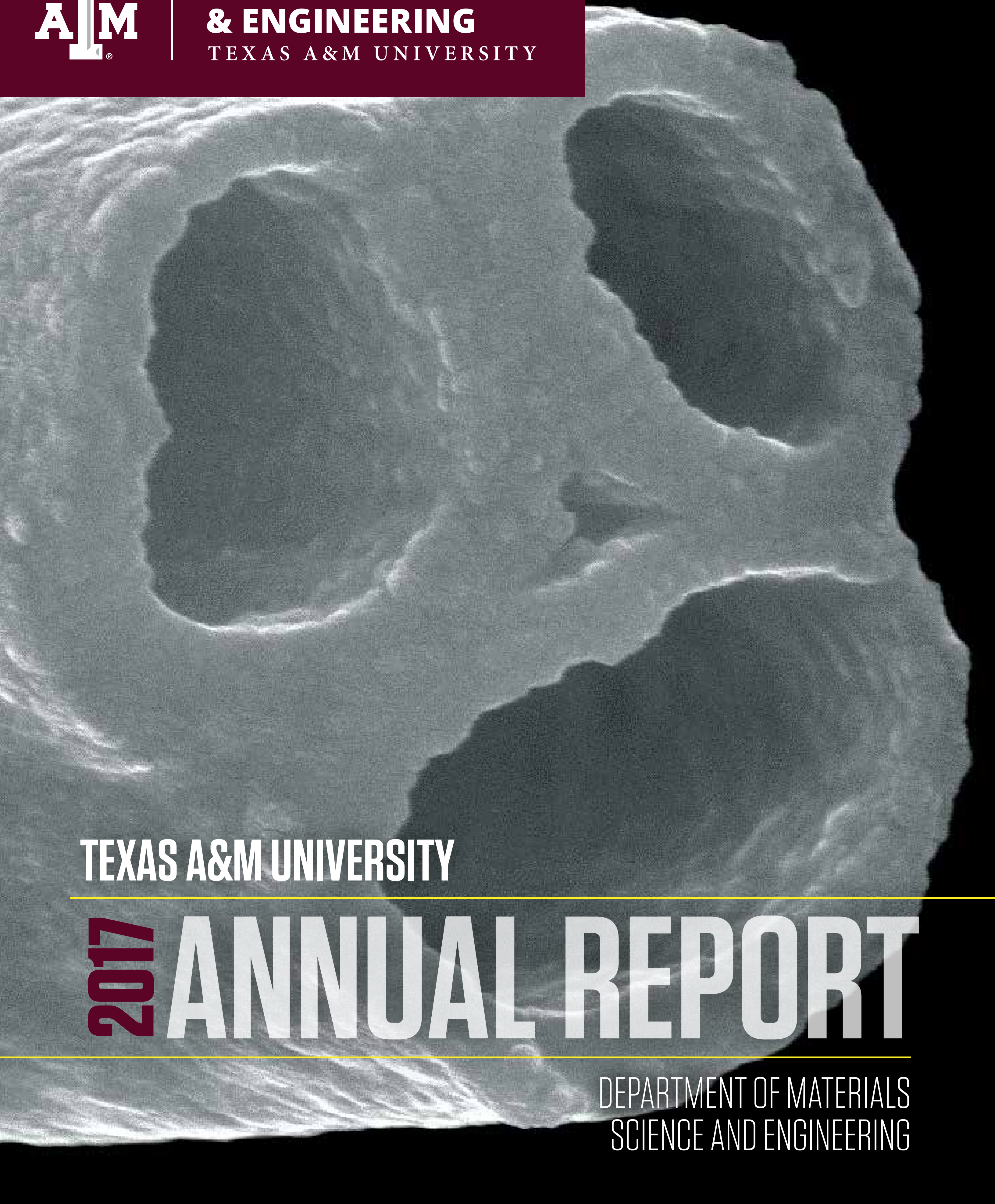

MATERIALS SCIENCE & ENGINEERING
TEXAS A&M UNIVERSITY

TEXAS A&M UNIVERSITY

2017 ANNUAL REPORT

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

FROM THE
DEPARTMENT HEAD

Dear Colleagues and Friends,

2017 was a dynamic year for the Department of Materials Science and Engineering at Texas A&M University. Among the plethora of exciting events, we are most proud of receiving approval from the Texas Higher Education Coordinating Board for the Bachelor of Science degree program in materials science and engineering. This will be the first undergraduate program of its kind at a large, land-grant university in the state of Texas. We will welcome the first cohort of sophomore students to the department in fall 2018.

In addition to welcoming undergraduate students to the department, we reached record enrollment of 151 total graduate students in 2017 comprised of 26 master’s and 125 doctoral students.

As part of the Air Force Research Laboratory’s Minority Leaders Program, 12 minority doctoral students per year will be funded and have the opportunity to train in data driven materials discovery and design. Drs. Raymundo Arróyave, Ibrahim Karaman, Dimitris Lagoudas and Patrick Shamberger, are leading the effort for our students. Texas A&M and Georgia Tech University were the two universities selected to host the program.

With our growing enrollment, we have added a new faculty member in January 2018. Dr. Kelvin Xie came to us from Johns Hopkins University where he was an assistant research scientist.

Our faculty are excelling in many research endeavors while receiving recognition from their peers as prestigious award recipients. Dr. Svetlana Sukhishvili is leading an executive committee to establish and develop an interdisciplinary soft matters facility on our campus to unify research activities related to soft matter and improve multifunctional polymer-based materials that are used in many applications, including energy, health care and transportation.

NASA has selected a team of Texas A&M faculty for a five-year, $10 million grant as part of NASA Aeronautics’ University Leadership Initiative. Lagoudas, deputy director of the Texas A&M Engineering Experiment Station, will manage the team, which includes Dr. Darren Hartl as operations director. The faculty at Texas A&M, along with collaborators from six other institutions and companies, will research and design commercially-viable civil supersonic transport aircraft that can modify shape during flight under a range of conditions to meet noise and efficiency requirements for overland flight.

We are excited to announce the large donation of a brand-new FEI Titan Themis 300, double corrected high-resolution electron microscope, which will be installed in the Materials Characterization Facility this academic year, and will greatly impact materials research on campus.

AZZ Inc. has generously established two fellowships in the department for faculty and graduate students. The AZZ Inc. graduate fellowship will be used to recruit the best and the brightest domestic students in the country to the department, while the AZZ Inc. faculty fellowship will help our young faculty to develop into superstars of research, which will positively impact society.

I am honored to present the accomplishments of the Department of Materials Science and Engineering, and would like to offer a sincere thank you to the donors who generously support our programs through significant contributions in support of faculty, students and facilities.

