High conductivity, low temperature polymer electrolytes for lithium-ion batteries

**PI/Co-PI:** Bryan D. McCloskey (UC/LBNL)

**Objective:** The overall project objective is to design an ionomer-based electrolyte that possesses a unique combination of high Li\(^+\) transference number (>0.9) and liquid-like conductivities (>1 mS/cm) to enable faster charging Li-based batteries.

**Impact:**
- The high conductivity and Li\(^+\) transference number targeted will improve battery energy density through the reduction of concentration gradients within the electrolyte in porous electrodes, allowing thicker electrode designs.
- These electrolyte properties also are theorized to improve Li metal plating and stripping uniformity by reducing current distributions across the electrode surface.

**Accomplishments:**
- Showed for the first time an anti-correlation between ionomer ion content and conductivity, known as the compensation effect.
- Showed that certain additives could be used to break the compensation effect and dramatically improve conductivity.
- Developed a 1D finite element battery model in COMSOL to identify target transference numbers and conductivities for electrolytes.
- Completed the first exhaustive study of nonaqueous polyelectrolyte solutions that use solvent and salt composition as variables. This study paves the way to appropriate polyelectrolyte design for LIB electrolytes.

**Compositional effects in polyelectrolyte properties**

**FY19 Milestones:**
- Complete synthesis and characterization of a new Li\(^+\)-neutralized charged polymer (pFTO). (Q1)
- Complete NMR transport and viscosity measurements of pFTO dissolved in carbonate-based solvents. (Q2)
- Complete electrochemical transport measurements of pFTO in symmetric cells. (Q3)
- Complete characterization of rate capabilities of battery cells with pFTO solutions. (Q4)

**FY19 Deliverables:** 2 publications, an optimized pFTO-in-carbonate solution with high transference number (>0.9) and conductivity greater than 1 mS/cm.

**Funding:**
- FY19: $250K, FY18: $250K, FY17: $250K