Nanostructures for hydrogen production and storage

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Incorporating nanostructures may lead to more efficient hydrogen production and storage, according to researchers from the University of Georgia and the University of California, Santa Cruz who have secured $1.35 million in grants from the U.S. Department of Energy to work on clean energy technologies.

Yiping Zhao, assistant professor in the department of physics and astronomy at UGA and a recognized expert in the fabrication of nanostructures, is the principal investigator on the hydrogen storage aspect of the multi-institution project.

The grants cover two distinct projects based on nanoscale materials on which the researchers will collaborate; one is for generating a solar cell device to produce hydrogen and one is using nanomaterials to safely store the hydrogen. Both projects are dependent on the materials to be designed and fabricated by Zhao at UGA, which will then be characterized and tested by Jin Zhang at UCSC. Researchers also involved are Mathew D. McCluskey from Washington State University for the hydrogen storage project and Wei Chen from Nomadics, Inc., in the hydrogen generation project.

The grants are among 70 hydrogen research projects funded through a $64 million DOE initiative aimed at making vehicles powered by hydrogen fuel cells available, practical and affordable to American consumers by 2020. Generating hydrogen from solar energy – using it as a transportation fuel with only clean water as a byproduct – would

completely bypass fossil fuels as an energy source. Still, significant technological barriers continue to block this reality.

For example, about four kilograms of compressed hydrogen is needed to drive an automobile 300 miles. The present state of the technology would require a large volume, equal to about a 50-gallon drum, of the volatile element to be stored in a vehicle for use. Zhao is confident of reducing this volume with the use of nanostructures as a storage mechanism.

"Nanostructures are important in hydrogen storage because you have a higher surface area," said Zhao. "But what really sets this process apart is the nanofabrication techniques – we can design better structures and incorporate more complex materials, which is vital if this technology is to move forward."

The research on materials and generating hydrogen from solar cells will focus on the fundamental research needed to be able to mass produce these technologies for a consumer market. The basics of how hydrogen interacts with nanostructures, its diffusion and temperature thresholds on the scale of a billionth of a meter hold the key for its wider application.

"The one thing that we see on the hydrogen fuel front is the government funding agencies beginning to work in concert with many of our more innovative thinkers and engineers," said Dale Threadgill, director of the UGA Faculty of Engineering, which sponsors Zhao's work as a member and houses a laboratory dedicated to nanoscale fabrication. "Dr. Zhao certainly counts among these nationally."

"I'm delighted that Dr. Zhao is receiving these important grants from the Department of Energy," said Garnett S. Stokes, dean of the Franklin College of Arts and Sciences. "Clean, affordable energy is critical to everyone, and we're delighted to have a part in this ongoing effort."

"With these two projects, with the potential to turn water into hydrogen using solar energy and then burn the hydrogen into water as a fuel, we can have an inexhaustible source of clean energy," said Zhao.

Source: University of Georgia