PHYS.ORG

Breaking the barriers for low-cost energy storage

August 1 2012

A team of researchers has developed a cheap, rechargeable and eco-friendly battery that could be used to store energy at solar power plants for a rainy day.

Led by Sri Narayan, professor of chemistry at the USC Dornsife College of Letters, Arts and Sciences, the team developed an air-breathing battery that uses the chemical energy generated by the oxidation of iron plates that are exposed to the oxygen in the air – a process similar to rusting.

"Iron is cheap and air is free," Narayan said. "It's the future." Details about the battery will be published July 20 in the Journal of the Electrochemical Society.

As currently developed, Narayan's batteries have the capacity to store between eight and 24 hours' worth of energy. His patent is pending, and both the federal government and California utilities have expressed interest in the project.

Iron-air batteries have been around for decades – they saw a surge in interest during the 1970s energy crisis, but suffered from a crippling problem: a competing chemical reaction of hydrogen generation that takes place inside the battery (known as hydrolysis) sucked away about 50 percent of the battery's energy, making it too inefficient to be useful.

Narayan and his team managed to reduce the energy loss down to 4 percent – making iron-air batteries that are about 10 times more efficient than their predecessors. The team did it by adding very small amount of bismuth sulfide into the battery. Bismuth (which happens to be part of the active ingredient in Pepto-Bismol and helps give the pink remedy its name) shuts down the wasteful hydrogen generation.

Adding lead or mercury might also have worked to improve the battery's efficiency, but wouldn't have been as safe, Narayan said.

"A very small amount of bismuth sulfide doesn't compromise on the promise of an eco-friendly battery that we started with," he said.

Narayan's team included fellow USC researchers G. K. Surya Prakash, Aswin Manohar, Souradip Malkhandi, Bo Yang, Robert Aniszfeld, Chenguang Yang, Phong Trinh; and Andrew Kindler of NASA's Jet Propulsion Laboratory.

The California Renewable Energy Resources Act, signed into law by Gov. Jerry Brown in April 2011, mandates that the state's utilities must generate 33 percent of their power from renewable energy sources by the end of 2020.

This aggressive push toward renewable energy sources presents utilities with a problem: solar power works great on clear days and wind power is wonderful on windy days, but what can they do when it's cloudy and calm out? People still need electricity, and won't wait for the clouds to clear to turn the lights on.

Currently, solar and wind power make up a relatively small part of the energy used in California. In 2009, 11.6 percent of electricity in the state was generated by wind, solar, geothermal, biomass and small hydroelectric plants combined. (Large hydroelectric plants accounted for an additional 9.2 percent.) As such, dips in energy generation from solar and wind power plants can be covered by the more predictable coal-burning grid.

As California moves toward more renewable energy, solar- and wind-power plants will need an effective way of storing large amounts of energy for use during clouding and calm days.

Traditionally, utilities store power by pumping water uphill into reservoirs, which can then release the water downhill to spin electricity-generating turbines as needed. This method is not always practical or even feasible in drought-ridden California, where water resources are already in high demand and open reservoirs can suffer significant losses due to evaporation, Narayan said.

Batteries have typically not been a viable solution for utilities. Regular sealed batteries, like the AAs in your TV remote, are not rechargeable. Lithium-ion batteries used in cell phones and laptops, which are rechargeable, are at least 10 times as expensive as iron-air batteries.

Despite his success, Narayan's work is still ongoing. His team is working to make the battery store more energy with less material.

Provided by University of Southern California

Citation: Breaking the barriers for low-cost energy storage (2012, August 1) retrieved 24 April 2024 from https://phys.org/news/2012-08-barriers-low-cost-energy-storage.html