High Conductivity and Flexible Hybrid Solid State Electrolyte

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

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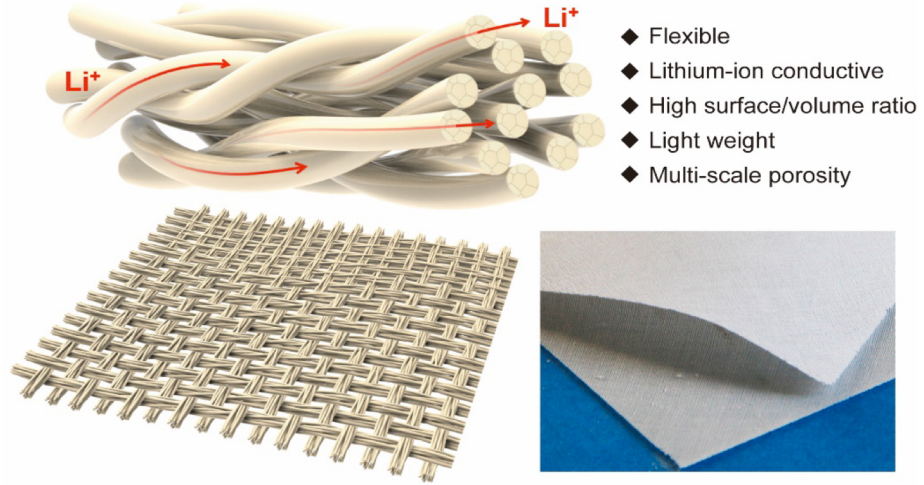
- ***Objectives:***
- Develop flexible, high mechanical strength (~ 10 MPa) and thermally stable, hybrid solid state electrolytes.
- Achieve high room temperature ionic conductivity (≥0.5 mS/cm) and stable interface with Li metal that blocks dendrites at current densities up to 3 mA/cm^2.
- Demonstrate Li-S battery performance of 450 Wh/kg and 1000 Wh/L, for 500 cycles.
- ***Impact:***

Success of this project will enable high-energy density, safe Li metal batteries with 2-3X energy density, that can be processed within the existing battery manufacturing infrastructure.

Hybrid Solid State Electrolyte

Flexible, solid-state, ion-conducting membrane with 3D garnet fiber networks for lithium batteries



Accomplishments:

- Fabricated 4 cm by 4 cm garnet nanofiber membrane
- Synthesized polymer electrolyte coated garnet nanofiber hybrid electrolytes
- Modeled Li^+ transport and developed understanding of Li^+ diffusion in garnet nanofibers and its response to mechanical deformation.
- Achieved hybrid SSE with a high ionic conductivity (~0.5x10^{-3} S/cm), high electrochemical stability (~ 4.5V), and high mechanical property.

FY 18 Milestones:

- Fully characterize electrochemical, mechanical and thermal properties of hybrid solid state electrolyte (SSE)
- Fabricate hybrid SSE with a thickness of ~20 µm and understand the Li-hybrid SSE interface through Li-SSE-Li symmetric cells
- Understand Li stripping and plating in thin SSE at a current density of ~3 mA/cm^2 without shorting
- No Li dendrites at ~3 mA/cm^2 for 500 cycles

FY18 Deliverables: Quarterly and annual reports

Funding:

— FY17: $403,384, FY18: $415,679, FY19: $430,938