Bio-inspired High-Performance Non-Aqueous Redox Flow Batteries (UMD17-04)

Keywords: Energy storage, flow battery, non-aqueous electrolyte, grid-scale energy storage

❖ **Mass CEC Catalyst award receiving technology 2017**

Applications

- *Small Scale Stationary Storage Systems:*
  -Community energy storage
  -Improving power quality in residential cluster applications.
  -Micro-grid applications and village-based peak demand shifting in third world countries.
- *Large Scale Grid-level Storage Systems:*
  -Alternative energy generation from intermittent resources

Competitive Advantages

- Environment friendly & non-flammable
- High stability: Robust in presence of air and water
- High temperature stability
- High performance:
  -Relatively high cell-voltage
  -High current density
- Cost-comparative

Patent: Pending

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Return to Available Inventions Page

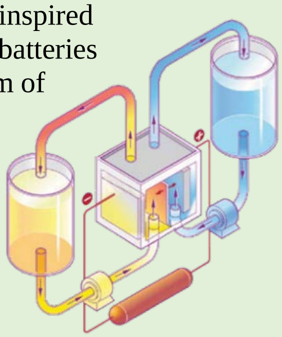
Background

Among several strategies under development to meet energy storage needs, redox flow batteries (RFBs) show promise due to their design flexibility and efficiency. Recent efforts have been made to develop non-aqueous systems. Utilization of aprotic solvents with wide electrochemical windows, low vapor pressure and melting points and high dielectric constants should allow higher energy and power density as well as improved thermal stability.
State-of-the-art non-aqueous redox flow battery (NRFB) systems are limited by decomposition of active materials and low power, often exhibiting significant capacity-fade after minimal cycling, even at low current density.
There is a strong motivation for improvements to existing storage solutions that overcome the poor stability, performance and lifetime issues in non-aqueous redox flow batteries.

UMass Technology

Dr. Ertan Agar and Dr. Patrick Cappillino have developed a bio-inspired

electrolyte for non-aqueous redox flow batteries which solves the decomposition problem of active materials in current NRFBs. They utilize metal chelators that have evolved as part of biological metal transport systems in mushrooms.



These molecules are extremely stable as a result of millions of generations of natural selection for effective metal-binding. They exhibit very strong and selective-metal-binding that shuts down decomposition pathways. Electrolytes based on this material show low capacity-fade at high current density.
Preliminary data suggest realistic performance targets of < 3% capacity-fade after 250 cycles at 150 mA·cm-2, making this a competitive technology with strong commercialization potential for residential/distributed or grid-scale electrical energy storage.

Market Potential

The market share of flow batteries (power capacity and revenue) for stationary energy storage across utility, commercial and industrial, and residential sectors, is expected to rise from 145 MW in 2016 ($151 million) to 5.77 GW ($2.92 billion) in 2025. The global market for grid-scale battery storage technologies is projected to reach nearly $4.0 billion in 2025 from $716 million in 2015.

Inventors

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Publication: http://pubs.rsc.org/en/content/articlelanding/2017/ta/c7ta00365j#!divAbstract