Development of High Energy Cathode Materials

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

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Technical Approach:

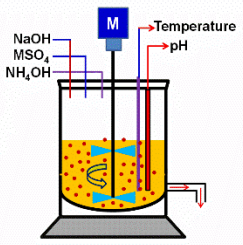
- Increase the capacity of NMC cathodes by improving the stability of NMC at higher cutoff voltage.
- Synthesize high tap density Ni-rich NMC cathode materials with optimized co-precipitation method.

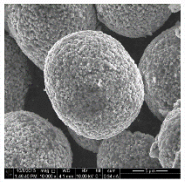
Status:

Identified the composition effects on the performance of Ni-rich NMC cathodes at high charge cutoff voltages and optimized the synthesis conditions. A discharge capacity > 190 mAh g^{-1} with less than 10% capacity fade was obtained in 100 cycles.

Technology:

- Optimize co-precipitation method to synthesize Ni-rich NMC cathodes with high specific discharge capacity.
- Increase charge cut-off voltage to incr discharge capacity of NMC cathodes.
- Use advanced microscopic characterizations to investigate the capacity degradation mechanism of N cathodes charged to high voltages.





Objectives:

- Develop low-cost, high-energy cathode materials for PHEV and EV applications.
- Identify synthesis-structure-performance relationship in cathode materials.
- Stabilize the electrode/electrolyte interfaces for long-term stable cycling of NMC cathode.

Deliverables: A cathode with 190 mAh g^{-1} for 100 cycles, ≤10% capacity fading

Funding:

Duration: 3 yrs (Yr 1)
FY16 Budget: $400K (DOE)

Milestones:

- **Q1:** Identify NMC cathode with190 mAh g^{-1}.
- **Q2:** Complete multi-scale quantitative atomic level mapping to identify the behavior of Co, Ni, and Mn in NMC during battery charge/discharge.
- **Q3:** Optimize charge voltage based on the correlation between structure stability and charge voltage of NMC.
- **Q4:** Optimize compositions of NMC materials to achieve improved electrochemical performance (90% capacity retention in 100 cycles).