Sciences

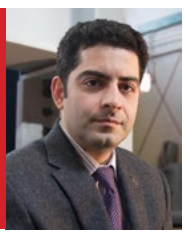


Dr. Ali Gokirmak
Professor
Electrical & Computer Engineering
School of Engineering

Dr. Xiuling Lu
Professor
Pharmaceutical Sciences
School of Pharmacy

Dr. Thanh Nguyen
Associate Professor
Mechanical Engineering
School of Engineering

Dr. Arash Esmaili Zaghi
Professor
Civil & Environmental Engineering
School of Engineering



Vahid Morovati Joins IMS Polymer Program Faculty

From the Institute of Materials Science

Dr. Vahid Morovati

Polymer Engineer, Vahid Morovati joined the University of Connecticut in the fall of 2022 with a joint appointment in the IMS Polymer Program and the Department of Civil & Environmental Engineering. Morovati completed his first Ph.D. in Civil Engineering at the Sharif University of Technology, Tehran, Iran. In 2020, he received a dual Ph.D. in Civil Engineering-Structural Engineering and Mechanical Engineering-Solid Mechanics from Michigan State University.

Vahid was a postdoctoral fellow in the Center for Mechanics of Solids, Structures and Materials and the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. His primary research interests lie in the multi-scale and micro-mechanical modeling of materials. As a part of his Ph.D. work, he developed a modular platform to study the nonlinear behavior of cross-linked elastomers. He is currently developing a computational framework to study the reliability of multi-layer thin films and the impacts of process-parameters on the mechanical properties of thin-film coatings. Vahid is also conducting research on the mechanics of multilayered van der Waals (vdW) materials to enhance their properties through strain engineering. He has published over 30 peer-reviewed journal papers and conference proceedings.

The Polymer Program faculty are excited to have Morovati as its newest member. His expertise in multi-scale modeling, the mechanical behavior of polymeric materials, and damage accumulation provides an excellent complement to the Program's current faculty, and will expand the variety, scope, and value of the Polymer Program's research.

Theo Kattamis Retires After Over 50 Years in Materials Science and Engineering Department

From the Materials Science & Engineering Department

Dr. Theo Kattamis

Theo Kattamis has played a vital role in the development of the Materials Science and Engineering (MSE) Department at UConn. He has witnessed the creation of an undergraduate program, expansion of the department and new research findings. He remained loyal to UConn because he "liked the University's environment which was very friendly and helpful, and the job which offered the possibility of growth." And now, after 50 years of employment, Kattamis has retired. He will extend his extraordinary contributions and service to UConn's MSE Department as an active emeritus professor.

When Professor Kattamis first came to UConn in 1969, he joined the Metallurgy Department which offered only a graduate program. "Since the Department was located from the early seventies in the Institute of Materials Science Building, its name evolved to the Department of Metallurgy and Materials," says Kattamis. "Many years later we added an Undergraduate program, and shortly thereafter, following a world-wide trend, we became the Department of Materials Science and Engineering."

Over the years, Kattamis taught three graduate courses: Solidification of Metals, Welding Engineering, and Powder Metallurgy Processing. He also taught two non-engineering electives for undergraduates: History of Materials and Technology and History of Engineering Until the Dawn of the 20th Century. More recently, he taught important core courses for the department related to processing and has taught, literally, thousands of UConn engineers through the Introduction to MSE course.

A Year of Honors for Cato Laurencin

Excerpted from UConn Today

Dr. Cato T. Laurencin

Dr. Cato Laurencin is internationally renowned for his work in biomaterials, stem cell science, nanotechnology, drug delivery systems, and the new field of regenerative engineering which he pioneered. He serves as the chief executive officer of the Connecticut Convergence Institute for Translation in Regenerative Engineering.

On June 15, 2022, Laurencin was honored by the American Orthopaedic Association (AOA) with its Distinguished Contributions to Orthopaedics Award adding him to its AOA Award Hall of Fame. He accepted the award at the AOA's Annual Leadership Meeting.

The Cato T. Laurencin Regenerative Engineering Founders Award

The American Institute of Chemical Engineers (AIChE) Regenerative Engineering Society is celebrating the leadership of Laurencin, its founder, with the launch of a new prize. The Cato T. Laurencin Regenerative Engineering Founders' Award will recognize the accomplishments of individuals who have demonstrated leadership in the science and practice of convergence research as applied to regenerative engineering. The inaugural award will be presented in at the Regenerative Engineering Society's 2023 Annual Meeting.

A University Professor and Albert and Wilda Van Dusen Distinguished Endowed Professor at the University of Connecticut, Laurencin will also receive the 2023 Priestley Medal, the highest honor of the American Chemical Society (ACS).

Dr. Laurencin has three additional awards in his name by different organizations.

The Society For Biomaterials created the Cato T. Laurencin, MD, Ph.D., Traveling Fellowship to support underrepresented students in the field of biomaterials.

The National Medical Association and the W. Montague Cobb/NMA Health Institute established the Cato T. Laurencin Lifetime Research Achievement Award. It was bestowed upon Dr. Ezra Griffith of Yale University at the opening ceremonies of the 2022 National Medical Association national meeting.

The University of Connecticut Foundation established the Cato T. Laurencin Scholars Award. This award is given to the top academically performing Black male graduating undergraduates from the University of Connecticut's Scholars House Community.

Anson Ma Named UTC Professor in Engineering Innovation

Excerpted from UConn Today

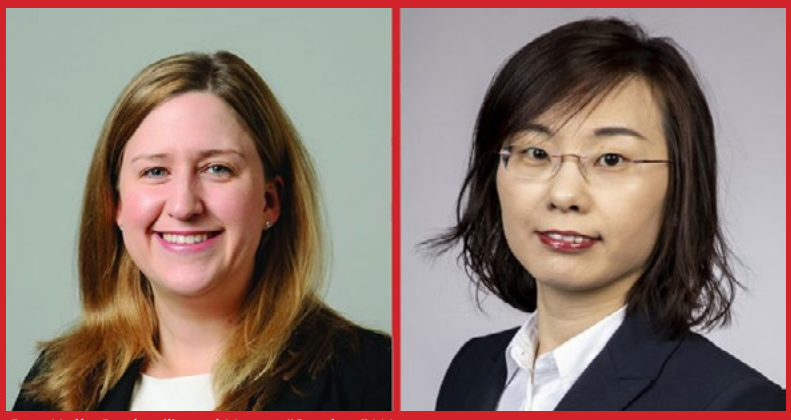
Dr. Anson Ma

Anson Ma has been named the United Technologies Corporation (UTC) Professor in Engineering Innovation. This professorship was established to recognize the exceptional achievements of young faculty who exemplify excellence in the areas of research productivity and impact, teaching contributions, and service contributions and are at the very top of their area of research.

Ma's research group focuses on rheology and 3D printing. He currently serves as the UConn Site Director of the National Science Foundation (NSF) SHAP3D Center for Additive Manufacturing. He has received a number of awards, including the Distinguished Young Rheologist Award from TA Instruments, NSF CAREER award, Arthur B. Metzner Early Career award from the Society of Rheology, 3M Non-Tenured Faculty Award, Early Career Award from the American Association of University Professors (AAUP)-UConn Chapter, UConn Polymer Program Director's Award for Faculty Excellence, and U.S. Air Force Summer Faculty Fellowship.

IMS Faculty Members Named 2022 American Chemical Society PMSE Young Investigators

From the Institute of Materials Science



Drs. Kelly Burke (l) and Xueju "Sophie" Wang

Each year, the American Chemical Society's Division of Polymeric Materials: Science and Engineering (PMSE) honors young investigators through its PMSE Young Investigator Symposium which provides an opportunity to highlight the accomplishments of its honorees. Honorees are chosen from early-career emerging leaders who have made significant contributions in their respective fields within polymer materials science and engineering. The invited honorees speak at a two-day "PMSE Young Investigator" symposium, held during the Fall National Meeting of the American Chemical Society.

IMS faculty members Kelly Burke and Xueju "Sophie" Wang were named PMSE Young Investigator Honorees for 2022 and spoke at the two-day "PMSE Young Investigator" symposium, held during the Fall National Meeting of the American Chemical Society.

Kelly Burke joined the UConn faculty in 2014 as Assistant Professor of Chemical and Biomolecular Engineering with an appointment in the Institute of Materials Science. She has been recognized for her accomplishments, including the National Institute of Health Ruth L. Kirschstein National Research Service Award and the prestigious NSF CAREER Award. She was appointed Director of the IMS Polymer Program in September 2021.

Sophie Wang joined the UConn faculty in 2020 as an Assistant Professor in the Materials Science and Engineering Department with an appointment in the Institute of Materials Science. She has consistently distinguished her research with numerous publications and as the recipient of the ASME Orr Early Career Award, and the NSF CAREER Award. She is an associate faculty member of the IMS Polymer Program.

Four IMS Faculty Members Elected to CASE

Excerpted from UConn Today

(l-r) Drs. Rainer Hebert, Sangamesh Kumbar, Mu-Ping Nieh, and Carolyn Teschke

The Connecticut Academy of Science and Engineering (CASE) announced the election of 35 new members for 2022 who the organization describe as leading experts in science, engineering, mathematics, medicine, and technology. 12 of those newly elected members are UConn faculty and four are faculty members of the Institute of Materials Science (IMS).

Rainer Hebert, Professor of Materials Science and Engineering; Director of Pratt & Whitney Additive Manufacturing Center, Associate Director of the Institute of Materials Science.

Sangamesh G. Kumbar, Associate Professor, Orthopaedic Surgery, Biomedical Engineering Health.

Mu-Ping Nieh, Professor, Dept. of Chemical and Biomolecular Engineering, UConn School of Engineering and Institute of Materials Science.

Carolyn Teschke, Professor and Interim Department Head, Molecular and Cell Biology, and Chemistry.

Sophie Wang Receives EML Young Investigator Award

From the Institute of Materials Science

Dr. Xueju "Sophie" Wang

Extreme Mechanics Letters (EML) enables rapid communication of research that highlights the role of mechanics in multi-disciplinary areas across materials science, physics, chemistry, biology, medicine and engineering. The journal honors the best young researchers who have published their highly impactful papers in EML by bestowing upon them the EML Young Investigator Award (YIA).

IMS faculty member, Xueju "Sophie" Wang was named one of four recipients of the 2022 award. She was nominated for the award based on her paper entitled "Reconfiguration of multistable 3D ferromagnetic mesostructures guided by energy landscape surveys".

The winners of the EML YIA are presented with a certificate, an honorarium, and an opportunity to present an EML Webinar.

In Memoriam: Dr. Jeffrey Schweitzer

From the Institute of Materials Science

Dr. Jeffrey Schweitzer

IMS is saddened to report the passing of Dr. Jeffrey Schweitzer, Professor in the department of Physics with an appointment in IMS. We are grateful to Dr. Peter Schweitzer (not related) for the following recap of Dr. Schweitzer's background and tenure at UConn:

Dr. Schweitzer earned his B.S. from Carnegie Institute of Technology (1967) and M.S. (1969) and Ph.D. (1972) from Purdue University. He was postdoc at the California Institute of Technology (1972-1974) and Scientific Advisor for the Schlumberger-Doll Research Laboratory (1974-1996). Since 1997, was a Research Professor in the Department of Physics at UConn.

After receiving a Ph.D. in low energy nuclear physics, Jeff's research activities have included many areas of basic research in a broad range of fields employing nuclear physics techniques. Jeff conducted basic nuclear physics and astrophysics research in the use of radioactive ion beams. He studied the kinetics of chemical reactions including nanoscale studies of cement chemistry with nuclear resonant reaction analysis. He worked on the development of new detectors for nuclear radiation, and was an expert in non-linear time series analysis of variable solar and astrophysical phenomena. Other areas of research included medical physics, forensic science, nuclear geophysics, geology and geochemistry, as well as industrial applications.

Jeff's more recent research was funded by NASA and focused on planetary science topics and instrument development for satellites and landers including the modelling of surface bulk elemental composition measurements on Venus as well as Martian subsurface elemental composition measurements with neutron and gamma ray instruments.

At UConn, Jeff mentored many students and younger professors. Among his Ph.D. advisees are:

Nada Jevtic, now Assistant Professor of Physics, Bloomsburg University, Pennsylvania

James Zickefoose, now Senior Research Scientist, Mirion Corporation (formerly Canberra Industries), Meriden, Connecticut

Jeff's Research Gate profile contains links to many of his works: https://www.researchgate.net/profile/Jeffrey-Schweitzer.