Sincerely,

Dr. Ibrahim Karaman

Department Head and Chevron Professor I

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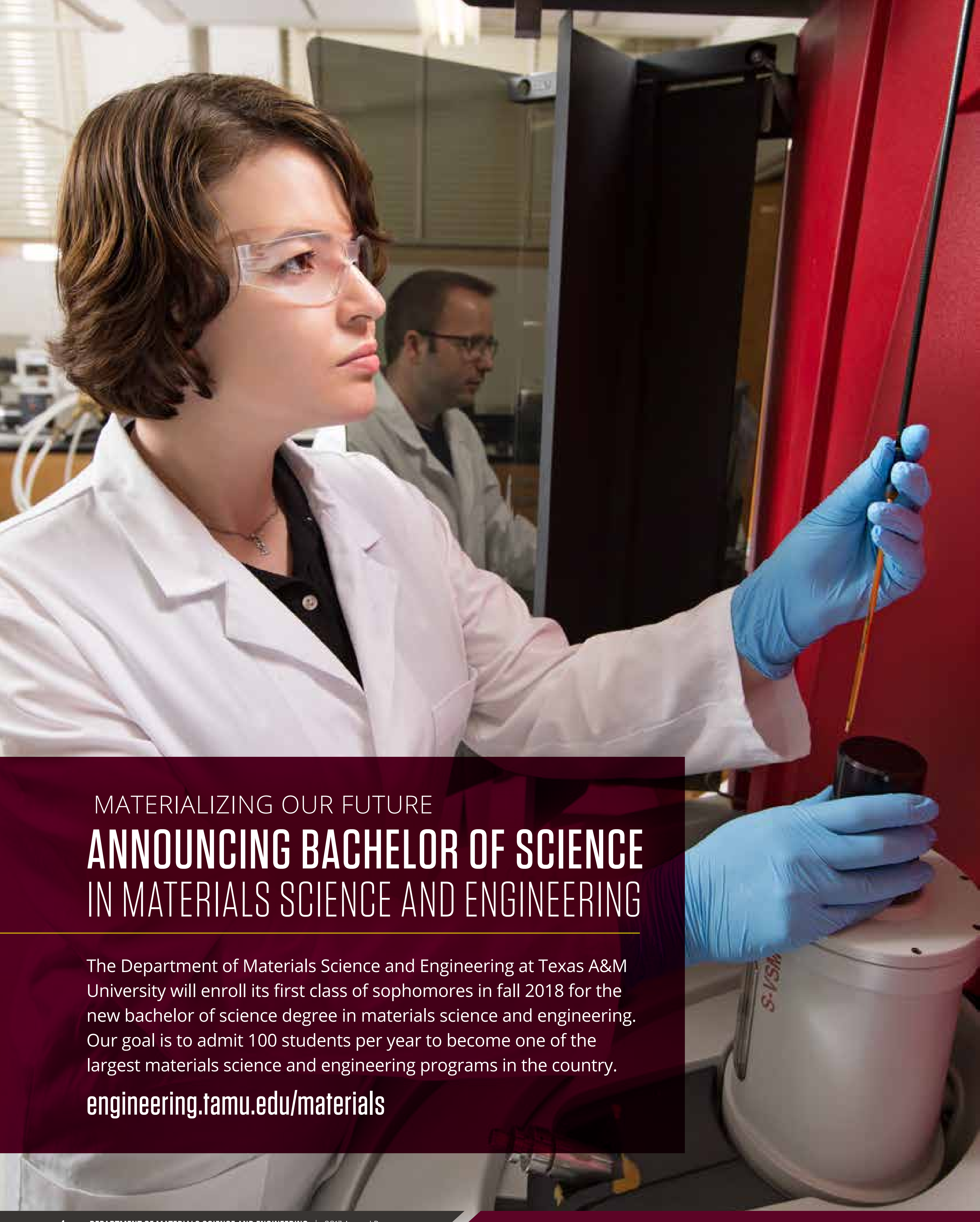
Provided by Dr. Mohammad Naraghi, affiliated faculty member in the Department of Materials Science and Engineering

Texas A&M Engineering Communications 2018



MATERIALIZING OUR FUTURE

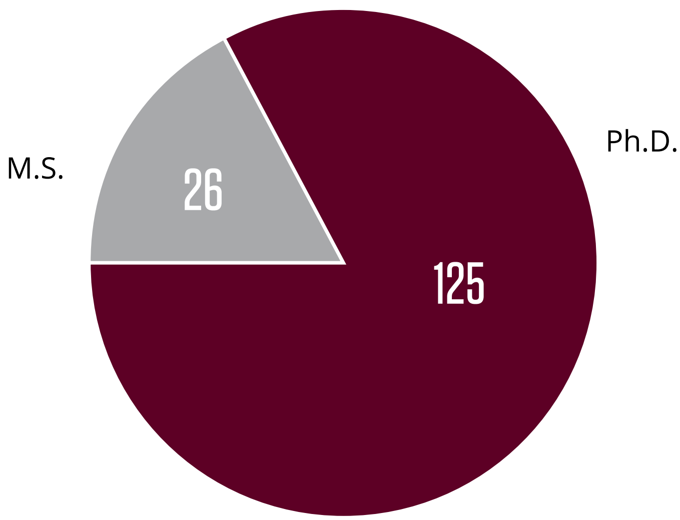
ANNOUNCING BACHELOR OF SCIENCE IN MATERIALS SCIENCE AND ENGINEERING

The Department of Materials Science and Engineering at Texas A&M University will enroll its first class of sophomores in fall 2018 for the new bachelor of science degree in materials science and engineering. Our goal is to admit 100 students per year to become one of the largest materials science and engineering programs in the country.

engineering.tamu.edu/materials

2017 IN NUMBERS

ENROLLMENT • 151



STUDENT DIVERSITY

54%
Incoming Domestic Graduate Students

33%
Incoming Minority Graduate Students

26%
Female Enrollment

FACULTY

Tenured/Tenure-Track	15
Professors	8
Associate Professors	4
Assistant Professors	3
Professors of Practice	1
Affiliated Faculty	49
National Academy of Engineering Members	2

RESEARCH IMPACT

Average journal articles published per faculty member	7.4
Average journal articles published per graduating Ph.D. student	7

RESEARCH AREAS

- Advanced structural materials
- Computational materials science and design
- Corrosion science and engineering
- Materials for extreme environments
- Multifunctional materials
- Polymers and composites

INDUSTRY ADVISORY BOARD

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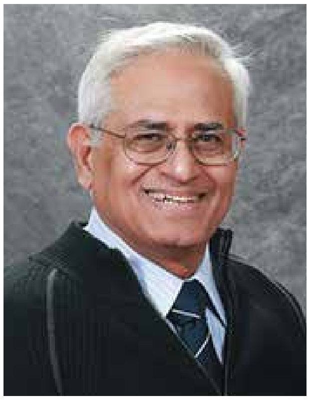
Bell Helicopter Textron, Aerospace/Aviation OEM

Roxanne Warren
Arconic/ RTI Directed Manufacturing, Additive Manufacturing

TALREJA RECEIVES THE 2017 OUTSTANDING RESEARCH AWARD FROM THE AMERICAN SOCIETY FOR COMPOSITES



Dr. Ramesh Talreja, Tenneco Professor of Engineering in the Department of Aerospace Engineering and the Department of Materials Science and Engineering at Texas A&M University, has received the 2017 Outstanding Research Award in Composites from the American Society for Composites (ASC).

The ASC describes the winner of the award as "a distinguished member of the composites community who has made a significant impact on the science and technology of composite materials through a sustained research effort over a number of years." The ASC's mission is to provide a communication forum for the engineering and scientific community and to expedite growth of knowledge gained from inter-disciplinary engineering and scientific research in composite materials, as well as to promote the exploitation of the unique properties of composite materials in emerging applications.

In 2013 Talreja received the highest honor, the Scala Award, from the International Committee on Composite Materials (ICCM). The award comes with the designation World Fellow and Life Member of ICCM.

Talreja has published extensively in the field of damage mechanics and fatigue of composite materials. He has authored the monograph "Fatigue of Composite Materials," and has edited several major works including Polymer Matrix Composites, Damage Mechanics of Composite Materials, Multiscale Modeling and Simulation of Composite Materials and Structures and PMC Fatigue–Fundamentals, and has contributed more than 30 chapters to numerous books. His book "Damage and Failure of Composite Materials," co-authored with C.V. Singh, was published by Cambridge University Press. He is on the editorial boards of 14 journals, and has served as associate editor of *Mechanics of Materials* and as editor-in-chief of *International Journal of Aerospace Engineering*. His current focus is on structural integrity, durability and sustainability of composite materials in aerospace and wind power structures.

Prior to joining the faculty at Texas A&M, Talreja was a professor of aerospace engineering at Georgia Institute of Technology from 1991-2001. His academic career began at the Technical University of Denmark where he received his Ph.D. and Doctor of Technical Sciences degrees in 1974 and 1985, respectively, and served in different academic positions until 1991. From 1978-83 he had a joint appointment at the Risø Laboratory of Sustainable Energy in Denmark.

