Rechargeable Lithium-Air Batteries

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

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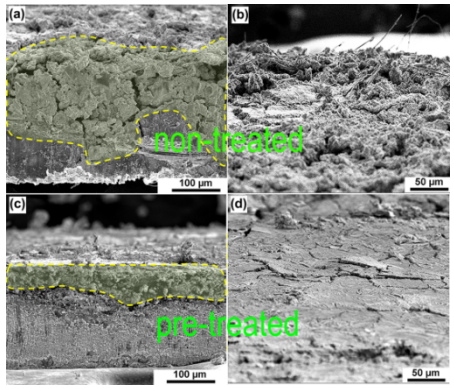
Objective:

- Stabilize Li metal anode, reduce the charging over-potential to improve cycling life of high energy Li-O_2 batteries. Investigate the degradation mechanism in Li-O_2 chemistry.

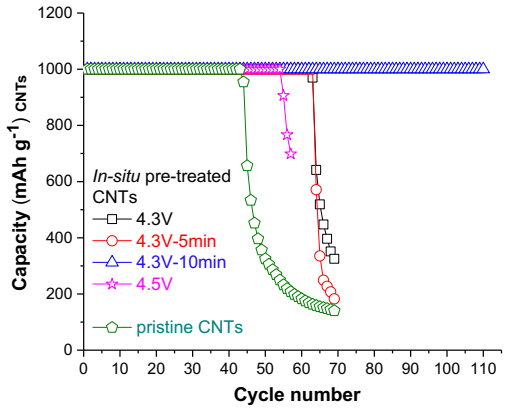
Impact:

- Protect Li metal anode by *ex-situ* and *in-situ* strategies to enable more stable operation of high-capacity Li-O_2 battery.
- Improve the cycling life of Li-O_2 batteries using concentrated electrolytes and optimized electrodes.

Enhanced cycle life of Li-O_2 battery



Untreated Li metal anode ehibits sereve corrosion (a, b), while *In-situ* pre-treatment greatly stabilizes Li metal anode even after 110 cycles in Li-O_2 cells (c, d).



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

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-O_2 battery.
- Identified for the first time the effects of temperature on ORR mechanism of Li-O_2 batteries in -20 ~ 40 °C and E-TEM in-situ observation on ORR-OER processes.

FY 18 Milestones:

- Investigate electrolyte additives to form stable SEI layer on Li metal anode of Li-O_2 batteries
- Develop inorganic/polymeric composite hybrid electrolyte membranes to protect Li metal anode in Li-O_2 batteries
- Develop thick air electrodes of at least 4 mg/cm^2 areal loading for Li-O_2 batteries
- Evaluate cycling performance of Li-O_2 batteries with protected Li metal anode and thick air electrode

FY18 Deliverables:

- Quarterly reports and annual report

Funding:

— FY18: 200K, FY17: 170K, FY16: 200K