FACULTY
RESEARCH

A Conversation with IMS Director Steven Suib About the IMS Move to Science 1

From the Institute of Materials Science

Dr. Steven L. Suib, Director of IMS

What are the unique features of Science 1?

There are so many new features of Science 1. First of all, all teaching, research, and outreach efforts of materials scientists and engineers will be in one place. This will enhance communication and camaraderie of faculty and staff members. There are numerous informal and formal meeting rooms for everyone to enjoy. The labs are modular and have been individually designed by faculty members. The external ground work, the open structure of the building, and the natural lighting create a spectacular place to work.

Science 1 boasts an array of state-of-the-art technologies and a host of environmentally friendly features. Can you talk about some of the benefits Science 1 labs will offer for our research faculty, students, and technical staff?

The facilities in Science 1 will provide excellent environmentally friendly spaces for research, teaching, meetings, and gathering spaces. The materials used for all aspects of construction were chosen to be long lasting, stable, and safe. The new Clean Room facility will offer capabilities for studying materials that are not now possible at UConn. The Active Learning room will provide a unique place for users across campus.

IMS has close ties with Connecticut industry through its Industrial Affiliates Program. The program's annual meeting draws representatives from the aerospace and defense industries, companies working on green technologies, medical instrumentation, and many more.

What do you think UConn's investment in STEM says to our industry partners about its commitment to the advancement of scientific research?

The Industrial Affiliates Program is an important program but is only one avenue that IMS provides for industrial interactions. There are about 8 new Centers of Excellence driven by industrial needs including research projects, a certificate program, and use of facilities by industrial researchers.

UConn's investment in STEM in terms of Science 1 has wowed industrial visitors and shows a major commitment to academic industrial relations. There are already new industrial interactions based on programs in IMS that are enhanced by Science 1.

Mock-up of Clean Room at Science 1

Even science is not all science. IMS's administrative staff supports the research of its faculty members including accounting services for grants, ordering and distribution of supplies and equipment, payroll management, and student support. What are some of the things that you feel administrative staff will love about Science 1?

First off, the administrative staff that carry out financial duties are the finest on campus. All of the administrative staff

will now be located together where ideas and resources can be shared. The staff offices are very close to the new Café and that is a plus. The entranceway and signage in the building will make it very clear where students and visitors need to go. Moving to a new building will be a big effort on the part of the administrative staff during a transition period. Having a new home where state of the art lighting, electrical, cooling, heating, internet, and other features will be a refreshing change.

The Active Learning Space

The Active Learning Classroom

The move to Science 1 is a serious undertaking. There must have been innumerable tiny details that needed to be addressed prior to setting the date for the administrative staff's move on December 1. How were you able to juggle working with the planners and successfully carrying out your duties as a professor and researcher as well as director of IMS?

The staff of UPDC are outstanding and have led the way in terms of Science 1. Our concerns, both major and minor, were always met in a respectful and educational way. You are right that there were innumerable tiny details that were always presented, and we were asked for approval. These planners established timely meetings from day one to make sure everything was on schedule. One needs to think in such situations what the final building might be like in 40-50 years and try to plan for longevity and the ability to make changes. UPDC led the way in these discussions. Individuals and groups were asked for their opinions throughout the process. Joshua Strecker, building manager of IMS, provided many examples of what is needed for proper operation of such a building.

Our time in Gant has been memorable but we're all looking forward to the move to Science 1. Are there particular events or gatherings that stand out for you? Is there anything you will miss about Gant? And, for humor's sake, what are some things you will not miss?

As a scientist, meeting room IMS-20 with those wildly colored seats was always a treat. The view out the North Eagleville side of the building is memorable, with all the hustle and bustle of students and faculty. Years ago and now IMS has led the way for interactions with industry and the community. Many of those meetings are quite memorable. Early on our lab was fortunate to have some high tech ultrahigh vacuum equipment that would shut off during power outages, which were much more prevalent back then. Getting to the lab during any outage to shutdown such a system before the power came back on will not be missed. Fortunately, technology now provides devices that automatically shut down systems when outages occur.

Clean Room Gowning Room

A Conversation with Yuanyuan Zhu, Winner of DOE 2022 Early Career Award

From the Institute of Materials Science

Dr. Yuanyuan Zhu

Established in 2010, the Department of Energy (DOE) Office of Science Early Career Research Program supports the individual research programs of outstanding scientists early in their careers and stimulates research careers in the disciplines supported by the DOE Office of Science: Advanced Scientific Computing Research (ASCR), Biological and Environmental Research (BER), Basic Energy Sciences (BES), Fusion Energy Sciences (FES), High Energy Physics (HEP), Isotope R&D and Production (IP), and Nuclear Physics (NP).

Among the 83 university and DOE national lab researchers announced as recipients of the award for 2022, Assistant Professor of Materials Science and Engineering Yuanyuan Zhu is the only Connecticut researcher to receive the honor. IMS News asked Dr. Zhu about her research and the award.

In 2019, you were appointed Director of the UConn DENSsolutions InToEM Center for in-situ TEM research at IPB Tech Park. You have since had papers published related to the research the Center is conducting. As we are seeing more and more evidence of the effects of climate change, how do you hope your research at the InToEM Center will assist in solving some of the problems we are now dealing with?

Yes, we have published a couple of papers since 2019 using the in-situ environmental TEM gas cell. Here you can find our full publications: https://scholar.google.com/citations?hl=en&user=HlDqamcAAAAJ&view_op=list_works&sortby=pubdate .

It is a coincidence that the DENSsolutions' ETEM gas cell system is named as "Climate", because it involves a gas environment for chemical reactions in a microscope. Another example is their liquid cell system, which is called "Stream" simply because of the reaction stimuli involved.

There are many materials researches related to energy and environment, including climate change, that can benefit from the in-situ ETEM research. One immediate example is heterogeneous catalysis used for natural gas conversion and H_2 production. And the fusion energy materials research funded by the DOE ECA is another good example.

Congratulations on receiving the Department of Energy's Early Career Award for 2022. What are your hopes for your research on Understanding Thermal Oxidation of Tungsten and the Impact to Radiation Under Fusion Extremes?

Fusion energy holds great promise for replacing fossil fuels for 24/7 baseload electrical power. We are excited that the DOE Early Career Award will fund our in-situ ETEM study to directly address a well-known fusion safety hazard concerning aggressive high-temperature oxidation of plasma-facing material tungsten. We hope to gain fundamental understanding of tungsten degradation in case of air-ingress scenarios that could inform the best strategy for responding to accidents, and could guide the design of advanced W-based materials that better preserve divertor integrity for even more demanding DEMO fusion extremes. Simply put, we want to make the operation of fusion energy systems safer and more reliable.

You have several Ph.D. candidates under your advisement. How do you hope to influence these young scientists?

Our research group provides a welcoming, supportive and inclusive working environment to drive personal success for each Ph.D. researcher. Through the first-hand work on such research projects closely to clean energy and sustainability, I believe our Ph.D. students will gain confidence and skills in research and also develop a solid sense of social responsibility.

We are seeing many more women represented in STEM. What advice would you give to young women who may be considering a career in science, technology, engineering, and mathematics?

We need everyone in STEM, and anything is possible if one follows his/her/their passion. Research is fun but progress is built on failure and resilience.

Anna Tarakanova is Studying Elastins to Develop Aging-Related Therapies

From UConn Today

Mechanical engineering professor Anna Tarakanova listens during the 2020 Women in STEM Frontiers in Research Expo, which she co-organized. (Contributed photo)

Anna Tarakanova has long had an interest in how objects and bodies work. Her chosen specialty in the field of Mechanical Engineering – studying the structure, function, and mechanics of biological systems and materials, especially fibrous protein materials such as elastin and collagen – merges the two.

> **"For me, it was kind of a natural extension of what I wanted to do as a professor, being a woman in STEM and being a minority for most of my educational career."**
>
> ~ Anna Tarakanova, Assistant Professor
> Mechanical Engineering

The assistant professor of mechanical engineering and her team are working to establish a high-fidelity modeling framework for both healthy and degenerated elastins for use as a tool to resolve different pathological stressors affecting how elastin functions from a nanoscale.

During aging and with chronic, often age-related illnesses such as diabetes, cardiovascular disease, and osteoarthritis, elastin can degenerate, causing a decline in normal function. Elastin is an essential structural protein that gives the skin, heart, blood vessels, and other elastic tissues in the body the stretchy quality they need to function.

"At the molecular scale, there are a number of physical-chemical modifications that occur that drive this mechanical degeneration over time," Tarakanova says. "Because they are quite numerous and act in parallel, it's difficult to deconstruct which triggers impact mechanics and to what degree. If we can understand the mechanism, we can think about novel therapies to target aging and aging-associated diseases."

Tarakanova's work has earned her a 2022 Early Career Development (CAREER) Award from the National Science Foundation. She is one of 11 junior faculty members at UConn this year to receive the coveted award, which recognizes the recipient's potential as a role model in education and research.

CAREER Awards come with five years of funding intended to provide a foundation for a young professor's research program. Beyond advancing her research, Tarakanova plans to use the funding to create activities and events to engage and support undergraduate and graduate students, especially those from underrepresented groups. The effort will include a reboot of a Women In STEM Frontiers in Research Expo she co-organized with a colleague in January 2020.

"For me, it was kind of a natural extension of what I wanted to do as a professor, being a woman in STEM and being a minority for most of my educational career," Tarakanova says.

Elastin and collagen are not the only protein materials getting her attention. Early in the pandemic, Tarakanova and two of her graduate students began exploring the spike protein associated with SARS-CoV-2 to figure out how it moved when it interacted with the immune system. She is now working with Paulo Verardi, a pathobiologist in UConn's College of Agriculture, Health and Natural Resources, and UConn biochemist Simon White to develop new and potentially better ways to stabilize spike proteins for use in COVID-19 vaccines, particularly in relation to emerging new variants of the virus.

"Some of the methods we are using to study the spike protein are related to the methods that we've used and continue to use to look at elastin," she says. "It's a different project, but it does broadly fall under this fusing of computing and computational models, physics, biomechanics, and biochemistry to understand the dynamic behavior of the COVID spike protein, the protein that sits on part of the corona."

Yao Lin Receives Multi-Year NSF Grant

From the Institute of Materials Science

Dr. Yao Lin

Yao Lin has been awarded a five-year National Science Foundation (NSF) grant (DMR #2210590, $719,664), for his research project, "Advancing Processability and Material Performance of Synthetic Polyamino Acids with Transformable Secondary Structures."

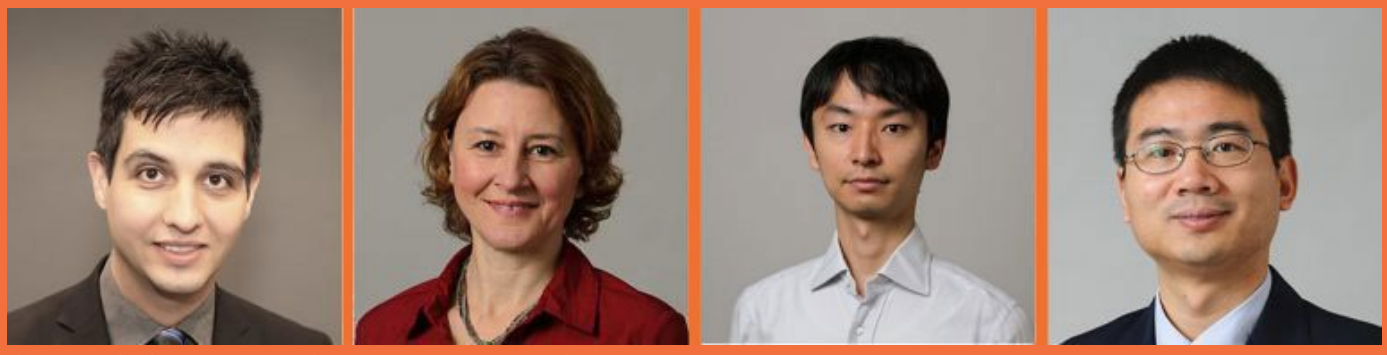
Dynamic transition from helices to sheets in fibrous proteins facilitates a remarkable increase in the strength, stiffness, and energy dissipation capacity. Polyamino acids (PAAs), also known as synthetic polypeptides, can adopt analogous secondary structures. However, inducing the structural transitions in the solid PAA of high molecular weights (MWs) is a largely unmet challenge. As a result, many of the PAA materials either have poor thermomechanical properties or are incompatible with polymer processing techniques such as extrusion and compression molding. This project aims to develop a general strategy to significantly improve the thermomechanical properties and processability of synthetic PAAs by taking advantage of metastable, transformable structures of PAAs and control over their in-situ transition and hierarchical organization.