Talreja received his plaque and award of $1,000 at the awards banquet of the 32nd Annual Technical Conference, to be held at Purdue University on Oct. 24.

CASTANEDA-LOPEZ TO RECEIVE 2018 HERBERT H. UHLIG AWARD

The National Association of Corrosion Engineers (NACE) has selected Dr. Homero Castaneda-Lopez, an associate professor in the Department of Materials Science and Engineering at Texas A&M University, to receive the 2018 Herbert H. Uhlig Award.

The award recognizes outstanding young educators in postsecondary corrosion education who have effectively excited their students through outstanding and innovative teaching in corrosion engineering.

Castaneda-Lopez is director of the National Corrosion and Materials Reliability Center at Texas A&M, where the focus is to develop the next-generation leaders in corrosion science and technology to work in various industries including energy, national defense, auto, healthcare, infrastructure and multiple government agencies.

"We work to bridge the gap between fundamental research (science) and technology (engineering)," Castaneda-Lopez said. "We serve as a world-class corrosion education and research center creating tomorrow's leaders in corrosion science and engineering."

Castaneda-Lopez will receive the award in April at CORROSION 2018, the world's largest corrosion conference and exposition.

SRIVASTAVA RECEIVES 2017 HAYTHORNTHWAITE RESEARCH INITIATION GRANT

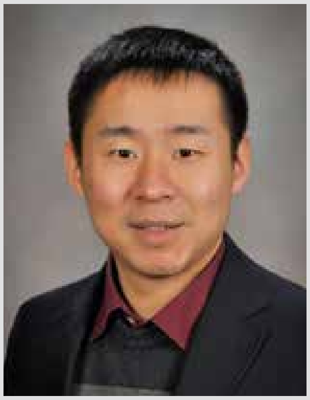
Dr. Ankit Srivastava, an assistant professor in the Department of Materials Science and Engineering at Texas A&M University, was selected as one of the four Haythornthwaite Research Initiation Grant recipients by the executive committee of the Applied Mechanics Division (AMD) of the American Society of Mechanical Engineers (ASME). Srivastava received his award during the AMD Honors and Award Banquet at the 2017 ASME International Mechanical Engineering Congress and Exposition (IMECE) in Tampa, Florida.

This award will provide $20,000 to support Srivastava's work on investigating microstructure-fracture correlations in multi-phase materials using in-situ scanning electron microscope experiments and microstructure-based modeling.

"The technological need of lightweight structures for weight-critical products, such as aircrafts and long-haul trucks, and to decrease emissions from automobiles, calls for materials with high density-normalized strength," Srivastava said. "The current materials with high density-normalized strength suffer from poor fracture resistance, which limits the performance, reliability and manufacturability of their components."

As a result, the overarching goal of Srivastava's project is to enable the design and discovery of more fracture resistant, high strength structural materials. The outcome of Srivastava's project will be presented at the 2018 ASME IMECE.

XIE JOINS MATERIALS SCIENCE AND ENGINEERING



Dr. Kelvin Xie has joined the Department of Materials Science and Engineering at Texas A&M University as an assistant professor.

Xie comes to Texas A&M from Johns Hopkins University where he received his postdoctoral training. He earned his Ph.D. in mechanical engineering and his bachelor degrees in biomedical engineering and finance all from the University of Sydney, Australia.

Xie's research focuses on understanding and designing lighter and stronger structural materials, such as Magnesium alloys, boron carbide and 3-D printed ceramics, assisted by advanced nano-scale and atomic-level characterization techniques.

"In the area of ceramic engineering, we revealed the twinning mechanisms in boron carbide, a light-weight body armor material, as a function of chemistry and local bonding," Xie said. "This ability to control twinning is expected to help design the next generation of lightweight body armor, where twin interfaces provide additional strength and toughness."

In the area of metallurgy, Xie and his colleagues systematically investigated the dislocation and twin structures in deformed bulk magnesium single crystals, which substantially contributed to the understanding that explains why Magnesium and Magnesium alloys generally exhibit poor ductility and formability.

Xie will teach fundamentals of materials science and engineering classes this spring.

QIAN, WANG FEATURED IN *2-D MATERIALS*

Electronic devices have been constantly decreasing in size and increasing in speed and efficiency, from miniaturized personal computers to pocket-sized cell phones. Researchers in the Department of Materials Science and Engineering at Texas A&M University have discovered a class of two-dimensional (2-D) materials to aid in further reducing the size and improving the performance of various devices.

Dr. Xiaofeng Qian, an assistant professor, and Hua Wang, a graduate student in the department, were featured in a recent issue of *2-D Materials* for their work in 2-D multiferroic materials.

“Most 2-D materials studied so far have shown one ferroic characteristic,” Qian said. “When we looked into group IV monochalcogenide layers, we discovered that these 2-D materials have two ferroic characteristics simultaneously.”

Their paper “Two-Dimensional Multiferroics in Monolayer Group IV Monochalcogenides” demonstrates a special class of two-dimensional semiconductors. These materials are special due to their ability to exhibit a large spontaneous lattice strain called ferroelasticity, and a giant switchable electric polarization called ferroelectricity. These properties appearing simultaneously in the monolayer group IV monochalcogenides lead to 2-D ferroelastic-ferroelectric multiferroicity.

“2-D materials with more than one ferroic characteristic can be very useful for miniaturized multifunctional devices such as sensors and actuators,” Qian said. “However, they are very scarce in nature.”

This unique class of 2-D multiferroic materials could be useful for 2-D ferroelectric memory and ferroelastic memory that are as thin as one nanometer. In pocket-sized devices, this new material could help make the device smaller by decreasing the size of the sensors and materials inside the device. They can also be useful for exploring ferroelectric excitonic photovoltaics that take advantage of both large ferroelectricity and extraordinary excitonic optical absorption.

