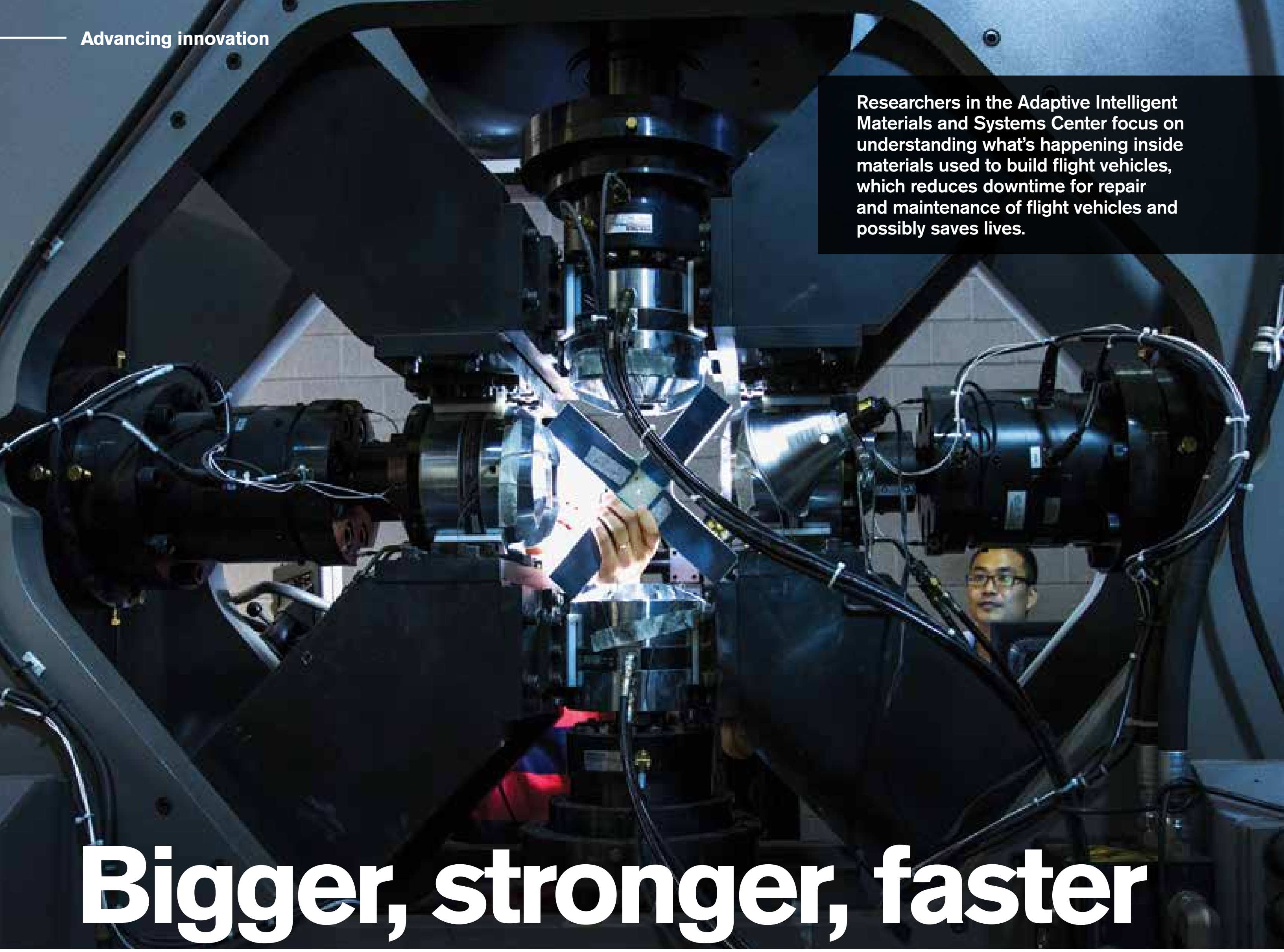
Changing the shape of the future

IRA A. FULTON SCHOOLS OF engineering
ARIZONA STATE UNIVERSITY

School for Engineering of Matter, Transport and Energy

SEMTE 2014–2015 Annual Report



Researchers in the Adaptive Intelligent Materials and Systems Center focus on understanding what's happening inside materials used to build flight vehicles, which reduces downtime for repair and maintenance of flight vehicles and possibly saves lives.

Bigger, stronger, faster

The School for Engineering of Matter, Transport and Energy at Arizona State University is making technological advances through new knowledge and innovative applications of chemical, materials, mechanical and aerospace engineering.

Whether the task is rebuilding and modernizing infrastructure, developing more efficient transportation systems, new sources of energy or more effective therapeutic drugs, progress can hinge on the right people in the right place at the right time. Our School is positioned to meet society's biggest challenges.

We are pursuing research to make aircraft — and air travel — safer and electronics, energy systems and medical technologies faster and better. We are laying the groundwork for progress in renewable energy sources and energy-saving materials, and finding out how to control "robot swarms" that perform challenging tasks.

Our research profile is boosted by increasing collaborations among faculty members — both at ASU and with other institutions.

Our faculty are participating in two National Science Foundation Engineering Research Centers: the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG), led by ASU, and the Nanotechnology Enabled Water Treatment (NEWT) Systems, led by Rice University. By combining our expertise in various branches of engineering and in specialties within those fields, we are ready to meet some of the world's pressing technological needs.

This multidisciplinary approach also is proving to be a horizon-expanding benefit to students. It is enabling not only graduate students but also undergraduate students to participate in diverse and multifaceted research endeavors that broaden their learning beyond the scope of the classroom.

Range of expertise and collaborative environment drive innovative research projects

- Self-sensing and self-healing materials that would boost the resilience and performance of many advanced transportation and defense technologies.
- Stronger metal alloys that could help make U.S. military forces better equipped to deter and battle threats.
- Electronic 3D dynamic tactile displays designed as a tool to aid people living with visual impairment.

These are only some of the innovative research projects that have been emerging from the collaborative efforts of faculty members in the School for Engineering of Matter, Transport and Energy.

The key to that innovation is found in creative approaches to solving technological challenges born from combining perspectives provided by diverse expertise in different branches of engineering and science.

Such interactions are producing novel ideas for tech advances that have attracted funding from some of the leading supporters of research to meet the nation's most critical needs.

"The technical expertise of our faculty, their willingness to engage across disciplines, and a structure in the Fulton Schools that encourages transdisciplinary research leads to an environment where true innovation is possible. I am proud of the level of support our faculty have received for these projects," said Kyle Squires, dean of the Fulton Schools of Engineering.

Molecular damage control

Mechanical, aerospace and chemical engineering know-how is being applied in an endeavor to utilize stress-sensing mechanophores — compounds whose reactions are triggered by mechanical force — to develop polymeric materials with damage-sensing and damage-repair capabilities at the molecular level.

The country's armed forces want such advances as a defining feature of the next generations of its air and ground vehicles, protective armor and weapons systems.

The project that has brought a $480,000, three-year grant from the U.S. Department of Defense Army Research Office is led by Aditi Chattopadhyay, an Arizona State University Regents' Professor and Ira A. Fulton Professor of mechanical and aerospace engineering. She is director of the Adaptive Intelligent Materials & Systems (AIMS) Center.

The co-principal investigator is Lenore Dai, a professor of chemical engineering and director of the School for Engineering of Matter, Transport and Energy.

Chattopadhyay and Dai will use high-performance polymers to build chemically cross-linked microstructures that should increase stress-resistance in the materials.

HIGH-PERFORMANCE POLYMERS may hold the key to developing materials that can signal when they are damaged or even repair damage.

The materials would then be capable of detecting and signaling when molecular damage begins and monitor its progression.

In designing and structuring thermoset polymers to employ these distinctive abilities, the team expects to gain better understanding of the underlying physics and mechanochemistry that make self-sensing and self-healing materials possible.

What they learn is anticipated to provide practical foundations for developing systems, methods and techniques to improve the structural stability and reduce the probability of failure of many kinds of materials.

NIK CHAWLA, pictured, and Kiran Solanki are designing new metal alloys that can better withstand the rigors of military use.

Stronger defense through tougher materials

Successful national defense efforts often hinge on the durability, mobility and versatility of the technology that military forces can bring to the battlefront.

With the increasingly challenging and far-flung environments in which those forces must operate, there's a critical need for the tools of transport and combat to be lightweight, energy-efficient and at the same time more resilient.

ASU engineers Nikhilesh Chawla and Kiran Solanki are working to provide the kinds of advanced materials the U.S. Army relies on.

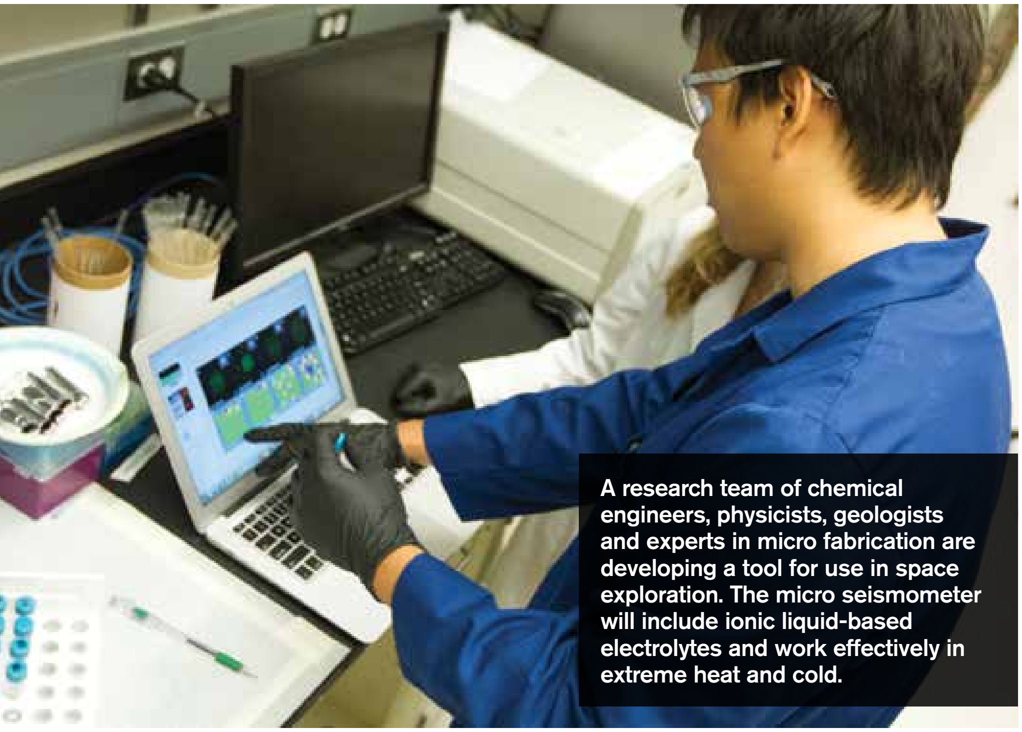
Chawla is a Fulton Professor of Materials Science and Engineering. Solanki is an assistant professor of mechanical and aerospace engineering.