The findings from this project may enable the generation of polymeric systems that will approach the level of sophistication and versatility found in some of nature's biomaterials. The research also provides a model system of synthetic polymers with intrinsic secondary structures in which the different partitioning of intramolecular and intermolecular networks determines the macroscopic properties of materials, enabling comparison of the experimental results with predictions from simulations and modeling.

Graduate and undergraduate students will be trained on bioinspired polymeric materials and acquire skills in polymer synthesis, material characterization, mechanics, and computer simulations.

Four IMS Faculty Members Receive OVPR Spring 2022 Scholarship Facilitation Award

From the Institute of Materials Science



(l-r) Drs. Farhad Imani, Jasna Jankovic, Tomoyasu Mani, and Luyi Sun

The Scholarship Facilitation Fund program provides up to $2,000 to UConn faculty across all disciplines to promote, support, and enhance research, scholarship, and creative endeavors across UConn Storrs and regional campuses. Four IMS faculty members were among the 67 faculty named as recipients of the award for Spring 2022:

Farhad Imani, Mechanical Engineering: Brain-inspired Hyperdimensional Computing for Empowering Cognitive Additive Manufacturing

Jasna Jankovic, Material Science and Engineering: STEAM Tree Earth Day Celebration

Tomoyasu Mani, Chemistry: Stereoselective Control of Electron Transfer Reactions

Luyi Sun, Chemical and Biomolecular Engineering: Publication in PNAS, a Premium Journal for Maximum Impact.

Leveraging Stratasys Objet 500 Connex to Advance Multi-material 3D Printing

From Innovation Partnership Building at UConn Tech Park

3D-printed multi-material components

Dr. Anson Ma

The month of May 2022 brought an advanced 3D printer, the Stratasys Objet 500 Connex, to the Science of Heterogeneous Additive Printing of 3D Materials (SHAP3D) lab in the Innovation Partnership Building (IPB).

"We are extremely excited about bringing this state-of-the-art 3D printer to IPB and leveraging it to accelerate our multi-material printing research," says Professor Anson Ma, SHAP3D UConn Site Director. The printer works by jetting and combining different print materials with high precision, thereby achieving a wide range of physical properties through changing the digital print design. This printer also complements the advanced prototyping capabilities that already exist at IPB's Proof of Concept Center (POCC), directed by Joe Luciani.

Now armed with this powerful printer, Prof. Ma and team aim to expand the choice of materials that can be printed using this machine. Of interest are functional materials with excellent mechanical, thermal and electrical properties. Another topic of interest is to develop in-situ metrology for monitoring the print process in real time and ensuring the quality of 3D printed parts. This is especially important for high performance applications, such as aerospace, where the printed parts must meet stringent requirements. Ideally, all the printed parts must be qualified as they are produced, termed "born-qualified." Prof. Ma's long-term ambition is to develop autonomous 3D printers that are intelligent, through working closely with machine learning experts like Prof. Qian Yang from the Department of Computer Science and Engineering at UConn.

In addition to aerospace, the auto industry, and other major manufacturing sectors, organizations that will benefit from the SHAP3D research include 3D printer manufacturers and material suppliers. As the SHAP3D team continues to expand the material selection and improve the robustness of 3D printing, more application opportunities will open up. Professor Ma is eager to get started, although he cautions, "before we can run, we need to learn how to walk." With the addition of the Objet 500 Connex, the SHAP3D team will be sprinting soon.

> **"We are extremely excited about bringing this state-of-the-art 3D printer to IPB and leveraging it to accelerate our multi-material printing research."**
>
> ~ Anson Ma, Associate Professor

Established in July 2018, Science of Heterogeneous Additive Printing of 3D Materials (SHAP3D) is an Industry/University Cooperative Research Center (I/UCRC) funded by the National Science Foundation to catalyze the technological development of additive manufacturing, also known as 3D printing. The partners are University of Massachusetts at Lowell (UML), University of Connecticut (UC), and Georgia Institute of Technology (GT).

A Conversation with Richard Parnas on FOG, Biofuels, and Wastewater Management

From the Institute of Materials Science

Dr. Richard Parnas works on his biodiesel reactor.

Professor Emeritus of Chemical and Biomolecular Engineering, Richard Parnas, has been working on solutions to the oily waste we humans produce on a daily basis. He has been on a journey to convert that waste into usable energy. This quest has led to the patent of proprietary technology and the formation of REA Resources Recovery Services, a company he co-founded. Along with his partners in the company and in partnership with UConn, Dr. Parnas set about to convert FOG (Fat, Oil, Grease) into biodiesel for the benefit of municipalities in the state.

In 2019, REA contracted with the City of Danbury to build a FOG to biodiesel processing facility at the city's wastewater treatment plant. That project has entered the construction phase and Parnas, REA, and UConn are now looking forward to the day the facility converts its first oily waste into usable biodiesel. IMS News reached out to Dr. Parnas about his research, the Danbury project, and the future of wastewater management.

You have been researching and developing methods to convert FOG (Fat, Oil, Grease) into biodiesel fuel since 2006. When did you first become interested in biofuels and what about biodiesel, in particular, led you down your current path?

I've been interested in biofuels, and green processing and green materials in general, for many years before coming to UConn. One of the important motivations for joining UConn was to participate in the development of the green economy. An undergraduate helped get me started working on biodiesel in the summer of 2007 by simply requesting my help to set up a biodiesel synthesis reaction in a fume hood.

When you became Director of the Biofuel Consortium here at UConn, you moved the bar from six gallons of biofuel produced over the course of a year to over 50 gallons continual production daily less than three years later. When did you realize the scale at which you might be able to convert FOG into biodiesel? What were the obstacles you faced and how were they overcome?

We used the yellow grease from UConn cafeterias to make biodiesel at that time, and the scale of operations was determined by the yellow grease production rate from the cafeterias. As a Chemical Engineer, my goal is always to maximize the use of available raw materials, and waste as small a fraction of that raw material as possible. Shortly after we started the Biofuel Consortium, we polled the various food service establishments at UConn to determine the yellow grease availability, and found it to be over 100 gallons per week. We then designed, built and installed a 50 gallon batch system, and produced 2 or 3 of the 50 gallon batches each week.

There were a number of obstacles. Production at that scale is not a typical academic activity so we faced skepticism from the facilities folks who ran the fuel depot for the buses. They asked if our fuel would be any good and how we would prove it to them, so we had to set up testing capability. Our testing was developed and run by Prof. James Stuart, an analytical chemist. Prof. Stuart and I received a grant of over $600,000 dollars to set up a biodiesel fuel quality testing facility in the Center for Environmental Science and Engineering (CESE) to test our biodiesel and the biodiesel produced by private companies. We also faced skepticism from the UConn administration since we were operating at

Richard Parnas filling a truck with biodiesel fuel.

a much larger scale than was typical. Safety concerns are important when conducting such operations with students who are just learning how to handle chemicals.

REA Resource Recovery Systems, a company which you co-founded and worked in collaboration with UConn to patent exclusive technology, has entered Phase 4 of its planned development of a 5000 square foot facility in Danbury that will turn FOG into biofuel. How important is wastewater management for municipalities and what will be the benefits for the City of Danbury once the facility is online?

I joined my two partners, Al Barbarotta and Eric Metz, to found REA at the end of 2017. The UConn patents were already in place for a piece of core technology called a counterflow multi-phase reactor that plays a key role in both the chemical conversion and in the product purification. Prof. Nicholas Leadbeatter from Chemistry is a co-inventor with me on that reactor, along with two undergraduate students. Beginning in 2015, I started working with a very low-grade feedstock called brown grease, which is much harder to process than the yellow grease we had been working with earlier. Every single wastewater treatment plant in the world has a brown grease management and disposal problem, and every municipality has a wastewater management problem. In much of the world, wastewater management is required by law and heavily regulated to ensure that effluent meets standards for discharge into rivers and oceans.

Here in CT, the brown grease problem was handled by DEEP many years ago by mandating that certain wastewater treatment plants in the state become FOG receiving stations. Brown grease is the component of FOG that causes all the problems. These FOG receiving stations were given a small set of choices as to how to dispose of the brown grease they received, such as by landfilling or incineration. All the choices cost money and vectored pollution into the air, the land, or the water.

Danbury was mandated to become a FOG receiving facility several years ago and undertook a general plant upgrade project to build a FOG receiving facility and then dispose of the FOG using biodigesters. When that disposal pathway became too difficult due to high cost they sought alternatives. REA was ready at that time to provide the alternative of converting the brown grease into a salable product, biodiesel. This solution provides two benefits to Danbury, an environmentally excellent disposal method and a source of revenue. REA estimates that the revenue will offset the cost of the project in Danbury in about 7 years, and that the payback period will be significantly shorter in larger facilities.

It has been 15 years since you undertook this journey of making biodiesel a viable alternative energy source. How does it feel to see your years of work coming to fruition with the Danbury project?

Richard Parnas discusses biofuel conversion with Representative Rosa DeLauro and former New Haven Mayor Toni Harp.

It feels terrifying because we have not yet started up the Danbury plant. When we successfully start Danbury, the relief and satisfaction will be enormous. Until then, for the next few months, everyone associated with the project is working very hard to finish the installation.

Since retiring in 2020, you appear just as active in your pursuit of science. What continues to drive you and is there anything you miss now that you have retired?

I am driven by the desire to see this biodiesel project through to completion and by the desire to play some small role in mitigating the unfolding climate catastrophe. When I started at UConn I was surprised that the academic definition of project completion is a final report. As an engineer, that did not seem to be enough because most reports are ignored and forgotten. Sometimes I miss the teaching aspect of working at UConn, but I think I most miss the camaraderie of my colleagues, with whom I have much less time now than I used to.

Rapid Virus Test Being Studied in Zhang Group will Differentiate SARS-CoV-2 from Other Respiratory Viruses

From the Institute of Materials Science

(from left to right) Guangfu Wu, Huijie Li, and Zhengyan Weng, advised by Professor Yi Zhang, are checking an array of graphene field-effect transistors.

In recent years, from H1N1 and now to SARS-CoV-2, global pandemics caused by highly contagious viral species have been threatening human life and putting tremendous pressure on healthcare services as well as the economy. Rapid testing and timely interventions for asymptomatic or mild infections caused by SARS-CoV-2, for example, would enable efficient quarantine of infected patients, thus significantly reducing the spread rate of the virus. Importantly, SARS-CoV-2 is expected to continue in the future fall/winter seasons, when it will coincide with the seasonal outbreak of other infectious respiratory diseases, including those caused by influenza virus and respiratory syncytial virus, which have similar signs and symptoms in the early stages. Considering the overlap in the seasonal peaks, symptoms, and underlying risk factors of these illnesses, having a rapid test to detect and differentiate SARS-CoV-2 from other infectious respiratory viruses will be clinically important.

In response to this clinical need, the Institute of Materials Science and Biomedical Engineering Assistant Professor Yi Zhang led the development of the most sensitive amplification-free SARS-CoV-2 diagnostic platform, the CRISPR Cas13a graphene field-effect transistor. This study, entitled "Amplification-Free Detection of SARS-CoV-2 and Respiratory Syncytial Virus Using CRISPR Cas13a and Graphene Field-Effect Transistors," was published online on May 12, 2022, in the journal *Angewandte Chemie International Edition*.

"The key features of viral diagnostics are rapidness and sensitivity," said Zhang. According to Zhang, most virus detection techniques, including the gold-standard RT-PCR, relies on viral sequence amplification, which can dramatically complicate the detection process and increase the risk of cross-contamination, therefore subject to elevated false-positive rates. However, current amplification-free methods are still limited by compromised sensitivity. "Our work revolutionized the field of amplification-free nucleic acid diagnostics by introducing a biosensing platform with sensitivity comparable with RT-PCR," he said.

Derived from adaptive immunity in prokaryotes, Nobel-winning clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR-associated (Cas) technology leverages nucleic acid base pair complementarity between a guide RNA and targeted nucleic acid sequence and affords high target specificity capable of discriminating single mismatches. Recently, several CRISPR/Cas systems, including Cas13a, were found to perform cleavage of nonspecific bystander nucleic acid probes triggered by target detection, known as "collateral cleavage." Such collateral cleavage demonstrates a multi-turnover behavior, turning a single target recognition event into multiple probe cleavage events, and therefore leads to signal amplification.

