To realize the next generation rechargeable lithium batteries, it is critical to use novel electrode materials with higher lithium storage capacity. However, the high capacity electrode materials are facing a serious common problem of fast capacity fading. To improve the cycle stability, rational design and synthesis of the electrode materials becomes essential. In this presentation, a number of novel lithium battery electrode materials including silicon anode, tin anode, and sulfur cathode will be presented.

Silicon (Si) and tin (Sn) possess very high lithium storage capacities. However, they suffer from fast capacity fading induced by the drastic volume expansion and shrinkage during lithium insertion and extraction. A rational solution to address this problem is to embed Si or Sn particles into a conductive and resilient porous framework to accommodate the volume change. This presentation will highlight a mesoporous Si-C composite material prepared from seeded dispersion polymerization method, and Sn-C composite particles via spray pyrolysis technique.

Besides enhancing anodic capacity, the capacity of cathode can also be improved by using sulfur that has high theoretical capacity of 1675 mAh g⁻¹ (current cathodic capacity is about 160 mAh g⁻¹). The greatest challenge for sulfur cathode is the fast capacity fading due to the dissolution-away of active materials in electrolyte during charge-discharge cycling. This presentation will introduce two novel strategies to stabilize sulfur: the first one is to impregnate sulfur into disordered carbon nanotubes as barrier; the second one is to synthesize novel sulfur-carbon composite enabled by Li-nitrile interaction.

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