**Lithium Dendrite Prevention for Lithium Batteries**

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**Objective:**
- To enable lithium (Li) metal as an effective anode in rechargeable Li-metal batteries for long cycle life at practical current density.

**Impact:**
- Understand the effects of various lithium salt mixtures, inorganic fillers and polymer types on ionic conductivity, Li CE, Li anode morphology, and battery performances in 4-V Li||NMC cells with relatively high areal loading.
- Develop new hybrid composite electrolytes that can lead to dendrite-free Li deposition with high CE will enhance Li metal anode and improve Li metal battery performances.

**Accomplishments:**
- Demonstrated that LiTFSI-LiBOB is the most stable dual-salt electrolyte among four imide-orthoborate dual-salts electrolytes on the stability of Li metal anode and the cyclability of related Li||NMC batteries.
- Identified the effects of Li capacity utilization (up to 4 mAh cm\(^{-2}\)) on the stability of Li metal anode and the cyclability of related Li||NMC batteries.
- Demonstrated the synergistic effects of additives LiAsF\(_6\) and VC in electrolytes on Li deposition and the long-term cycling performance of Li||NMC333 cells.
- Increased average Li CE from 90.6% to 98.1% by optimizing the solvent compositions and adding combinational additives in LiTFSI-LiBOB/carbonate electrolytes.

**Significantly enhanced Li anode & cell performance**
- (Right) Enhanced Li cycling efficiency and Li||NMC cycling stability by optimizing solvent compositions and adding combinational additives in LiTFSI-LiBOB/EC-EMC electrolytes.
- (Below) Revealed synergistic effects of additives LiAsF\(_6\)+VC in electrolyte on Li deposition morphology.

**FY 18 Milestones:**
- Develop a lithium salt mixture with an ambient melting temperature and an ionic conductivity over 1 mS cm\(^{-1}\)
- Investigate effects of inorganic fillers and polymers on hybrid composite electrolytes
- Develop an inorganic/polymeric hybrid composite electrolyte with ionic conductivity over 1 mS cm\(^{-1}\) and Li CE over 99%
- Achieve over 300 cycles for 4-V Li||NMC batteries with ~ 2 mAh cm\(^{-2}\) cathode loading

**FY18 Deliverables:**
- Quarterly reports and annual report

**Funding:**
- FY18: $400K, FY17: $340K, FY16: $400K