"As the COVID-19 pandemic wanes, our virus diagnostic tool can be easily adapted to combat the future outbreak of unknown viral species."

~ Guangfu Wu, Postdoc in the Zhang lab

"The idea of our biosensor design originates from exploiting the signal amplification by translating CRISPR technology onto an ultrasensitive detection platform," said Huijie Li, a Ph.D. student in Zhang's lab; she is also the leading first author of the study. Graphene, as a two-dimensional material, exhibits extraordinary charge carrier mobility and

Dr. Yi Zhang

thus high electrical conductivity. Thanks to its atomic thickness, graphene, when constructed into biosensors as a sensing material, is highly sensitive to the interaction with biological analytes. In this study, by immobilizing probes on graphene-based field-effect transistors and allowing Cas13a collateral cleavage of these probes activated by target detection, SARS-CoV-2 down to 1 aM level in both spiked and clinical samples, was successfully detected within a 30 min detection time.

Simply by changing the guide RNA design, CRISPR Cas13a graphene field-effect transistor platform was reconfigured to target respiratory syncytial virus with the same attomolar sensitivity. "As the COVID-19 pandemic wanes, our virus diagnostic tool can be easily adapted to combat the future outbreak of unknown viral species," Guangfu Wu, a Postdoc in Zhang's lab; he is the co-first author of this work, said.

This study marks a significant milestone towards our goal of developing an integrated point-of-care biosensing platform for viral diagnostics. "We are aiming to offer patients a fast, ultrasensitive all-in-one tool that can streamline sample treatment and analysis and deliver results without any specialized training," said Zhengyan Weng, a Ph.D. student in Zhang's lab; he is also the co-first author of this study.

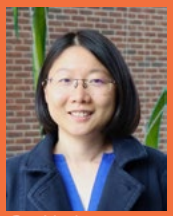
Fall 2022 Scholarship Facilitation Fund Awardees

From the Institute of Materials Science

The Office of the Vice President for Research (OVPR) offers internal funding for faculty projects that are at critical stages of development. This funding is provided to serve as high-leverage, strategic investment in outstanding faculty research projects. The Institute of Materials Science is proud to announce our faculty members who have received internal funding for the Fall 2022 funding period.

Dr. Menka Jain

Dr. Xiuling Lu



Dr. Na Li

Dr. Helena Silva

Dr. Xiuling Lu Named 2023 Faculty Research Advising Award Recipient

From UConn Today

Dr. Xiuling Lu

Xiuling Lu was selected as the 2023 Faculty Research Advising Award recipient by the UConn School of Pharmacy. This award, presented during commencement weekend, marks the second year the award has been presented.

Lu is a professor of pharmaceutics in the Department of Pharmaceutical Sciences. She has mentored approximately 50 undergraduate and professional students on research projects over the past 10 years. Many have stayed on in her lab to conduct research throughout their undergraduate and professional programs.

"I am grateful for the recognition and feel lucky to mentor those talented undergraduate and Pharm.D. students," says Lu. "They are passionate about research, and especially interested in learning about formulation and nanoparticle-based drug delivery. I enjoy seeing their excitement when discussing the projects and plans and am also glad to guide them through the challenges when conducting experiments."

She has served as a major advisor for three students and associate advisor for one student who were selected as University Scholars. Lu initiated the Student Educational Assistance (SEA) program to promote student-centered teaching and learning. The SEA program plays an important role for School of Pharmacy students and did so especially during the COVID-19 pandemic.

"The research experience is not meant to be just something on their CV, but an opportunity for practicing problem solving, creativity, collaboration, persistence, and even patience," says Lu.

Lu currently has two University Scholars and three honors students doing research in her lab for their honors theses. These students have earned multiple research awards and fellowships, and drafted or co-authored manuscripts for publications.

Cao, Hohman, and Norato Working to Solve the Nation's Energy Problems

From UConn Today

Dr. Yang Cao

Three new grants totaling $7.5 million from ARPA-E and the U.S. Department of Energy (DOE) are enabling UConn researchers to conduct ground-breaking work on some of the nation's most pressing energy problems.

Advanced Research Projects Agency-Energy (ARPA-E) grants provide funding for the development of transformational technologies that provide new ways of generating, storing, and using energy.

Shrinking Substations for Green Energy Integration

Yang Cao, a professor in the School of Engineering, is working on a three-year ARPA-E project to create a new technology that will help stabilize the power grid and integrate renewable energy sources into the existing energy infrastructure.

Substations are sprawling networks of wires, towers, and transformers. Substations change the high voltage that comes directly from energy generation stations into low voltage that can safely be delivered to homes or businesses.

The century-old energy infrastructure in the United States is prone to power outages, especially during increasingly common severe weather.

This infrastructure is also poorly suited to renewable energy sources as they were designed for fossil fuels.

With something like wind or solar energy, the energy sources are spread out across a huge expanse rather than coming from a neatly packaged oil barrel. Solar panels or wind turbines also tend to be in remote areas far from major cities that have massive electrical needs. This means we need more efficient technologies that can link distributed energy generators to urban areas.

Cao will work with Virginia Tech on the project, titled *Substation in a Cable for Adaptable, Low-cost Electrical Distribution (SCALED)*, to develop high-voltage cables to replace bulky substations.

"We need a more versatile and compact conversion and integration solution for distributed renewable energies," Cao says. "This overall project is targeting that."

Making something this compact will be highly advantageous as they can be placed almost anywhere, whereas current substations require a tremendous amount of open space.

The goal of the project is to greatly reduce the footprint of substation technologies without compromising its effectiveness.

> **"We need a more versatile and compact conversion and integration solution for distributed renewable energies. This overall project is targeting that."**
>
> ~ Yang Cao, Director
> Electrical Insulation Research Center

"We could really have a very compact substation that helps to convert and integrate the distributed energy generation into a grid instead of having really large, bulky substations," Cao says.

A Better Path for New Materials

Nate Hohman, assistant professor of chemistry, is working on a new DOE grant to develop artificial intelligence (AI) tools to improve the synthesis of new materials.

Dr. Nate Hohman

While scientists are constantly innovating new materials for energy, biotechnology, and many other applications, currently, the best tool they have at their disposal for this process is trial and error.

> **"Engineering a new hypothetical material today requires guesswork at every step."**
>
> ~ Nate Hohman, Assistant Professor
> Chemistry

"Engineering a new hypothetical material today requires guesswork at every step," Hohman says. "We guess what compounds might crystallize into a structure that may have a property of interest, hope we get the material we expected, and pray it has the properties we imagined. This is inefficient, labor intensive, and has a low likelihood of success."

Hohman will combine nano-crystallographic characterization with Euclidean neural networks to develop a better technique for real-time characterization of materials using a continuously variable model material system.

Crystal characterization allows scientists to see how the atoms that make up a molecule are arranged. This information is critical for designing new materials as this structure is what determines what the material can do.

Hohman recently found a way to study crystal structure using an X-ray beam. This allowed his team to capture a crystal's single diffraction pattern and merged them into a data set they can use to determine the atomic structure. This speeds up the process of characterizing new materials from months or even years to just hours.

Euclidean neural networks are artificial neural networks inspired by the human brain. A set of artificial neurons transmits signals to other neurons in the system in order to classify objects. Hohman's collaborator Tess Smidt at MIT developed Euclidean neural networks that can handle 3-D geometries, like those of molecules.

Hohman in collaboration with other synthetic materials scientists, computational crystallographers, and deep learning researchers will use these networks to train machine learning algorithms to predict new phases of materials. This will help eliminate guesswork from materials development.

Hohman will have the neural networks will help scientists design and generate novel atomic geometries with desirable properties based on what the scientists want the material to do.

Dr. Julián Norato

Designing for High Heat

Julián Norato, associate professor of mechanical engineering, is working on an ARPA-E grant to develop computational techniques to design highly efficient and compact heat exchangers.

Heat exchangers are mechanical devices that transfer heat from a hot to a cold fluid. They are found in everything from air conditioners to space heaters to chemical plants to airplanes.

The heat exchangers Norato's group will focus on operate at temperatures above 1100 degrees Celsius (approximately 2000 degrees Fahrenheit). These high-temperature heat

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exchangers are used in many applications, including gas turbine engines, waste heat recovery and hydrogen production.

The grant will focus on plate-and-frame heat exchangers, which consist of stacks of plates bolted together to a frame. The hot and cold fluids flow between alternate plates. Each plate has a pattern of obstacles to the flow embossed on one side. This helps increase the amount of heat transferred from the hot fluid to the plates, and to the cold fluid flowing through the adjacent plates.

"The fluid is forced to go through the flow structures inside the plates," Norato says. "Essentially, you're putting obstacles to the fluid to force it to mix and spend more time going from the inlet to the outlet of the plate."

> **"Essentially, you're putting obstacles to the fluid to force it to mix and spend more time going from the inlet to the outlet of the plate."**
>
> ~ Julián Norato, Associate Professor
> Mechanical Engineering

What these obstacles look like will determine how efficient the heat transfer is. The computational techniques that Norato's group will formulate will determine the optimal shape and pattern of these obstacles to maximize the heat transfer. At the same time, the design must ensure the pressure drop the fluid experiences as it flows through a plate is kept to a minimum, and that the plates can sustain the pressure the fluid exerts at the high operating temperatures.

The researchers are also interested in making the device as small and light as possible, which is especially important in aerospace applications that have space and weight restrictions.

The project will be conducted in collaboration with Altair Engineering, whose computational fluid dynamics software the researchers will use to simulate the heat transfer and the mechanical behavior of the heat exchanger.

Norato will also collaborate with researchers from Michigan State University, who have developed an additive manufacturing technique to efficiently 3D print the heat exchanger plates out of a metal alloy that can operate at high temperatures. They will 3D print the plate designs obtained by the computational techniques developed by Norato and test the performance and integrity of the heat exchanger in an experimental setup.

IMS Faculty Members Mentor 2022 SURF Award Winners

From the Office of Undergraduate Research

Dr. Helena Silva

Dr. Linnaea Ostroff

With the assistance of faculty mentors, UConn students in all majors, across all UConn campuses, conduct research or creative projects each year in pursuit of the Summer Undergraduate Research Fund (SURF) Award.

UConn recently announced that 39 students had been awarded the 2022 SURF Award. Two Institute of Materials Science (IMS) faculty members served as mentors to winners for this year's cohort of winners.

Dr. Helena Silva (Electrical and Computer Engineering) served as mentor for Derek Lefcort ('23, Electrical Engineering, ENG) for his project entitled Fabrication and Electrical Characterization of Multi-Contact PCM Toggle Device.

Dr. Linnaea Ostroff (Physiology and Neurobiology) served as mentor to Rebecca Tripp ('23, Physiology and Neurobiology, CLAS) for her project, Characterizing Neurons Containing Calcium-Binding Proteins in the Amygdala of Female and Male Rats.

IMS congratulates all the winners and commends Drs. Silva and Ostroff for their dedication in serving as mentors.

Multidisciplinary Team Wins $3M for Graduate Program

From UConn Today

Arash Esmaili Zaghi, left, associate professor of civil and environmental engineering, left, Fabiana Cardetti, professor of mathematics, and Jie Luo, a graduate student, with the fMRI, and Fumiko Hoeft, professor of psychological sciences, Nicole Landi, associate professor of psychological sciences, are in the control room at the UConn Brain Imaging Research Center on March 7, 2022. (Peter Morenus/UConn Photo)

An ambitious team of researchers from across the University has won $3mn from the National Science Foundation to pursue a project in the neuroscience of learning.

The program, known as TRANSCEND: TRANSdisciplinary Convergence in Educational Neuroscience Doctoral training, aims to get graduate students from both classic and atypical backgrounds into educational neuroscience research.

"We will take an innovative approach and truly break the silos in educational neuroscience between lab research, research in the schools and the community. We also have a particularly strong focus not only on neurodiverse learners as the topic of research but also to involve them as graduate students. Neurodiverse learners are one of the most underrepresented groups in higher ed and the STEM workforce despite their tremendous talent," says Fumiko Hoeft, interim director of the Waterbury campus, director of UConn's Brain Imaging Research Center (BIRC) and the principal investigator on the project.

