2021 - 2022 ANNUAL REVIEW

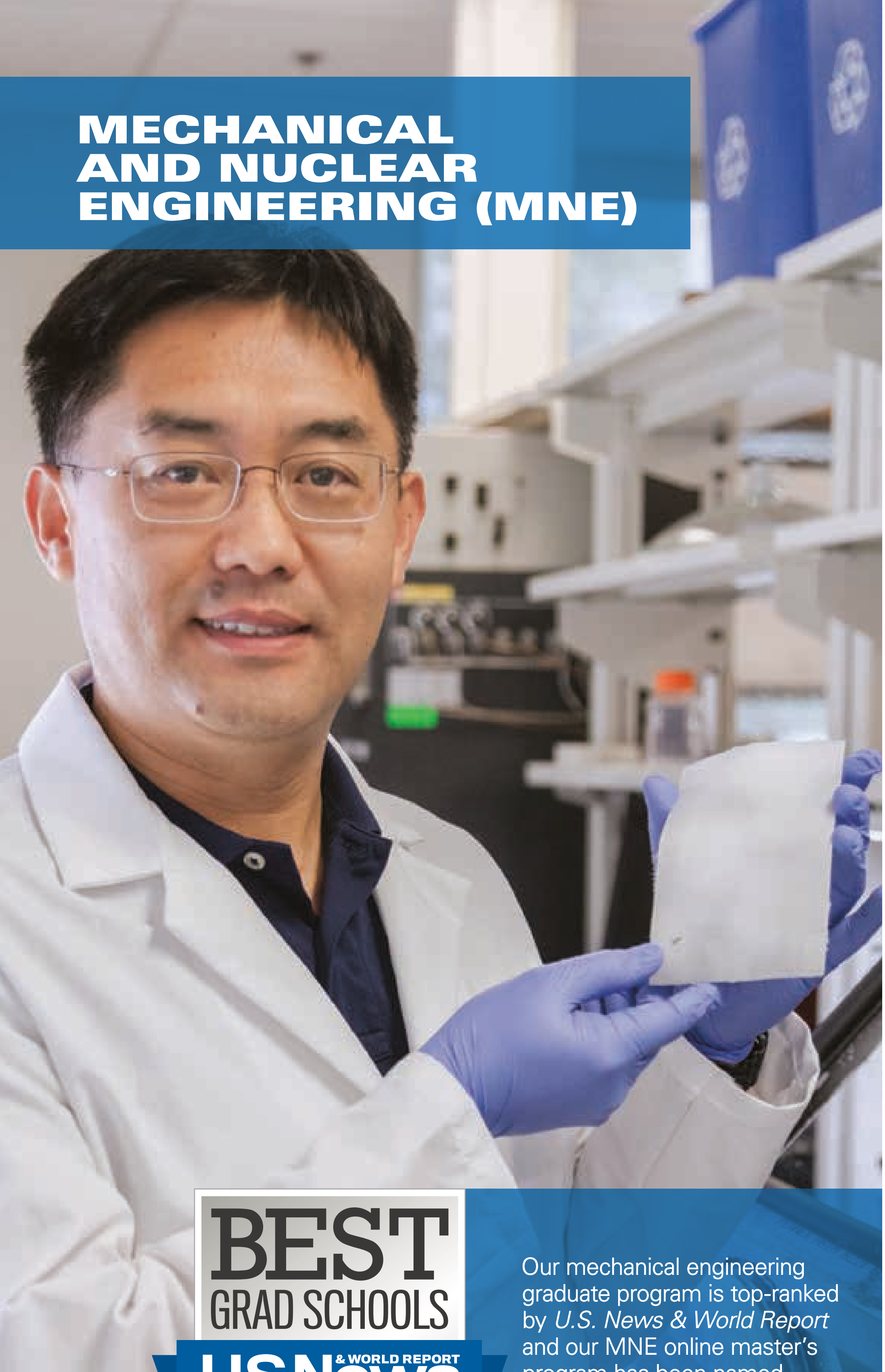
VCU Engineering

UNCOMMON ENGINEERING

MECHANICAL AND NUCLEAR ENGINEERING

VCU College of Engineering

MECHANICAL AND NUCLEAR ENGINEERING (MNE)



Our mechanical engineering graduate program is top-ranked by *U.S. News & World Report* and our MNE online master's program has been named one of the best values for online education in the nation according to Best Value Schools.

