ES Program ORNL

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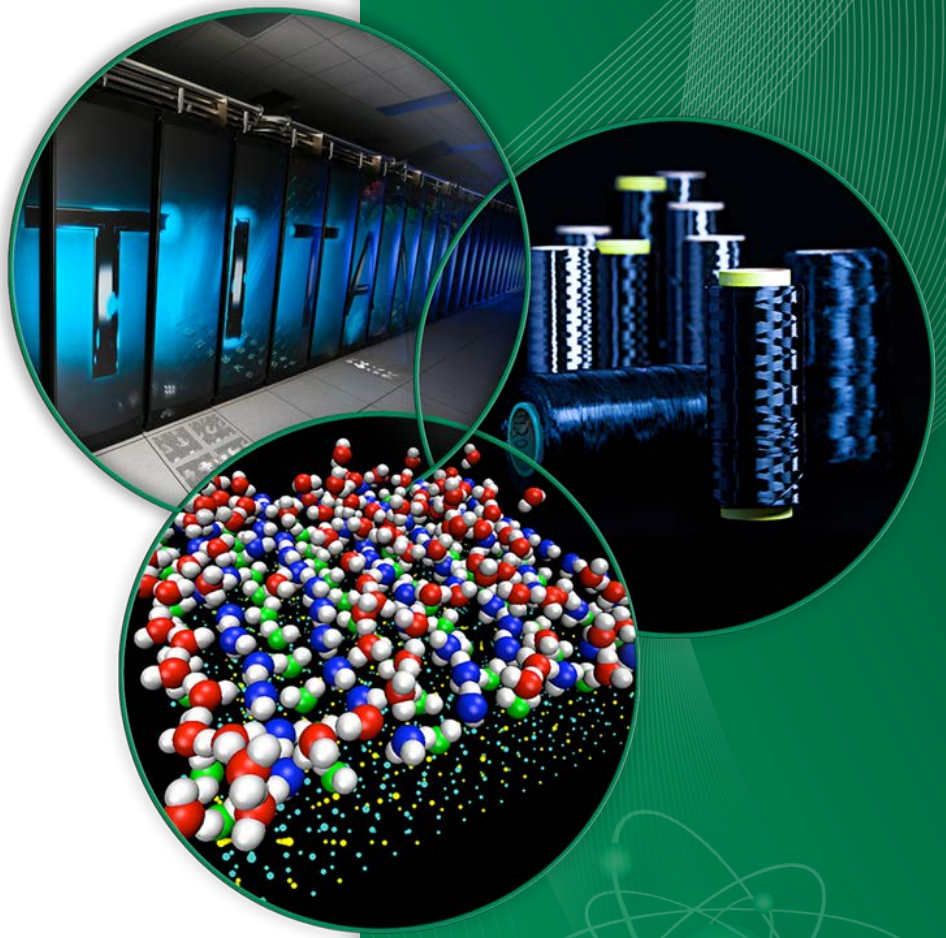


Non Aqueous Organic Radical Redox Flow Batteries

Description

Develop Na-ion conducting membranes for anion radical based redox flow batteries

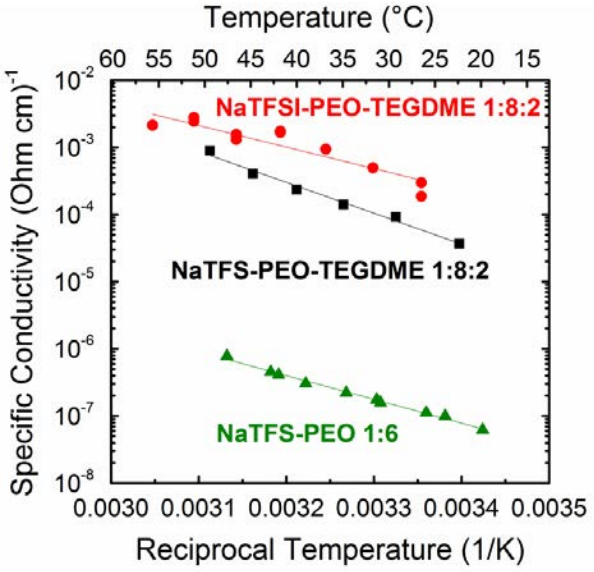
- Using tetraethylene glycol dimethyl ether (TEGDME) as a plasticizer we increase the ionic conductivity of poly(ethylene oxide) PEO membranes by several order of magnitude using sodium triflate(NaTFS) and sodium bis(trifluoromethanesulnonyl)imide(NaTFSI) salts