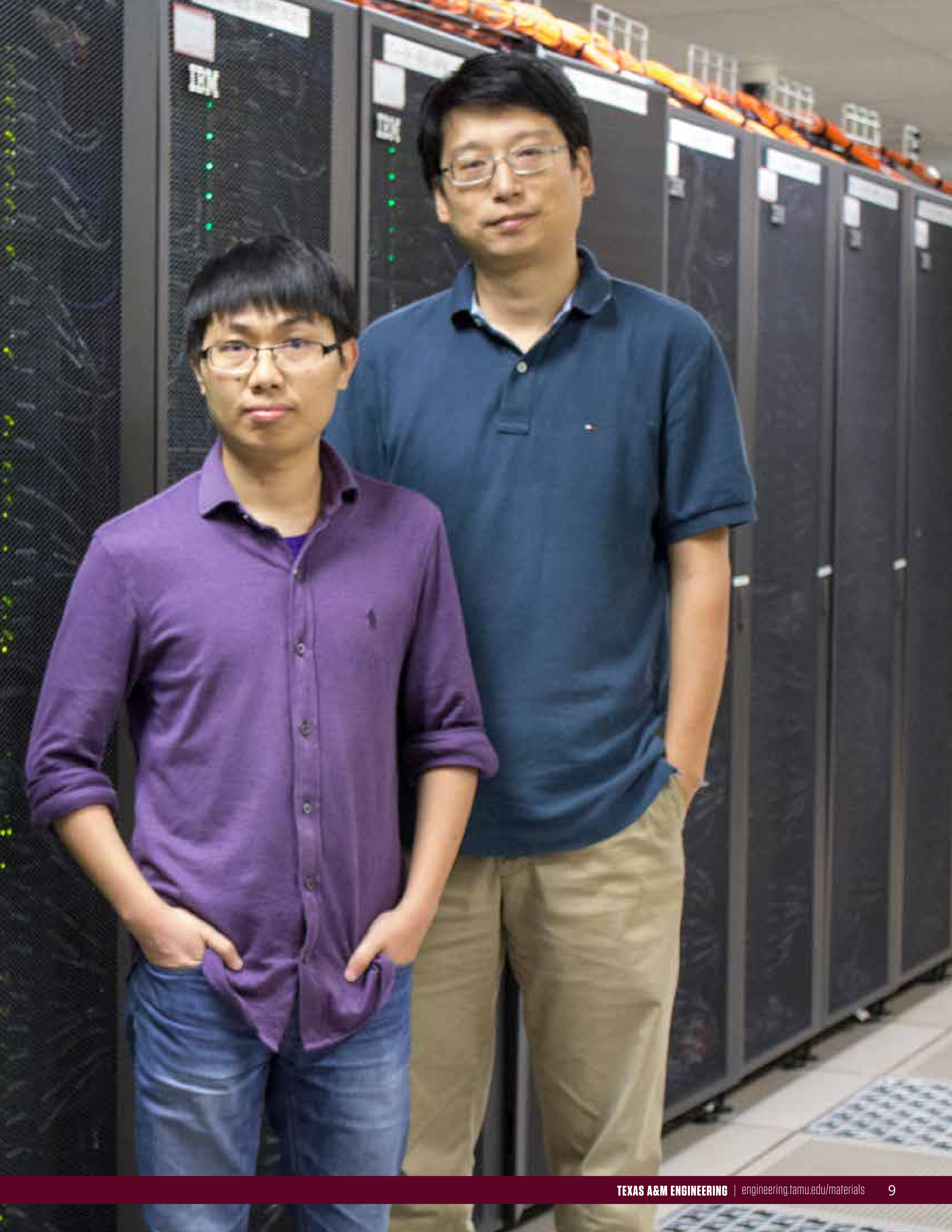
“Additionally, these 2-D materials with multiple ferroic orders provide an ideal platform to demonstrate 2-D nonvolatile photonic memory with much lower power consumption and at a faster speed,” Qian said.

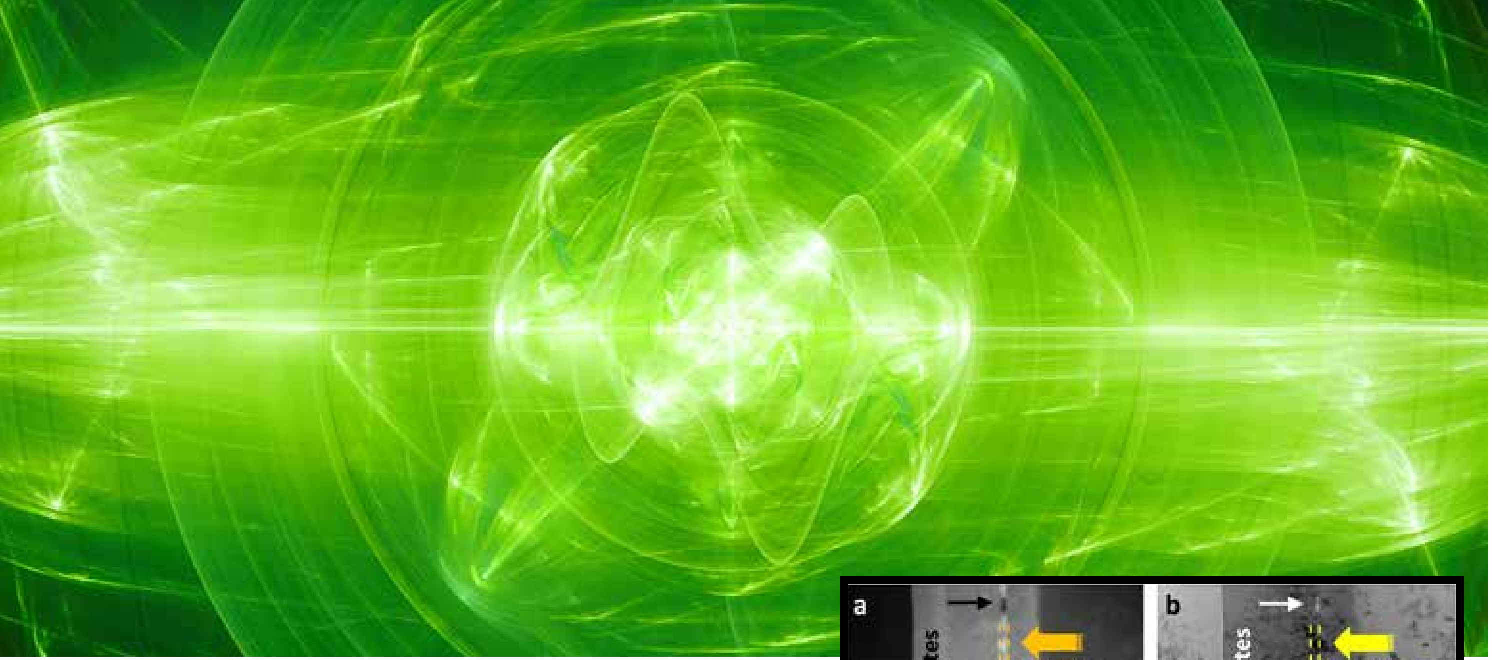
Currently, the group is working to better understand the microscopic mechanisms of the domain wall motion and discover other novel 2-D multiferroic materials.

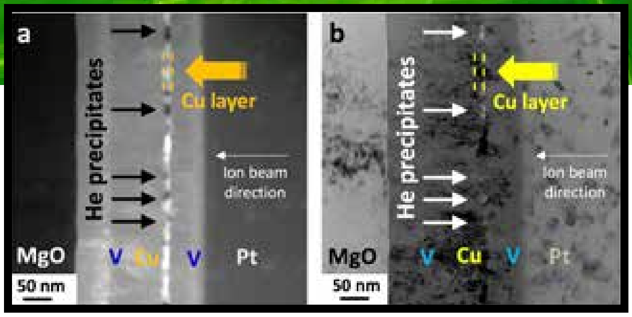
“Our ultimate goal in this project is to design multiferroicity into 2-D materials,” Qian said. “We also want to be able to fine tune and control their multiferroicity for a variety of electronic, optical and energy applications.”

Results of the duo’s work will provide new opportunities for 2-D multifunctional materials research toward miniaturized energy efficient applications.

“Many interesting properties and potential applications have been discovered in 2-D materials and their hybrid structures. There are a lot of new fascinating properties waiting to be discovered,” Qian said. “It is so fortunate and exciting to work in this field and understand their fundamentals and implications for future device and energy technologies.”







CHANNELING HELIUM:

RESEARCHERS TAKE NEXT STEP TOWARD FUSION ENERGY

Fusion is the process that powers the sun, harnessing it on Earth would provide unlimited clean energy. However, researchers say that constructing a fusion power plant has proven to be a daunting task, in no small part because there have been no materials that could survive the grueling conditions found in the core of a fusion reactor. Now, researchers at Texas A&M University have discovered a way to make materials that may be suitable for use in future fusion reactors.

The sun makes energy by fusing hydrogen atoms, each with one proton, into helium atoms, which contain two protons. Helium is the byproduct of this reaction. Although it does not threaten the environment, it wreaks havoc upon the materials needed to make a fusion reactor.

“Helium is an element that we don't usually think of as being harmful,” said Dr. Michael Demkowicz, associate professor in the Department of Materials Science and Engineering. “It is not toxic and not a greenhouse gas, which is one reason why fusion power is so attractive.”

However, if you force helium inside of a solid material, it bubbles out, much like carbon dioxide bubbles in carbonated water.

“Literally, you get these helium bubbles inside of the metal that stay there forever because the metal is solid,” Demkowicz said. “As you accumulate more and more helium, the bubbles start to link up and destroy the entire material.”

