Polymeric Materials for Li Metal Batteries

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

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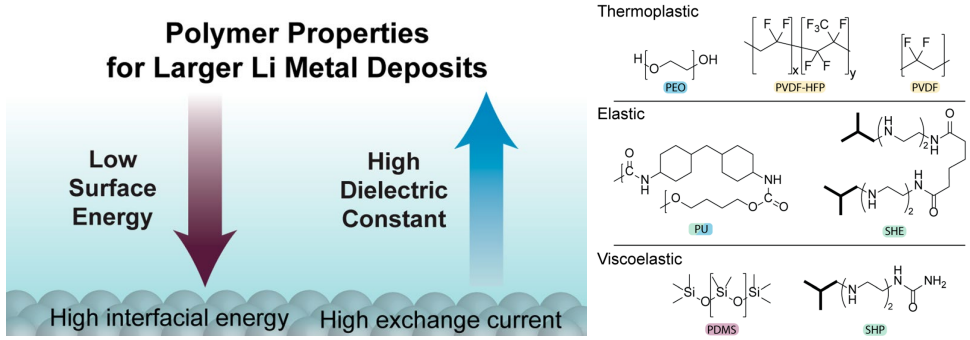
Objective: Explore the rational polymer materials design to effectively suppress the dendrite growth, control volume change and manage side reactions related to lithium metal charge/discharge processes.

Impact:

- Improve cycling stability, Coulombic efficiency and current density of lithium metal anode
- Enable high-energy lithium-metal batteries for electric vehicles and at the same time reduce cost of batteries

Systematically study the effects of different polymer coatings on electrodeposited Li metal and identify the intrinsic benefits from polymer coatings with low surface energy and high dielectric constant. (J. Am. Chem. Soc. 2018, 140, 11735−11744)



Accomplishments:

- Design and synthesize a series of self-healing polymers (SHPs) with adaptive mechanical property
- Show the Li metal deposition morphology with self-healing polymer as protection layer
- Establish standard processing method for polymer coating and demonstrate improved cycling life for Li metal under SHP protection
- Additionally apply SHP to silicon anode and demonstrate enhanced performance (*Adv. Energy Mater.* 2018, 8, 1703138)

FY 19 Milestones:

- Identify at least two different types of SHPs with promise to suppress dendrites (Q1)
- Identify one SHP to suppress Li dendrites with current density at 1 mA/cm^2 and 150 cycles of stable Li cycling (Q2)
- SHP suppressing Li metal dendrite with current density at 2 mA/cm^2 and 150 cycles of stable Li cycling (Q3)
- SHP suppressing Li metal dendrite with current density at 3 mA/cm^2 and 150 cycles of stable Li cycling (Q4)

FY19 Deliverables: Quarterly reports, battery cells meeting the desired deliverables

Funding:

— FY19: $450,000, FY18: $300,000, FY17: $300,000