FY15 Accomplishments

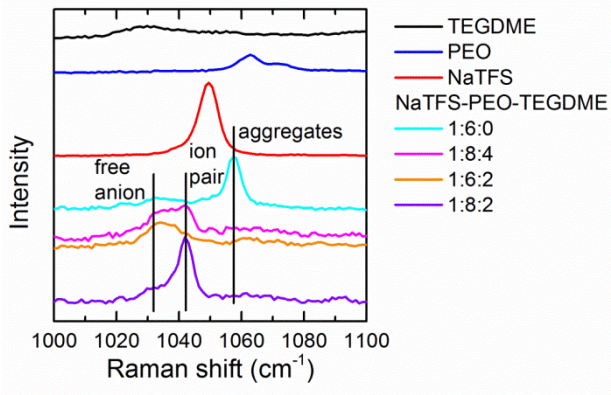
- Plasticizing with TEGDME yields 3 orders of magnitude increase in ionic conductivity for NaTFS and 4 orders of magnitude increase for NaTFSI
- Raman and FT-IR studies of ion coordination correlate with conductivity measurements

FY16 -17 Plans

- Develop a flow cell to test membranes for organic radical mediated redox flow battery
- Test a prototype cell that utilizes sulfur as a test cathode to oppose the anion radical mediated anode and evaluate the chemically mediated discharged and charged products using spectroscopic and materials characterization methods



Measurements of ionic conductivity of PEO membranes with and without TEGDME plasticizer



Raman spectroscopy showing change in coordination of TFS anion in different PEO membranes

POC: Jagjit Nanda nandaj@ornl.gov

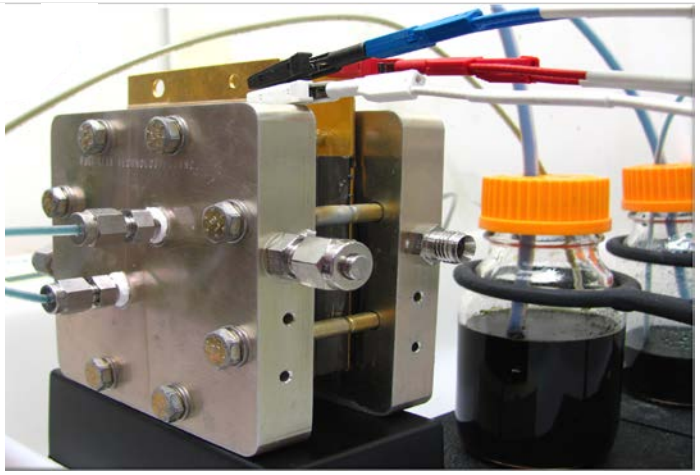
Redox Flow Batteries, ORNL, UTK

Description

Increase performance of RFBs, lower costs, and provide tools and data to industry for development of grid-scale batteries:

1) Produce novel electrodes with enhanced kinetics and mass transport
2) Develop a membrane database characterizing key parameters,
3) Foster participation and adoption of cell materials in the industrial supply chain.

HP VRFB Performance



Max power density : **2588mW/cm^2**; Max current density : **5033mA/cm^2**,

FY15 Accomplishments

- Studied Concentration Polarization leading to Improved Cycling
- Translating VRB research to WattJoule
- New Directions based on studying key components
- Route to high performance NA-RFBs
- Metal-air batteries: improved cycling with new electrolyte
- 6 papers submitted/published in FY15

FY16-17 Plans

- Continue component studies to improve membranes and electrodes
- Developing new diagnostics for failure modes and durability,
- Strengthen and grow interactions
- Continue to disseminate findings to industry
- Moving on to promising chemistries
- Metal electrodes, air electrodes
- High ED Non-aqueous

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Low Cost Lithium-Sulfur Batteries for Electric Grid Applications, ORNL

Description

- Overcome problems of conventional Li-S batteries by replacing flammable liquid electrolytes with nonflammable solid electrolytes
- Develop, test, and validate large format Li-S batteries with solid electrolytes.

Megaton storage of S

- **Performance**
- **Cost**
- **Safety**

Solid-state Li-S batteries are expected to be high performance, low cost, and intrinsically safe

FY15 Accomplishments

- Discovered high-conductivity of sulfide-based solid electrolytes
- Synthesized Li-ion conducting polysulfide cathode materials.
- Demonstrated cyclability of all-solid Li-S batteries in coin-cell format

FY16-17 Plans

- Scale up synthesis of solid electrolytes.
- Validate solid electrolyte electrochemical properties.
- Optimize lithium-ion conducting polysulfide based cathode compositions for all-solid-state Li-S batteries
- Assemble 2” x 2” pouch cells based on results of ½ inch coin cells

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EV Battery Second-Use, ORNL

Develop prototype for secondary applications of EV batteries on the grid

Description

- Supporting industry partners to develop a secondary use energy storage system prototypes and to drive the technology to commercialization faster.
- Test and validate applications that potentially demonstrate a positive business case.
- Evaluate and optimize multiple value streams.

10kW/20kWh
residential prototype

FY 15 Accomplishments

- Architecture developed with open API in labview.
- Full prototype under signal chemistry developed as an example demonstration.

FY16-17 Plans

- Development of prototype using multiple battery systems from different vehicles.
- System year-long testing demonstrating multiple applications and value streams.

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