Development of High-Energy Lithium-Sulfur Batteries

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

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Technical Approach:

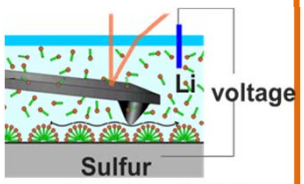
- Study the electrochemical behaviors of high loading sulfur electrodes at relevant scales.
- Investigate the chemistry/electrochemistry of polysulfides in Li-S batteries.
- Use a stable anode to study the stability of S/C composite cathode in Li-S batteries.

Status:

Graphite was successfully employed as an anode for sulphur cathode study in ether based electrolyte without any additive. Identified interfacial reaction mechanism on graphite in the 5Ṁ LiTFSI-DOL.

Technology:

- Use *in situ* AFM to study both the interface of graphite and sulfur reaction processes.
- Enhance the electrolyte penetration of high sulfur loading electrode by employing electrolyte additives.
- Reduce the required electrolyte volume with new sulfur cathode structure/composition design.



In situ AFM

Objectives:

- Develop high energy lithium-sulfur (Li-S) batteries.
- Use advanced in situ techniques to characterize the interfacial reactions in Li-S batteries.
- Investigate the fundamental reaction mechanism of polysulfides in high sulfur loading electrodes.

Deliverables: A stable sulfur cathode with a sulfur loading of 4mg/cm^2, electrode thickness of 60 µm.

Funding:

FY16 Budget: $400K (DOE)

Milestones:

- **Q1:** SEI study on graphite surface in the new EC-free electrolyte
- **Q2:** Demonstrate prototype Li-ion sulfur cells with >95% Coulombic efficiency (no additive) and > 80% capacity retention for 100 cycles.
- **Q3:** Identify effective approaches to facilitate electrolyte penetration within thick sulfur cathode (≥ 4mg/cm^2).
- **Q4:** Complete pouch cell assembly and testing by using optimized electrode and electrolyte.