High Conductivity and Flexible Hybrid Solid State Electrolyte

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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/cm².
- 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.

**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/cm² without shorting
- No Li dendrites at ~3 mA/cm² for 500 cycles

**FY18 Deliverables:** Quarterly and annual reports

**Funding:**
- FY17: $403,384, FY18: $415,679, FY19: $430,938