"Artificial Leaf" Might Provide Easy, Mobile Energy

Can an artificial system to turn sunlight into storable energy?

By Tiffany Stecker and ClimateWire | March 29, 2011 | 5

MIMICKING NATURE: An artificial leaf might be able to turn sunshine into storable energy Image: WeFt via WikiMedia Commons

An artificial "leaf" that collects energy in much the same way as a natural one could provide a day's worth of power for homes without access to an electricity grid.

The leaf, a silicon-based square the size of a playing card, closely mimics the way plants use the process of photosynthesis to create energy. The device is dropped into a bucket of water, or even a muddy puddle, and placed in direct sunlight.

"Leaves are buzzing with electricity," said Daniel Nocera, a researcher at the Massachusetts Institute of Technology who heads the research, "they just don't have any wires in them." Neither does the artificial leaf.

The leaf contains catalysts -- or molecules that accelerate chemical reactions -- that split H_2O into hydrogen and oxygen gas. The gases are then sent to a fuel cell, which in turn produces a wireless current of electricity. Hydrogen and oxygen catalysts cover each side of a thin silicon layer -- the same material used in solar cells -- to accelerate the water-splitting reaction. The reaction is visible to anyone looking through a clear glass of water, as gases bubble around the leaf.

The idea of an silicon-based leaf is not a new one: Researchers at the U.S. National Renewable

Energy Laboratory came up with a similar idea in 1998. That version, however, was created with expensive rare materials, including platinum, and a had a short life span.

Two years ago, Nocera discovered a way to use cheaper, readily available elements, including cobalt and nickel, that make the new leaf up to 10 times more efficient at creating energy than a natural one.

Nocera says this leaf could provide up to 30 kilowatt-hours of electricity per day, on par with the typical American household's electricity use, according to the U.S. Energy Information Administration. The leaf can produce energy for up to 45 hours in the lab, without interruption. He expects to develop an effective prototype for the leaf in the next two to three years.

Energy for the poor and the mobile

This cheap technology is especially promising to communities without electricity in Africa, Asia and other developing regions. Highly mobile units, like military installations, would also benefit, said Nocera.

"Soldiers are killed guarding on supply lines," he said, and if they could carry their energy around, it could lead to less casualties.

Another plus, says Nocera, is that the water source needn't be pure, an advance from past experiments, and a necessity in places where clean water is a luxury.

The direct solar fuels system this technology employs, said Nocera, avoids the need to store energy in a battery for later use, a method he called a "short-term Band-Aid" compared to large-scale, stationary energy storage.

"If you're going to get to terawatts of storage," as will be needed as energy demands continue to rise, especially in developing countries, "there's not going to be enough batteries, because they're not going to have enough energy [storage]."

While the technology, like traditional solar cell technology, still encounters the drawbacks of cloudy days, said Nocera: "It shouldn't stop you from trying to not use fossil fuels and ignore the sun."

Nocera presents his findings today at the American Chemical Society's annual meeting in Anaheim, Calif.

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