Rechargeable Lithium-Air Batteries

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**Objective:**
- Stabilize Li metal anode, reduce the charging over-potential to improve cycling life of high energy Li-O₂ batteries. Investigate the degradation mechanism in Li-O₂ chemistry.

**Impact:**
- Protect Li metal anode by *ex-situ* and *in-situ* strategies to enable more stable operation of high-capacity Li-O₂ battery.
- Improve the cycling life of Li-O₂ batteries using concentrated electrolytes and optimized electrodes.

**Accomplishments: (FY17)**
- Demonstrated concentrated LiTFSI-3DMSO electrolyte with optimized salt-solvent coordination to protect Li metal anode and to enhance electrolyte stability.
- Invented an efficient approach to protect both Li metal anode and carbon air-electrode by a simple *in-situ* electrochemical pre-charging process under inert atmosphere, which greatly improved the cycling life of Li-O₂ battery.
- Identified for the first time the effects of temperature on ORR mechanism of Li-O₂ batteries in -20 ~ 40 °C and E-TEM in-situ observation on ORR-OER processes.

**Enhanced cycle life of Li-O₂ battery**

Untreated Li metal anode exhibits severe corrosion (a, b), while *in-situ* pre-treatment greatly stabilizes Li metal anode even after 110 cycles in Li-O₂ cells (c, d).

Optimal *in-situ* pre-charging treatment (4.3V-10min) can greatly enhance the cycle life of Li-O₂ to 110 cycles.

**FY 18 Milestones:**
- Investigate electrolyte additives to form stable SEI layer on Li metal anode of Li-O₂ batteries
- Develop inorganic/polymeric composite hybrid electrolyte membranes to protect Li metal anode in Li-O₂ batteries
- Develop thick air electrodes of at least 4 mg/cm² areal loading for Li-O₂ batteries
- Evaluate cycling performance of Li-O₂ batteries with protected Li metal anode and thick air electrode

**FY18 Deliverables:**
- Quarterly reports and annual report

**Funding:**
- FY18: 200K, FY17: 170K, FY16: 200K