With support of a $360,000 grant from the Department of Defense, they are seeking to develop designs for new and stronger metal alloys — specifically aluminum-copper and aluminum-silicon alloys — that can be used to boost the sustainability of the military's fleets and structures.

To do this, Chawla and Solanki are tackling one of the fundamental quests for knowledge in their field: understanding the complex relationship between the structures of such materials at the microscopic level and how those microstructures determine the behavior and mechanical properties of the materials.

Next, they will work to precisely quantify specific mechanisms for developing processes that can be used to manipulate microstructures in ways that produce materials better able to withstand the rigors of military use.

That accomplishment would open a plethora of technology research and industry pursuits for the new processes and new alloys.



A research team of chemical engineers, physicists, geologists and experts in micro fabrication are developing a tool for use in space exploration. The micro seismometer will include ionic liquid-based electrolytes and work effectively in extreme heat and cold.

3D solution for impaired sight

Another research project based on exploiting the physical and chemical properties of materials seeks to maximize their "environmental responsiveness" for development of technologies to serve the visually impaired.

Supported by a three-year, $400,000 grant from the National Science Foundation's Division of Civil, Mechanical and Manufacturing Innovation, the work is led by Hanqing Jiang, an associate professor of mechanical and aerospace engineering.

Lenore Dai is a co-principal investigator along with Hongyu Yu, an associate professor of electrical engineering in the School of Electrical, Computer and Energy Engineering and in ASU's School of Earth and Space exploration.

They are collaborating on efforts involving materials synthesis, processing technology and multiphysics analysis to achieve an integration of light-responsive gels and hard materials for producing 3D tactile electronic screen displays.

Embedded optical devices made of hard materials would amplify the device's optical light emissions, triggering the soft, light-sensitive gels to rise or descend and change the topography of images on the screen displays of cellphones, computers and similar technologies.

The changing display surfaces would enable people to feel the texture of screen images to identify those images.

Among the project's technological challenges are engineering light-responsive gels with a broader range of transition for screen-surface topography and to provide faster response time for users.

The work is expected to advance knowledge in experimental control of the synthesis and assembly of environmentally responsive materials and lead to developing other technologies based on integrating gels and similar soft materials with hard materials — as well as developing the microfabrication processes for producing devices.

Creating the 3D tactile display should also lead to research findings that can be applied to additional kinds of human-machine interaction technologies.

Microseismometer with ionic liquid based electrolytes

A project combining materials and chemical engineering with expertise in physics, geology and microfabrication is being led by Yu, with Dai as co-principal investigator.

A grant from the National Aeronautics and Space Administration (NASA) of close to $588,000 is supporting the work to develop an Integrated Seismic Instrument System for use in space exploration.

The research team includes Edward Garnero, a seismologist and professor of geology in the School of Earth and Space Exploration, and researchers at the Johns Hopkins University Applied Physics Laboratory.

The objective is to produce a prototype for a high-performance microseismometer capable of withstanding the range of harsh conditions on various planetary and lunar surfaces throughout the solar system.

A major challenge involves development of ionic liquid-based electrolytes to enable the instruments to operate effectively in extreme heat or cold — over a temperature range of 400 degrees Centigrade, from 200 degrees to minus 200 degrees.

The instrument will consist of a sensing cell package combining the sensing element and an electrolyte, as well as other mechanical structures and accessories.

The package will include flexible diaphragms for fluidic channels, temperature sensors, a magnetic feedback loop to improve its response over a wide frequency range and enhance that range, plus a system of electrical circuits to enable the instrument to digitize signals, export data and control other parts of the system.

All of that adds up to an easily deployable, energy-efficient but advanced microseismometer capable of providing NASA with precise information that is potentially critical to future exploratory missions.

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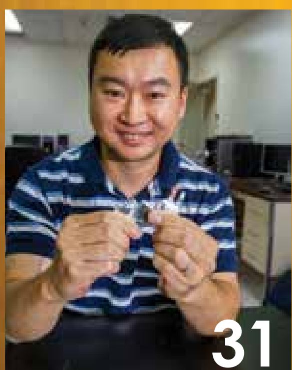

Front cover: Stretchable batteries developed by a team of Arizona State University engineers won top choice as an emerging technology with the greatest potential for innovation in the “med tech” field by readers of Qmed, a medical device industry news website.

Back cover: Student organizations like the ASU chapter of the Society of Automotive Engineers encourage, engage and inspire the next generation of engineers.

Contributors

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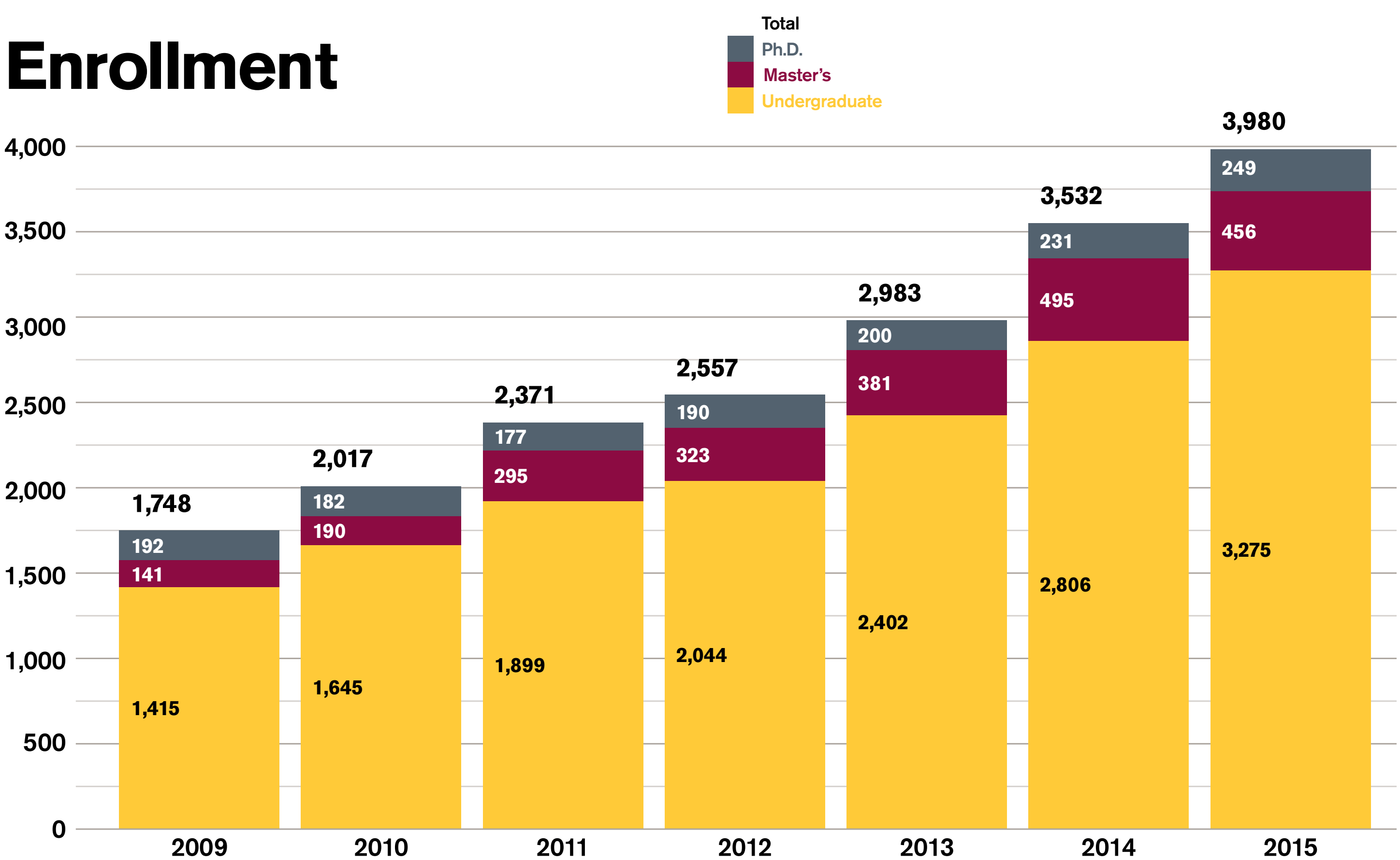
inside

Enrollment



Total
Ph.D.
Master's
Undergraduate
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2009
1,748
192
141
1,415
2010
2,017
182
190
1,645
2011
2,371
177
295
1,899
2012
2,557
190
323
2,044
2013
2,983
200
381
2,402
2014
3,532
231
495
2,806
2015
3,980
249
456
3,275

Engineering a bold future

The School for Engineering of Matter, Transport and Energy is continuing its growth as a school with nationally recognized programs in Aerospace Engineering, Mechanical Engineering, Materials Science and Engineering and Chemical Engineering with an upward trajectory for the future.

Our academic programs provide outstanding intellectual and professional development opportunities for all of our students. From our Aerospace Engineering program which is ranked in the top 25 nationally to our Solar Energy Engineering and Commercialization Professional Science Master's program — a graduate program geared toward understanding of the technical and nontechnical issues affecting the development and commercialization of solar energy — the depth and breadth of the School's programs provide a unique experience for our students and transdisciplinary opportunities for our faculty.

Since 2013, we have welcomed 16 new faculty members to the School. This year, I am pleased to introduce our newest faculty to you in this report. Our faculty enhance the School's national reputation through significant awards and honors.

Five of our new faculty members have earned highly competitive and prestigious grants. These early career honors are awarded to young faculty who are both innovative researchers and exceptional teachers committed to inspiring the next generation of engineers in the classroom and through outreach activities. You will read about awards to Assistant Professors Liping Wang, Jagannathan Rajagopalan, Panagiotis Artemiadis, Spring Berman and Yang Jiao in this report.

Assistant Professors Heather Emady and Owen Hildreth were recognized as outstanding academics and researchers with "the potential to transform ideas into great value for society" by the Science Foundation Arizona's Bisgrove Scholars program.

And we think beyond our labs and engineering solutions. Associate Professor Cody Friesen was one of 20 academics nationally to be chosen as an Aspen Institute Henry Crown Fellow. The program is designed to challenge prominent leaders in fields such as business, industry, law, public policy and governance, international relations and cultural affairs to expand their leadership skills beyond professional success to a focus on solving society's biggest problems.

These achievements prove our individual expertise, but our faculty go beyond their discipline to work with other experts — from engineering and other disciplines, here at ASU and at other institutions — to make exciting discoveries and innovations happen and fuel solutions to the nation's defense and transportation needs.

Our strong transdisciplinary environment and the quality of our programs are proving to be attractive characteristics for prospective students. We are seeing a continuous increase in our undergraduate and graduate programs — enrollment for Fall 2015 is at 3,980, an increase of 56 percent since 2012.

While the numbers of students go up, the quality of learning has continued to stay strong. More than 25 percent of our Chemical Engineering students and 35 percent of the Materials Science and Engineering students are enrolled in Barrett, the Honors College at ASU.

