Overcoming the Challenges in Li-S and Li-O_2 Batteries

Linda NAZAR, SiHyoung OH, Robert BLACK, JinHyon LEE, and Scott EVERS
Department of Chemistry
University of Waterloo
200 University Ave W., Waterloo Ontario Canada N2L 3G1

Li-S and Li-O_2 batteries represent promising technologies to meet the needs for high energy density storage systems. The presentation will compare and contrast the two, and focus on their improvement with emphasis on porous cathode materials comprised of two-phase nanophase systems deliberately designed to overcome some of the challenges presented by inherent cell chemistries. For both energy storage systems, porous carbons are critical cathode elements as a host to either store the sulfur and its discharge product Li_2S_2/Li_2S; or to store the discharge product, Li_2O_2, in the case of Li-O_2 batteries. These embody mesoporous carbon materials with high surface area, large pore volume, and good electrical conductivity to function as electrically conductive scaffolds. Nonetheless, the requirements are different for the two systems. In the case of Li-S cells, complete confinement of active mass including soluble reaction intermediates during cycling is vital. The diffusion of polysulfides which is mostly retarded by the nanostructure may still occur at a slow rate, which limits the long term cycling performance. We will discuss the merit of a variety of our recent approaches to solving these issues. In the case of Li-O_2 cells, we will discuss our exploration of high surface area transition metal oxide catalysts where surface defects offer increased levels of catalytic activity and stability, and hierarchical porosity can aid in optimizing storage capacity and charging characteristics.