Novel Cathode Materials and Processing Methods

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**Technical Approach:**
- Advance the performance and stability of high-capacity ‘layered-layered’ cathodes via integrated spinel components
- Explore spectrum of processing routes (0.01-1kg batches) to synthesize high-energy/power/life, layered-layered-spinel (LLS) electrodes

**Status:**
- Progress has been made in the development of composite, LLS electrodes that can deliver discharge capacities ≥200 mAh/g with high first cycle efficiencies (~90%)

**Technology:** Demonstration of ‘Layered-Layered-Spinel’ processing and high capacity LLS compositions (200 mAh/g)

**Objectives:**
- Development of low-cost, high-energy and high-power, Mn-oxide-based cathodes
- Improvement of design, composition and performance of advanced electrodes with stable architectures and surfaces
- Atomic-scale understanding of electrochemical and degradation processes enabling the rational design of new materials

**Deliverables:** Synthesis and electrochemical characterization of advanced, Mn-based, metal-oxide cathodes

**Funding:**
- Duration: 3 yrs (Yr 1)
- FY16 Budget: $500K

**Milestones:**
- **Q1:** Optimize the composition and cycling stability of structurally integrated materials with low Li$_2$MnO$_3$ contents
- **Q2:** Scale up promising materials to 10g-100g-1kg
- **Q3:** Identify unique surfaces and coatings
- **Q4:** Integrate milestones to deliver 200-230 mAh/g at greater than 3.5 V (~800 Wh/kg) on extended cycling

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**LLS by CSTR (tap ~2.3 g/cm$^3$)**

**Li half-cell**
- 4.6-2.5 V (1$^{st}$ cyc)
- 4.45-2.5 V (cyc 2-5)
- 15 mA/g (30$^\circ$C)

**Oxalate synthesis**
- Charge
- Discharge

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