Working with a team of researchers at Los Alamos National Laboratory in New Mexico, Demkowicz investigated how helium behaves in nanocomposite solids, materials made of stacks of thick metal layers. Their findings, recently published in *Science Advances*, were a surprise. Rather than making bubbles, the helium in these materials formed long channels, resembling veins in living tissues.

“We were blown away by what we saw,” Demkowicz said. “As you put more and more helium inside these nanocomposites, rather than destroying the material, the veins actually start to interconnect, resulting in kind of a vascular system.”

This discovery paves the way to helium-resistant materials needed to make fusion energy a reality. Demkowicz and his collaborators believe that helium may move through the networks of veins that form in their nanocomposites, eventually exiting the material without causing any further damage.

Demkowicz collaborated with Di Chen, Nan Li, Kevin Baldwin and Yongqiang Wang from Los Alamos National Laboratory, as well as former student Dina Yuryev from the Massachusetts Institute of Technology. The project was supported by the Laboratory Directed Research and Development program at Los Alamos National Laboratory.

“Applications to fusion reactors are just the tip of the iceberg,” Demkowicz said. “I think the bigger picture here is in vascularized solids, ones that are kind of like tissues with vascular networks. What else could be transported through such networks? Perhaps heat or electricity or even chemicals that could help the material self-heal.”

MATERIALS SCIENCE AND ENGINEERING GRADUATE STUDENT SERVES AS ASM INTERNATIONAL OFFICER

Olga Eliseeva, a graduate student in the Department of Materials Science and Engineering at Texas A&M University, is serving as one of three student voices on the board of trustees for ASM International (ASMI).

“The mission of ASMI is to connect material engineers from research, industry and government, as well as provide access to reference materials, data and educational content,” Eliseeva said.

She hopes to one day become a member of the board of directors for a company or larger international organization and credits this experience with providing exclusive opportunities to learn more about large organizations and how they function.

“I also enjoy meeting individuals leading the cutting-edge companies in the field of materials science and engineering,” Eliseeva said. “This opportunity excites me because I love learning of people’s stories and how their careers have unfolded. This also gives me a better understanding of what to expect in the future.”

Satisfying her desire to give back, this position sparked Eliseeva’s interest with its ability to leave a lasting impact on the organization that has benefitted her so greatly. Eliseeva’s duties include ensuring the future of ASMI, advising and serving as a voice of the student members to the members of the board.

“My favorite part about serving ASMI in this capacity is that I get to meet interesting people every day,” Eliseeva said. “It’s not common to have lunch with delegates from India one day and the president of a major company the next.”

Previously, Eliseeva served as an officer of Material Advantage, an ASM student chapter, for four years at Case Western Reserve University while completing her undergraduate degree. At Texas A&M, she currently serves as the chair of Material Advantage.

EMBEDDED SHAPE MEMORY ALLOY SENSORY PARTICLES MAY BETTER DETECT DAMAGE IN AIRCRAFT AND SPACECRAFT

Most of us take flying in an airplane for granted. We book our tickets, sit through the long check-in lines, and if we're lucky, take off on time to our chosen destination. Day in and day out we do this without any regard to the age and health of the airplane we're flying on.

The airplanes that fly multiple flights a day incur wear and tear, such as cracks, in places not always easily seen. While there are standards and careful procedures in place to inspect aircraft for excessive wear and tear or minor defects, these important safeguards can be very expensive and time-consuming. A team of researchers at Texas A&M University is working to find a better method for detection of such cracks.

Dr. Darren Hartl, assistant professor in the Department of Aerospace Engineering and Dr. Ibrahim Karaman, department head and professor in the Department of Materials Science and Engineering at Texas A&M, have received a National Science Foundation (NSF) grant for nearly $400,000 to investigate the feasibility of embedding stress-sensitive active material particles into structural components to identify cracks the moment they occur. The project will be a part of the "Mechanics of Materials and Structures" program portfolio at the NSF.

One of the greatest dangers to structural safety and reliability in airplanes is uncontrollable growth of cracks in unknown locations within the underlying material. Currently, aircraft must undergo scheduled inspections taking them out of service, and if necessary, additional downtime is needed for repair. This method has been effective, limiting the number of incidents associated with aircraft structural failure to just four percent of all accidents.

Unfortunately, these inspections are time-consuming and may be performed on an aircraft that is in minimal danger of structural failure, thus wasting time and manpower. On the other hand, standard inspections may not provide all the information needed to reveal underlying damage that can cause catastrophic failure later.

A fast and effective detection method that is unique to each individual aircraft and minimizes downtime would provide a more accurate description of the state of the aircraft. Utilizing a smarter monitoring system could result in an estimated 44 percent reduction in inspection time.

Recently, a nondestructive evaluation method has been proposed allowing for accurate crack detection in an aircraft or spacecraft structure. By strategically embedding stress-sensitive active material particles into structural components, the formation of cracks can be identified by detecting changes in the mechanical or magnetic responses of the embedded particles near such damage.

This method could allow earlier detection of cracks and other damage, and preclude the need for traditional inspection approaches. Each vehicle could be repaired on an as-needed basis saving time and money while gaining

valuable information about how these aircraft behave in harsh environments.

Hartl and Karaman propose to use a composite they are developing in which single and polycrystalline magnetic shape memory alloy (SMA) sensory particles are embedded into aluminum alloys to detect cracks with the magnetic signals that emanate from these particles near the crack damage zone. Magnetic signature measurement is accurate and avoids false positives during operation.

SMAs are unique because the responses they exhibit are due to temperature, stress or magnetic field-induced phase transformation. As a crack forms, particles in the vicinity of the damage will transform between two different material phases. Both are solid, but they exhibit different properties so that the change from one to another can be detected using a number of different methods depending on the material.

The materials enabling this novel technology are a special sub-class of meta-magnetic SMAs (MSMAs), whose magnetic properties drastically change when they undergo a stress induced solid-solid martensitic transformation. The small size and wide distribution of the particles throughout the material should permit damage detection much earlier than existing technologies, leading to improved reliability and reduced costs.

A study will be carried out using models of embedded sensory particles, each model having varying particle sizes and densities. Model simulations will be used to determine which size and density configurations maximize transformation signal strength, while minimizing the effect that the particles have on overall performance of the material.

The focus of this research project will be on tailoring and fabricating specific sensory particle alloys and addressing the fabrication challenges for embedding these particles in aluminum alloys. Experiments will be performed to detect and interpret magnetic signals, developing an accurate model of the MSMA material behavior and designing sensory particle distributions for damage sensing at the component level.

The end goal is the effective magnetic detection of cracks, and the team hopes to demonstrate that phase-transforming sensory particles comprised of alloy systems exhibiting thermal-magnetic-mechanical couplings can be successfully embedded in aluminum components, and can be used to provide magnetic signatures during experiments where damage is introduced into these components.

Hartl says, “By combining the research strengths of my team with that of Ibrahim’s, I have no doubt that some important developments will result from this new support.

TEXAS A&M REPORTS ADVANCES IN CONTROL OF CHAMELEON-LIKE MATERIAL FOR NEXT-GENERATION COMPUTERS

Researchers from Texas A&M University report significant advances in their understanding and control of a chameleon-like material that could be key to next-generation computers that are even more powerful than today's silicon-based machines.

The existing paradigm of silicon-based computing has given us a range of amazing technologies, but engineers are starting to discover silicon's limits. As a result, for computer science to keep advancing it is important to explore alternative materials that could enable different ways to do computation, according to Dr. Patrick J. Shamberger, assistant professor in the Department of Materials Science and Engineering. Vanadium dioxide is one example.

