Novel porous nano-sized materials development for lithium ion battery anode application

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Improvement of energy density and power density is attracting much attention for lithium ion batteries to expand its applications. The preparation of different high capacity anode materials has been explored, such as alloys, metal oxides, and metal sulfides. Silicon is known to have the highest theoretical specific capacity (4200 mAh g^{-1}) and considered to be an optimal anode material for the energy intensive LIBs. Silicon oxide is one of the good candidates for silicon containing anode materials. Because during Li reaction, Li_2O, generated by the reaction of Li with SiO during the initial lithiation process, can act as a buffer component to improve the cycling performance of electrode.

In this paper, novel Si/Al oxide material has been proposed to use as lithium ion battery anode, which has specific porous structure. The structure is helpful to accommodate the volume change and alleviate the structure strain during Li ion's insertion and extraction. Both nano-sized (70-100nm) and submicron-sized (200-300nm) materials were synthesized by hydrothermal methods for better comparison. XRD, SEM, FTIR had been used to characterize the materials.

During electrochemical and performance test, lithium foil was used as counter electrode. The electrolyte consisted of 1M $LiPF_6$ in a non-aqueous solution of ethylene carbonate (EC) and dimethyl carbonate (DMC) with a volume ratio of 1:1. Cyclic voltammetry and electrochemical impedance spectroscopy were tested for the mechanism study. Cyclic and rate discharge performance were tested at different charge/discharge rates.