Development of Novel Electrolytes and Catalysts for Li-Air Batteries

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

PI/Co-PI: Khalil Amine (Argonne), Larry A. Curtiss (Argonne), and Jun Lu (Argonne)

Objective:

- Understand the role of electrolyte and catalyst in the discharge product growth mechanism and charge mechanism in Li-O_2 batteries through experiment and theory

Impact:

- Control of discharge and charge processes can achieve increased efficiency, cycle life, and capacity
- Li-O_2 batteries can potentially achieve high energy densities for long range vehicles

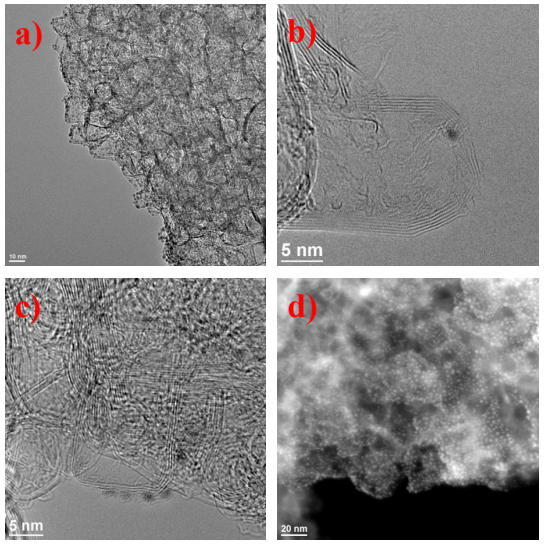

Figure (a) TEM image of Pt-hollow graphene nanocages (HGNs). (b,c) High-magnification TEM images of Pt-HGNs. (d) DF-STEM image of Pt-HGNs.

Accomplishments:

- Synthesized ultra-small Pt coated hollow graphene nanocages as cathodes for Li-O_2 batteries.
- Developed a titration method using a Ti(IV)OSO_4 solution to determine amount of Li_2O_2 in a discharge product.
- Extended the titration method to make it a more powerful tool to determine the amounts of LiO_2 as well as Li_2O_2 present in the discharge product.
- Developed a hierarchical networked structure to decouple pathways for electrolyte and oxygen gas, significantly improving Li-O_2 battery performance.

FY18 Milestones:

- Use of size selected Ir clusters as electrocatalysts and formation of Ir_3Li alloys
- Investigation of dependence of discharge composition on electrolyte from experiment and theory
- Effect of different electrocatalyst on charge mechanism in Li-O_2 batteries

FY18 Deliverables: Quarterly reports, new catalysts for small charge overpotentials, new electrolytes

Funding: FY18: $500,000 FY17: $500,000 FY16: $400,000