"It's a very interesting, chameleon-like material that can easily switch between two different phases, from being an insulator to being a conductor, as you heat and cool it or apply a voltage," said Dr. Sarbajit Banerjee, professor with joint appointments in the Departments of Chemistry and Materials Science and Engineering. "And if you think about those two phases as being analogous to a zero and a one, you can come up with some interesting new ways of information processing."

Banerjee and Shamberger are corresponding authors of a paper describing their work, which was published in the January 2018 issue of *Chemistry of Materials*.

"Before vanadium dioxide can be used in computing, we need to better control its transition from insulator to conductor and back again," Shamberger said. In the paper the team describes doing just that by adding tungsten to the material.

Among other things, the researchers showed that tungsten allows the transition to occur over two very different pathways. The result is that the transition from insulator to conductor happens easily and quickly, while the transition from conductor back to insulator is more difficult.

"Think of it as driving from point A to point B and back again. Going there you take a superhighway, but coming back you're on back roads," Banerjee said.

Essentially the addition of tungsten allows the vanadium oxide to switch quickly in one direction and much more slowly in the other, phenomena that could be exploited in future computers.

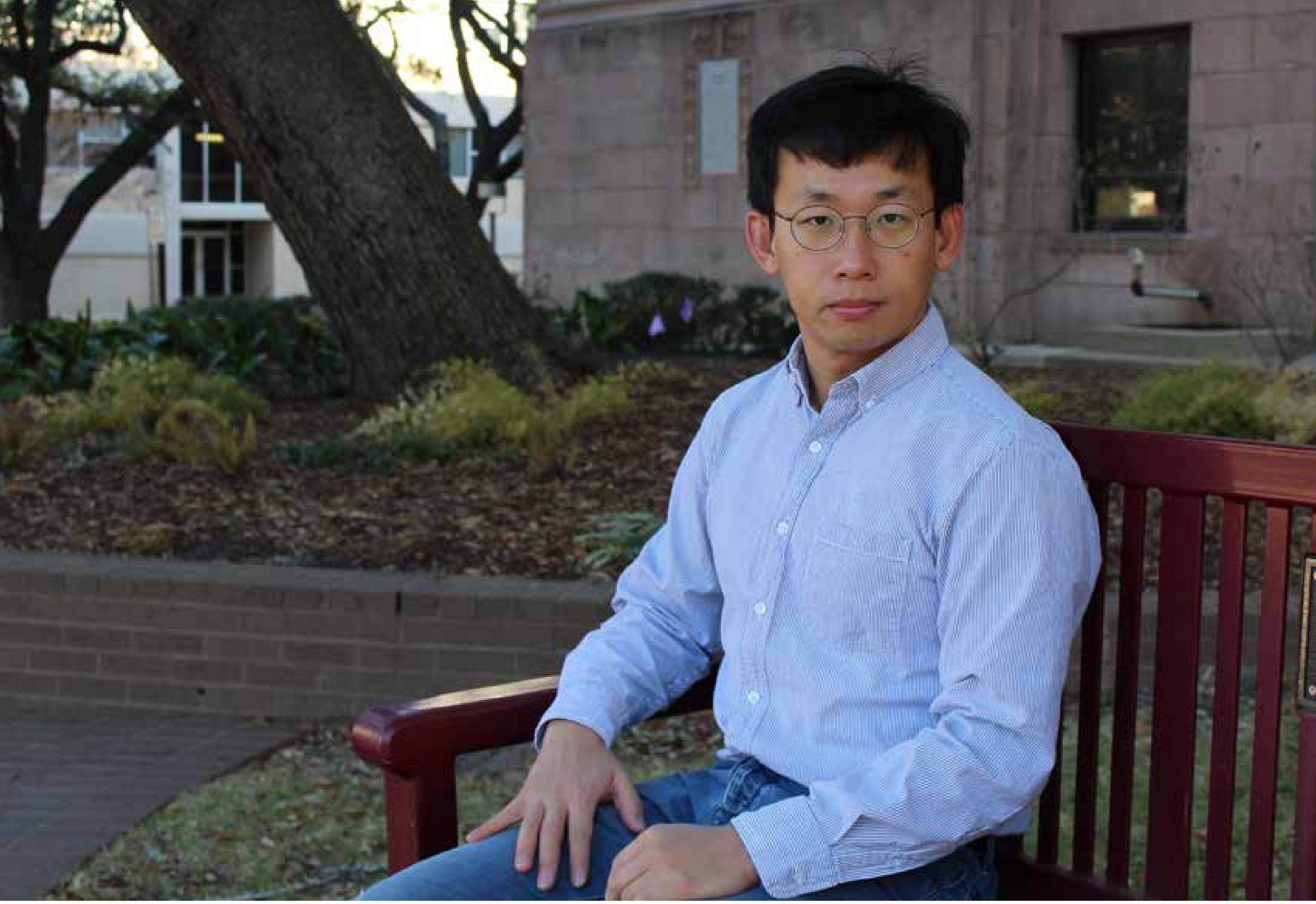
"It provides an additional 'knob' to tune how you go back and forth between the two states," said Erick J. Braham, a graduate student at Texas A&M who was the first author on the paper.

The team has also found that the addition of tungsten allows them to better control, or tune, the different temperatures where the transitions occur.

Banerjee notes the interdisciplinary nature of the work, which involved four groups with expertise ranging from computational materials science to electron microscopy, has been key.

"We've really looked at this puzzle from different ends to try to make sense of exactly what's going on," he said. "It's been very exciting."

Additional authors from Texas A&M are Dr. Raymundo Arroyave from materials science and engineering; Nathan A. Fleer, graduate student in chemistry; Diane Sellers, assistant research scientist in chemistry and materials science and engineering; Ruben Villarreal, graduate student in mechanical engineering; and Katie E. Farley and Emily Emmons, both former graduate students. Authors from the University of Illinois at Chicago are Dr. Reza Shahbazian-Yassar, professor, and Hasti Asayesh-Ardakani, a visiting researcher. Their work was supported by the National Science Foundation and the Air Force Office of Scientific Research.



INSECTS MAY HOLD THE KEY TO MORE EFFECTIVE COATINGS AND LUBRICATION SYSTEMS

Dr. Jun Kyun Oh was highlighted in the *Materials Today* journal for his work, which was funded by the National Science Foundation, that aims to understand how forces at the molecular level determine adhesion kinetics and dynamics.

Oh, a former student in the Department of Materials Science and Engineering and postdoctoral researcher in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, investigated the structural properties of the hind leg femur-tibia joint in adult katydids, or bush crickets.

"We showed that the katydid hind leg femur-tibia joint had unique surfaces and nanoscale textures," Oh said. "Importantly, the sheared surfaces at this joint showed no sign of wear or damage, even though it had undergone thousands of external shearing cycles."

The potential of their bioinspired research is leading to further studies to develop more effective coatings and lubrication systems.

"The research will seek to determine the main features of surface morphology of different characteristics of insect joints and how these features influence the adhesion between insect joints," Oh said. It will also establish the role of their internal nanostructure on their mechanical properties such as stiffness and hardness."

Oh is collaborating with Dr. Spencer Behmer, professor in the Department of Entomology, and Richelle Marquess, a student of Behmer's.

MATERIALS SCIENCE & ENGINEERING
TEXAS A&M UNIVERSITY

Selected 2017 Publications

Dr. Raymundo Arróyave

Presidential Impact Fellow
Professor

Ph.D., Massachusetts Institute of Technology, 2004

Arróyave specializes in computational thermodynamics and kinetics of materials. His research focuses on thermodynamics of materials, kinetics of phase transformations and thin film thermodynamics.