The team also includes co-principal investigators Assistant Professor of Educational Psychology Ido Davidesco, Associate Professor of Developmental Psychology Nicole Landi, Associate Professor of Civil and Environmental Engineering and IMS faculty member, Arash Esmaili Zaghi, and Professor of Clinical Psychology Inge-Marie Eigsti; and co-investigators Professor of Psychology James Magnuson, Professor of Mathematics Fabiana Cardetti, Professor of Computer Science and Engineering Jinbo Bi, and Vice Provost for Graduate Education Kent Holsinger. Hoeft and Landi will co-direct TRANSCEND.

TRANSCEND will use the grant to allow second year graduate students to spend a full year researching convergent questions in educational neuroscience, with an emphasis on virtuous cycles between school and lab-based research, interdisciplinary team science, and in all areas of learning such as STEM and reading as well as developing the next generation of learning technologies using artificial intelligence (AI), with an underlying theme of neurodiversity.

The hope is that the students will then stay in the program and continue research on their topic of choice for their dissertation. Graduate students can be from any field of cognitive science, neuroscience, educational psychology, mathematics, computer science, and engineering. All graduate students in the program will have the opportunity to collect data in classrooms and in UConn labs, including the BIRC, the Cognitive Sciences Shared Electrophysiology Resource Lab, and the new mobile neuroscience lab by the College of Liberal Arts and Sciences that is planned to come online by this winter.

Community engagement will be key for generating project ideas and at every step of the process; graduate students will research questions that communities and teachers want answered. Leveraging Hoeft's new position at UConn Waterbury and this grant, she hopes to engage the Waterbury students and the community to bring new programs and collaboration to the campus.

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Researchers from Dr. Landi's lab training high school student interns to place an EEG cap on a younger student's head at the AIM Academy. (Landi Lab Photo, with permission from AIM Academy).

For example, a team of students from computer science, educational psychology and cognitive neuroscience may develop a learning technology leveraging AI and natural language processing models, using accessible neuroimaging technologies such as portable electroencephalography, in partnership with an education technology company and a school.

"We want every STEM and Education grad student in the University to know they can join this. The funding is for their second year, but we want the graduate students to stay involved in the program throughout graduate school," says Arash Zaghi, a structural engineering professor.

Zaghi began researching neurodiversity when he was diagnosed with ADHD early in his career as an engineer. He found that there was a lot of research showing great creative potential from neurodiverse people, but also great difficulties that lead them to drop out of university settings. Part of the motivation behind this collaboration is to generate strategies that both teachers and students can use to create strength and success from neurodiversity.

Hoeft and Zaghi also emphasize __that neurodiverse students are strongly encouraged to apply. The team has partnership with universities in the NSF INCLUDES national network such as Landmark College, a college for students with learning disabilities. They hope to attract their students into graduate school at UConn through this grant. There are also almost 40 other partners, including schools, the Connecticut Department of Education, advocacy groups, and technology companies, all of whom are interested in gaining interns from the program and participating in research through partnership with UConn. Through this program, their hope is that neuroscience can help design and deliver education that helps all students reach their full potential, and at the same time enhance the STEM workforce.

Menka Jain Receives NSF EAGER Funding

From the Institute of Materials Science

Dr. Menka Jain

National Science Foundation (NSF) EArly-concept Grants for Exploratory Research (EAGER) provide funding for work in its early stages on untested, but potentially transformative, research ideas or approaches. The work of EAGER grantees is usually considered high-risk, high-reward as it involves radically different approaches, applies new expertise, or engages novel disciplinary or interdisciplinary perspectives.

Associate Professsor of Physics and IMS faculty member, Menka Jain and co-PI, Assistant Professor of Physics Ilya Sochnikov, have been awarded NSF EAGER funding for her research entitled *CRYO: New Quantum Elastocaloric Demagnetization Refrigeration for the Millikelvin Range*, which seeks to develop new technology in refrigeration.

Jain explains that, due to the increasing scarcity of helium and lack of portability or scalability of current technologies, there is a growing demand to develop alternative refrigeration technology that can cool below 1 Kelvin for supporting emerging applications, such as quantum sensors and quantum computers. The overarching goal of her research is to realize a solid-state millikelvin Quantum Elastocaloric Adiabatic Refrigeration technology in which a cooling cycle will be achieved via periodic application of elastic strain/stress, without or with small a magnetic field.

"Such an approach has the potential to materialize into a groundbreaking discovery for on-chip scalable cooling applications," Jain explains.

Jain's research with co-PI Ilya Sochnikov, jointly supported by the Division of Chemical, Bioengineering, Environmental and Transport Systems and the Division of Materials Research, will train a diverse group of students in thermal, material and quantum sciences. This training will be provided through the development of a new curriculum focusing on low temperature cooling in an advanced undergraduate teaching laboratory, in research projects through the McNair program for underrepresented undergraduate students, and through graduate-level research projects.

Research Excellence Program Awardees

Excerpted from UConn Today

The Office of the Provost has named the recipients of the the 2022-2023 Research Excellence Program Awardees. IMS congratulates resident and affiliate faculty members.

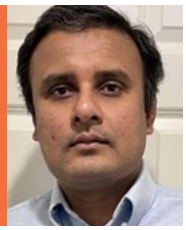
Dr. Kelly Burke
$25,000
Implantable Degradable Films for Right-Size Post-Operative Pediatric Pain Control

Dr. Bodhisattwa Chaudhuri
$49,998
Continuous manufacturing (CM) of the biological drug product for pulmonary drug delivery

Dr. Jie He
C-H Bond Electroactivation of Nonpolar Organic Substrates in Water: Enzyme-Mediated Reaction Pathways in Micro-emulsions

Dr. Menka Jain
$50,000
New approaches for on-chip cooling for applications in electronics and quantum devices

Dr. Naba Karan
$48,372.
Evaluation of Nanoscale Lithium Distribution Within a Secondary Cathode Particle for for Li-ion Battery Using Identical Location (S)TEM-EELS



Dr. Seok-Woo Lee
$25,000
Investigation on cryogenic shape memory effects of kinetically frozen ThCr2Si2-structured intermetallic compounds

Dr. James Rusling
$50,000
Rapid CRISPR-based blood test for early Alzheimer's disease

Dr. Tanin Schmidt
$74,853
Role of Proteoglycan 4 (PRG4) in Inflammatory Bone Loss

Dr. Yi Zhang
$49,863
A wireless, battery-free multimodal neural probe for simultaneous neuropharmacology and membrane-free neurochemical sampling in freely moving rodents

Nukavarapu and Zaghi Elected to CASE

Excerpted from UConn Today

Dr. Syam Nukavarapu

Dr. Arash E. Zaghi

IMS faculty members Syam Nukavarapu and Arash Zaghi were among the 11 UConn and UConn Health researchers elected as members of the 2023 class of inductees to the Connecticut Academy of Science and Engineering (CASE).

The Connecticut General Assembly chartered the Academy in 1976 to advise the state on matters of science and engineering, especially pertaining to economic advancement and social welfare.

A total of 35 new members were inducted on May 24 at the 48th annual CASE meeting and dinner in Branford.

Read the full story

Menka Jain is Co-organizer of 28th IWOE

From the Institute of Materials Science

IWOE attendees and organizers

Dr. Menka Jain

The International Workshop on Oxide Electronics (IWOE) series has become an important venue to discuss recent advances and emerging trends in this developing field. The aim of the workshop is to provide an interdisciplinary forum for researchers – theorists as well as experimentalists – on understanding the fundamental electronic and structural properties and also on the design, synthesis, processing, characterization, and applications of (epitaxial) functional oxide materials.

Associate Professor of Physics and Institute of Materials Science (IMS) faculty member Menka Jain served as co-organizer of the 28th International IWOE LogoWorkshop on Oxide Electronics (IWOE) which was held October 2-5, 2022 in Portland, Maine. Dr. Jain served on the program committee with Ryan Comes of Auburn University, Charles H. Ahn of Yale University, and Divine Kumah of North Carolina State University. She is also the designer of the logo for the workshop.

The workshop showcased results of critical scientific importance as well as studies revealing the technological potential of functional oxide thin films to create devices with enhanced performance.

Dr. Jain with IWOE co-organizers

IWOE participants listening to presentation

STUDENT NEWS

2022 Polymer Program first year students.
l-r: Josh Bodin, Mohak Desai, Brenden Ferland,
Cassidy Soard, and Justin Amengual

Polymer Program Holds First In-Person Poster Session Since 2019

From the Institute of Materials Science

Poster boards were dusted off and set up in the Gant Complex Atrium

After two years of restrictions due to the COVID-19 virus, the IMS Polymer Program held its first in-person poster session since 2019.

The event kicked off a 2-day open house for graduate student recruitment and also broke the long streak of virtual events.

Poster boards were dusted off and set up in the new Gant Complex Atrium, now called the "Light Court", with a new collection of posters. Faculty and students expressed much gratification for the escape from the cyber world and return to the tradition of in-person discussions. Despite the masks, the smiles could be seen and the joy of the event could be felt by all.

A few faculty and students passing through the area felt the magnetic pull of the science talk and enthusiastically joined the fun. The event included 15 posters from polymer research laboratories, more than two dozen students, five visiting prospective students, and faculty from four departments. While the times change and technology evolves, it will be difficult to replace the glory of a traditional poster session.

A Conversation with National Defense Science and Engineering Graduate Fellow Mason Freund

From the Institute of Materials Science

Ph.D. Student Mason Freund

Since its inception in 1989, the National Defense Science and Engineering Graduate (NDSEG) Fellowship has been awarded to only 4,400 students. In that time, over 65,000 have applied. The highly competitive fellowship, sponsored by the Air Force Office of Scientific Research (AFOSR), the Army Research Office (ARO), and the Office of Naval Research (ONR), was established by the U.S. Congress to increase the number of U.S. citizens receiving doctoral degrees in science and engineering disciplines of military importance.

Materials Science and Engineering Ph.D. candidate Mason Freund has been named a recipient of this prestigious fellowship. IMS News spoke with Mason about his early interests in science and the catalysts and decisions leading to his being named a NDSEG Fellow.

You earned your Bachelor of Science degree in mechanical engineering with a concentration in aerospace engineering. In your pursuit of your Ph.D. your focus remains on aerospace science. When did you begin to be interested in aerospace science and what about aerospace science keeps you engaged?

I think there's always been some interest in aerospace science starting from playing with toys and enjoying sci fi movies as a kid. This steered me towards spaceships and planes and slowly evolved into an interest in the sciences and engineering. Finally, being able to learn about aerospace engineering during my undergrad seemed to bring everything together. And now being a fellow under the Air Force Office of Scientific Research (AFOSR) I will be able to interact with the field on a deeper level. I am constantly learning new information and techniques that keeps the learning experience engaging but there are also always new discoveries and ideas that keep pushing the known boundaries to something that is better, faster, or stronger. I think those new discoveries and possibilities will keep me engaged for a long time.

How/when did you begin to tie materials science into your interest in aerospace science?

The mechanical engineering curriculum requires an introduction to materials science. I didn't know what the field of materials science was or could lead to, but I quickly became interested in learning more about the field. I decided to go for a minor and take courses that could add another dimension to my curriculum and benefit my aerospace science interests.

Congratulations on being named a 2022 DoD NDSEG Fellow. How did you come to apply for the NDSEG Fellowship and what was your reaction after learning you had been selected for the fellowship?

My advisor (Volkan Ortalan) made me aware of some different fellowships early on in my graduate studies. After doing more research over the course of last fall, I applied to a few different fellowships. Then came a long 4-6 month wait to April when the results were expected to come out. I checked my email one night at the end of March and was surprised to see an email from NDSEG. I was then even more surprised and excited to realize it was an acceptance letter. It was the first one I got back, and I wasn't even expecting a letter for at least another few days. I was very excited and slightly caught off guard, but it made my night and my week.

Tell us about your research and its short- and long-term implications for real-world applications.

My group is primarily a microscopy group. We spend most time on transmission electron microscopes (TEM) in addition to other instruments and techniques. Our lab has a special ultrafast TEM which allows us to investigate reactions and dynamics at very short time scales. Specifically, my research will take advantage of these capabilities to investigate reaction dynamics of nano energetic materials to better understand behaviors from these materials as well as nanoparticle enhancement at the necessary timescales.

This work is useful for further insights into nano energetics and optimization for use in propellants and other relat-

Continued on next page

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ed technologies as well as directly relating to programs within the AFOSR. The field of nano energetics plays a role in many propulsion applications as well as high power linear actuators. There are also possibilities for use in miniature applications such as micro or nano satellites. This research will provide a more fundamental understanding of the behaviors and can lead to better control, optimization, and performance of the technology.