On an individual level, some of our students are recognized among the top in the nation. Chemical Engineering student Morgan Kelley is among the highest academic achievers throughout the country. Because of her scholarship, she was awarded a Goldwater Scholarship — considered the premier undergraduate scholarship for mathematics, science and engineering majors. Kaleigh Johnson, also in the Chemical Engineering program, was awarded a scholarship to participate in the 2015 Fulbright Summer Institute in the United Kingdom. Additionally, in 2015 nine of our recent alumni and current students received National Science Foundation (NSF) Graduate Research Fellowships and are pursuing doctoral degrees around the country.

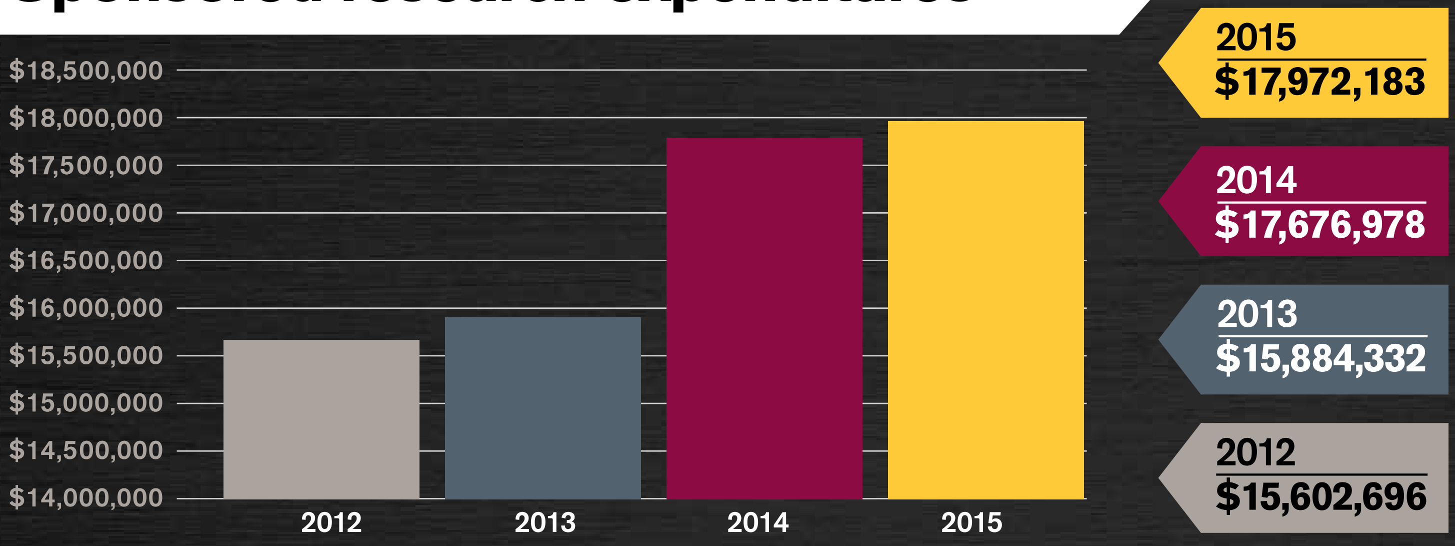
As we move forward, the School will continue to exemplify excellence and promote the visibility of students, staff, faculty and programs. We will strive for accelerated advancement of the degree programs and promote our innovations in curricula and unique student experiences important to producing next-generation engineers. And ultimately, we will look to capitalize on our core strengths of interdisciplinary and diverse research expertise to tackle large-scale problems and provide sophisticated, thorough and multidimensional solutions.

All of these achievements and future goals are thanks to the hardworking and high-achieving staff and faculty in addition to our dedicated alumni, volunteers and students.

Lenore Dai

Professor of Chemical Engineering
Director of the School for Engineering of Matter, Transport and Energy

Sponsored research expenditures



Kyle Squires

appointed dean of Fulton Schools after serving as interim dean

Kyle Squires, founding director of the School for Engineering of Matter, Transport and Energy, was appointed to the position of dean of the Ira A. Fulton Schools of Engineering in February 2016. This follows Squires' appointment as vice dean in June 2015 and interim dean on July 1, 2015.

"Kyle has distinguished himself as a leader, a researcher and a professor. He brings to this deanship the perfect combination of experience that our engineering programs need as they develop the inventors and problem-solvers of the future," said ASU President Michael M. Crow. "He has played a fundamental role in developing the educational excellence of our engineering program, and he understands where we need to take the Fulton Schools to provide the maximum benefit for the state and the nation."

Squires led SEMTE through a period of rapid faculty, enrollment and research growth, and has overseen degree and research programs in aerospace engineering, chemical engineering, materials science and engineering, mechanical engineering and the professional science master's program in solar energy engineering and commercialization. He also has served as interim co-director of ASU's Security and Defense Systems Initiative prior to its reconceptualization as the Global Security Initiative.

"Over the next five years, our goal is to achieve global leadership in engineering education," Squires said. "That means, people will not only admire and recognize what we do, they will adopt our methods and emulate our organization. Continued investment in the Fulton Schools of Engineering will pay dividends to ASU and the state in terms of use-inspired solutions and the preparation of a high-tech workforce."

Squires' expertise and interests encompass computational fluid dynamics, turbulence modeling, high-performance computing, and science, technology, engineering and math (STEM) education and research. His modeling studies have spurred new understanding of particle-laden turbulence through simulations and have been used to improve the aerodynamics of aircraft, ground vehicles and sports equipment, among other applications.

Squires received his doctoral degree in mechanical engineering from Stanford University and came to ASU in 1997 from the University of Vermont. He has served in a wide range of leadership positions in the Fulton Schools of Engineering, including most recently his school director position, and previously as the chair of the Department of Mechanical and Aerospace Engineering, and associate chair of the department's graduate program.

"Our faculty members continue to achieve impressive successes in research, from winning major centers to garnering numerous recognitions, especially among the cohort hired over the past few years," said Squires. "I hope to help accelerate the Fulton Schools' accomplishments and, as we advance, also cultivate new opportunities for our students, staff and faculty."

Faculty excellence

SCHOOL FOR ENGINEERING OF MATTER, TRANSPORT AND ENERGY

2014–2015 faculty awards

RON ADRIAN, Outstanding Achievement Award, University of Minnesota

PANOS ARTEMIADIS, DARPA Young Faculty Award [page 18]

SPRING BERMAN, DARPA Young Faculty Award [page 19]

PETER CROZIER, Fulton Exemplar Faculty [page 11]

LENORE DAI, Top 5% Teaching Award, Fulton Exemplar Faculty [page 12]

HEATHER EMADY, Bisgrove Scholar Award [page 20]

CODY FRIESEN, Aspen Institute Henry Crown Fellowship [page 21]

MARCUS HERRMANN, Fulton Exemplar Faculty [page 13]

OWEN HILDRETH, Bisgrove Scholar Award [page 20]

YANG JIAO, DARPA Young Faculty Award [page 15]

STEPHEN KRAUSE, Best Paper, Journal of Engineering Education [page 32]

NATHAN NEWMAN, Top 5% Teaching Award

JAGANNATHAN RAJAGOPALAN, National Science Foundation Faculty Early Career Development Award [page 17]

KAUSHAL REGE, Fulton Exemplar Faculty [page 14]; New Investigator Award, American Society for Photobiology [page 22]

MICHAEL SIERKS, named Fulton Entrepreneurial Professor

LIPING WANG, National Science Foundation Faculty Early Career Development Award [page 16]

Peter Crozier

Peter Crozier, associate professor, has **extensive experience** in developing and applying advanced transmission electron microscopy techniques to problems related to energy and the environment with special emphasis on oxides, catalytic materials and atmospheric aerosols. He **leads the Electron Microscopy for Energy and the Environment Group**, which aims to understand the structure and function of nanomaterials and nanostructures related to energy and the environment. He currently serves as **director and treasurer of the Microscopy Society of America.** He has **published more than 130 archival journal and book articles.**

The Fulton Exemplar Faculty program recognizes tenured and tenure-track faculty distinguished by the unique combination of having high research productivity, instructional load, student evaluations and doctoral student mentoring. Four faculty members in SEMTE were among the inaugural designees chosen in November 2014 — placing them among five percent of the Fulton Schools' faculty recognized for this achievement.

PETER CROZIER
Associate Professor

LENORE DAI
Professor

MARCUS HERRMANN
Associate Professor

KAUSHAL REGE
Associate Professor

Lenore Dai

Lenore Dai is a professor of chemical engineering and **the director of the School for Engineering of Matter, Transport and Energy.** Her research interests lie in surface, interfacial, and colloidal science, polymers and polymer composites, ionic liquids and environmentally responsive ("smart") materials.

Dai is currently a **principal investigator or co-principal investigator on five innovative and collaborative research projects** — ranging from developing next generation dispersants for oil-recovery/clean-ups to producing 3D tactile electronic screen displays for the visually impaired to developing ionic liquids for an instrument to gather seismic activity on faraway planets. She is a recipient of multiple research and teaching awards such as the **NSF CAREER Award, Whitacre Award for Excellence in Engineering Research, ASU Parents Association Special Recognition Award, and Lockheed Martin Engineering Teaching Award.**

Marcus Herrmann

Associate Professor Marcus Herrmann's progress in understanding flow dynamics in immiscible interfaces — such as unmixable gases and liquids — earned him an **NSF CAREER Award in 2011.** He has since led a team of graduate students in developing better computational tools and methods for simulating the flows of immiscible gases and liquids under various environmental and operational conditions — playing a **pivotal role** in areas such as fuel efficiency and energy performance. In 2011, Herrmann was the recipient of the **Fulton Schools of Engineering Teaching Award.** This year he also became the **editor of the Atomization and Sprays journal.**

Kaushal Rege

Kaushal Rege, associate professor of chemical engineering, is **advancing research in nanomaterials** that can be used to seal and repair body tissues that are either incised during surgical operations or ruptured during trauma. This research, which could have major implications for repair and regeneration of ruptured intestines, colorectal tissue, skin and eye injuries and possibly even the removal of cancer cells, has been **recognized by the American Society for Photobiology (ASP),** which gave Rege its **New Investigator Award in 2014.** Rege's research also includes novel materials and approaches for drug and gene delivery, cancer cell dormancy and radiation dosimetry. His work has attracted **funding from the National Science Foundation, the National Institutes of Health, the Defense Threat Reduction Agency, Arizona Biomedical Research Commission and the Mayo Clinic Center for Regenerative Medicine.** Many of his graduate students have gone on to academic and industrial positions and have won awards at national conferences.

Early career awards tap into the promise of innovation and teaching

Recent achievements of junior faculty members signal a promising trajectory for what's ahead in SEMTE.

Five faculty members have earned highly-competitive and prestigious grants awarded to young faculty that are both innovative researchers and exceptional teachers committed to inspiring the next generation of engineers in the classroom and through outreach activities.

These early career honors include National Science Foundation (NSF) Early Faculty Development (CAREER) Program Awards, Defense Advanced Research Projects Agency (DARPA) Young Faculty Awards and Air Force Office of Scientific Research Young Investigator Research Program (AFOSR YIP) Awards.