- Abu-Odeh A; Galvan E; Kirk T; Mao H; Chen Q; Mason P; Malak R; Arroyave R; “Exploration of the High Entropy Alloy Space as a Constraint Satisfaction Problem,” arXiv, 2017
- Braham EJ; Sellers D; Emmons E; Villarreal R; Asayesh-Ardakani H; Arroyave R; Shamberger PJ; Banerjee S; “Modulating the Hysteresis of an Electronic Transition: Launching Alternative Transformation Pathways in the Metal–Insulator Transition of Vanadium (IV) Oxide,” Chemistry of Materials, 2017
- Chaudhary N; Abu-Odeh A; Karaman I; Arroyave R; “A data-driven machine learning approach to predicting stacking faulting energy in austenitic steels,” Journal of Materials Science, Vol. 52 (18), 2017
- Tapia G; Johnson L; Franco B; Karayagiz K; Ma J; Arroyave R; Karaman I; Elwany A; “Bajesian Calibration and Uncertainty Quantification for a Physics-Based Precipitation Model of Nickel-Titanium Shape-Memory Alloys,” Journal of Manufacturing Science and Engineering, Vol. 139 (7), 2017
- Arroyave R; Talapatra A; Duong T; Son W; Gao H; Radovic M; “Does aluminum play well with others? Intrinsic Al-A alloying behavior in 211/312 MAS phases,” Materials Research Letters, Vol. 5 (3), pp. 170-178, 2017
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- Fowler DA; Arroyave R; Ross J; Malak R; Banerjee S; “Looking Outwards from the “Central Science”: An Interdisciplinary Perspective on Graduate Education in Materials Chemistry,” Educational and Outreach Projects from the Cottrell Scholars Collaborative Undergraduate and Graduate Education, Vol. 1, 2017
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Dr. Amine Benzerga

Professor

Director, Center for Intelligent Materials and Structures (CiMMS)

Ph.D., Ecole des Mines de Paris, France, 2000

Benzerga's research interests include mechanics of materials, high-performance computing, anisotropy in plasticity and fracture, ductile fracture, discrete dislocation plasticity and dislocation mechanics, and macromolecular mechanics of polymers and their composites. He has a joint appointment with the Department of Aerospace Engineering.

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- Basu S; Dogan E; Kondori B; Karaman I; Benzerga AA; "Ductility Enhancement in Mg Alloys by Anisotropy Engineering," Magnesium Technology, pp. 153-158, 2017

Dr. Tahir Cagin

Professor

Ph.D., Clemson University, 1988

Cagin's research interests include computational materials science and nanotechnology, characterization and development of multifunctional nano-structured materials, materials for thermal management, power generation and energy harvesting, and development and application of multiscale simulation methods.

- Su J; Yuan S; Wang HY; Huang L; Ge JY; Joseph E; Qin J; Cagin T; Zuo JL; Zhou HC; "Redox-switchable breathing behavior in tetrathiafulvalene-based metal-organic frameworks," Nature Communications, Vol. 8 (1), pp. 2008, 2017
- Yuan S; Zou L; Qin JS; Li J; Huang L; Feng L; Wang X; Bosch M; Alsalme A; Cagin T; Zhou HC; "Construction of hierarchically porous metal-organic frameworks through linker labilization," Nature Communications, Vol. 8, pp. 15356, 2017
- Yapicioglu H' Mobaraki A; Kandemir A; Cagin T; Gulseren O; Sevik C; "Thermal Transport Properties of Transition Metal Dichalcogenide Monolayers," Bulletin of the American Physical Society, Vol. 62, 2017
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Dr. Raymundo Case

Professor of Practice

Ph.D., University of Manchester, 2002

Case's research interests include corrosion mechanisms and modeling of corrosion damage evolution in low alloy steels, stainless steels and corrosion resistant alloys (CRA), especially in CO_2/H_2S containing environments, the effects of H_2S on the pit growth kinetics and passivity stability in CRA, liquid metal embrittlement of CRA and high strength titanium by exposure to metallic Hg, corrosion mechanisms and mitigation in super critical environments.

- Shadravan A; Case R; Rumann A; "Nanostructured Steel Susceptibility to Sulfide Stress Cracking," Meeting Abstracts, pp. 685, 2017
- Case R; Harris J; Daniels J; Achour M; "In Situ Electrochemical Evaluation of Pitting Corrosion of Carbon Steel Pipelines Exposed to Slightly Sour Seawater Service," CORROSION, 2017

Dr. Homero Castaneda

Associate Professor

Director, National Corrosion and Materials Reliability Center

Ph.D., Pennsylvania State University, 2001

Casteneda's research interests include multiscale tools for corrosion analysis and mitigation in oil and gas systems, dynamic electrochemical characterization and monitoring of operating batteries and damage evolution of coatings / steel and coatings / aluminum interfaces.

- Cho S; Cubides Y; Castaneda H; "Probing the degradation mechanism of a Cr (VI) coating/ aluminum alloy 2024-T3 system based on dynamic mechanisms and a 2D deterministic-probabilistic approach," Electrochimica Acta, Vol. 236, pp. 82-96, 2017
- Li X; Castaneda H; "Damage evolution of coated steel pipe under cathodic-protection in soil," Anti-Corrosion Methods and Materials, Vol. 64 (1), pp. 118-126, 2017
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- Chiu TM; Hunt EM; Allen B; Castaneda H; "Electrochemical Performance of Nano Engineered-Coatings Based on Antimicrobial Nano-Alloy in Corrosive Environment, Paper No. C2017-9465," NACE New Orleans, 2017
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Dr. Michael J. Demkowicz

Associate Professor

Ph.D., Massachusetts Institute of Technology, 2005

Demkowicz specializes in computational materials design, fundamental physics of material behavior mechanical behavior and radiation response of materials.

- Chen D; Li N; Yuryev D; Baldwin JK; Wang Y; Demkowicz MJ; "Self-organization of helium precipitates into elongated channels within metal nanolayers eaao2710," Science Advances, Vol. 3 (11), 2017
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Dr. Karl 'Ted' Hartwig

Professor

Ph.D., University of Wisconsin, Madison, 1977

Hartwig's research interests include development of better materials, structure-property-processing relationships, sever plastic deformation of materials via equal channel angular extrusion, and applied superconductivity.

- Levin ZS; Hartwig KT; "Strong ductile bulk tungsten," Materials Science and Engineering: A, Vol. 707, pp. 602-611, 2017
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Dr. Ibrahim Karaman

Department Head, Professor,
Chevron Professorship I Holder

Ph.D., University of Illinois, Urbana-Champaign, 2000

Karaman's research interests include processing-microstructure-mechanical/functional property relationships in metallic materials exhibiting simultaneous dislocation slip and twinning deformation, and slip-twinning-martensitic transformation; twinning and martensitic phase transformation in metallic materials; and magnetic, thermal and mechanical activation of martensitic phase transformation.

- Bruno NM; Wang S; Karaman I; Chumlyakoy YI; "Reversible martensitic transformation under low magnetic fields in magnetic shape memory alloys," Scientific Reports, Vol. 7, 2017
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Dr. Dimitris Lagoudas

University Distinguished Professor
Senior Associate Dean for Research

Ph.D., Lehigh University, 1986

Lagoudas specializes in micromechanics of active materials and smart structures, in addition to phase transformations in shape memory alloys (SMA), thermoelectric heat transfer in SMA actuators, SMA elastomeric composite dampers, and oxidation and damage in metal matrix composites. He has a joint appointment with the Department of Aerospace Engineering.

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Dr. Pao-Tai Lin

Assistant Professor

Ph.D., Northwestern University, 2009

Lin's research is focused on mid-infrared integrated photonics, biomedical sensors on a chip, multiscale fabrication technologies, reconfigurable materials, nanophotonics and meta-materials. He has a joint appointment with the Department of Electrical and Computer Engineering.

