Multifunctional, Self-Healing Polyelectrolyte Gels for Long-Cycle-Life, High-Capacity Sulfur Cathodes in Li-S Batteries

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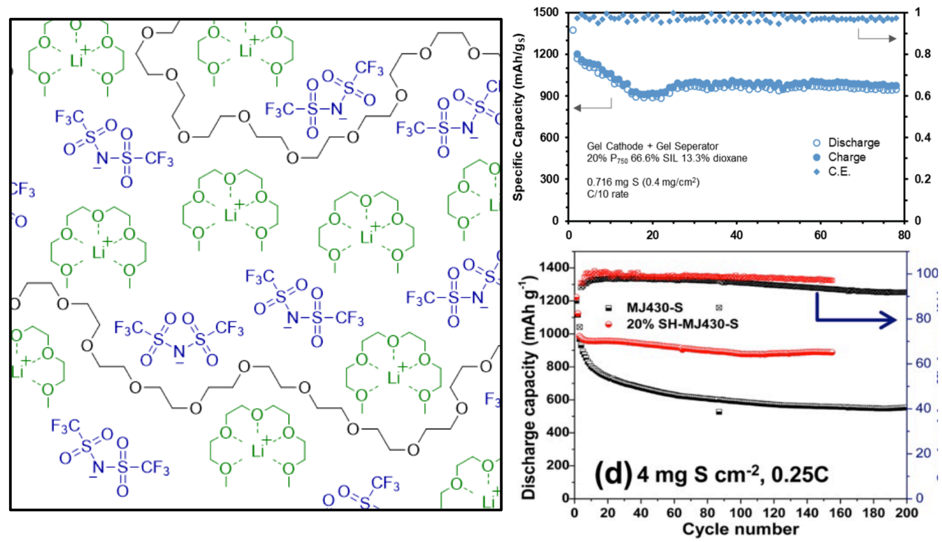
Objective:

Develop novel self-healing and polysulfide-trapping polyelectrolyte gels containing ionic liquid, and demonstrate their potential to enable rechargeable Li-S batteries which meet the EV Everywhere blueprint target.

Impact:

- Rational molecular design of gel electrolytes improves lithium interface stability, polysulfide-trapping, and self-healing for electrode integrity
- Engineered polyelectrolyte gels can greatly improve Li-S battery cyclability
- Low-cost and scalable materials/fabrication enable solution for high-energy-density Li-S EV battery

Molecular Design Enables High Li^+ Conductivity in Self-Healing and Polysulfide-Trapping Ionogels



Accomplishments (FY18):

- Designed, synthesized, and optimized solvate ionogel polyelectrolytes containing varying compositions with lithium ion conductivity > 10^{-3} S/cm and t_{Li+} > 0.5
- Developed fabrication procedures for Li-S cells containing ionogels in both the cathode and separator
- Demonstrated restored mechanical properties of optimized self-healing polymer composites with Young's moduli > 60 Mpa
- Demonstrated significantly improved capacity retention in Li-S cells with polysulfide-trapping thiophenol functionalized carbon cathode with high sulfur loading of 4 mgcm^{-2}

FY19 Milestones:

- Synthesis of materials for optimized gel formulations
- Provide detailed cell fabrication procedures and performance data (capacity and efficiency as a function of cycle number, voltage profiles, self-discharge test results, and other relevant data) for optimized materials used in the practical loading cell testing

FY19 Deliverables: Quarterly reports, Annual report, Test cells with capacity >10 mAh (12 baseline cells, 12 improved cells, documented test procedures for evaluation)

Funding:

— FY19: $416,667, FY18: $416,667, FY17: $416,667