

# Rechargeable Lithium-Air Batteries

U.S. DEPARTMENT OF

## ENERGY

Energy Efficiency &  
Renewable Energy

**PI/Co-PI:** Ji-Guang Zhang (PNNL) / Wu Xu (PNNL)

### Objective:

- Develop rechargeable lithium-oxygen ( $\text{Li-O}_2$ ) batteries with long-term cycling stability through in-depth research on more stable electrolytes, highly efficient catalysts for air electrodes, and protection of Li metal anodes.

### Impact:

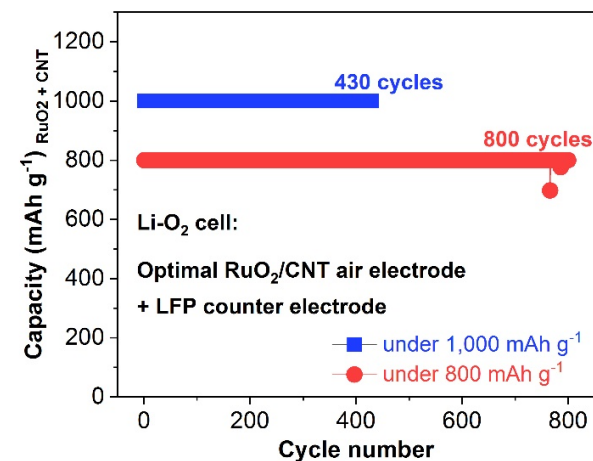
- Develop efficient catalyst-decorated air electrodes for long cycling stability of  $\text{Li-O}_2$  batteries.
- Protect Li metal anode by *ex-situ* and *in-situ* strategies to enable more stable operation of  $\text{Li-O}_2$  battery.
- Explore high-loading air-electrodes that could lead to long cyclability in high energy  $\text{Li-O}_2$  batteries.

### Accomplishments:

- A low-cost in-situ electrochemical method has been developed to simultaneously produce ultrathin protective films on both CNTs air electrodes and Li metal anodes, significantly suppress oxidation of carbon air electrodes, and minimize corrosion of Li anode.
- $\text{Li-O}_2$  cells based on an optimal  $\text{RuO}_2/\text{CNTs}$  air electrode and LFP counter electrode demonstrated superior cycling stability (800 times under a constant capacity of  $800 \text{ mAh g}^{-1}$ ).
- Combination of the efficient thick air-electrode with  $4 \text{ mg cm}^{-2}$  and the protected Li anode could result in desired enhancement in good cycling of  $\text{Li-O}_2$  batteries.

### Significantly improved cycle life of $\text{Li-O}_2$ cells

has been demonstrated by the use of an optimized  $\text{RuO}_2/\text{CNTs}$  air-electrode and LFP counter electrode



### FY19 Milestones:

- Develop highly elastic and stable protective composite layers for Li anode in  $\text{Li-O}_2$  batteries (Q1)
- Protect Li metal anode by using gel-polymer crosslinked electrolytes for  $\text{Li-O}_2$  batteries (Q2)
- Develop stable host structure to protect Li anode in oxygen rich environment (Q3)
- Evaluate cyclability of  $\text{Li-O}_2$  batteries with protected Li metal anodes and optimized air electrodes (Q4)

### FY19 Deliverables:

- Quarterly reports and annual report

### Funding:

— FY19: 200K, FY18: 200K, FY17: 170K