After earning your bachelor's degree, you chose to continue your graduate studies at UConn. What was the catalyst for your decision?

As I mentioned, I started my minor and was taking MSE courses throughout my time in undergraduate studies. In one of the MSE courses the professor was Dr. Ortalan who is now my advisor. He asked me what I was planning on doing after graduation. I knew that I might want to go back to graduate school eventually, but I was also initially looking for jobs in industry. He mentioned about his open position for a graduate student and about the work that would be required but also the benefits and investment that it would be for my future. This really was the catalyst for my decision. I would have taken it either way but graduating in 2020 at the beginning of the pandemic and hearing about difficulties in job hiring made the decision even easier.

Elyse Schriber Named NSF Graduate Research Fellow

From the Institute of Materials Science

MSE Graduate Student Elyse Schriber

Elyse Schriber Schriber, a second-year materials science graduate student in the lab of Assistant Professor of Chemistry J. Nathan "Nate" Hohman, was named among five UConn students to receive the prestigious National Science Foundation Graduate Research Fellowship (NSF GRFP).

The program aims to ensure the quality, vitality, and diversity of the scientific and engineering workforce of the United States. GRFP seeks to broaden participation in science and engineering of underrepresented groups, including women, minorities, persons with disabilities, and veterans. The five-year fellowship provides three years of financial support inclusive of an annual stipend of $37,000.

Elyse began working with Hohman as an undergraduate research assistant in 2017, when he was a staff scientist at the Molecular Foundry at Lawrence Berkeley National Lab before coming to UConn.

She started working on method development for serial femtosecond chemical crystallography (SFCX) at an X-ray free electron laser (XFEL) facility in 2018. This is an X-ray crystallography technique that determines single crystal structures of materials from microcrystalline powders. She continues that work at UConn currently. The duo published their first paper on the method in the journal *Nature*. IMS featured their research in the 2022 Annual Newsletter.

Elyse plans to continue to work on different facets of the SFCX project in her graduate program, including studying ultrafast nonequilibrium excited state structural dynamics in materials.

"I started my undergraduate degree as a nontraditional student at the local community college and as a result, did not have a straightforward pathway into graduate school or academia," says Schriber. "Being awarded the GRFP, especially with my background, makes me hopeful that more students with similar experiences can be empowered to believe that they can be successful, regardless of how they got their start."

"I started my undergraduate degree as a nontraditional student at the local community college and as a result, did not have a straightforward pathway into graduate school or academia"

~ Elyse Schriber

2022 Newsletter Cover featuring research of Dr. Nate Hohman's group inclucing MSE Graduate Student Elyse Schriber.

Polymer Program 2021-2022 Award Winners

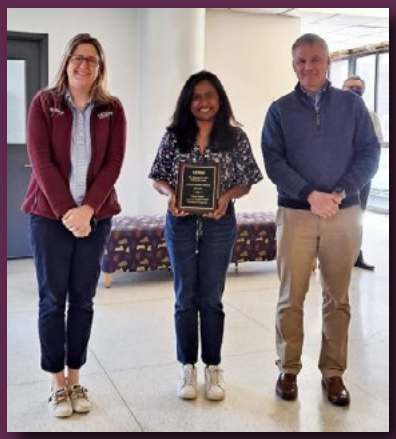
From the Institute of Materials Science

The IMS Polymer Program announced its student award winners for the 2021-2022 academic year.

Chung-Hao Liu received the Samuel J. Huang Graduate Student Research Award. This award recognizes a graduate student for outstanding research in the field of polymer science and engineering. Chung-Hao completed his fourth year as a polymer PhD candidate under the guidance of Prof. Mu-Ping Nieh. He has been diligent in conducting advanced nanoscience research including materials characterization and designing polymer nanostructures. His efforts have resulted in two published journal articles, one currently in review, and contributions to many more. Chung-Hao has also made many collaborating efforts with other research groups and mentored undergraduate engineering students. Outside the lab, Chung-Hao has been an Society of Polymer Engineers, Storrs Chapter, committee member for 3 years, serving as both Vice President and President. His positive attitude and strong work ethics have made contributions to Prof. Nieh's lab and the IMS research community.

Probodha Abeykoon has been recognized as this year's Stephanie H. Shaw Fellowship Scholar. This award is designated for a female student showing academic achievement and contributions outside of research. Probodha has served as the leader of the Adamson Research Lab and has taken it upon herself to be the resident expert in several analytical techniques, such as four-point probe and thermal conductivity. She has two published papers and a third manuscript recently submitted. She has also presented her work at several ACS National Meetings. During the past 4 years Probodha has grown into an excellent scientist and group leader.

The Polymer Program congratulates this year's awardees for their tremendous efforts in both research and leadership in the IMS community.



Probodha Abeykoon (center), winner of the Stephanie H. Shaw Fellowship Scholar Award, with Polymer Program Director Kelly Burke and advisor, Dr. Douglas Adamson.

Chung Hao (center), winner of the Samuel J. Huang Graduate Student Research Award, with Polymer Program Director Kelly Burke (left) and advisor, Dr. Mu-Ping Nieh.

Robert Williams Selected for Fulbright Fellowship

From the Materials Science & Engineering Dept.

MSE Undergrad Robert Williams

Undergraduate student Robert Williams was selected for a Fulbright Fellowship in Vietnam. The Fulbright Program is a prestigious worldwide program whose purpose is to unite the people of the United States and the people of other countries through educational and cultural exchanges.

"To be selected to be a Fulbright grant recipient, it is expected that you serve as a cultural liaison in addition to upholding the Fulbright mission: Respect all peoples and cultures, value diversity, and commit to international education and mutual understanding while serving as a catalyst for a peaceful and interconnected world inspired by international educational exchange," says Williams.

Williams will serve during the 2022-2023 academic year. He chose to apply for the fellowship in Vietnam for personal reasons: "As a biracial Vietnamese-American, I applied to the Vietnamese ETA position to gather a deeper understanding of my culture and heritage, bridge cross-cultural discrepancies and similarities of Vietnamese and American culture, and provide opportunities for students, staff and locals to grow as individuals," he states. At Fulbright in Vietnam, Williams will interact with his local community, work collaboratively with international partners in scientific fields and participate in research.

Photomicrography and the Art of Science

From the Institute of Materials Science

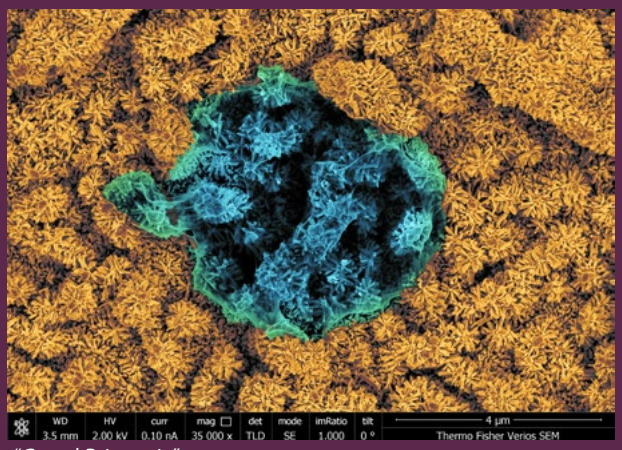
Ph.D. Student Xueni "Shirley" Huang

The use of microscopy in the world of scientific research has led to many advances in medicine, manufacturing, and technology. And recently, microscopy is revealing the art of science.

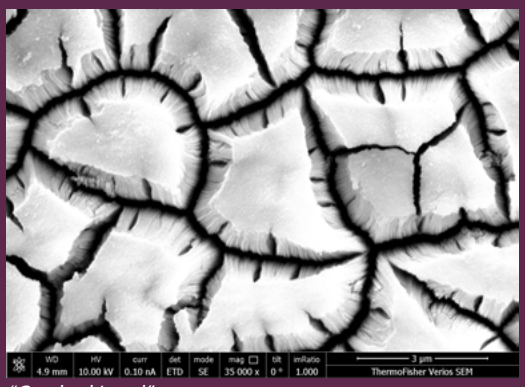
Photomicrography, the practice of taking photographs of objects under a microscope, is seeing unprecedented popularity as crucial scientific research conducted in laboratories around the world yields fascinating images. Competitions are on the upswing, and art galleries have noticed that art lovers share in the beauty and complexity of images from photographing microscopic objects.

This year's cover image is a photomicrograph taken by graduate student, Xueni "Shirley" Huang. Shirley is a student in the Department of Chemistry under the advisement of Dr. Steven L. Suib, Director of IMS. She has won multiple recognitions for her photomicrography including third place in both the "Artistic Micrography – Color" and "Artistic Micrography – Black & White" categories at the International Metallographic Society's 2022 International Metallographic Contest. She received an honorable mention in the color category and two honorable mentions in the black & white category in 2021. She has been an avid photographer from a young age.

"I took my first photo of a bee landing on a canola flower at the age of five, and I was really amazed to see how the pollens were stuck onto the tiny scopal hairs," Shirley recalls. While that experience certainly shaped her love of photography, it was the first scanning electron microscopic (SEM) image she got from scanning iron oxide nanorods as a junior undergrad that started her interest in photomicrography.

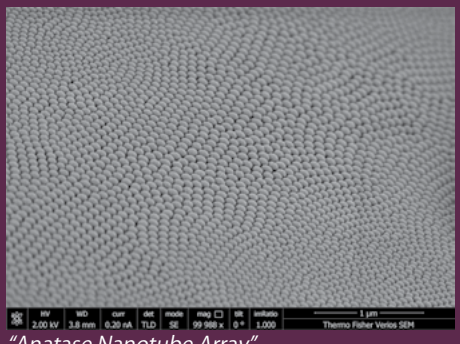


"Grand Prismatic"



"Cracked Land"

"At the Mountains of Madness"



"Anatase Nanotube Array"

"It was not a perfect picture to be honest, blurry with a big scale bar in micrometers, but to me it opened the gate to a fascinating nanosized world where mountains, forests and deserts also exist."

Shirley's research as a graduate student is in the area of light-driven catalytic reactions, or photocatalysis. She describes the process as 'the synthesis of metal oxide semiconductor nanomaterials for photocatalytic reactions like dye degradation and water splitting.'

While she does recognize the artistic quality of photomicrographic images, as a scientist Shirley views micrographic photography first as a means for researchers to 'see what is going on with your own eyes.' She notes that the results of photomicrographic images provide guidance to failure analysis and further experiment design, especially for researchers dealing with materials.

"It is inspiring to me that my images are not just part of the research outcomes to be analyzed and cropped by different software, but also have some artistic value. I really appreciate my advisor, Dr. Suib, for allowing me access to all these gigantic and high-tech "cameras" countless numbers of times. Also, great appreciation to Dr. Lichun Zhang and Dr. Haiyan Tan for the training and discussion on the microscopes."

As for her future after graduation, Shirley hopes to devote herself to either applying the technique for scientific analysis or improving the performance of the instruments used in the research.

CONGRATULATIONS GRADUATES!

