Proton flow battery advances hydrogen power

February 6 2014

The concept advances the potential for hydrogen to replace lithium in battery-powered devices.

(Phys.org) —Researchers have developed a concept hydrogen battery based simply on storing protons produced by splitting water.

The novel concept developed by researchers at RMIT University advances the potential for hydrogen to replace lithium as an energy source in battery-powered devices.

The proton flow battery concept eliminates the need for the production, storage and recovery of hydrogen gas, which currently limit the

efficiency of conventional hydrogen-based electrical energy storage systems.

Lead researcher Associate Professor John Andrews, from RMIT's School of Aerospace, Mechanical and Manufacturing Engineering, said the novel concept combined the best aspects of hydrogen fuel cells and battery-based electrical power.

"As only an inflow of water is needed in charge mode - and air in discharge mode - we have called our new system the 'proton flow battery'," Associate Professor Andrews said.

"Powering batteries with protons has the potential to be a much more economical device than using lithium ions, which have to be produced from relatively scarce mineral, brine or clay resources.

"Hydrogen has great potential as a clean power source and this research advances the possibilities for its widespread use in a range of applications - from consumer electronic devices to large electricity grid storage and electric vehicles."

The concept integrates a metal hydride storage electrode into a reversible proton exchange membrane (PEM) fuel cell.

During charging, protons produced from splitting water are directly combined with electrons and metal particles in one electrode of a fuel cell, forming a solid-state metal hydride as the energy storage. To resupply electricity, this process is reversed.

Published in the *International Journal of Hydrogen Energy* (January, 2014), the research found that, in principle, the energy efficiency of the proton flow battery could be as high as that of a lithium ion battery, while storing more energy per unit mass and volume.

The published paper is the first to articulate and name the proton flow battery concept, and the first to include an experimental preliminary proof of concept.

"Our initial experimental results are an exciting indicator of the promise of the concept, but a lot more research and development will be necessary to take it through to practical commercial application," Associate Professor Andrews said.

Provided by RMIT University