Electrochemically Stable High Energy Density Lithium-Sulfur Batteries

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

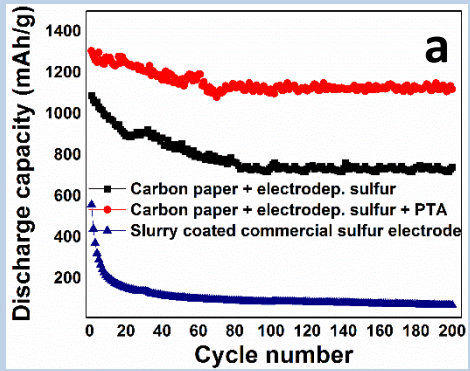
PI/Co-PI: Prashant N. Kumta (UPitt)/ Moni Kanchan Datta (UPitt)/ Oleg I. Velikokhatnyi (UPitt)

- ***Objective:*** To successfully generate novel lithium ion conductor (LIC) coatings, doped sulfur nanoparticles (SNPs), new high loading directly doped sulfur architecture (DDSA) cathodes and polysulfide trapping agent (PTA) configurations to improve the performance of sulfur cathodes and enable Li-S batteries exhibiting high energy densities for meeting the EV everywhere blueprint target.

Impact:

- With the development of the proposed lithium sulfur battery (LSB) technology high energy density > 500 Wh/kg will be achieved. it is thus anticipated that the EVs/PEVs will be powered by these batteries.

Title of Graph/Concept



(a) Electrochemical cycling behavior of the PTA – DDSA compared with commercial sulfur and **(b)** novel inorganic CFM compared with the performance of commercial sulfur cathodes.

Accomplishments:

- Synthesis of Composite Polymer Electrolytes (CPEs) with inorganic nanoparticles exhibiting exceptional stability over 100 cycles with commercial sulfur electrodes.
- Development of DDSA – PTA electrode improved the specific capacity of sulfur demonstrating 1305 mAh/g initial capacity and ~1128 mAh/g for over 200 cycles with 0.0014%/cycle fade rate.
- Design, synthesis and electrochemical characterization of inorganic Complex Framework Material (CFM) that demonstrate high sulfur loading and maintain a capacity of 1051 mAh/g for over 100 cycles with 0.0017% fade at 0.2C rate.

FY 18 Milestones:

- Preparation of high capacity LIC coated SNPs
- Synthesize CFM electrodes with very low fade rate
- Identify and synthesize high loading (high sulfur weight%) DDSA electrode
- Prismatic/pouch-type full cell assembly of integrated electrodes (IE) with optimum thickness.

FY18 Deliverables:

Sulfur Cathodes with >350Wh/kg, >750Wh/l, >1400 mAh/g, cyclability (~1000 cycles), fade ≤0.01% per cycle, CE: ~80%. Full cells of 4 mAh.

Funding:

— FY18: $333,333, FY19: $166,667