Assistant Professors Liping Wang and Jagannathan Rajagopalan earned CAREER Awards which, according to NSF, support "junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations."

Wang will use the award to address the urgent need for high-efficiency renewable energy sources and energy-saving materials — specifically controlling thermal radiation with novel man-made nanostructures. He will also develop an educational and outreach program, including but not limited to graduate and undergraduate student mentoring, invited seminars, international student/scholar exchange and K-12 education to take every opportunity to train next-generation engineers and researchers in STEM.

Rajagopalan's award will support fundamental research that lays the foundation to employ nanocrystalline metals and alloys as smart, functional materials that have applications in aerospace, medicine and robotics. His research will integrate materials science education and outreach through a new mentoring program, scientific demonstrations for high school students, teacher workshops, course enhancements and training of undergraduate and graduate students in multidisciplinary materials research.

The DARPA Awards went to Assistant Professors Spring Berman for "Specification and Control of Customizable Multi-Robot Systems for Distributed Sensing and Cooperative Manipulation," Yang Jiao for "Integrated Computational Scheme for the Characterization Modeling and Predicting of Microstructure Evolution and Fatigue Response in Titanium Alloys," and Panagiotis Artemiadis for "Optimizing human supervision of multi-agent systems."

Artemiadis also earned an AFOSR YIP award, which supports scientists and engineers who "show exceptional ability and promise for conducting basic research … and enhance early career development of outstanding young investigators." He received the award for his research project "Perception and Action Interfaces in the Symbiosis of Humans and Multi-Agent Systems."

Early career awards can include an outreach component. Students in our School help inspire the next generation of engineers by leading hands-on activities at outreach events.

High-efficiency and renewable energy:

Meeting the need for energy sources and energy saving materials

Today we face an urgent need for high-efficiency renewable energy sources and energy saving materials, brought on by our rapid consumption of conventional energy reserves and ever-changing environmental conditions. Liping Wang and his Nano-Engineered Thermal Radiation Lab are working to meet those needs by enhancing solar energy harvesting and saving energy consumption by designing novel nanoengineered materials that selectively control thermal radiation.

His research, recently granted a prestigious National Science Foundation Faculty Early Career Development Program (CAREER) award, aims to develop nanoengineered materials that are nearly 100 percent efficient in their absorption of the right spectrum of sunlight but emit very little heat. The more thermal loss, the more energy is lost as well. Thermal loss happens at the longer wavelengths so the goal is to achieve "spectral selectivity" with nanoengineered materials.

The CAREER award is being used to engineer new materials with micro/nanoscale feature sizes comparable to or smaller than the wavelength of light. Wang's lab is employing physics to improve the conversion efficiency of solar thermal, solar photovoltaic and solar thermophotovoltaic energy-harvesting applications.

Wang said what makes his lab distinct is that they can take their concepts all the way through the engineering process — they design and fabricate the materials as well as develop the state-of-the-art instrumentation to characterize material properties and thus optimize performance.

Wang's CAREER program will ultimately lead to a wide range of civil, military, aerospace and industrial applications as well as "smart" coatings, which could be used to convert solar energy to heat and power, as well as saving energy by radiative cooling or heating.

Smart coatings, Wang explained, could be laminated on building roofs or embedded in exterior material and would ideally radiate heat to cool in the summer or absorb more to heat the building in winter.

By controlling the optical properties of these coatings with tunable materials, the technology would be used to power spacecraft and satellites, or even create clothing that would help heat or cool a person in different environments.

LIPING WANG has his sights set on developing nanoengineered materials that will approach 100 percent efficiency of solar energy-harvesting applications. These new materials would have a wide-range of applications — possibly even powering spacecraft and satellites.

JAGANNATHAN RAJAGOPALAN, right, works with graduate students Rohit Sarkar, left, and Ehsan Izadi to improve a material's ability to remember and return to its original shape after exposure to heat or deformations.

Shaping the future of metal

A National Science Foundation (NSF) CAREER Award was recently given to Assistant Professor Jagannathan Rajagopalan to support his pioneering work in understanding and improving "shape memory" materials. Shape memory is a material's ability to "remember" and return to its original shape after being deformed by heat or another external stimulus.

Advances in the development of such materials would benefit aerospace, robotic and medical technologies, among many other applications.

Rajagopalan's CAREER award will provide close to $520,000 over five years to support his research, which seeks to both understand the physics and mechanics of shape memory materials, as well as engineer the microstructures of materials to fully enhance their shape-memory capabilities.

With the help of cutting edge tools, such as electron microscopes at ASU's LeRoy Eyring Center for Solid State Science and labs designed for the fabrication of advanced micro-electro-mechanical systems (MEMS), Rajagopalan hopes to realize his project's most ambitious goal: finding ways to make a material's shape-memory capability permanent.

"The idea is to take things a step further — to know how to alter the microstructure so that metals can regain their shape not only once or a few times but over and over again," Rajagopalan said.

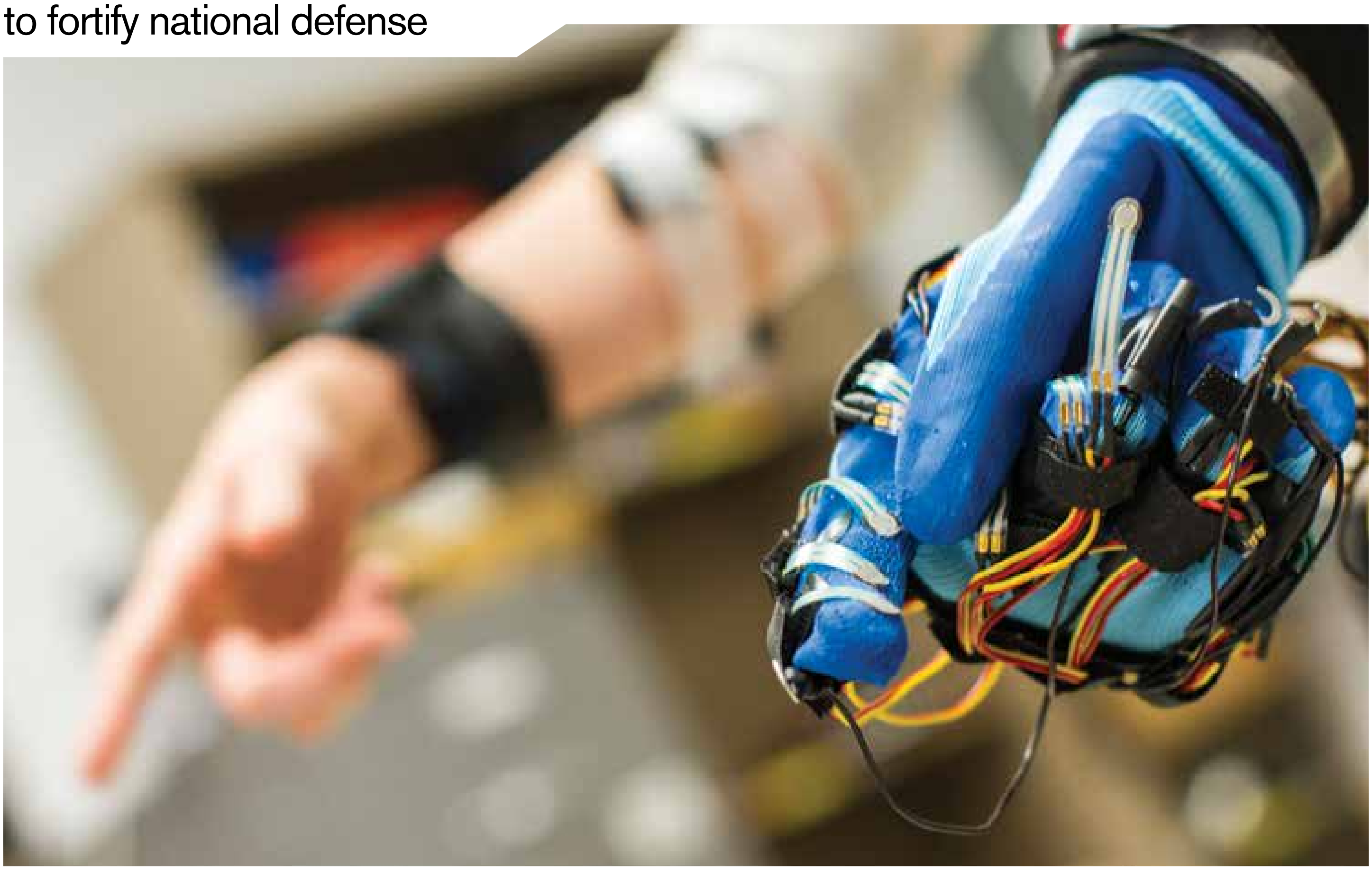
The NSF award also will enable Rajagopalan to do educational outreach. He will organize a program to give high school students opportunities to learn about research by visiting ASU labs, talking to faculty and performing basic experimentation.

In addition, he will provide workshops to help high school teachers incorporate lessons about the research into their class instruction, and offer training in materials research for university undergraduate and graduate students

ASU's state-of-the-art tools like the high-powered electron microscopes in the LeRoy Eyring Center for Solid State Science and fabrication labs make Rajagopalan's work possible.

Robot swarms and resilient materials

to fortify national defense



Three Arizona State University engineers are undertaking research to make technological advances that would strengthen the capabilities of the nation's military forces.

Panagiotis Artemiadis, Spring Berman and Yang Jiao were among the 33 researchers from across the nation who received Young Faculty Awards from the Defense Advanced Research Projects Agency (DARPA) to support their separate projects.

Brain-machine connections

Artemiadis' work centers around human-machine interface systems, which enable someone to control swarms of unmanned aerial vehicles (UAVs) solely through brain activity. Such systems would not only establish brain-machine communication that controls a swarm of UAVs, but also would allow them to receive information from the vehicles in return.

PANAGIOTIS ARTEMIADIAS (left) will work on human-machine interface systems enabling individuals to control multiple unmanned aerial vehicles (UAVs) solely through brain activity.

The systems Artemiadis will develop have the potential to control a range of different vehicles, from hundreds of small, two- to three-inch robots to foot-long quadcopters or even airplanes about half the size of a Boeing 707 jet airliner.

To achieve this, he will explore the capacities of the human brain to perceive, collect and process information from artificially intelligent technology with the use of electrodes placed on the head.

The technology would allow many military operations to be performed remotely and safely without endangering the lives of personnel.

Controlling robot swarms

Taking inspiration from nature, Berman is developing a system that would enable robotic swarms to perform reliably in unknown environments or without global positioning systems signals and radio communication.

SPRING BERMAN, right, is developing a system that allows swarms of robotic machines to perform reliably in unknown environments and with limited or unreliable communications.

"You see ant colonies and bee colonies, schools of fish and flocks of birds that have hundreds or even thousands of individuals that all act autonomously, but still work toward a collective goal," Berman explained. "My project is about getting robotic swarms to act like that. In a way, we are engineering robotic ants."

