SnO_2-carbon composite based anodes for Li-ion batteries

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Lithium ion battery (LIB) has been widely regarded as the most promising power source for the coming plug-in hybrid electric vehicle (PHEV) and electric vehicle (EV). New generation electrode materials with high energy, high rate or high safety performance have been extensively studied to meet the challenge requirements for PHEV and EV applications. State-of-the-art anode material for LIB is graphite, which has a theoretical capacity of 372 mAh g-1. Tin-based oxides have been considered as a potential substitute for graphite because of their higher theoretical reversible capacity (e.g., 781 mAh g-1 for SnO_2).(1) The practical application of SnO_2, however, is hampered by poor cyclability arising from the large volume change in repeated charging and discharging process, which causes mechanical failure and the loss of electrical contact. (2, 3)

At Argonne National Laboratory, we recently developed a series of approaches to fabricate tin oxide- carbon composites as high capacity, long life anode materials for LIB. We report here a novel ethylene glycol-mediated solvothermal-polyol route for synthesis of SnO_2-carbon composites. One example is the SnO_2-carbon nanotubes composites. The prepared SnO_2-CNTs consist of highly dispersed 3-5 nm SnO_2 nanocrystals on the surface of CNTs. As anode materials for Li ion batteries, the composites showed high rate capability and superior cycling stability with specific capacity of 500 mAh g-1 up to 300 cycles (figure 1). The second example is SnO_2-graphene composites. Similar to SnO_2-CNTs system, highly dispersed 3-5 nm SnO_2 nanocrystals were formed on the surface and in between the graphene layers. Longer cycle stability was found for the SnO_2-graphene system, which implies that two-dimensional support is better that one-dimensional support for stabilizing SnO_2.

Detailed synthesis, structural characterization and electrochemical test results of the SnO_2-carbon composites will be discussed.

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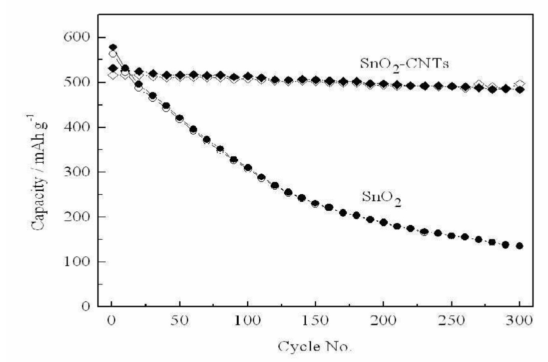

Figure 1. Charge/discharge capacities of the pure SnO_2 and SnO_2-CNTs composite electrodes

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