Grid Energy Storage: Electrochemical Flow Capacitor

Brief Overview

Traditional flow batteries suffer from slow response rates due to faradaic reactions at the electrode-electrolyte surface and have limited cycle lifetimes (<12,000 cycles) which is a critical factor for grid scale energy storage. In contrast, the electrochemical flow capacitor is a rechargeable electrochemical energy storage system that utilizes flow battery architecture and is based on the fundamental working principles of supercapacitors. The primary difference between traditional flow cells and the EFC is that the EFC utilizes a **flowable carbon-electrolyte** 'slurry electrode' for *capacitive energy storage* (see **Figure** below). During operation the slurry is pumped from a storage reservoir through two polarized plates (charging process). Once fully charged, the slurry is pumped out of the cell and stored in external reservoirs until the process is reversed and the slurry is discharged. The charged slurry stores charge electrostatically at the carbon/electrolyte interface, which allows for rapid charging and discharging leading to a higher power density. Faradaic charging processes have losses that cause degradation of the device over time compared to electrostatic charging, which has near 100% efficiency and millions of charge-discharge cycles.

Applications

- Grid scale energy storage
- Desalination
- Rapid energy recovery and delivery

Advantages

- Higher power than flow batteries
- Rapid charging and discharging
- Long lifetime - millions of cycles
- Safe, low-cost, non-toxic materials
- Scalable energy storage capacity

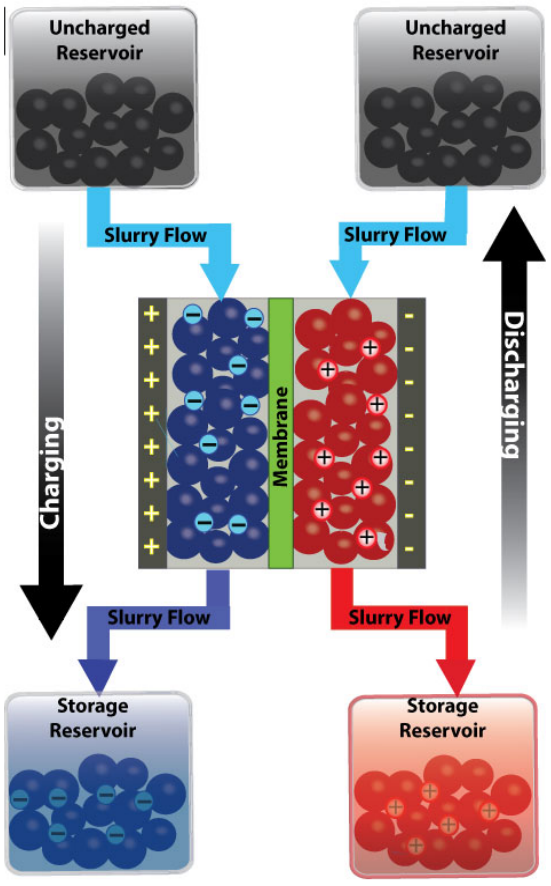

Figure: Operational schematic of the electrochemical flow capacitor. Uncharged slurry flows through polarized plates and charged. At the pore level, electrode neutrality is maintained at the interface between the electrolyte and active material. This slurry is then pumped into external reservoirs for storage. The process is reversed during discharge.

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Intellectual Property and Development Status

US utility patent application in prosecution for energy storage devices and methods. Experimentally demonstrated proof of concept. Working prototypes in progress.

Commercialization Opportunities

Drexel is currently seeking commercial partners to license and/or sponsor research to further develop this technology for commercial devices and applications.

Inventors

Yury Gogotsi, Volker Presser, Emin C. Kumbur

Web Site

http://nano.materials.drexel.edu

www.mem.drexel.edu/energy

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Contact Information

For Technical Information:

E. Caglan Kumbur, Ph.D.
Assistant Professor of Mechanical Engineering
Electrochemical Energy Systems Laboratory
Drexel University, Philadelphia, PA 19104
Ph : 215.895.5871
Fax: 215.895.1478
E-mail: eck32@drexel.edu

For Intellectual Property and Licensing Information:
Elizabeth Poppert, Ph.D.
Licensing Manager
Office of Technology Commercialization
3180 Chestnut Street, Suite 104
Philadelphia, PA 19104
Phone: 215-895-0999
Email: lizpoppert@drexel.edu