That will require making small robots that can interact with each other and with their environment, with the ability to collaborate to perform tasks. Berman hopes to design a swarm-control framework that allows users to give directions to robotic swarms using normal language. The framework would also be able to generate programs that dictate the type and number of robots needed to effectively perform specific tasks in a particular environment.

Such technology could undertake security surveillance, search and rescue activities, and detection of chemical, biological and nuclear materials.

Swarms also could monitor weather and climate conditions, transport materials, and collect and transmit data from underwater environs or from planets and asteroids.

Recipes for resilient materials

Jiao's research will focus on titanium alloys, composite metals widely used in aircraft and space vehicles. He'll work to gain deeper knowledge of the microstructures of the materials so that he can devise a "recipe" for processing and fabricating stronger alloys.

He will need to come up with a set of mathematical tools and computational formulas that enable exact quantifications of complex multi-level microstructural patterns. That quantification can yield more precise predictions about how various environmental conditions or varying degrees of applied force will affect the microstructure of the alloys.

Jiao also will look to reveal what conditions are required to produce specific microstructures with properties that will result in more resilient titanium alloys with more predictable performance. He wants to formulate a set of instructions for software programs that provide the mathematical recipes for such custom-tailored microstructures.

His methods will likely have the potential to be applied to improving a wide array of other composite materials for myriad uses beyond aerospace applications.

Jiao's project, and those led by Berman and Artemiadis, will give engineering graduate students opportunities to assist in the research.

Panagiotis Artemiadis, Spring Berman and Yang Jiao

have received Young Faculty Awards from the Defense Advanced Research Projects Agency (DARPA) to support their separate projects that are undertaking research to make technological advances to strengthen the capabilities of the nation's military forces.

Research promising industry impacts

draws science foundation’s support for ASU engineers

Science Foundation Arizona’s Bisgrove Scholars program is designed to help the state attract and keep outstanding academics and researchers with “the potential to transform ideas into great value for society.”

Assistant Professors Heather Emady and Owen Hildreth are now included among those promising leaders in their fields.

Emady and Hildreth received Bisgrove Awards to support their research — securing ASU three of the five Bisgrove Awards bestowed by the foundation this year.

“Arizona’s future is dependent on the ability to attract and retain the best minds in science and engineering,” said Bill Harris, Science Foundation Arizona’s president and CEO. “Bisgrove Scholars are synonymous with top-tier science and engineering research talent. This program and these select individuals have the ability to transform their fields of research into direct value not only for Arizona, but for all of society.”

The Bisgrove Award provides winners $100,000 per year for two years to support their research endeavors.

Pursuing innovations in particle technology

Emady, a chemical engineer, is doing research on granular materials to make more effective use of them in a variety of industries — including mining, agricultural chemicals, consumer products, pharmaceuticals and chemical catalysts.

More than half of the sales in the world involve products for which granular materials are used in processing or are contained in the products.

“Despite their extensive use and their economic and environmental impacts, few engineering and design principles exist for these particulates,” Emady said.

She is focusing on advancing knowledge of the fundamental nature and properties of particulate materials with the aim of developing methods to tailor their properties.

“If we can develop ways to control the properties of particulate materials, then we could actually predict these properties,” Emady explained. “That would lead to more efficient product and process design. Processing would require less money and energy, and less time and material would be wasted doing a lot of experiments.”

She is concentrating her efforts on particulate materials relevant to industries in Arizona.

HEATHER EMADY

Tools for printing electronic devices

Hildreth is developing new chemistries and techniques for microscale and nanoscale fabrication of complete microelectronic devices using simple inkjet-types printers — including microfluidic and microelectromechanical systems.

“Micro and nanoscale fabrication lacks these tools, and the facilities required to produce the devices cost millions or even billions of dollars. As a result, the number of companies participating in these areas is steadily shrinking as innovation becomes more expensive,” Hildreth said.

His research into nano-inkjet printing and reactive inks seeks to radically simplify fabrication of functional devices to enable small businesses to develop their own products at significantly less cost than those that must now be made by laboratory cleanroom-based techniques.

OWEN HILDRETH

The reactive inks will enable an inkjet-style printer to print the layers of plastic, copper, silver, glass and other materials that make up the parts of electronic devices.

His Bisgrove Award is supporting his work to develop and improve reactive inks for printing copper, glass and nickel for applications in electronics manufacturing, photovoltaic technology and medical sensors.

Entrepreneurial DNA

Friesen to join high-powered leaders in prestigious Aspen Institute fellowship

Only 20 of several hundred nominees are chosen each year to be Aspen Institute Henry Crown Fellows. They participate in a program designed to challenge prominent leaders in fields such as business, industry, law, public policy and governance, international relations and cultural affairs to expand their leadership skills beyond professional success to a focus on solving society's biggest problems. This year, Associate Professor Cody Friesen joins the few named as Crown Fellows.

As an academic and a researcher, Friesen doesn't fit the typical profile. "But they want some people who are a different from the rest of the group, so that may be why I've been selected," he said.

He does fit in, however, by virtue of his entrepreneurial drive — the key trait the Aspen Institute considers in selecting new Crown Fellows. Entrepreneurship "is in my DNA," Friesen said.

His research has produced technological innovations that are the foundation of two growing business startups.

Fluidic Energy is based on advances in battery technology. Friesen has developed the first rechargeable metal-air battery, one that significantly decreases the cost of storing energy.

This has led to the batteries being deployed in emerging markets at commercial sites where the power grid has very low reliability. Fluidic Energy's batteries have already covered more than half a million power-grid outages, many lasting for well over 10 hours.

The second startup, Zero Mass Water, uses technology his team has developed to produce potable water, using solar energy to power machinery that performs the process.

The system could potentially enable water supplies to be produced locally and affordably without the need to be connected to infrastructure systems, Friesen said.

Both ventures are attracting investors and partners, and Zero Mass Water is setting up pilot projects in Latin America, Africa and the Middle East, where water is scarce.

Friesen is looking forward to his experience as a Crown Fellow to give him an "immersion in leadership culture at a high level that will help me evolve into the kind of leader I will need to be to maximize the potential positive impact of the technologies we are developing," he said.

His fellowship team members "are fascinating people with very impressive accomplishments, and I am excited to get to work with them."

CODY FRIESEN will be immersed in a high-profile "leadership culture" over the next two years as an Aspen Institute Henry Crown Fellow. As a fellow, he will employ his expertise and talents to serve his community and work on solutions to society's most pressing problems.

Repairing body tissues

with photothermal nanomaterials

KAUSHAL REGE, right, melds nanotechnology, molecular engineering and photobiology in pursuit of medical advances. His research findings have major implications for repair of tissues and skin and eye injuries.

Chemical engineer Kaushal Rege was recognized by the American Society for Photobiology (ASP) as an emerging research leader in the field — particularly for the use of photobiology in pursuit of medical advances.

The organization gave Rege its New Investigator Award at the ASP annual national meeting.

Rege's research melds nanotechnology, molecular engineering and photobiology, or the study of the interactions of light — specifically non-ionizing radiation — and living organisms.

Rege has made notable progress with photothermal nanomaterials, using them with polymers and polypeptides to repair body tissues.

His research findings have major implications for repair and regeneration of ruptured intestines, colorectal tissue and the repair of skin and eye injuries.

He is using nanomaterials — gold nanorods — with optical properties that convert light into heat, which can be used to seal together body tissues to help repair the impacts of surgery. He has also used the photothermal properties of gold nanorods to trigger a process that is being shown to kill cancer cells.

Rege is co-editor of a book that is having an impact on efforts to advance nanobiotechnology research, and is editing a new book that is expected to be a significant reference for researchers using nanotechnology along with cellular and molecular engineering to improve cancer diagnosis and treatment.

His work has attracted funding from the National Science Foundation, the National Institutes of Health and the Mayo Clinic Center for Regenerative Medicine.

In recent years, his research findings have been featured in several leading science and engineering news publications, including Scientific American.

In addition to his achievements as a researcher, Rege has proven himself as an educator. In particular, graduate students he has supervised have won major research fellowships and awards for presentations of their research at science and engineering conferences, including the American Institute of Chemical Engineers annual national meeting. Additionally, a number of high school students Rege has mentored have won awards at the Arizona Science and Engineering Fair.

faculty expertise

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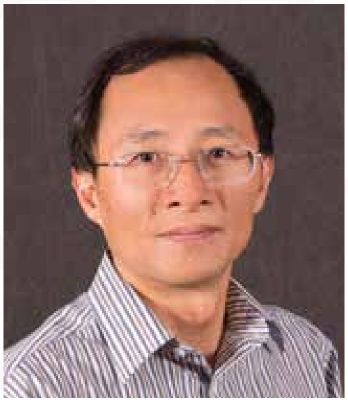
New faculty



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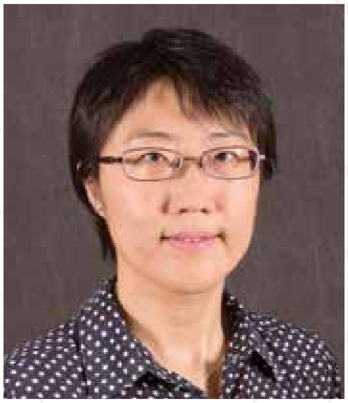

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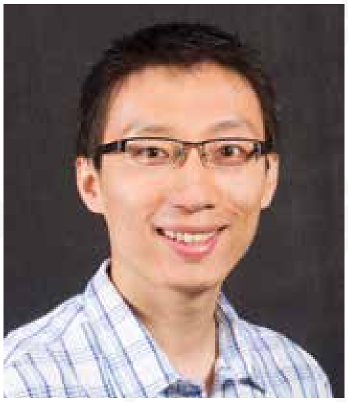

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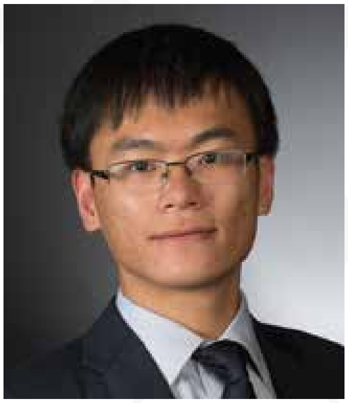

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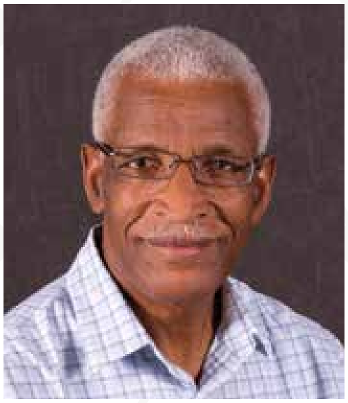

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Materials research center attracts funding from government, industry

What if the materials that make up components in the wings of an airplane could tell us when they are feeling material damage or deterioration?

The Adaptive Intelligent Materials and Systems (AIMS) Center is pushing the boundaries of structural health monitoring to make discoveries like this possible, including developing techniques and patents that can enable smart materials and systems to sense and communicate — and possibly even heal themselves.

Under the lead of Regents' Professor and Director Aditi Chattopadhyay the AIMS Center has raised $1,251,626 in recognition for awards since August 2014, and $10,809,484 in recognition for awards since the center was founded in 2006.

