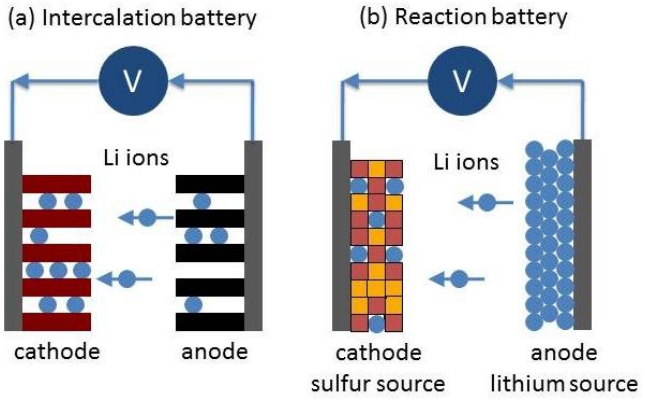
Lithium-Sulfur Reaction Batteries for High Capacity Energy Storage

University of California Santa Barbara

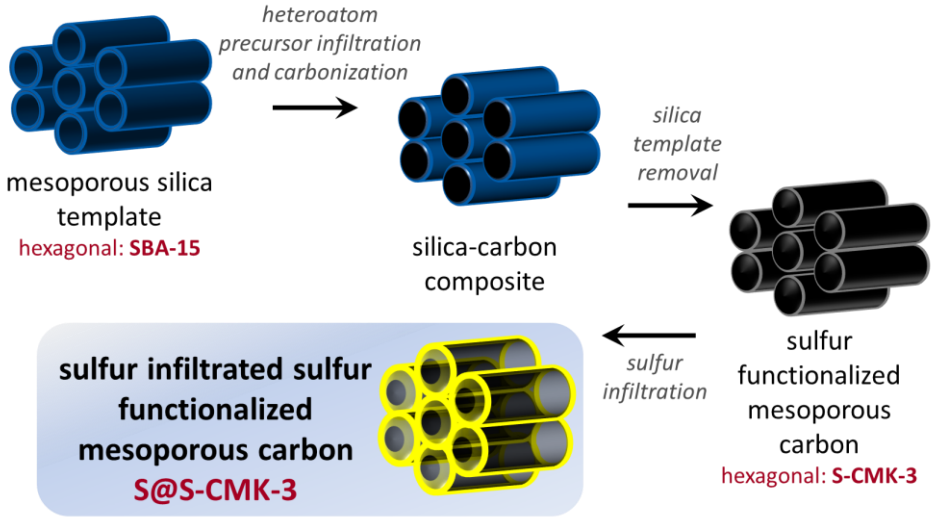
ConvEne IGERT
Supported by the National Science Foundation

Reaction type systems such as the Li-S cell have the potential to increase both the discharge capacity and cyclability over ubiquitous intercalation Li-ion batteries. The biggest challenge of the Li-S battery system is developing a sulfur-containing, conductive cathode which exhibits high surface area for increased reactivity of insulating sulfur as well as lithium polysulfide retention for enhanced cyclability. During the discharge of a Li-S cell, a step-wise reaction mechanism forms intermediate long-chain Li_2S_x species which are soluble in the organic electrolytes conventionally used. These polysulfide species can then migrate to the Li anode to form Li_2S causing a steady decrease in capacity as the cell is cycled due to the loss of active material.

Our goal is to prepare modified, mesoporous conductive carbons which contain sulfide moieties in order to achieve both of these goals. The lithium polysulfide intermediates traditionally lost to electrolyte during cycling are better retained within the sulfur-modified carbons than in nearly identical carbon pores with no sulfur modification. We consider the effectiveness of S-containing mesostructured carbon materials in a reaction type Li-S battery versus unmodified porous carbons and high surface area carbon cathodes.



Reaction type batteries can exhibit capacities much higher than intercalation systems. The theoretical capacity of the Li-S system is 1670 mA.h/g while traditional intercalation cells are limited to around 300 mA.h/g.



The mesoporous carbon hosts are hard templated with highly ordered mesoporous silica. This procedure is adapted from D. Ji., K.T. Lee, & L. Nazar, *Nature Materials,* **2009**, 8, 500-506.

Kimberly See