Highly Efficient Regenerative Fuel Cell for Renewable Electric Power

TITLE

Hydrogen-Bromine Supported Molten-Salt Electrocatalytic (SMSEC) Unitized Regenerative Fuel Cell (URFC) for Electrical Energy Storage

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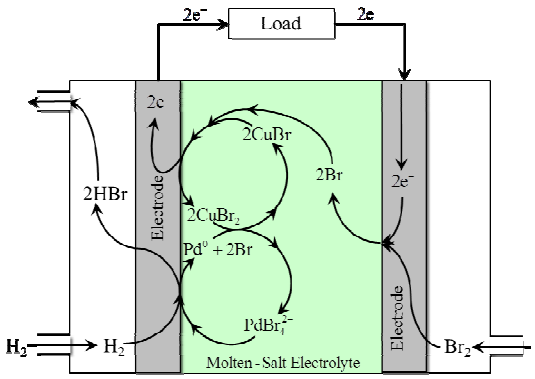
Molten-Salt Fuel Cell



SUMMARY

- A hydrogen-halogen based unitized regenerative fuel cell (URFC) comprised of a molten-salt electrolyte operating at high temperature gas-phase chemistry
- The cell stores energy by electrolyzing HBr to H_2 and Br_2 and releases it by generating HBr as a H_2-Br_2 fuel cell
- The molten salt serves a dual role of the electrolyte and the catalyst solvent.
- Innovative ceramic porous supports reduce battery internal resistance and extend unit lifetime

BACKGROUND

For renewable electric power to make inroads into the US electric utility market, new technologies for grid-scale electrical energy storage are needed that are efficient, cost effective, fast, reliable, scalable, and broadly deployable. Electrochemical energy storage for this purpose is appealing in principle but elusive in practice. In today's market, batteries are bulky and/or expensive, while the hydrogen-oxygen proton-exchange membrane (PEM)-unitized regenerative fuel cell (URFC) is expensive, insufficiently durable, and inefficient because of the sluggish oxygen electrode reaction.

A revised URFC involving Br_2, a much more reactive oxidant than O_2, operating at high temperature (250 – 450 ºC) can be more efficient and more durable. Previous attempts at creating H_2-Br_2 URFCs were low-temperature, PEM-based, dilute aqueous phase systems, plagued by internal crossover, low Faradaic efficiency, and catalyst poisoning that make them impractical. We expect the proposed SMSEC-URFC to be twice as efficient, half as expensive, and longer lasting, compared to conventional URFCs, as well as be competitive with conventional battery energy storage solutions

ADVANTAGES

- Inexpensive reactants and construction materials
- Double efficiency over traditional H_2-O_2 URFC
- Ceramic support is more durable than polymer membrane
- Scalable up to and beyond kW models
- Bromine can be stored as liquid, reducing unit size and cost
- Reaction kinetics are fast, reducing system response time