From cancer research to energy storage, Berkeley Lab scientist takes on big challenges

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The clean-energy commute of the future could come from research conducted at facilities like Berkeley Lab's Molecular Foundry, where Rizia Bardhan is helping to develop new hydrogen storage materials.

On a typical day, Rizia Bardhan walks through the doors of Lawrence Berkeley National Laboratory's Molecular Foundry and immerses herself in the tricky business of tweaking optical spectroscopy equipment to study phase transitions in metal hydrides.

It's fair to say that what she does is difficult to grasp. Why she does it is easy: "I want to help solve big problems. That's why I'm here," she says.

In this case, the big problem is energy—or how you can drive to work without consuming fossil fuel or emitting CO2. Bardhan's research is part of a Department of Energy goal to develop an on-board hydrogen-storage system that will enable a fuel cell powered car to go 300 miles without refueling, with water as the only by-product.

Getting there requires synthesizing new materials that can safely store a lot of hydrogen in a small package without costing too much. The work is part fundamental science and part real-world know-how. It's also the perfect challenge for Bardhan, who recently earned a spot on Forbes' list of 30 people under 30 who are rising stars in science.

Science seems to surround the 29-year-old chemist. Her husband, a researcher at Intel Corporation, also made the Forbes' 30-under-30 list for work on nanotube supercapacitors for high-energy batteries. She grew up in India, where her father and several uncles are engineers. She came to the U.S. ten years ago, studied chemistry at a small liberal arts college in Missouri, and then received a PhD in chemistry from Rice University. Her graduate work focused on developing plasmonic structures for cancer therapy and diagnosis.

In 2010, she was offered a postdoctoral position in Jeff Urban's lab at the Molecular Foundry. The research focused on clean energy, not cancer research, but she jumped at the opportunity. It was a natural transition.

"When I think of science, I think of major problems that I can help solve," she says. "There's human health. There's also human sustainability, and for me, that means clean energy production and storage. We need to find renewable energy sources that have very little impact on the environment."

Vehicles powered by hydrogen fuel cells could be one such solution, but there are significant hurdles to overcome. Chief among them is storing enough hydrogen in a car to provide a driving range that competes with a tank of gas. The most common way to store hydrogen is in a pressurized tank that contains gaseous or liquefied hydrogen. But this approach has safety issues. And the volumetric density of a tank of gaseous or liquefied hydrogen—or how much energy it holds—is very low.

Instead, Bardhan and her colleagues in Jeff Urban's lab at the Molecular Foundry are developing storage materials composed of metal hydrides, a compound in which hydrogen is bound to a metal. Metal hydrides have the potential to store a lot of hydrogen in a small volume, and release it at low temperatures and pressures.

Recently, they designed a new composite consisting of nanoparticles of magnesium metal uniformly embedded through a matrix of a hydrogen-selective polymer, which is related to Plexiglas. Bardhan says the material is very close to the Department of Energy's goal of six weight percent, meaning six percent by weight of the metal hydride is hydrogen. They're now optimizing the material even more, with the goal of edging toward the material's theoretical limit of 7.6 weight percent.

Part of this optimization involves gaining a better understanding of how a metal transitions to a metal hydride, such as how Mg becomes MgH2. To do this, Bardhan is developing optical spectroscopy techniques that will enable scientists to watch this transformation in real time as it happens.

"Without understanding these very fundamental processes, we cannot improve the properties of the materials," says Bardhan.

Provided by Lawrence Berkeley National Laboratory

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