Development of High-Energy Lithium-Sulfur Batteries

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

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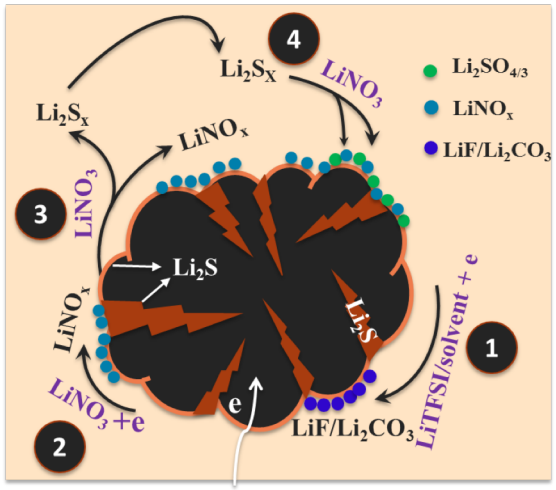
Objective:

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

Impact:

- Li-S batteries have potentially 2-3 times higher energy than that of state-of-the-art Li-ion batteries and largely reduced cost. If successful, the proposed work will accelerate the market penetration of long-range electrical vehicles (EV), required by the EV Everywhere Grand Challenge proposed by DOE/EERE.

Electrolyte degradation and its effects on high loading sulfur cathode



- Identified degradation of electrolyte solvent, salt and additive on sulfur cathode, which affects sulfur utilization and cycle life particularly when using high loading sulfur cathodes and lean amount of electrolyte.

Accomplishments:

- Demonstrated 200 cycles for high loading sulfur electrodes (≥4 mg/cm2) with capacity retention over 80%.
- Identified electrolyte additive degradation mechanism at sulfur cathode side by in-situ/ex-situ techniques.
- Developed polymer coated membrane to minimize quick capacity drop and efficiency fluctuation during initial cycles of thick sulfur electrodes.
- Studied electrolyte/sulfur ratio on battery performance using large size pouch cells and high loading sulfur cathodes.

FY 18 Milestones:

- Study compatibility of electrolyte and binder with carbon host materials and their effects on sulfur utilization and cycle life.
- Design electrochemical cell using ceramic Li^+ conductive separator for focused sulfur cathode study.
- Study failure mechanism of sulfur cathode under lean amount of electrolyte by removing the interference of Li anode.
- Develop functionalized separator to suppress polysulfide shuttle and improve interfacial stability of Li anode.

FY18 Deliverables:

Large area double-side functionalized separator for high energy pouch cell assembly; quarterly/annual report.

Funding: FY18: $400k, FY17: $400K, FY16: $400K