Dr. Prabodha Abeykoon

"Studies of Graphite Exfoliation via Solvent Interface Trapping Method"

Major Advisor: Dr. Douglas Adamson

Dr. Mohamadreza Arab Baferani

"Novel Nanodielectrics for High-Voltage/Medium-Voltage Direct-Current Insulation"

Major Advisor: Dr. Yang Cao

Dr. Rasika Dahanayake

"Temperature and Solvent Induced Coil-globule Transition of Polypropylene Oxide in Solutions and its Behavior Within Self-Assembled Nanostructures"

Major Advisor: Dr. Elena Dormidontova

Dr. Behrad Kangarlou

"Internal Structural Characterization of Self-assembled Nanoparticles"

Major Advisor: Dr. Mu-Ping Nieh

Dr. Harshul Khanna

"Application-Driven Development of Porous Transition Metal Oxides"

Major Advisor: Dr. Steven L. Suib

Dr. Cong Lui

"Desulfurization: The Critical Problem in Producing Biodiesel from Brown Grease"

Major Advisor: Dr. Richard Parnas

Dr. Sean T. McDermott

"Functional Surfaces with Polymer Brushes and Graphene Doped PEDOT"

Major Advisor: Dr. Douglas Adamson

Dr. Sarshad Rommel

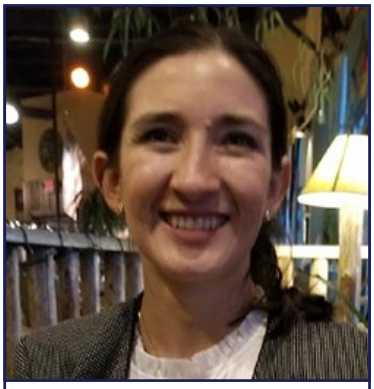
"Corrosion Phenomena in a Powder-Processed Al Alloy Containing Icosahedral Quasicrystalline Dispersoids"

Major Advisor: Dr. Mark Aindow

Dr. Uchenna Anene

"Computational Studies of the Interfacial and Surface Chemistry of Materials Using First-Principles Calculations"

Major Advisor: Dr. S. Pamir Alpay



Dr. Natalia Clarke

Graduate Certificate in Advanced Materials Characterization

Major Advisor: Dr. Steven L. Suib

Dr. Kevin Co

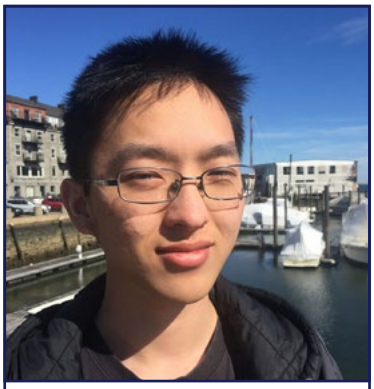
"Multi-scale Modeling of Ferroelectric Perovskite Thin-Films and Nanostructures"

Major Advisor: Dr. S. Pamir Alpay

Mr. Daniel Cramer, M.S. Chemical Engineering

"Effect of Oil and Thickener on Lotion Stability"

Major Advisor: Dr. Anson Ma



Dr. Cain Hung

"Al-Co and Al-Ce Based Alloys for As-built Additively Manufactured Parts"

Major Advisor: Dr. Rainer Hebert

Dr. Joel Kearns

Graduate Certificate in Advanced Materials Characterization

Major Advisor: Dr. Steven L. Suib

Dr. Anna Marie LaChance

"One-Step Coassembly of Nacre-like Polymer Nanocomposites and Effects of Processing"

Major Advisor: Dr. Luyi Sun

Dr. Jessica Maita

"Micromechanical Characterization of Nanocrystalline and Medium-range Ordered Materials"

Major Advisor: Dr. Seok-Woo Lee

Dr. Lakshmi Ravi Narayan

"Experimental Determination of the Material Properties for Solidification Cracking"

Major Advisor: Dr. Rainer Hebert

Ms. Kierstyn Raines

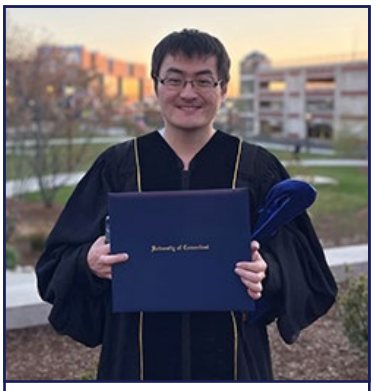
Graduate Certificate in Advanced Materials Characterization

Major Advisor: Dr. Steven L. Suib

Ms. Holly Schipper

M.S., Materials Science

Major Advisor: Dr. Luyi Sun



Dr. Jianhang Shi

"Investigations on Magnetocaloric and Multiferroic Properties of Perovskite-type Rare Earth Chromites"

Major Advisor: Dr. Menka Jain

Dr. Andrew Smith

"Synthesizing Semiconductor Photocatalysts with Vacancy Defects for Enhanced Color Switching"

Major Advisor: Dr. Luyi Sun

Dr. Yonglei Sun

"Temporal Fluctuations in the Fluorescence of Single Quantum Dots"

Major Advisor: Dr. Jing Zhao

Dr. Dennis Trujillo

"Machine Learning as Applied to Solving Complex Problems in Materials Science"

Major Advisor: Dr. S. Pamir Alpay

Staff News and Outreach News

IMS Industrial Affiliates Program Gets Back to Normal in 2022

From the Institute of Materials Science

Just as pandemic issues began to subside and allow the IMS Industrial Affiliates Program (IAP) to return to normal, we had the added excitement of moving to Science 1. That meant packing up, moving, and unpacking dozens of our precision instruments. The new building provides much-needed space for the ever-growing laboratories at IMS, as well as and design, layout, and infrastructure to efficiently accomplish research. In addition, new state-of-the-art laboratory instrumentation and new facilities, including a cutting-edge new clean room, will be added.

A significant number of new instruments have been added to IMS Core Labs in Science 1. This will improve IAP sample analysis throughput.

The Spectroscopy Lab will receive a new FTIR spectrometer; the Thermal Analysis Lab will receive a full suite of instruments including TGA, DSC, and DMTA; and the Mechanical Testing Lab will have a new universal mechanical testing system.

The REFINE Lab has a new confocal microscope, an excellent non-contact 3D surface profiler which can achieve nanometer, micrometer and millimeter resolutions while also providing vital color information.

On May 25, 2023, IAP will host its first in-person annual meeting in three years! We are very excited to once again welcome our members and partners to the UConn campus in Storrs. The annual meeting will feature presentations from UConn researchers, administrators, and faculty; tours of Science 1 facilities; and the IMS Polymer Program and Materials Science and Engineering Department joint poster session.

The IAP webinar series, which commenced during the pandemic in 2020, continues to be very well-attended. IAP plans to continue to offer these virtual learning opportunities. Look for announcements for future webinars throughout 2023.

We continue to welcome new IAP member companies: one makes cleaning fluids for electronics, medical devices and fiber optics; another company supplies lasers and photonics globally for a broad range of applications. Both companies have added to the broad range of our widely diverse materials characterization projects.

IAP has continued to work with faculty in a robust way over the past year, and we believe the experience has been mutually beneficial for our partners, IAP and those faculty members. The breadth of the work runs from catalyst and surface chemistry, to polymer processing, and metal properties and failure analysis.

We are very pleased that Dr. Seth March has joined the CAMMA electron microscopy lab as a postdoctoral researcher following the retirement of Roger Ristau. This was a big void to fill, and Drs. Lichun Zhang and Haiyan Tan have delivered excellent quality and efficient results during the transition.

SAVE THE DATE

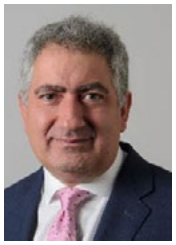
2023 ANNUAL MEETING - MAY 25, 2023

Anne D'Alleva, Provost and Executive Vice President for Academic Affairs, will deliver our keynote address.

Steven L. Suib
Director IMS

Bryan Huey
MSE Dept. Head

Kelly Burke
Director IMS
Polymer Program



George Matheou
Asst. Prof. Mechanical Engineering

Vahid Morovati
Asst. Prof. Civil & Environmental Engineering

Yuanyuan Zhu
Asst. Prof.
Materials Science and Engineering

Paul Nahass
Director
IMS Industrial Affiliates Program

Hatice Bodugoz-Senturk
Associate Director
IMS Industrial Affiliates Program

Root Cause Analysis of Metal Part Performance: An IMS/IAP Sample Project

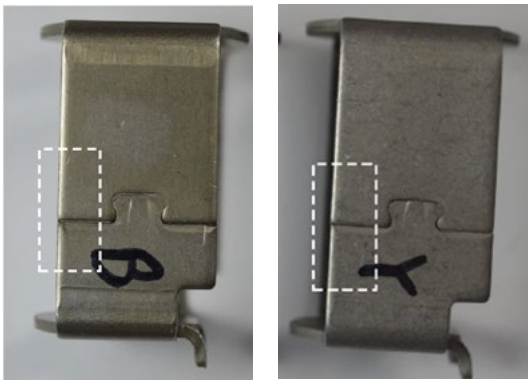
From the Institute of Materials Science

One of the most common requests IAP receives is to determine the root cause of the poor performance of a product in the field. In a situation such as this, IAP typically will bring IMS technical experts and the company together to understand what information is available. To be able to determine the appropriate analyses, we often ask the company the following questions:

- Are the parts/materials from the same supplier?
- Are they from the same batch?
- What are the specifications supplied with the parts/materials?

Based on the answers and the type of material, we develop an approach. For example, in 2022 we were asked to identify the cause of a performance difference between two supposedly identical metallic samples, one of which was causing a significant problem for the end-use customer. The samples (shown below) were from different suppliers. They were specified to be carbon steel with an exterior hardened to a certain thickness. IAP engaged one of its metallurgy experts and we put a plan together:

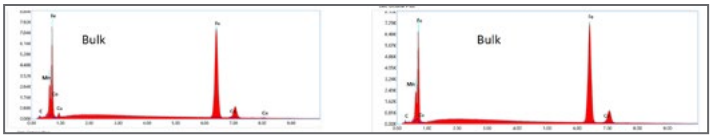
- Examine the parts with optical microscopy to look for obvious defects
- Determine the overall elemental composition with SEM/EDS
- Pot, polish, and etch the parts to examine grain structure to determine the thickness of the hardened layer
- Measure the hardness of different areas of the parts with micro-indentation



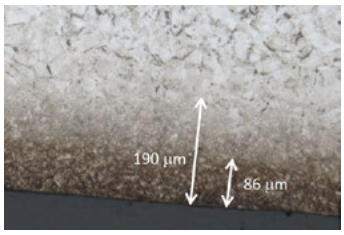
The Results of the characterization were as follows:

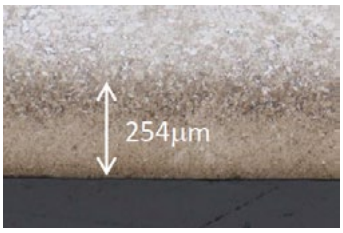
- Optical microscopy showed both materials were of good quality with no major defects.

- Elemental composition from SEM/EDS showed an unusual amount of copper in one of the parts.



- The normal etchant used for carbon steels did not work with the copper-containing part, and a more aggressive etchant, normally used for stainless steel was used. The microstructure of the polished parts showed the hardened outer layer of the part with copper (left) was much thinner than that of the carbon steel (right).





We were able to conclude the following from as a result of our characterization of both samples:

- The alloys of the two batches of parts were different, though they both met the criteria for the specific steel.
- Both alloys had been hardened similarly.
- The sample that was poor-performing had a notably higher Cu content.

Position	Yoke B		Yoke Y	
	HK	HRC	HK	HRC (HRB)
Case	615.8	54.3	669.3	57
	670.1	57	737.9	60.2
	672.9	57.2		
Transition	589.6	53	574.4	52.2
	431.9	42.8	366.3	36.5
Bulk	262.8	21.8	231.7	15.5 (94.5)
			211.7	10.9 (91.2)

Based on our characterization of the samples the company was able to go back to their supplier and modify the part specification to improve its performance consistency in their customer's application environment.

IAP routinely works to resolve challenges such as this. Difficult problems such as this often require numerous techniques, and technical experts who can draw valid conclusions by putting together the different pieces of the puzzle.

CIC Award Winner Fighting Emerging Contaminants in Our Water With the "Bio-Filter"

From the Institute of Materials Science

Snigtha Mohanraj holds her invention, the Bio-Filter.

Snigtha presenting her research at the International Science and Engineering Fair.

Congratulations to Snigtha Mohanraj for her 2022 award winning project titled "Bio-Filter"! This is the second year in a row that Snigtha has won the Excellence in Materials Science award presented by the Institute of Materials Science in partnership with the Connecticut Invention Convention (CIC).

The Connecticut Invention Convention has supported STEM initiatives for students in grades K-12 since 1983. The CIC is an internationally recognized educational organization that uses invention and entrepreneurship to develop student skills in creative problem-solving and critical thinking.

The State Finals were hosted virtually again this year, including the top 689 inventors out of the nearly 10,000 that participated in Invention Convention programming. Students who elect to participate at the State Final level submitted a video presentation, pictures of their prototype, and their invention log to the online application portal to be reviewed by a panel of trained judges.

Snigtha was a high school freshman upon her win in the spring of 2022 and has been participating in CIC programming since sixth grade. In addition to her participation in the CIC this year, she has also competed in the International Science and Engineering Fair, National Junior Science and Humanities Symposium, and the RISE Global Challenge, where she was named a Top 100 Global Winner.

For over three years, Snigtha's interest in the environmental sciences has driven her research on finding solutions for removing harmful contaminants from our water. Last year Snigtha won the Excellence in Materials Science award for her project titled "Ferro-Sponge", for which she has since applied for a patent. She summarized that project as, "a polyurethane sponge coated in iron oxide to remove microplastics and oil from water."

