Solar cell converts water into hydrogen

Some people envision a future world powered only by the sun and water. No longer dependent on petroleum, this society would harness the sun's energy to produce hydrogen gas, a clean-burning, renewable fuel that can be packaged in fuel cells or piped directly to homes.

Now, John A. Turner and Oscar Khaselev of the National Renewable Energy Laboratory (NREL) in Golden, Colo., have taken a small step toward that lofty goal. They have fabricated a solar cell that harnesses sunlight to produce hydrogen gas from water. This photocell absorbs light and converts it into an electric voltage strong enough to split water into hydrogen and oxygen.

Other systems that produce hydrogen from water follow the same principle, says Turner, but they keep the light-absorbing and water-splitting components separate. The new photocell combines the two parts into "a single, monolithic device," he explains.

Eliminating the need to channel the absorbed energy from one component to the other boosts the device's efficiency to 12.4 percent, nearly twice as high as other methods have achieved. Improving efficiency is important for making such systems commercially viable.

The photocell consists of a layer of gallium indium phosphide, a semiconductor that absorbs visible light, laid upon a double layer of gallium arsenide, which absorbs infrared light. Both materials convert light into electric voltage.

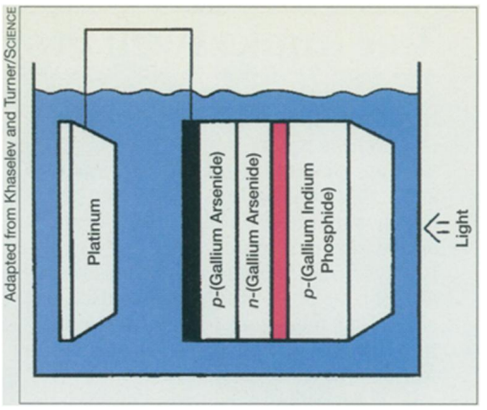
To complete their setup, the researchers immerse the photocell and a platinum electrode in a weak acid solution. When they shine a light with 11 times the intensity of sunlight on the photocell, the researchers see hydrogen bubbling off the surface of the cell and oxygen rising from the platinum electrode.

The team reports its findings in the April 17 SCIENCE.

Although the integration of components in the photocell may increase its efficiency, that approach adds "a heck of a lot of complexity," says Allen J. Bard, an electrochemist at the University of Texas at Austin. The need to immerse the whole chip in a solution could be a disadvantage, he adds.

The researchers did see some damage on the photocell surface as the hydrogen bubbles collected. Although the cell operated for 20 hours without a problem, Turner says, a practical device must remain stable for 5 to 20 years.

Turner thinks this particular device has reached its highest possible efficiency but says a different combination of materials might do better. Scientists have predicted an 18 to 24 percent theoretical efficiency for these kinds of systems, he notes.



When light hits the photocell, it creates an electric voltage that splits water (blue). Hydrogen bubbles form on one surface (black band), while oxygen forms on the platinum electrode.

At present, hydrogen is much too expensive to compete with oil, and the NREL device doesn't purport to decrease the cost, Turner stresses.

A crossover to hydrogen fuel might not be possible for 50 to 100 years, says Bard, but "no question, eventually we're going to run out of fossil fuels." Solar conversion of water into hydrogen is "a viable alternative," he adds, but "the world is dreaming of a very simple, low-cost system. No one's found it yet." —*C. Wu*

Climate change measure for the common folk

Siberians and Alaskans may be shedding their fur coats noticeably earlier this spring, according to a new measure of climate change.

To find out when global warming would be readily perceived by people, researchers at NASA's Goddard Institute for Space Studies in New York have created what they call a commonsense climate index. Using records of temperature and precipitation, they found that, since 1951, climate in most parts of the world has not shifted enough to be noticeable. However, in parts of Asia and northwestern North America, "climate change might already be apparent to longtime residents," say James Hansen and his colleagues in the April 14 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"What this is focusing on is what people will feel—how many hot days there are, how many days of rain there are," comments Michael C. MacCracken of the U.S. Global Change Research Program in Washington, D.C.

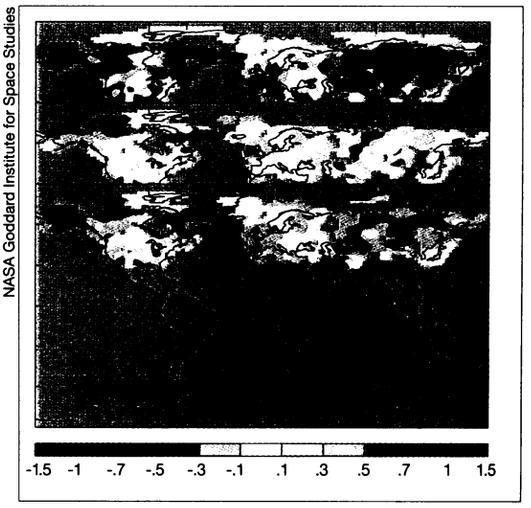
The researchers chose to analyze temperature and precipitation because these climate variables affect people, crops, and the environment, says study coauthor James Hansen. The challenge, he says, was to distinguish normal climatic variation from long-term trends stemming from global warming (SN: 5/24/97, p. 316; 3/15/97, p. 156). Scientists measure global warming by assessing Earth's overall change in temperature, but compared to normal seasonal changes, those fractions of degrees Celsius don't seem like much.

Reasoning that many of today's adults grew up between 1951 and 1980, the team selected that interval as a baseline. The researchers hypothesize that to strike most people as noteworthy, weather patterns must have occurred, on average, only once every 6 or 7 years during the baseline period. Such a year was given a climate index of 1 or -1, depending on whether it was especially hot or especially cold.

The researchers combined several different annual measures of temperature and moisture into the climate index. For temperature, they used seasonal averages, the number of degree days for both the heating and cooling seasons, and the frequency of extremely hot or cold days. For moisture, the team included seasonal precipitation totals, the frequency of heavy precipitation, and a measure of drought stress on plants.

"I see this becoming more useful as time goes on. We're going to put this on the Web," Hansen says. "When you get an unusual year—unusually warm, unusually cold—you can look at [the index]" to see how the weather compares to the long-term trends.

—*M.N. Jensen*



Changes from 1951 to 1997 in temperature (top), moisture (center), and composite climate indexes (bottom). For indexes of more than 1 or less than -1, people in the region were likely to have noticed the change. Warmer, wetter conditions are represented by red; cooler, drier conditions by blue.