Innovation Center for Battery500

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

PI/Co-PI Jun Liu (PNNL) and Yi Cui (Stanford University)

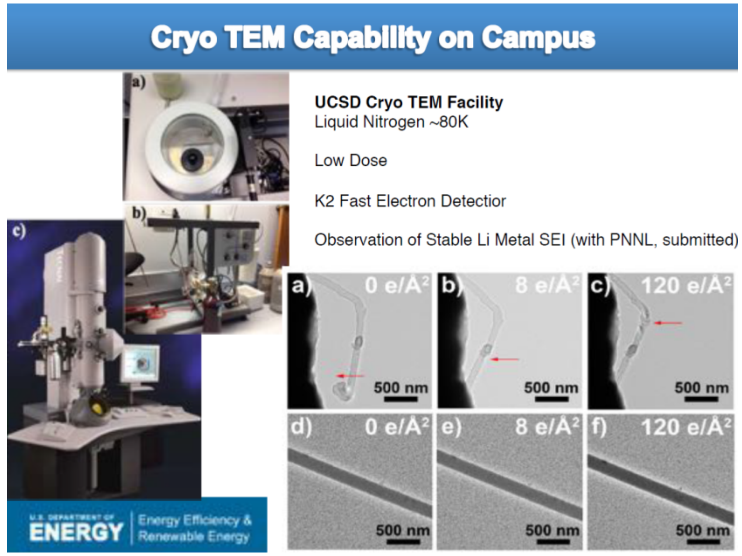
- ***Objective:***

The project aims to develop commercially viable lithium battery technologies with a cell level specific energy of 500 Wh/kg through innovative electrode and cell designs that enable the extraction of the maximum capacity from advanced electrode materials. In addition, the project aims to achieve 1000 cycles for the developed technologies

Impact:

- The results of this project will be used for the development of technologies that will significant increase the energy density, cycle life and reduce the cost of rechargeable batteries for electric vehicles

Title of Graph: Battery500 team developed Cryo TEM to study the Li metal anode for high energy density batteries



Accomplishments:

- Completed the screening and selection for candidates of cathode materials, electrolytes, electrolyte additives, separators, for the Li-NMC full cell assembly
- 3D structured Li/carbon cloth composite anode has been developed and shows good rate capability and cycling stability in Li||NMC622 cells.
- Core−shell nanoparticle coating has been prepared as an interfacial layer for dendrite free Li metal anodes.
- A robust coating layer of crystalline methyl lithium carbonate was formed in-situ on Li metal surface to protect Li metal anode.
- Cryo TEM technology was developed for Li anode study

FY 18 Milestones:

- Q1: Scale up the capacity of high Ni content NMC to 500 g
- Q2: Develop stage 1 pouch cell testing protocols and provide updated component parameters toward 350 Wh/kg
- Q3: Develop procedures to identify Li anode failure in coin cells and pouch cells.
- Q4: Develop and implement methods to improve and understand cycle and calendar life limitations of pouch cells.

FY18 Deliverables: Integrate materials and components developed in FY18 into 1 Ah pouch cell and demonstrate 350 Wh/kg cell with over 50 charge discharge cycles

Funding:

— FY18: $8,000,000, FY17: $8,000,000, FY16: $8,000,000

New Lamination and doping Concepts for Enhanced Li – S Battery Performance

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EXAMPLE

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

Objective:

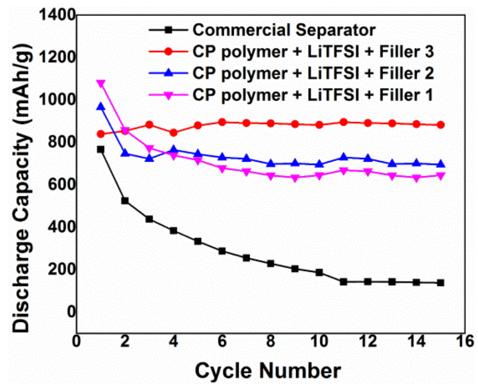
Successfully demonstrate generation of novel approaches using improved lithium ion conductor (LIC) coatings and doping strategies to improve performance of sulfur cathodes for Li-S batteries to achieve the EV everywhere blueprint target.

Impact:

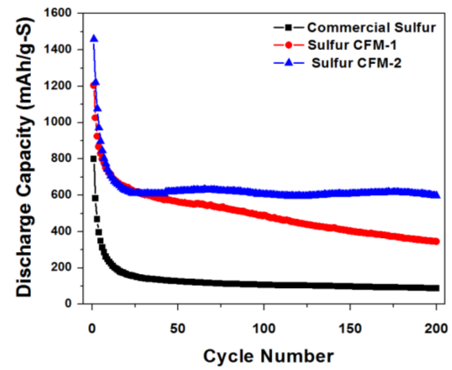
- LIC coatings and complex framework materials (CFM) will help retain polysulfides improving performance
- Theory and experiments will identify and develop doped LICs with much higher Li-ion conduction
- Novel dopants identified by theory and experiments will improve electronic conductivity, rate capability and cyclability

Improved Cycling Behavior

Composite Polymer (CP) Based Sulfur Batteries Showing No Fade



CFM Based Electrodes Demonstrating Minimal Fade Over 300 Cycles



Accomplishments:

- Demonstrate effectiveness of LIC materials in improving sulfur cathode cyclability (4-5 mAh/cm^2).
- Synthesis of high stability flexible sulfur nanowires (~0.003%fade/cycle) and complex framework materials (CFM) with stability over ~300 cycles.
- Development of polymeric LIC systems with doped oxide nanoparticles exhibiting stability over 100 cycles. Composite polymers (CPs) exhibits exception no fade characteristics for commercially obtained sulfur electrodes.
- Identification of doped inorganic LIC systems using first principles and corresponding synthesis of LIC materials displaying ~3 orders of improvement in ionic conductivity.

FY 17 Milestones:

- Synthesis of VACNT and LIC coated chemically synthesized nanosulfur based composite materials
- Design and engineer doped sulfur nanoparticles with improved electronic and ionic conductivity
- Design and engineer high capacity doped LIC coatings on doped nanosulfur

FY17 Deliverables: Quarterly reports, Full cells (4 mAh) meeting the desired deliverables

Funding:

— FY17: $416,687, FY16: $416,687, FY15: $416,687