Advanced in situ Diagnostic Techniques for Battery Materials

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

PI/Co-PI: Xiao-Qing Yang and Xiqian Yu (BNL)

Technical Approach:

- Using synchrotron based *in situ* x-ray diffraction technique to study the Fe substituted high voltage spinel during charge-discharge cycling
- Using the combination of *in situ* synchrotron based X-ray diffraction (XRD), x-ray absorption spectroscopy (XAS) and mass spectroscopy (MS) to perform thermal stability and diagnostic studies of new electrode materials.

Status:

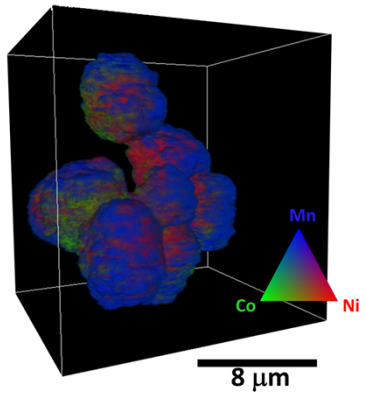
- Developed new synchrotron based in situ diagnostic tools and applied them to Li-ion battery studies.

Technology:

Develop and apply the combination of synchrotron based in situ XRD, XAS and MS for diagnostic studies of new electrode materials for lithium-ion batteries.

Develop and apply transmission X-ray microscopic (TXM) to study concentration gradient NCM cathode

3-D Co, Ni, Mn mapping by TEM



Objectives:

- Develop new advanced in situ material characterization techniques
- Support the development of new cathode and anode materials for the next generation of lithium-ion batteries for plug-in hybrid electric vehicles

Deliverables: Complete and report the studies on:

•in situ x-ray diffraction studies on Fe substituted high voltage spinel during charge-discharge cycling

•TR-XRD and TR-XAS studies on structural changes of $Li_{1-x}Ni_{1/3}Co_{1/3}Mn_{1/3}O_2$ during high rate charge

Funding:

— Duration one year from October 1, 2015

— Total - $600,000.00 DOE - $600,000.00

Milestones:

- Q1 Milestone: Complete the thermal stability studies of Fe substituted high voltage spinel cathode materials using time-resolved x-ray diffraction (XRD) and MS techniques.
- Q2 Milestone: Complete the energy resolved transmission X-ray microscopic (TXM) investigation on new concentration gradient NCM cathode sample particles.
- Q3 Milestone: Complete the TR-XRD studies of the structural changes of $Li_{1-x}Ni_{1/3}Co_{1/3}Mn_{1/3}O_2$ during high rate charge.
- Q4 Milestone: Complete the TR-XAS studies of the structural changes of $Li_{1-x}Ni_{1/3}Co_{1/3}Mn_{1/3}O_2$ during high rate charge .