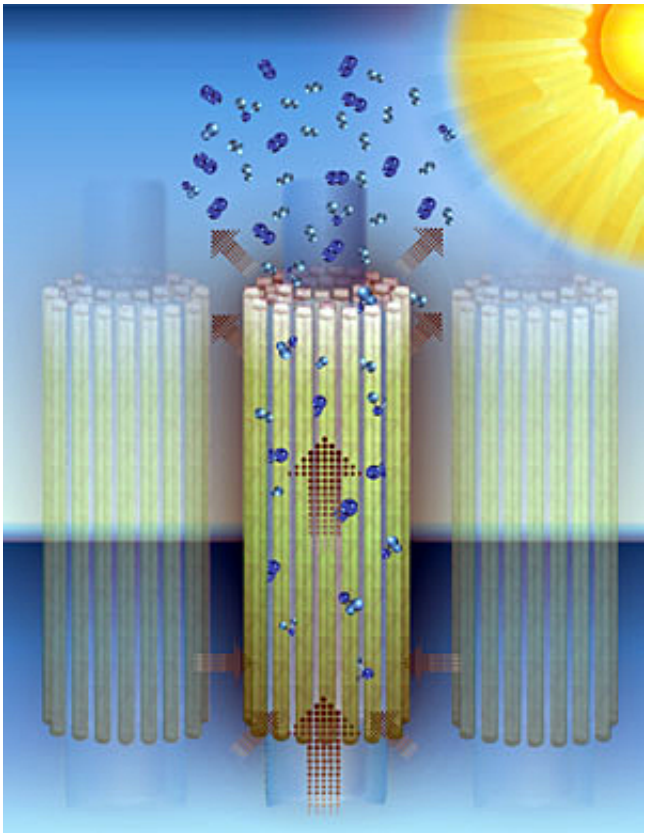
A tree may have the answers to renewable energy

July 23 2014, by Jasmine Sola



An illustration of the water splitting process Wang describes.

Through an energy conversion process that mimics that of a tree, a University of Wisconsin-Madison materials scientist is making strides in renewable energy technologies for producing hydrogen.

Xudong Wang, an assistant professor of materials science and engineering at UW-Madison, recently collaborated with researcher, Dr. Zhiyong Cai, in the U.S. Forest Products Laboratory in Madison on research to use cellulose nanofibers (CNFs) for water splitting, a process that converts solar energy to hydrogen fuel.

Wang's vision is to use cellulose like a sponge "tree" that soaks up water from a lake or ocean. At the top would be a photocatalyst that splits the water into hydrogen and oxygen.

And while researchers have explored water-splitting techniques for years, those techniques have relied on photocatalysts submerged in the water, which limits light penetration to the catalyst. "People made photocatalysts in the water and shone light into the water to generate hydrogen and oxygen," Wang says. "But the limitations included light penetration through the water to get to the catalyst. You cannot simply increase the amount of the catalyst since sun is refracted and diffracted. That limited the efficiency of those techniques."

Wang and his collaborators are soaking water up out of the body of water and splitting it in the air. At the top of their "tree" is a mesoporous titanium dioxide photocatalyst created on a cellulose template, which offers a huge surface area. Placed in a body of water, the tree's cellulose "roots" draw water up to the photocatalyst "leaves", where it reacts and splits into hydrogen and oxygen.

"Usually, catalysts are made in a powder form. Not long ago, people started using nanowires for catalysts," Wang says. "We are the first to use a CNF-based template for the catalyst coating and take advantage of its extraordinary hydrophilic property."

This technique greatly improves the process of water splitting, he says. Essentially, it doubles the efficiency of the conventional in-water setups.

"If you have a container in the ground, or build a panel like a tree; panels are like leaves and take space in the air to enhance solar energy absorption," Wang says. "This can eliminate the limitations of water surfaces and maximize solar energy conversion."

Such panels could be placed in lakes and oceans and could generate hydrogen from water using solar energy. "It's a concept that you could use to build a plant that produces hydrogen fuels. The factory could be on land or on a body of water," Wang says.

His research addresses growing interest in converting water into hydrogen as a clean energy source. The hydrogen economy model revolves around the notion that energy can be delivered to anything from cars to buildings using hydrogen.

Funding for the research comes from the U.S. Department of Energy. Next, Wang and his collaborators hope to build a larger-scale prototype. Forest Products Laboratory currently is pursuing a patent for the work.

Provided by University of Wisconsin-Madison