Artificial Photosynthesis Takes a Step Forward

Researchers have demonstrated a long-lasting device for making hydrogen from sunlight and water—but funding is running out.

A U.S. government-backed research effort has taken an important step toward mimicking a plant’s ability to convert sunlight and water into fuel. The problem is the researchers don’t have enough money to continue the effort.

The Joint Center for Artificial Photosynthesis (JCAP), a research program created by the Obama administration in 2010, involves researchers at several academic labs, led by a team at Caltech. These researchers have demonstrated a way to extend the life of a promising type of solar electrolyzer, which uses sunlight to directly split water to form oxygen and hydrogen. The hydrogen produced could be stored and used to generate electricity at night in power plants or fuel cell vehicles. JCAP was founded in 2010 as one of a handful of U.S. Department of Energy Innovation Hubs, with a promise of $122 million over five years. Nathan Lewis, the director of the center, hopes the latest progress might persuade Congress to extend its funding. “We’re on a roll now and hope to get to continue,” he says.

It’s possible to make hydrogen with solar power indirectly, by using solar panels to power a conventional electrolyzer. But this is expensive—an amount of hydrogen fuel equivalent to a gallon of gasoline would cost $10 to $20. A device capable of using sunlight to split water could reduce costs significantly; Lewis says the resulting hydrogen could cost as little as $2 to $4 for an amount equivalent to a gallon of gasoline, although he says it’s too early to put much faith in such estimates.

The JCAP researchers used two commercially proven technologies to create their device: electrolysis and silicon or cadmium-telluride solar cells. To cut costs, they combined elements of both into a single device in a way that makes it less complex, and potentially more efficient. Electrolyzers have two electrodes equipped with catalysts that reduce the amount of energy required to split water. In the new system, researchers added catalysts to solar cells, allowing them to double as electrolyzer electrodes, reducing the part count. They also optimized the catalysts to work with the solar cells.

The alkaline solutions used in most electrolyzers will ordinarily destroy solar cells in seconds, but the researchers found that a type of nickel oxide can serve as a catalyst and also protect solar cells. The catalyst helps free oxygen atoms from
water molecules and produces oxygen gas, using energy from the solar cells. In tests, the material allowed the solar cells to last for over 1,000 hours—not quite long enough for a commercial device, but a dramatic improvement.

The device acts as one of the two electrodes in an electrolyzer. For a practical device, the hydrogen catalyst needs to be improved. Some efficient catalysts exist, but they typically work in acidic environments, not alkaline ones.