The nine awards received in 2014-2015 have come from supporters such as the National Science Foundation, the Department of Defense and NASA.

The ability to produce novel ideas and tech advances, directly impacting the nation's most critical defense and infrastructure problems, has been possible due to the diverse expertise of the center's members.

ADITI CHATTOPADHYAY, center, is a leading expert on composite materials, structural health monitoring, multidisciplinary design optimization and their application the aerospace and civil industries.

The AIMS industry consortium with members from nationally recognized companies such as Boeing, Honeywell and Alcoa has opened up new opportunities for collaboration and student support through industry-sponsored graduate scholarships and internships.

While the center continues to be a national leader in the area of intelligent materials and adaptive systems, recent awards also have enabled exciting new research thrusts.

New research on multifunctional materials with superior mechanical, self-sensing and self-healing capabilities, integrated with ab initio multiscale computations, will enable the development of paradigm shifting materials — directly impacting the nation's need for new structural design concepts and their life-cycle management.

Two new Defense University Research Instrumentation Program (DURIP) awards from the Department of Defense will further expand the center's capabilities in material testing.

A low-load, thermomechanical tensile test frame will enable a full suite of characterization tools for low modulus materials and result in new project proposals.

An ultra-high cycle thermo-mechanical fatigue system will give AIMS Center researchers the unique capability of material testing beyond the conventional fatigue regime — leading to an improved understanding of structural durability and material damage tolerance under extreme fatigue conditions.

All of this is expected to enhance an active collaboration with researchers at the Department of Defense, and other supporters, for years to come.

Designing crack-resistant metals

KARL SIERADZKI

Research led by Materials Science and Engineering Professor Karl Sieradzki is uncovering new knowledge about the causes of stress-corrosion cracking in alloys used in pipelines for transporting water, natural gas and fossil fuels — as well as for components used in nuclear power generating stations and the framework of aircraft.

His research team's findings were detailed in an advance online publication in the paper "Potential-dependent dynamic fracture of nanoporous gold" on the website of the journal Nature Materials.

Using advanced tools for ultra-high-speed photography and digital image correlation, the team has been able to closely observe the events triggering the origination of stress-corrosion fracture in a model silver-gold alloy and to track the speed at which cracking occurs.

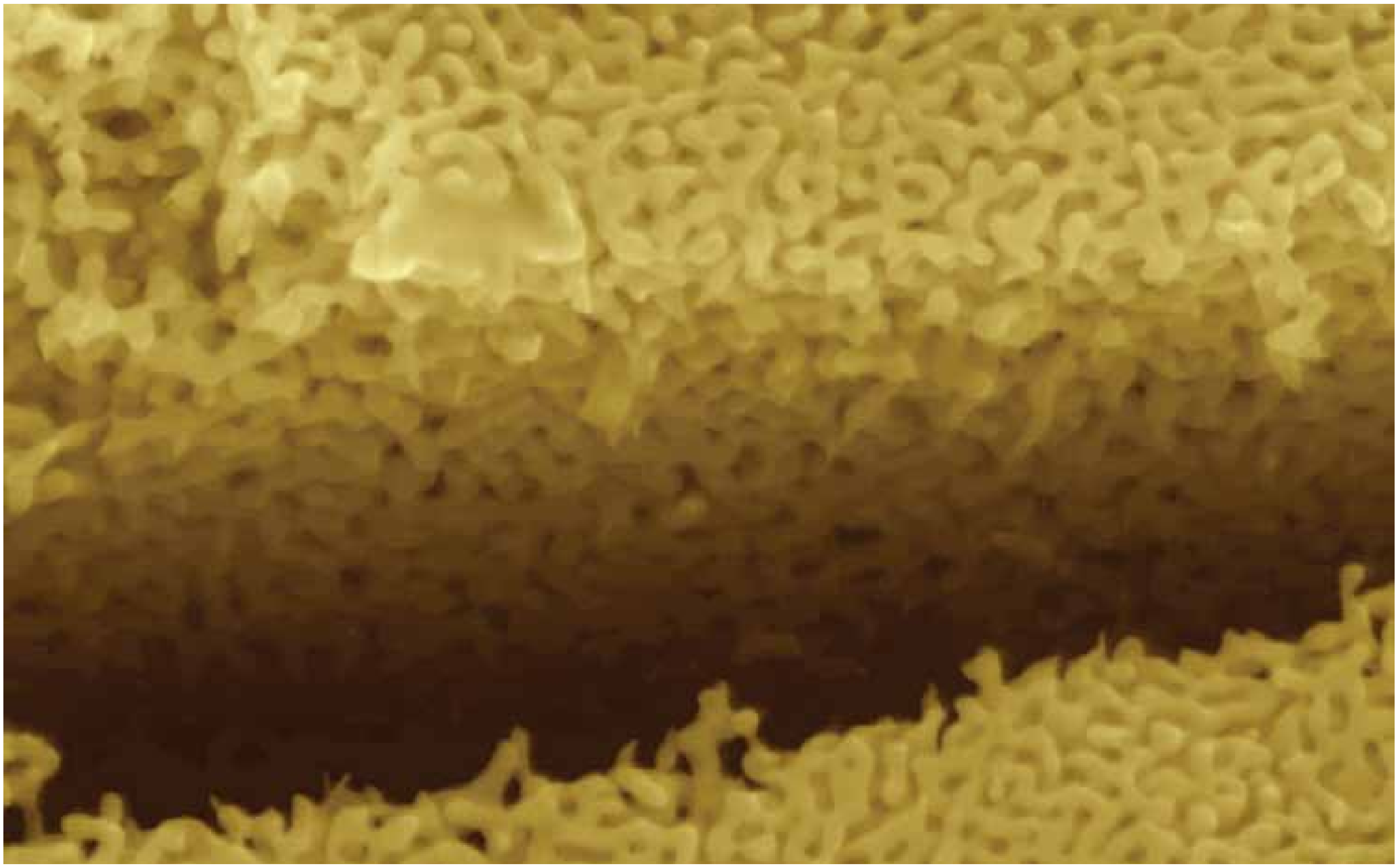
They discovered that in certain corrosive environments and with the presence of porosity and stress certain metals can fail as if they were made of glass.

These results provide a deeper understanding of the stress-corrosion behavior that threatens the mechanical integrity of important engineered components and structures.

The research has been funded by the Department of Energy's Basic Energy Science program.

His co-authors on the Nature Materials paper are former or current ASU materials science and engineering graduate students. Shaofeng Sun earned her doctoral degree in 2013. Xiying Chen is a third-year doctoral student. Nilesh Badwe earned a doctoral degree in early 2015.

In a corrosive environment, silver is selectively dissolved from the silver-gold alloy, shown below, causing porosity to form. If this occurs while the alloy is stressed, then the material fails as if it were made of glass. Using advanced tools for ultra-high-speed photography and digital image correlation, the team measured cracks moving at speeds of 200 meters per second corresponding to about half of the shear wave sound velocity in the material.



Putting waste to work cleaning water

Torres explores microbial fuel cell applications

What if the bacteria found in wastewater could power its own purification system?

Chemical Engineering Professor César Torres is exploring this possibility with several new grants in the area of anode respiration and wastewater treatment technologies.

His research involves using microbial fuel cells (MFCs) and is supported in large part by a $1,900,000 grant from the Department of Defense.

MFCs contain anode-respiring bacteria (ARB) that can produce electricity when electrons from wastewater organics are transferred to an anode.

"In this system organic compounds can be removed from water, while electrical power is simultaneously produced," said Torres.

The electrical power in MFCs produces hydrogen peroxide — a powerful oxidant that can then be reused to treat and disinfect wastewater.

"This oxidant is rarely used in wastewater treatment because of its high cost, but MFCs allow on-site hydrogen peroxide production using energy from wastewater," said Torres.

This reliable and energy efficient wastewater treatment option is of special interest to the U.S. Armed Forces in order to avoid the costs and risks normally associated with water transport in remote locations.

Two additional grants from the Department of Defense's Office of Naval Research further exploration in MFC research, including understanding the mechanisms that allow ARB to produce electrical currents and efforts to study the use of MFCs as power sources for sensors at the bottom of the ocean.

Torres is also leading an effort to better understand the role that ARBs can play in municipal wastewater sludge with a $333,000 grant from the National Science Foundation. This research has the potential to use MFCs as an analytical tool for measuring the rate at which ARB respire, important for improving the design and optimization of current technologies in the wastewater treatment field.

CÉSAR TORRES, left, is developing a reliable and energy-efficient wastewater treatment that can work in remote locations to improve municipal wastewater management. His work with microbial fuel cells could even power sensors at the bottom of the ocean.

Stretchable batteries developed by a team of Arizona State University engineers won top choice as an emerging technology with the greatest potential for innovation in the med tech field by readers of Qmed, a medical device industry news website.

Stretchable batteries

Fusing art and engineering

A research team led by Hanqing Jiang is using a variation of origami, the ancient art of Japanese paper folding called kirigami, to design a template for batteries that can stretch to more than 150 percent of their original size and maintain full functionality.

Previously, flexible batteries based on origami were able to flex, but not stretch. Jiang's team has developed a prototype to overcome this limitation. Sewn into an elastic band, the flexible battery was able to fully power a smart watch while being stretched inside the band.

This technology could lead to improvements in wearable technology, and even be integrated into fabrics.

In addition to Jiang, the research team is comprised of Hongyu Yu, an associate professor in the School of Electrical, Computer and Energy Engineering and the School of Earth and Space Exploration; Zeming Song, a materials science doctoral student; and Xu Wang, a mechanical engineering doctoral student. Other contributors include ASU engineering graduate students Cheng Lv, Yonghao An, Mengbing Liang, Teng Ma and David He, a Phoenix high school student, along with Ying-Jie Zheng and Shi-Qing Huang from the MOE Key Lab of Disaster Forecast and Control in Engineering at Jinan University, Guangzhou, China.

Safer flight: High-fidelity models reduce the unknowns

Professor Marc Mignolet's progress in structural dynamics research continues to attract significant support from national defense agencies and industry.

His focus is on formulating, developing and validating faster ways to analyze the behavior of structures when subjected to large loads and heating.

Mignolet's lab team has looked specifically at hypersonic aircraft and re-usable space flight vehicles, and the relationship between temperature-caused deformations of a structure and aerodynamics.

Each of these areas can be analyzed by separate high-fidelity but high-computational cost methods — computations that can last weeks even when using big computing clusters. Mignolet's methods are based on high-fidelity models that reduce the number of unknowns, translating to computational efficiency. Those savings can be used for more analyses and possibly even design.

Interest in what Mignolet's research can reveal has drawn grants from the U.S. Air Force through the Collaborative Center for Structural Sciences, the Multi-University Research Initiative, and the Air Force Office of Scientific Research's structural mechanics program.

Additional support has come from the Boeing aircraft company, Sandia National Laboratories and through an Air Force collaboration with ZONA Technologies Inc., an engineering and software developer for the aerospace industry.

