



Jennifer L.M. Rupp

Solid-state chemist and a voice of change

By Humaira Taz



With climate change becoming a bigger concern every day, scientists all around the world are trying to find the next revolution in renewable energy that will stop our dependency on fossil fuels. One such activist and scientist is Jennifer Rupp. She is currently the Thomas Lord Associate Professor of Materials Science and Engineering and an associate professor in the Department of Electrical Engineering and Computer Science at the Massachusetts Institute of Technology. Her research work in the field of solid-state materials for energy and information devices focuses broadly on the processing and structural properties of ceramics.

Rupp's work with solid-state batteries not only explores chemistries and how to mass-produce this means of storage, but it also investigates other applications of lithium-based materials.

She termed this area of research as "lithionics." While the third industrial revolution was marked by the invention of transistors, what would the fourth industrial revolution bring in the field of materials?

"Artificial intelligence is certainly driving the fourth industrial revolution, and the impact of that in materials development would be computer-controlled manufacturing. Smart ceramics processing, where the design and fabrication of ceramic materials is automated, will be the way to go," said Rupp. One of her projects resulted in reduction of the thickness of solid-state battery electrolytes with fast Li-garnet

conductors from millimeters to some hundred nanometers. However, the vacuum deposition process used to make these batteries was making them cost-prohibitive for mass adaptation. Around that time, she designed chemistries via wet processing methods to deposit solid-state battery ceramic components at reduced cost. Another remarkable finding was her proposed concept and the use of anodes from a lithium-ion battery performing deep neural and synaptic spiking network operations, which is an example of lithionics giving classic Li battery materials more functionalities for future devices.

Rupp's interest in science started at the age of 11 when she joined an environmental science group at school. She took an interest in chemistry and later decided to pursue her science degree at the University of Vienna. Following that, she completed her PhD degree at ETH Zürich and eventually became a professor there in 2012. At that point, she was drawn to research areas that had an impact on society (e.g., low energy

footprint sensing and computing devices, renewable energy).

"The older I get, the more active role I want to play as an activist and scientist to educate the general public and policymakers," she said. Rupp has been on the Panels of Future Computational Devices and Energy with the World Economic Forum. Many politicians rely on scientists for information in order to make well-informed decisions. She also sees strong value collaborating as a scientist with industry in these areas. "Government support toward renewable energy is certainly vital, but at the same time, the push from private sectors toward green technology accelerates the progress," she said.

Rupp also plays a major role with the Materials Research Society (MRS). She organizes symposia for battery and neuromorphic computing-related research and is the chair for the Outstanding Early-Career Investigator Award. "I take this role very seriously, and it's an amazing discussion platform for up and coming impactful research," she said. Her journey with MRS started when she was an undergraduate student. During her postdoctoral studies, she found several women who were role models in her field, and that encouraged her to become a professor.

"Mentorship is really important to create a shift in statistics, where we see scientists of all colors and genders. I always emphasize this to my students and peers, to find time to mentor people so that they can have the courage to pursue their dreams, even if that means for me publishing one less paper a year," she stressed. Rupp provides mentorship to female scientists and offers fellowships to women and underrepresented minorities on solid-state materials outside of her group.

When she is not in the laboratory or in boardrooms, Rupp enjoys spending time outdoors with her family, such as paddling, hiking, and ice skating. "To be a good inventor, you have to hang loose too," she laughed.

She encourages aspiring young scientists to work on scientific problems that have a socioeconomic impact. "Those of us who have the luxury to be well educated, we need to seek out the tough problems that society has and tackle those—not just the ones that have funding available," she said. In addition, Rupp highlighted the importance of actively taking part in science communication. She added, "We live in a world where facts are twisted. As scientists, we need to spend time to deliver technical facts that are meaningful to the public and that will help the decision-makers make the right choices." □

Humaira Taz is an entrepreneur-in-residence at TandemLaunch Inc. and CTO of her startup Omniply in Montreal, Canada.