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Researchers discover way to make solar cells more efficient

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Yuri Dahnovsky and TeYu Chien, both UW faculty members in the Department of Physics and Astronomy, co-wrote a research paper that studied improving the efficiency of solar cells that could prolong the life of solar panels (pictured) or solar car batteries. The paper was published in *Applied Physics Letters*. Credit: University of Wyoming

When it comes to improving the efficiency of solar cells, a group of University of Wyoming professors has discovered a way to do so by adding manganese atoms—an alternate metal—to the mix. Doing so, they found, dramatically increases solar cell energy conversion by an average 300 percent and, in some cases, up to 700 percent.

This research finding could be used in the future to help Wyoming farmers and ranchers access electric power in remote areas important to the state to aid crops and livestock, to boosting the use of electric cars in big cities, such as Los Angeles, in an effort to reduce smog there.

Jinke Tang and Yuri Dahnovsky, both UW professors in the Department of Physics and Astronomy; TeYu Chien, an assistant professor of physics and astronomy; and Wenyong Wang, an associate professor of physics and astronomy, co-wrote a research paper, which was published in *Applied Physics Letters* last fall. The paper, titled "Giant Photocurrent Enhancement by Transition Metal Doping in Quantum Dot Sensitized Solar Cells," was recently spotlighted again, in April, by the Department of Energy's (DOE) Office of Basic Energy Sciences.

The research was funded by the DOE, Office of Basic Energy Sciences, as part of the Established Program to Stimulate Competitive Research (EPSCoR) Program.

"They usually highlight the research funded by them," Chien says. "They pick key achievements and highlight them."

The Office of Basic Energy Sciences supports fundamental research to understand, predict and, ultimately, control matter and energy at the electronic, atomic and molecular levels to provide the foundations for new energy technologies and to support DOE missions in energy, environment and national security.

"We added into the PbS quantum dot with 4 percent manganese atoms. Our expectations were a 4 percent increase in solar efficiency," Dahnovsky says. "We had a 700 percent increase. That's very unusual."

Dahnovsky says it's unusual because electrons "tunneling" between manganese and zinc atoms do so much easier than between lead and zinc atoms located at the interface between a quantum dot and a semiconductor.

The quest for high efficiency solar cells has led to the search for new materials, such as manganese, to replace traditional silicon used for sensitizers and photoconductor—oxide—electrodes.

This might lead to a technical revolution for some industrial applications, Dahnovsky and Chien both say.

Practical uses for increased solar cells include more efficient solar panels at a lower cost for houses and other structures; if combined with portable devices, such as iPhones, iPads and computers, solar cells could keep them powered much longer before needing to be recharged; and allow electric cars to travel farther before needing to stop at a recharge station, which might make buying an electric car a more viable alternative, Chien says.

Dahnovsky adds that the science also could assist Wyoming, which is spread out, remote and has areas that lack electricity. For example, he says a herd of cattle that moves from one place to another to graze may be located far from electricity.

"A farmer may need a water pump in a remote area to water his livestock," he says. "If there's no electricity, he may use solar cells to power the water pump."

Chien says farmers also could use solar-powered sensors that could measure light, humidity, oxygen and temperature in their crop soil.

More information: Gaurab Rimal et al. Giant photocurrent enhancement by transition metal doping in quantum dot sensitized solar cells, *Applied Physics Letters* (2016). DOI: 10.1063/1.4962331

Provided by University of Wyoming