MARC MIGNOLET

Grants from 2013 through 2015 adding up to $1 million have brought Mignolet's total research funding to more than $5 million for his career, with an additional $400,000 projected funding.

Giving engineering teachers
measure for success in classroom

An in-depth report on extensive studies to determine the most effective methods for classroom teaching of engineering won the award for best paper published last year in the Journal of Engineering Education for ASU Professors Stephen Krause and Michelene Chi, and two co-authors from other universities.

The American Society for Engineering Education (ASEE) gave its prestigious William Elgin Wickenden Award to the authors at its national conference and exposition in 2014.

Krause teaches materials science and engineering. Chi is director of ASU's Learning Science Institute and a professor in the Mary Lou Fulton Teachers College.

The other authors are Muhsin Menekse, research scientist at the Learning Research and Development Center at the University of Pittsburgh, and Glenda Stump, associate director for education research at the Teaching & Learning Laboratory at the Massachusetts Institute of Technology.

For more than three years, the team explored a variety of teaching techniques to attempt to measure the effectiveness of each method for enabling students to acquire "deep conceptual knowledge" about particular subjects, Krause explained.

The studies focused on the teaching and learning of materials science and engineering concepts. The methods the researchers studied ranged from students' interactive engagement with discussion and debate of the topical content to passive listening about similar topical content in lectures.

The differentiated types of student learning were classified as interactive, constructive, active and passive. The team then tested students on their level of comprehension and retention of knowledge corresponding to the use of each of the different teaching approaches. Their results assessed the success of the teaching approaches compared to one another.

STEPHEN KRAUSE

Student learning was most effective for the interactive approach and least effective for the passive approach. The results were explained in terms of Chi's hypothesized theory of underlying cognitive processes that occur with each type of learning to account for the effectiveness of the different instructional methods.

The winning research paper is entitled "Differentiated Overt Learning Activities for Effective Instruction in Engineering Classrooms" in the Journal of Engineering Education, July 2013, Vol. 102, No. 3, pp. 346-374.

In 2014 SEMTE had

181 ARTICLES

133 Journals

47 areas

Top 10 Journals	Articles published
Langmuir	6
Journal of Applied Physics	6
Annals of Behavioral Medicine	5
Journal of Membrane Science	4
Applied Physics Letters	4
Scientific Reports	3
Organic Electronics	3
Journal of Photonics for Energy	3
Journal of Electronic Materials	3
IEEE Electron Device Letters	3

Top 10 Research Areas	Articles published
Materials Science	61
Engineering	54
Physics	43
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Student awards

Barrett student chosen for 2015 Fulbright Summer Institute

Kaleigh Johnson, a chemical engineering major and student in Barrett, The Honors College, has never traveled abroad, until now. Her first overseas trip has come courtesy of a prestigious scholarship from the US-UK Fulbright Commission.

Johnson is one of five ASU students — all in Barrett, The Honors College — who have been awarded scholarships to participate in the 2015 Fulbright Summer Institute in the United Kingdom.

The US-UK Fulbright Commission is the only bi-lateral, transatlantic scholarship program offering awards and summer opportunities for study or research in any field at any accredited U.S. or UK university. The Commission is part of the Fulbright program established by U.S. Sen. J. William Fulbright in the aftermath of World War II to promote leadership, learning and empathy between nations through educational exchange.

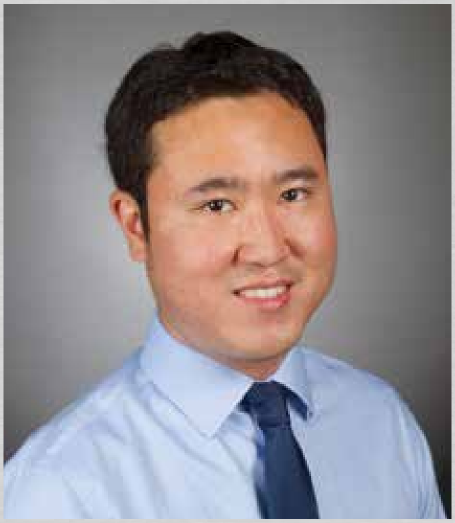
Each year, the Commission provides scholarships to around 60 undergraduate students in the U.S. and the UK for programs at leading institutes in the U.S. and UK. This year, the Commission is hosting nine Summer Institute programs at institutions throughout the UK.

Johnson will spend four weeks, June 27–July 25, at the University of Exeter, where she will participate in Fulbright Week exploring climate change issues and three weeks at the university's International Summer School.

"I was thrilled to find out I was selected to attend the University of Exeter. As it will be my first experience with global travel, I am excited to gain a broadened perspective and see what life is like as a university student in the UK," she said.

"I also hope to learn how universities in the UK are tackling important issues involving sustainability. I hope the knowledge I gain will make me a more well-founded engineer as I continue to research this important field through chemical engineering."

KALEIGH JOHNSON joined more than 150 international students from around the world at the 2015 Fulbright Summer Institute in the United Kingdom.



ANDREY GUNAWAN received support from The Electrochemical Society. His research explores the feasibility of converting automobile exhaust heat into electricity to help power vehicles.

Renewable energy research project earns graduate fellowship award

Andrey Gunawan was one of the few graduate students selected in 2014 to receive support for their research through the prestigious Summer Fellowship program of The Electrochemical Society (ECS), an international educational organization.

Gunawan, pursuing his doctoral degree in mechanical engineering, will use the $5,000 provided by the award to aid his work in making advances in renewable and alternative energy technologies.

He is exploring how to convert thermal energy — such as geothermal, solar thermal or waste heat from power plants, industrial processes and automobiles — into electricity, using a generator system based on the thermogalvanic (or thermoelectrochemical) effect.

Gunawan specifically wants to explore the feasibility of systems that would convert automobile exhaust heat into electricity to help power vehicles. Only one third of the energy generated by fuel is used to move a vehicle, much of which is lost in the form of exhaust. If Gunawan's systems are able to make use of that lost energy, they could potentially improve the fuel economy of cars with conventional internal combustion engines.

He is testing how the system performs in the desert environment of the Phoenix area throughout the different seasons of the year and plans to test its performance in the varied climates of major metropolitan areas across the United States.

His report on the research project will be published in the winter issue of the ECS quarterly journal, Interface.

Undergraduate research experiences lead to NSF graduate fellowships

Nine recent graduates are pursuing doctoral degrees with support from National Science Foundation (NSF) Graduate Research Fellowships awarded to them in 2015.

The NSF uses the highly sought-after fellowships to aid graduate students in engineering, science, mathematics and technology — areas considered crucial to advancing the nation's economic and security interests.

Students selected to receive the prestigious fellowship awards — providing more than $30,000 per year (plus tuition and fees allowances) for up to three years — have demonstrated skills and creativity necessary to develop into research, education and innovation leaders in their fields.

With his fellowship award, Joe Carpenter is striving to make advances in solar energy research as he pursues a doctoral degree in materials science and engineering.

He received his bachelor's degree in chemical engineering from ASU in 2014 and now wants to help create more effective solar cells. Carpenter plans to use silicon nanoparticles to replace unproductive materials in current cell architecture that are stacked atop those that capture sunlight for conversion into electricity.

"The current materials block reception of some of the sunlight. The silicon nanoparticles would not block as much," Carpenter explains. That would enable each cell to produce more electricity.

Other recent NSF Graduate Research Fellowship award winners who earned undergraduate degrees in SEMTE are undertaking graduate research across a range of engineering and science disciplines.

Katherine Cai earned her undergraduate degree in chemical engineering in 2013 and is now working toward a doctoral degree in mathematical sciences and statistics at ASU.

Eric Chang got his undergraduate degree in mechanical engineering at ASU in spring 2015 and is now in an engineering doctoral program at Stanford University.

Taylor Dolberg received a bachelor's degree in chemical engineering in 2014 and is pursuing a doctoral degree in the same field at Northwestern University.

Alison Gibson is in the aeronautics and astronautics doctoral program at the Massachusetts Institute of Technology after receiving a bachelor's degree at ASU in aerospace engineering with a concentration in astronautics.

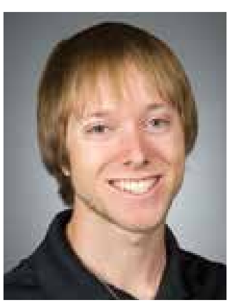
Maritza Mujica earned an undergraduate degree in chemical engineering in spring 2015 and is working for a doctoral degree in the same field at the Georgia Institute of Technology.

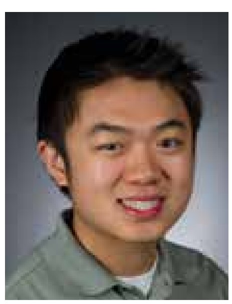
Jessica Nichols earned her undergraduate degree in 2013 in chemical engineering. She is studying in the chemical engineering doctoral program at the University of California, Berkeley.

Ellen Qin is in the doctoral program in biomedical engineering at the University of Illinois at Urbana-Champaign after getting her bachelor's degree in chemical engineering in 2014.

Noelle Rabiah got her undergraduate degree in chemical engineering in 2014. She is now in the chemical engineering doctoral program at Stanford University.


KATHERINE CAI


JOE CARPENTER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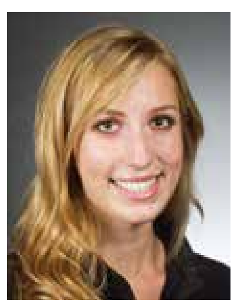
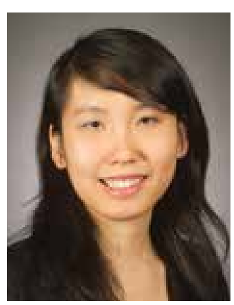
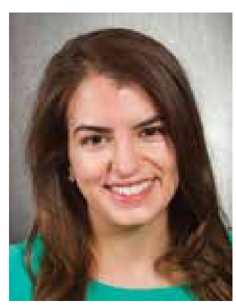

TAYLOR DOLBERG


ALISON GIBSON


MARITZA MUJICA


JESSICA NICHOLS


ELLEN QIN


NOELLE RABIAH

Love of research leads to Goldwater Scholarship

Morgan Kelley focuses her research on finding more effective ways to keep oceans and other water environments cleaner and healthier. Kelley has participated in many Fulton Difference programs including Fulton Undergraduate Research Initiative, a competitive research program, where she found her love of research.

Chemical engineering student Morgan Kelley is among the academic high-achievers throughout the country to be awarded a Goldwater Scholarship — considered the premier undergraduate scholarship for mathematics, science and engineering majors.

From more than 1,200 nominees she is one of 260 students — and one of 68 engineering majors — selected to receive the award that provides up to $7,500 per year to support completion of undergraduate studies.

The Goldwater Scholarship Program, honoring the late U.S. Sen. Barry Goldwater of Arizona, is intended to encourage outstanding students to pursue graduate studies and careers in engineering, science and mathematics fields.

A native of Glendale, Arizona, Kelley graduated from Xavier College Preparatory high school in Phoenix three years ago and was accepted into ASU's Barrett, The Honors College, enrolling in the chemical engineering program.