This year, Snigtha continued on with her passion for water contamination research by creating the "Bio-Filter". Her project is a water filtration system using biochar created from coconut shell biochar doped with iron oxide nanoparticles. Snigtha summarized her design, noting that, "water would pass through a top compartment that contained sand, which is effective for removing larger contaminants in water, and then a bottom compartment containing the doped biochar to remove 'emerging contaminants,' specifically targeting the removal of pharmaceuticals, pesticides, microplastics, and oil."

Ideally, Snigtha hopes the future of her project is a product that can be available worldwide, so all communities can benefit from a "Bio-Filter" that protects against emerging contaminants and their harmful effects. Being conscientious in the materials used, Snigtha championed her invention's construct, explaining that "with the abundance of biomass waste materials available for making biochar, this filter is inexpensive and environmentally friendly, while also being highly efficient."

Snigtha reflected on her time with the CIC, acknowledging that the presentation can be the most challenging part but reiterating the importance of discussing current environmental issues plaguing our society today. The environmental science enthusiast and climate advocate hopes to continue her research on water contamination to find, "well-rounded solutions for removing harmful contaminants from our water."

Welcome Lisa Conant and Christina Tamburro

From the Institute of Materials Science

Lisa Conant

Christina Tamburro

As research conducted by UConn IMS faculty members creates more funding opportunities, the need to expand administrative services to support the administrative function led to the hiring of two new administrative support team members. Both Lisa Conant and Christina Tamburro came to UConn IMS from within the University.

Lisa Conant previously served as Pre-Award Grants and Contracts Specialist for the Sponsored Program Services (SPS) section of the Office of the Vice President of Research (OVPR). Lisa honed her financial skills in the non-profit social services and municipal sectors. She also provided her financial expertise to The Jackson Laboratory. An avid writer and editor in her personal time, Lisa also loves trying new international recipes. She served her community in Coventry, CT, as an elected town council member for four years and currently serves on the town's Human Rights Commission. Lisa hopes her years of grants and research administration experience and skills will help support and grow IMS' already incredibly impressive success in winning research grants and contracts. "My goal is to serve as a resource for IMS faculty and staff in all things pre-award," Lisa says.

Christina Tamburro comes to us from the College of Agriculture, Health and Natural Resources (CAHNR) where she served briefly as Business Operations Specialist before returning to her passion for finance here in IMS. Prior to her time in CAHNR, Christina served as a Post-Award Grants and Contracts Specialist for SPS. Christina loves cooking and baking. She won second prize in the Connecticut State Agricultural Fairs statewide apple pie contest in 2005. Additionally, Christina describes herself as a "history nut" with particular interest in the American Civil War and colonial New England. She hopes to contribute additional expertise, enthusiasm and understanding to the grant management process here at IMS. "I am looking forward to working closely with grant holders, sponsors, and connections throughout the university to extend IMS' outstanding reputation," Christina says.

"My goal is to serve as a resource for IMS faculty and staff in all things pre-award"

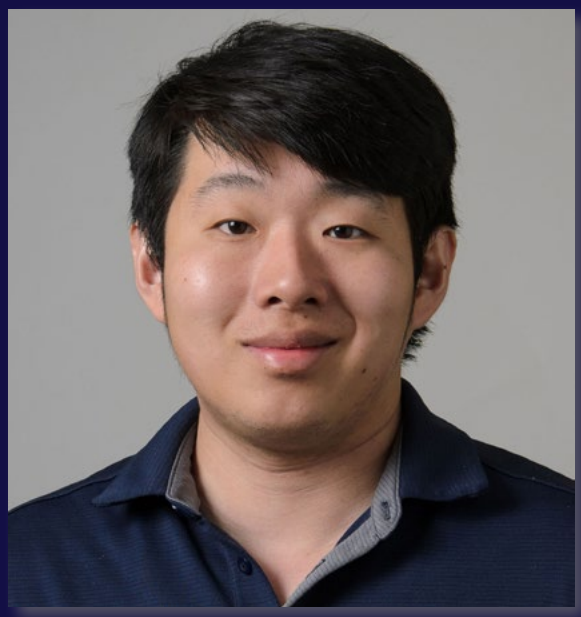
~ Lisa Conant

"I am looking forward to working closely with grant holders, sponsors, and connections throughout the university to extend IMS' outstanding reputation"

~ Christina Tamburro

IMS and Electrical Insulation Research Center Welcome Wesley Zhong

From the Institute of Materials Science



EIRC Lab Manager, Dr. Wesley Zhong

Wesley Zhong has joined the Institute of Materials Science (UConn IMS) as the new lab manager for the Electrical Insulation Research Center (EIRC). His specialties include high voltage safety, electrical insulation testing, partial discharge detection, experiment build and design, extreme environment testing, power electronics testing, technical writing, Lean Six Sigma and equipment maintenance and calibration.

Wesley earned his B.S. in Electrical and Computer Engineering Technology from Purdue University where he served as an undergraduate teaching assistant. Additionally, he served as Alpha Sigma Phi House Secretary and was a member of the Asian American Association. He worked as a dielectrics specialist at GE Global Research for the past five years designing, building, and running HV dielectric experiments involving aviation, power electronics, and motor/generators design.

Under the direction of Dr. Yang Cao, the Electrical Insulation Research Center has extensive facilities for characterizing the electrical properties of insulating materials used in electrical apparatus including distribution and transmission networks, rotating machinery component, electrostatic/electro-responsive devices, capacitive energy storage, and more.

Seth March Joins IMS as Postdoc in CAMMA Lab

From the Institute of Materials Science

Postdoctoral Researcher, Dr. Seth March

Seth March ('22) has joined the UConn/Thermo Fisher Scientific Center for Advanced Microscopy and Materials Analysis (CAMMA) laboratory at the Innovation Partnership Building (IPB) as a postdoctoral researcher.

Seth earned his Ph.D. in inorganic chemistry under the advisement of IMS Director Steven L. Suib. He served as a research assistant and a teaching assistant and has extensive research experience in materials characterization and data analysis.

Seth's research interests include materials synthesis, characterization and gas-phase catalysis. He earned his B.S. from UConn in 2017. He defended his Ph.D. thesis, *Partial Oxidation of Hydrocarbons Using Metal Oxides*, to complete his degree in August 2022.

Sanjubala Sahoo Joins IMS as Assistant Research Professor

From the Institute of Materials Science

Dr. Sanjubala Sahoo

Sanjubala Sahoo joined the Materials Science and Engineering department as an assistant research professor with an appointment in the Institute of Materials Science (IMS). She is also the program coordinator for the Global Hydrogen Alliance multi-national collaboration initiative and developing UConn's strategic positioning in the ecosystem.

Her research focuses on materials modeling in multi-scale regime using a combination of first-principles and quantum-chemical tools. She brings a decade of experience in developing novel concepts for catalysis research, generating clean energy from fuel cells, and carbon capture for environmental pollution control.

Her research interests also include magnetic, electronic, optical and thermodynamic properties of metal surfaces, complex alloys, nanomaterials and graphene-like (2D) materials for advanced applications.

Sahoo earned her Ph.D. in Physics from the University of Duisburg-Essen (Germany) Magna cum Laude, and was a Gold Medalist in M.Sc. Physics (India). Her postdoctoral experience from the Argonne National Laboratory, which is a strategic destination for advanced science, carrying out research on physics and chemistry of materials. She was nominated for the Blavatnik Regional Award from the UConn School of Engineering in 2019.

Jesse David Joins IMS as Stock Room and Lab Safety Manager

From the Institute of Materials Science

Jesse David

Jesse David has joined the Institute of Materials Science (IMS) as Stock Room and Lab Safety Manager. Jesse comes to IMS from within the University, having previously served as environmental health and safety coordinator for the Innovation Partnership Building (IPB).

An analytical chemist interested in research and development, cannabis, and quality testing roles, Jesse brings a strong background in method validation and analysis on HPLC, UPLC, GC/MS, GC/FID.

Jesse holds a B.S. in Chemistry from the University of South Florida and has held positions of increasing responsibility at alternative medicine company Trulieve in Tallahassee, Florida.

An avid environmentalist, Jesse has volunteered for environmental agencies including Coastal Cleanup in Tampa Bay, FL, and the Tampa Audubon Society.

IMS External Advisory Board Welcomes Two New Members

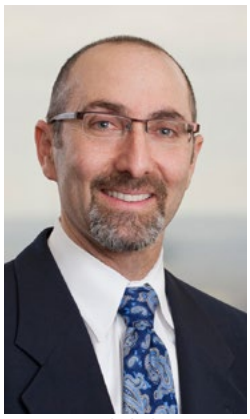
From the Institute of Materials Science

Dr. Akshay Waghray

Associate Director, High Temperature Composites at Collins Aerospace, Akshay Waghray brings a strong background in industrial process, materials and product R&D with a record of successful high impact projects.

Dr. Waghray's areas of technical expertise include chemical engineering, material science, composites, carbon science, chemical vapor infiltration/deposition (CVI/CVD), nanomaterials, vacuum systems, friction materials, heterogeneous catalysis, lithium-ion battery materials, electrochemistry, electroplating, anodizing, ceramics and polymers.

He earned his M.S. Chemical Engineering from Tulane University and a Ph.D. from the University of Pittsburgh.



Dr. Grant Ehrlich

Grant Ehrlich, Ph.D., Esq. is a Partner at Cantor Colburn, where he chairs the Energy Storage, Batteries, and Materials Practice Group. He supports technology-based companies in the development and implementation of effective intellectual property (IP) strategies. He has drafted and prosecuted patents and has prepared non-infringement, invalidity, and freedom-to-operate opinions in fields spanning batteries, fuel cells, thermoelectrics, displays, sensors, medical devices, metallurgy, magnetic and magnetocaloric materials, ceramics, water treatment, heating systems, lubricants, detergents, coatings, and phosphors.

Dr. Ehrlich has contributed to multiple IPR petitions directed to lithium-ion battery technology. In addition, he has significant licensing experience and has prepared and negotiated domestic and international patent license agreements, technology transfer agreements, and material transfer agreements.

Dr. Ehrlich earned a Ph.D. in chemistry from Cornell University. He graduated from UConn Law with honors.

In Memoriam: IMS External Advisory Board Member Karl Prewo

From the Institute of Materials Science

Dr. Karl Prewo

Dr. Karl Prewo, former Institute of Materials Science (IMS) External Advisory Board member, passed away February 9, 2022, after a long illness.

A graduate of Rensselaer Polytechnic Institute, Dr. Prewo earned his Ph.D. from Columbia University and began his career at United Technologies Research Center where he worked for 30 years. During that time, he was awarded 56 patents, two George Mead medals for engineering achievement, the Horner Citation, and several outstanding achievement awards. He became a Fellow of both the American Ceramic Society and ASM International, authored over 80 technical papers and four chapters in books about materials science.

Karl enjoyed lecturing and gave numerous presentations all over the world including teaching extension courses at UCLA, the University of Maryland, and the University of Surrey, United Kingdom. He participated for many years in an advisory capacity to the U.S. Air Force and the National Materials Advisory Board. He was elected to the Connecticut Academy of Science and Engineering (CASE) where he chaired the Economic Development Board.

He was a proud member of a group of fathers who founded Vernon Youth Soccer under the motto "Everyone Plays".

Karl is survived by the love of his life, his wife of 56 years, Karen; his son Karl Douglas and wife, Kristine, son Christopher and wife, Erin; and his grandchildren who were his pride and joy, Karl Ethan, Nicholas, Avery and Hudson, and a host of relatives living in Germany.

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Support the Institute of Materials Science

For nearly 60 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.

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

IMS Endowment Fund (30264)
Gifts to the IMS Endowment Fund provide long-term financial support for the Institute of Materials Science.

IMS Equipment and Maintenance Fund (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 Fund (20334)
This account supports graduate students and faculty studying polymer mixtures.

IMS Surface Science Research Fund (20328)
Gifts to the Surface Science Research Fund provide support for research at the Institute of Materials Science.

IMS Electrical Research Fund (20319)
Gifts to the Institute of Materials Science Electrical Research Fund provide support for research supplies and equipment.

Stephanie H. Shaw Alumni Fellowship Fund (22176)
Gifts to the Stephanie H. Shaw Alumni Fellowship Fund support female Ph.D. students in the Institute of Materials Science Polymer Program.

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.

To donate, please visit the UConn Foundation page for campus initiatives. Select "Research and Institutes" from the category menu, select "Institute of Materials Science" from the subcategory menu, choose fund(s) for donation
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