Composite Electrolytes to Stabilize Metallic Lithium Anodes

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

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Objective:

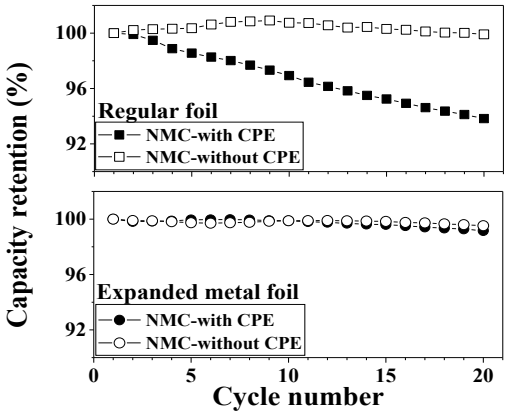
- Prepare composite electrolytes to meet the challenging combination of physical, chemical and manufacturing requirements to protect and stabilize the lithium metal anode

Impact:

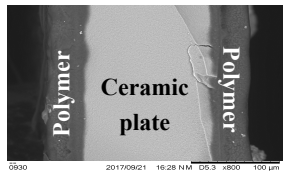
- Design rules developed for this study will guide formation of composites with alternative and improved component phases as they become available.
- A thin, yet robust solid electrolyte membrane will enable use of metallic Li anodes for improved energy density.

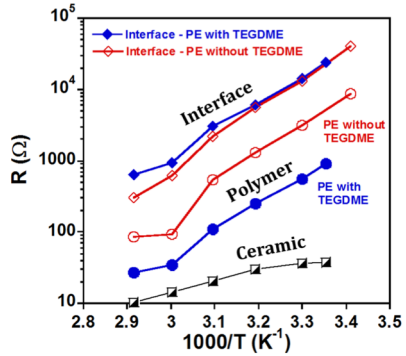
A full battery was fabricated

Cycling data of NMC($LiPF_6$,EC/DMC) cathode/composite electrolyte/Li cell on regular and expanded metal foils



Method for resolving the interface resistance developed





(CPE, PE in the figures = composite, polymer electrolytes)

Accomplishments:

- Verified that spray coating gives good dense membranes (pycnometer measurements).
- Acid base treatment on Ohara particles: surface chemistry change observed, but effect on ion conductivity was limited.
- A transference number of 0.79 of the composite electrolyte was determined.
- Method and experimental protocol for calculating interface resistance between Ohara and PEO+LiTF was identified.
- A full cell was fabricated by spray coating the electrolyte onto the cathode.

FY 18 Milestones:

- Minimize the interface ASR by chemical and mechanical treatment with a goal of < 100 ohm.
- Confirm the effect of DMC plasticizer on polymer structure, Li ion mobility, interface resistance.
- Move beyond model materials like Ohara and PEO. Identify promising polymer ceramic systems with interfacial ASR less than 10 ohm.

FY18 Deliverables: Demonstrate cycleability of full battery incorporating spray coated composite electrolyte and Li anode, optimize battery performance.

Funding: FY18: $400,000 FY17: $400,000, FY16: $400,000