Advanced Cathode Materials for High Energy Lithium Ion Batteries

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

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Technical Approach:

- Synchrotron techniques and microscopy are used to characterize Ni-rich NMC materials as a function of composition, synthesis method, and electrochemical history. Novel synthesis methods (e.g., spray pyrolysis) are used to make improved materials.

Status:

- High Ni-content NMCs have been synthesized and are under study.

Objectives:

- Optimize synthesis of Ni-rich NMCs
- Understand what limits high voltage cycling behavior
- Develop strategies to mitigate surface reactivity, including Ti-substitution, coatings, and graded composition materials
- Coordinate with other team members (W. Tong, R. Kostecki, B. McCloskey, C. Ban) to understand what limits cycling behavior.

Deliverables: High capacity (> 200 mAh/g) cathode materials with improved safety and long cycle life.

Funding:

Duration: 3 yrs (Yr 1)

FY16 Budget: $675K (DOE)

Milestones:

- **Q1:** Synthesize baseline NMC-523 and 622 and Ti-substituted variants by spray pyrolysis and co-precipitation
- **Q2:** Complete surface characterization of pristine materials by XAS and XPS
- **Q3**: Complete soft XAS experiments on electrodes cycled to high potentials
- **Q4:** Go/no go decision on core-shell composites made by infiltration and re-firing of spray-pyrolyzed hollow spherical particle.

Technology:

Elemental mapping of a spray-pyrolyzed NMC-442 cathode material, with elemental associations (right), obtained by a synchrotron transmission x-ray microscopy (nanotomography) technique. *Nature Energy* doi:10.1038/nenergy.2015.4 (2016).