"But when I came here, I didn't want to go to graduate school," she recalled. "I just wanted to get through school and get a job right away. But then I fell in love with research."

The opportunity to work in the lab with graduate students and be mentored by professors about how to do research has broadened her perspective on what she might be capable of achieving.

Now in her senior year, she is set on earning a doctoral degree, and getting a Goldwater Scholarship should help open doors to that pursuit.

Currently, she is delving deep into research aimed at engineering more effective ways to keep oceans and other water environments cleaner and healthier through the Fulton Undergraduate Research Initiative (FURI). Her FURI research project was the basis for the research proposal that helped Kelley win the Goldwater Scholarship.

In addition to her research work, Kelley has led or co-led student projects in Fulton Schools' Engineering Projects in Community Service (EPICS) program to develop and deliver portable technologies that provide lighting to students in Fiji and Uganda, where electrical power is unreliable. She is also is serving as a teaching assistant to help fellow students develop their EPICS projects.

She has won awards in student science and engineering competitions, including a semi-finalist award in the national Dell Social Innovation Challenge, and completed an internship with the Henkel Corporation in 2014.

She has been serving as a Fulton Ambassador, giving campus tours to prospective engineering students and visiting local high schools to tell young students about college engineering studies and careers, and as a counselor at E2, the Fulton Schools of Engineering freshman experience.

Winning a Goldwater Scholarship "is recognition of Morgan's exemplary accomplishments in the classroom, in the lab and in community service," said Fulton Schools of Engineering Dean Kyle Squires. "It's really gratifying to see students like Morgan capitalize on all the opportunities we are working to provide our students to help them grow as scholars, researchers and leaders in the community."

Kelley plans to graduate with her bachelor's degree in the spring 2016 semester, and begin graduate school soon after.

Military background laid foundation for student success

R. J. Mitchell became a U.S. Marine two weeks before his 21st birthday, continuing his family's long tradition of military service.

Throughout the course of his four-year enlistment, he was deployed to Iraq twice. During one of those tours, he was in the Second Battle of Fallujah — experiencing some of the heaviest urban combat U.S. Marines have been involved in since the war in Vietnam. For his heroic actions during the battle, he was awarded the Navy Cross, the second-highest military decoration for valor that may be awarded to U.S. Marines.

While he expected to be a career military man, he instead left the service and put the G.I. Bill to work at the Motorcycle Mechanics Institute in Arizona. Though a mentor urged him to pursue a law degree, he found his passion in figuring out how things worked mechanically. Mitchell soon enrolled at Ira A. Fulton Schools of Engineering, where he is studying to be a mechanical engineer.

When he's not in class, he's employed by Arizona Power Service, the state's largest utility company, which he describes as the perfect place for a mechanical engineer to work and explore.

Though he left the service, he hasn't lost touch with his military roots. His experience as a Marine helped him transition into a successful student with the discipline and structure of school mirroring that of military life. Mitchell also spent time employed at the Pat Tillman Veteran's Center, which helped him connect with other student veterans and create a sense of community. He's interested in putting his education to work designing prosthetics that could make the lives of disabled veterans easier.

He is forging a new path, embracing the challenges of being in what sometimes feels like a foreign environment — the classroom — while relishing the new knowledge his professors are teaching him.

He knows that engineering is "hard," but said there is one thing the Marines taught him, it is this: "There is a reward for hard work."

R. J. MITCHELL

Student organizations

With more than 60 student organizations connecting hundreds of Fulton Schools students, there is no shortage of action and achievements. Student organizations facilitate leadership, outreach, career growth and networking opportunities, all while bettering our university, local and global communities. And did we mention they ensure a lot of fun, too?

Fulton Schools student organizations include honors and professional societies, diversity organizations, service and major-specific groups and competitive teams that provide ample opportunities for each student to find a group that suits his or her needs — whether it is gaining hands-on experience with a team of aerospace engineers or building a network of friends and study partners.

The **Air Devils student team,** which builds airplanes to perform in competitive flight missions, placed in the top 25 of 100 teams at the American Institute of Aeronautics and Astronautics (AIAA) Design, Build, Fly (DBF) Competition, hosted by Textron Aviation and Raytheon Missile Systems and held in Tucson. Air Devils successfully completed all three flight missions and had one of the fastest airplanes at the competition — with a top speed of more than 60 mph.

Team leaders included then Air Devils president Eric Chang, a mechanical engineering recent graduate, and design leads Don Wood, Tyler Knight and Jeffrey Kirkham, all recent graduates in aerospace engineering.

At the **ASM International Geodesic Dome Design Competition** — known as the Domesday competition — two teams of ASU material science and engineering students earned awards. Students had to design and construct a geodesic dome with an open lattice structure that contained at least one hexagon.

The ASU Iron Lotus team, composed of juniors Michael Moorehead and Nathan Rodkey, placed third overall, winning a $500 prize. The ASU Golden Dome team placed fourth in the maximum load category, based on how much weight dome structures could bear before yielding. This team, composed of freshmen Hassan Al Mousa, Jacob Kintz, Ayan Rafique, Chris Nelson and Alex Crawley, was the youngest group of Domesday competitors.

After two years of designing and planning, **Engineering Smiles, an ASU Engineering Projects in Community Service (EPCIS) team,** is preparing to send a mobile dental clinic to Nicaragua with the help of a recently launched crowdfunding campaign. The campaign is the largest ever student-led fundraiser in the Ira A. Fulton Schools of Engineering.

The team of engineering students designed the mobile dental clinic in partnership with IMAHelps, a non-profit medical and dental outreach organization. The funding will go toward purchasing a mobile trailer and building the clinic with hopes of sending it on a medical mission in July 2016.

Engineering Smiles team members are Ilianna Chavez, engineering management; Gian Gonzalez, construction management; Nick Kemme and Sara Mantlik, both mechanical engineering; Fionnuala McPeake, biomedical engineering; and Leslie Thompson, chemical engineering.

ASU AIR DEVILS TEAM successfully completed all three flight missions — and had one of the fastest airplanes — at the AIAA Design, Build, Fly Competition in Tucson, Arizona.

Student satellite group keeping busy

with competitions, projects

STUDENTS IN THE SUN DEVIL SATELLITE LABORATORY take a break from building a satellite the size of a soda can to help inspire the next generation of engineers at DiscoverE Day, a free field trip day for third through eighth grade students. In addition to competing in CanSat, SDSL is also submitting a project proposal for Mars One University Challenge for an unmanned mission to Mars in 2018.

The Sun Devil Satellite Laboratory (SDSL) has stayed active in the past year. The ASU student group competed in an international astronautics competition and began preparing a proposal for a contest to contribute to a Mars exploration mission.

An SDSL team traveled to Texas for the CanSat Competition, where they competed with teams from all around the world to design an atmospheric re-entry container that could provide a safe landing for an important payload — in this case, an egg.

Organized by the American Astronautical Society and the American Institute of Aeronautics and Astronautics, the CanSat Competition involved designing, building and launching an atmospheric re-entry container.

The container — roughly the size of a standard soda can, hence the title CanSat for can satellite — was placed inside a rocket and launched upward of 1,000 meters before releasing and beginning a simulated re-entry through the atmosphere.

A parachute would slow the container's descent to only 12 meters per second until it began a free-fall at 500 meters. Students had to design another means of aero-breaking to provide their egg with a safe landing.

The CanSat also had to relay telemetry to a ground station the team had put together. Altitude, temperature, pressure and descent rate were relayed autonomously.

The CanSat team was comprised of SDSL vice president and aerospace engineering student Bryan Sonnenveldt; aerospace engineering students Heather Zunino, Sarah Smallwood and Ryan Teves; electrical engineering students Raymond Barakat, Zach Burnham and Miao Tang; mechanical engineering student Jana Devries; and astrophysics student William Merino.

SDSL is also submitting a project proposal for the Mars One University Challenge. Mars One is a not-for-profit organization that is attempting to mount resources for an unmanned mission to Mars in 2018.

Teams of university students are competing to have their ideas for scientific experiments and technology demonstrations on Mars become part of the mission.

In addition, the group also has several ongoing projects. They include construction of a vacuum chamber and a plasma pulse thruster that will be tested inside the chamber, and a CubeSat project in collaboration with ASU's School of Earth and Space Exploration to produce a small satellite capable of being launched into space.

SDSL has about 15 active members — including students majoring in aerospace, mechanical, electrical and computer systems engineering, and astrophysics — and is seeking additional members.

Outstanding staff

We would like to recognize our team of staff members in the School for Engineering of Matter, Transport and Energy.

From answering the phones to advising students and making sure all our research progress reports get done on time, they are the invisible strength behind our endeavors.

Thank you.

✸ indicates IMPACT Award recipient
✸ indicates IMPACT Award nominee
✸ indicates Sun Award recipient

Scott **Ageno**
Research Specialist

Shahriar **Anwar** ✸
Research Specialist Sr.

Susan **Baldi** ✸
Business Ops Specialist Sr.

John **Billings** ✸
Academic Success Specialist

Andrea **Brown** ✸
Academic Success Specialist

Leonard **Bucholz**
Shop Manager

Victoria **Burcham** ✸
Academic Success Specialist

Marilyn **Burckardt** ✸
Research Advancement Administrator

Jessica **Caruthers** ✸
Academic Success Coordinator

Karen **Dada**
Program Manager

Devon **Dale**
Program Coordinator

Thomas **Dobrick** ✸ ✸
Department HR Specialist Sr.

Kelley **Hall** ✸ ✸
Research Advancement Admin. Sr.

Richard **Hanley**
Engineer Assoc.

Lindsay **Harkins** ✸
Academic Success Specialist

Donley **Hurd** ✸ ✸
Support Systems Analyst Principal

Dallas **Kingsbury**
Laboratory Manager

Lauren **Kocher**
Academic Success Specialist

Mia **Kroeger** ✸
Assistant Director Academic Services

Leonardo **Leon**
Management Intern

Gayla **Livengood**
Department HR Specialist

Danielle **Lussier** ✸
Research Advancement Administrator

April **MacCleary** ✸ ✸
Research Advancement Manager

Andre **Magdelano**
Machinist Sr.

Myrna **Martinez** ✸
Academic Facilities Specialist

Durella **O'Donnell**
Administrative Assistant

Mariah **Pacey**
Business Operations Manager Sr.

Fred **Pena** ✸ ✸
Laboratory Manager

Shannon **Pete**
Business Operations Specialist

Elena **Pollard**
Program Coordinator

Christine **Quintero** ✸
Academic Success Specialist

Cara **Rickard**
Assistant to Director

Philip **Schulz**
Research Technician

Wesley **Scruggs**
Business Operations Specialist

Lexi **Shulla** ✸
Academic Success Specialist

Melissa **Sotomayor**
Business Operations Specialist

Bruce **Steele**
Laboratory Manager

Nancy **Terkelsen** ✸ ✸
Student Services Coordinator Assoc.

Albert **Thompson** ✸
Tech Support Analyst Senior

Elizabeth **Tripodi** ✸
Academic Success Specialist

Dave **Vega**
Academic Success Specialist

Tiffany **Wingerson** ✸
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