Building a better face mask

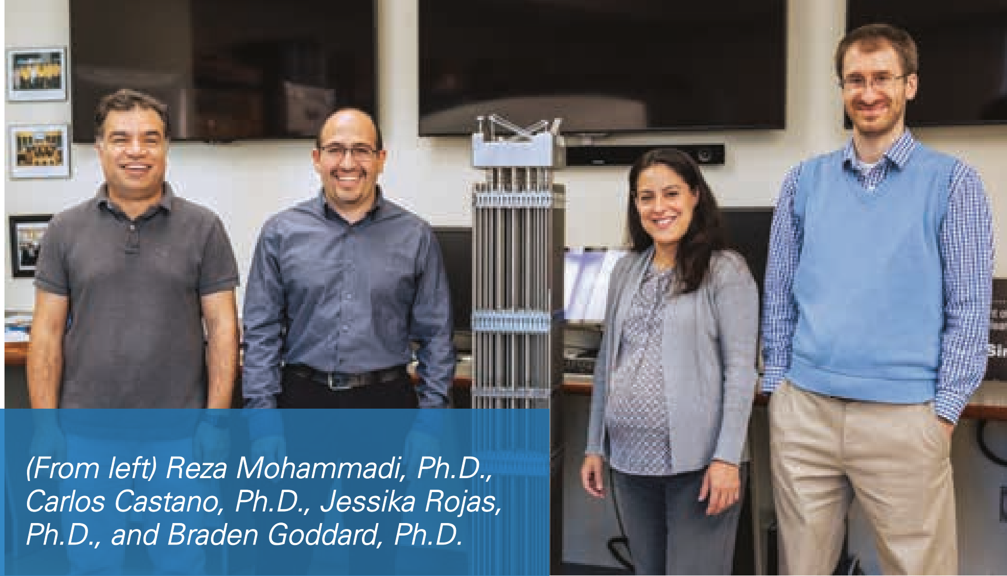
Highly contagious new COVID-19 strains call for better masks. MNE associate professor **Wei-Ning Wang, Ph.D.**, is working to meet this need with a mask design that uses chemical reactions and electrical charges to kill microbes.

> ***The middle layer catches virus particles with the same efficiency as N95 masks. Most particles will never make it past the outer layer, where the virus killing occurs …***

The mask's innermost layer also absorbs water vapor. "Human exhalation is saturated with water vapor, so it has 100% relative humidity," Wang said. "This means that these vapors will condense inside the face mask, causing discomfort." A mask that effectively absorbs those vapors will keep the wearer cooler and dryer — no more foggy eyeglasses.

The middle layer catches virus particles with the same efficiency as N95 masks. Most particles will never make it past the outer layer, where the virus killing occurs, because it is made of electrospun nanofibers embedded with nanocrystals containing an antibacterial and antiviral ammonia compound often found in detergents.

In other words, the researchers are developing a material designed to poison and electrocute the COVID-19 particle. The chemicals and other components of this material are nontoxic, low cost and reusable.



(From left) Reza Mohammadi, Ph.D., Carlos Castano, Ph.D., Jessika Rojas, Ph.D., and Braden Goddard, Ph.D.

VCU Engineering team investigates advanced materials for reactor safety

The Nuclear Regulatory Commission has funded a research team led by **Jessika Rojas, Ph.D.**, MNE associate professor, to investigate the behavior of nuclear materials with the aim of improving safety and performance for the U.S. nuclear power fleet. The team will analyze the behavior of candidate materials being considered for fabrication of nuclear fuel claddings.

Under investigation are iron-chromium-aluminum (FeCrAl) and a chromium-coated zirconium alloy (zircaloy), "smart materials" engineered for enhanced oxidation resistance at high temperatures and better material performance over a wide range of reactor conditions.

Laboratory experiments and computer simulations will enable the team to study the oxidation, degradation, and mechanical behavior of accident-tolerant fuels cladding candidates subjected to rapid high-temperature excursions and dry storage conditions.

Advanced materials for NASA missions in space

Ibrahim Guven, Ph.D., MNE associate professor, is part of a team working with NASA to develop an advanced structural material for a crewed mission to Mars.

Spacecraft transporting humans to deep space must withstand extreme changes in temperature and air density while also resisting potentially devastating impacts when hitting even tiny particles.

Guven and his collaborators have been developing material, based on carbon nanotube composites, strong enough to be safe but lightweight enough to be practical when sending humans into deep space. This material will ultimately be used as the main load-bearing fuselage of a spacecraft. It would also be suited for cargo containers transporting samples and other items back to Earth.

Student Standouts

Congratulations to these MNE students.

Department of Defense SMART Scholars:

Lars Axberg
Tristan Norrgard

Department of Energy University Nuclear Leadership Program Scholars:

Lucas Diehl
Sierra Tutwiler

Doctoral student receives 2021 Innovations in Nuclear Technology R&D Award

Dimitris Killinger, MNE doctoral student, received this award from the U.S. Department of Energy's Office of Nuclear Fuel Cycle and Supply Chain. His paper shows the performance of electrode materials in electrochemical techniques for real-time measurements of nuclear elements in advanced reactor technologies.

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