Facile Synthesis of BiSb/C Composite Anodes for High-Performance and Long-Life Lithium-Ion Batteries

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Abstract

Alloy-type antimony (Sb) is considered as an attractive candidate anode for high-energy lithium-ion batteries (LIBs) because of its high theoretical specific capacity and volumetric capacity. However, Sb suffers from enormous volume variation during cycling, which causes electrode cracking and pulverization, and hence the fast capacity decay and poor cyclability, limiting its practical applications as a LIB anode. Herein, we report a facile, scalable, low-cost and efficient route to successfully fabricate BiSb/C composites via a two-step high-energy mechanical milling (HEMM) process. The as-prepared BiSb/C composites consist of nanosized BiSb totally embedded in a conductive carbon matrix. As LIB anodes, BiSb/C-73 (with 30 wt % carbon) electrodes exhibit excellent Li storage properties in terms of stable high reversible capacities, long-cycle life, and high-rate performance. Reversible capacities of 583, 466, 433 and 425 mAh g–1 at a current density of 500 mA g–1 after 100, 300, 500 and 1000 cycles, respectively, were achieved. In addition, a high capacity of 380 mAh g-1 can still be retained at a high rate of 5 A g-1. Such outstanding cycling stability and rate capability could be mainly attributed to the synergistic effects between the ability of nanosized BiSb particles to withstand electrode fracture during Li insertion/extraction and the buffering effect of the carbon matrix. The as-prepared BiSb/C composites are based on commercially available and low-cost Bi, Sb and graphite materials. Interestingly, HEMM is more convenient, efficient, scalable, green and mass-production route, making as-prepared materials attractive for high-energy LIBs.

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