Synthesis and characterization of polysulfone-based copolymer electrolytes : High Conductivity, Low Temperature Polymer Electrolytes for Lithium-ion Batteries.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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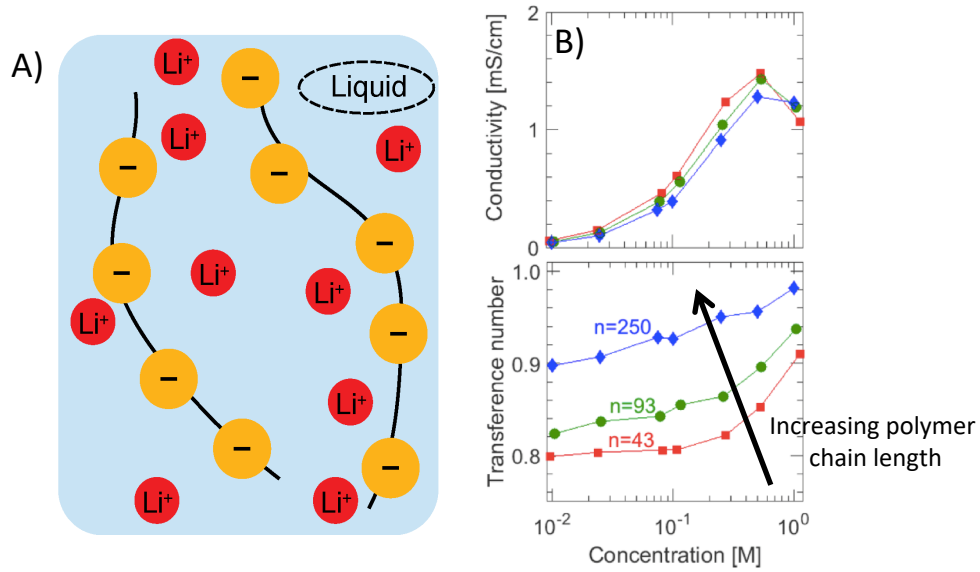
- ***Objective:*** Our project objective is to design an ionomer-based electrolyte with desirable ion transport and interfacial impedance characteristics sufficient for a practical Li-ion battery for mobile applications

Impact:

- High conductivity and Li^+ transference number targeted will improve battery energy density through the reduction of concentration gradients within the electrolyte in porous electrodes.
- Developed diagnostics to characterize electrolyte transport properties and stability, including pulsed field gradient NMR and impedance spectroscopy.

Polyelectrolyte solutions (A) and their transport properties (B)



Accomplishments:

- Developed a new series of polyelectrolyte compositions (ionomer+solvent) that exhibit liquid-like conductivities(>1 mS/cm at room temperature) and single ion conductor-like Li^+ transference numbers (>0.95).
- Developed diagnostics to quantify cation and anion mobility in polyelectrolyte solutions (pulsued field gradient NMR and electrochemical methods).
- Developed a novel polysulfone/poly(ethylene oxide) (PSF-PEO) polymer chemistry that provides a unique model polymer system to study important properties for conductivity and stability.
- Developed a 1D finite element battery model in COMSOL to identify target transference numbers and conductivities for electrolytes.

FY 18 Milestones:

- Finalize finite element modeling of thick porous electrodes.
- Complete synthesis/characterization of PSF-PEO ionomers of various molecular weights.
- Complete transport measurements of polyelectrolyte solutions
- Complete long-term cyclability of NM622 with and without residual lithium carbonate.
- Complete polyelectrolyte solution cycling measurements using Li metal electrodes .

FY18 Deliverables:

2 publications, a high transference number (>0.95) electrolyte with high conductivity ($1x10^{-3}$ S/cm) that cycles in a Li-based battery. The ability to measure a complete set of liquid electrolyte transport properties.

Funding:

— FY18: $250K, FY17: $250K, FY16: $250K