- Jin T; Lin H-Y G; Lin PT; "Monolithically Integrated Si-on-AlN Mid-infrared Photonic Chips for Real-Time and Label-Free Chemical Sensing," ACS Applied Materials Interfaces, DOI: 10.1021/acsami.7b13307, 2017
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- Lin PT; "Epitaxial Barium Titanate Thin Films for Mid-infrared Photonic Circuits," Advanced Photonics, 2017

Dr. Alan Needleman

University Distinguished & TEES Research Distinguished Professor

Ph.D. Harvard University, 1971

Needleman is a member of the National Academy of Engineering. His research interests include computational modeling of deformation, fracture processes in structural materials. A general objective is to provide quantitative relations between the measurable features of the materials' micro-scale structure and its macroscopic mechanical behavior.

- Kondori B; Needleman A; Benzerga; "Discrete dislocation simulations of compression of tapered micropillars," Journal of the Mechanics and Physics of Solids, Vol. 101, pp. 223-234, 2017
- Wen JF; Srivastava A; Benzerga A; Tu ST; Needleman A; "Creep crack growth by grain boundary cavitation under monotonic and cyclic loading," Journal of the Mechanica and Physics of Solids, Vol. 108, pp. 68-84, 2017
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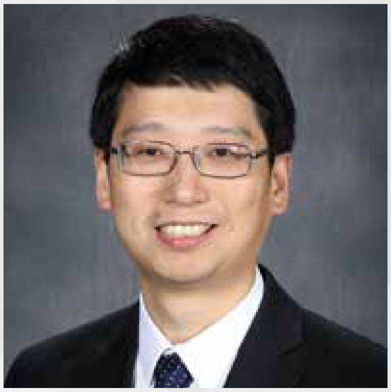

Dr. Xiaofeng Qian

Assistant Professor

Ph.D., Massachusetts Institute of Technology, 2008

Qian's research is in materials theory, discovery, and design for energy applications and device design aided by high throughout computing. He is involved in two-dimensional materials and their coupled multi-physical properties with applications in optoelectronics, photovoltaics, catalysis, sensing and energy storage.

- Zhang Q; Liu Z; Sun Y; Yang H; Jiang J; Mo SK; Hussain Z; Qian X; Fu L; Yao S; Lu M; Felser C; Yan B; Chen Y; Yang L; "Lifshitz Transitions Induced by Temperature and Surface Doping in Type-II Weyl Semimetal Candidate Td-WTe2." Physica Status Solidi (RRL)-Rapid Research Letters, 2017
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Dr. Miladin Radovic

Associate Professor

Director, Materials Characterization Facility

Ph.D., Drexel University, 2001

Radovic's research interests include processing of advanced ceramics and ceramics composites, high temperature materials for energy applications, characterization and modeling of mechanical properties of ceramic and ceramic composites, and resonant ultrasound spectroscopy.

- Gao P; Bolon A; Taneja M; Xie Z; Orlovskaya N; Radovic M; "Thermal expansion and elastic moduli of electrolyte materials for high and intermediate temperature solid oxide fuel cell," Solid State Ionics, Vol. 300, pp. 1-9, 2017
- Duong TC; Talapatra A; Son W; Radovic M; Arroyave R; "On the stochastic phase stability of Ti2AIC-Cr2AIC," Scientific Reports, Vol. 7, pp. 1-13, 2017
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Dr. Patrick Shamberger

Assistant Professor

Director, Undergraduate Degree Program

Ph.D., University of Washington, 2010

Shamberger's research interests include engineering of phase transitions with tailored properties, thermal storage materials for energy storage and thermal management applications, theory and methodology of diffraction-based materials analysis, and materials informatics.

- Braham EJ; Sellers D; Emmons E; Villarreal R; Asayesh-Ardakani H; Fleer NA; Farley KE; Shahbazian-Yassar R; Arroyave R; Shamberger PJ; Banerjee S; "Modulating the Hysteresis of an Electronic Transition: Launching Alternative Transformation Pathways in the Metal–Insulator Transition of Vanadium (IV) Oxide," Chemistry of Materials, 2017
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- Chang CN; Semma B; Pardo ML; Fowler D; Shamberger P; Arroyave R; "Data-Enabled Discovery and Design of Energy Materials (D 3 EM): Structure of An Interdisciplinary Materials Design Graduate Program," MRS Advances, pp. 1-6, 2017
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Dr. Ankit Srivastava

Assistant Professor

Ph.D., University of North Texas, 2013

Srivastava's research interests include micromechanical modeling of heterogeneous materials, microstructure-based crystal plasticity finite element modeling, phase transformations, statistical fracture modeling, quantifying constitutive behavior of materials by small-scale experiments, in-situ mechanical testing, failure analysis and microstructure design.

- Wen JF; Srivastava A; Benzerga A; Tu ST; Needleman A; "Creep crack growth by grain boundary cavitation under monotonic and cyclic loading," Journal of the Mechanics and Physics of Solids, Vol. 108, pp. 68-84, 2017
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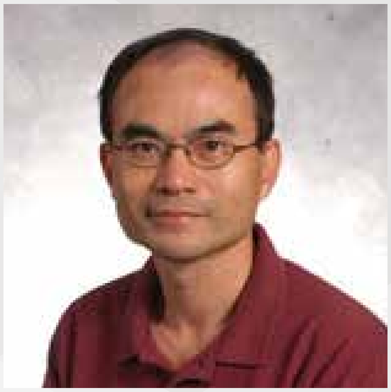

Dr. Hung-Jue Sue

TEES Professorship Holder

Ph.D., University of Michigan, 1988

Sue's research interests include high-performance functional materials, structure-property relationships, and utilization of processing tools to enhance physical and mechanical properties of polymers.

- Liu C; Mullins M; Hawkins S; Kotaki M; Sue HJ; "Expoxy Nanocomposites Containing Zeolitic Imidazolate Framework-8," ACS Applied Materials and Interfaces, 2017
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Sukhishvili's research interests include stimuli-responsive all-polymer and polymer nanocomposite assemblies, structure and dynamics of polyelectrolyte assemblies, and materials with controllable optical, swelling and drug-release responses, remote manipulation of material shape, smart antibacterial materials, surface modification for controlling wettability, adhesion and adsorption.

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POLYMER MOVEMENT:
KEY TO NEXT-GENERATION COATINGS

Researchers in the Department of Materials Science and Engineering at Texas A&M University, led by doctoral student Victor Selin and Dr. Svetlana Sukhishvili, are making headway in understanding fundamental principles that will help to create the next generation of biomedical coatings.

Medical devices, such as orthopedic implants, often need their surfaces modified with protective coatings. These devices have random shapes, which require the use of a superficial method to coat the surface controllably. These coatings can provide the surface of the objects with antireflection properties or make them able to release therapeutic compounds that kill bacteria and/or control the growth of mammalian cells.

The group is working to gain a fundamental understanding of the growth and behavior of multilayer polymer films to create functional films on the surface of different materials and aims to be able to control their properties and structures. These properties are important because they dictate how such films interact with aqueous and salinated solutions. Their work has revealed that by simple manipulations during film buildup, these properties can be easily controlled.

“By demonstrating how one can control the mobility of individual polymer chains layer-by-layer, we hope to facilitate practical applications of these films as a platform for functionalization of surfaces of biomedical devices,” Selin said.

Using several techniques, the group established a quantitative picture of the internal structure and polymer chain dynamics of these films. These experiments allowed the group to correlate the film properties with the behavior of individual polymer chains.

"The knowledge we are developing is needed to learn how to design surface coatings that will be able to controllably release multiple therapeutic agents," Selin said. "Our research provides a better understanding of the relationship between assembly conditions and the internal structure of resulting films, and therefore significantly contributes to the existing fundamental knowledge in polymer physics and materials science."

This research is part of a National Science Foundation research project focusing on the studies of layer-by-layer coatings led by Sukhishvili, a professor in the materials science and engineering department at Texas A&M, in close collaboration with Dr. John Akner, a lead instrument scientist at Oak Ridge National Laboratory, who is an expert in neutron scattering techniques.

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