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High Efficiency, High Power, Thermally Activated Lithium Hydride Hydrogen Generation System

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Inventors

Dr. Jekanthan Thangavelautham

Assistant Professor

School of Earth & Space Exploration

Background

Hydrogen fuel cells are ideal for producing continuous low power energy, but are quickly exhausted by fluctuating power demands of a motor. Typically, they are utilized in a hybrid system that protects the fuel cell from such fluctuations, for example, to charge a battery that handles variable power demand. In order to operate, fuel cells need a constant and uniform supply of hydrogen gas. Conventional hydrogen storage such as cryogenic liquid or compressed gas is bulky and dangerous, and current production techniques such as electrolysis or the steam reforming of hydrocarbon fuels are costly and inconvenient. As a solid, metal hydrides offer a safe solution, however, they are inefficient due to their low energy densities and the reaction time needed to extract the hydrogen. Additionally, their performance deteriorates as their active surfaces become contaminated with impurities from incomplete reactions or buildup of byproduct.

Invention Description

Researchers at ASU have developed a hydrogen generation system based on a temperature-controlled reaction of lithium hydride (LiH) with recycled water that achieves high fuel energy densities. Waste heat from the fuel cell, electrical load, and reaction chamber is used to keep the water vapor temperature between 70 and 120°C. Temperatures above 70°C speed up the hydrolysis reaction, decrease the surface area required for the reaction, and efficiently use all of the water, producing only hydrogen instead of lithium hydroxide monohydrate typically formed during incomplete reactions. Exhaust water from the fuel cell is mixed with air and recycled into the reaction chamber, and the reaction chamber is equipped with two membranes that regulate the production of hydrogen as needed. Combined with a fuel cell power supply, this system achieves fuel energy densities of 4,850 Wh/kg with output power of 10-50 W, ten times better than the best rechargeable batteries and twice that of gasoline engines.

Potential Applications

- Hydrogen Generation
- Energy Storage
- Grid Balancing
- Power Supply for
  - Unmanned Aerial Vehicles
  - Robots
  - Sensors

Benefits and Advantages

- **Effective** – Achieves energy densities and power supply ten times better than the best rechargeable batteries and twice that of gasoline engines
- **Efficient**
  - Makes use of waste heat generated by electrical loads and internal processes.
  - Recycles exhaust water from fuel cells.
  - Temperature control prevents the buildup of surface contaminates.
- **Environmental** – No greenhouse gas emissions.
- **Quiet** – Thermal signatures are minimizes for stealth applications.
- **Safe** – Solid storage and release of hydrogen.

Intellectual Property Status:

Pending

Contact

Bill Loux

Director of Business Development, Physical Sciences

Arizona Technology Enterprises, LLC (AzTE)

P: 480.884.1992

F: 480.884.1984

BLOUX@AZTE.COM

TECHNOLOGYVENTURES@AZTE.COM