Electrospun Antimony Tin Oxide Nanofibers with Superior Stability as Anode Material for Li-ion Batteries

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Tin oxide (SnO₂) is a promising alternative material to replace graphite as an anode material for lithium ion battery (LIB). However, bulky neat SnO₂ still suffers from serious pulverization and rapid decay of capacity during charging and discharging. In this study, to enhance the cyclic stability and rate performance of SnO₂-based anode, antimony tin oxide (ATO)-containing nanofibers were synthesized by a two-step process in this work, including electrospinning of SnCl₂/SbCl₃/PVP and calcination at 400°C-600°C in air. The electrospun fibers developed from solid to hollow structures through a Kirkendall diffusion process. All ATO nanofibers treated at different temperatures showed an extraordinary initial capacities, in the range of 1563 mAhg⁻¹-1711mAhg⁻¹ during the first discharge. Moreover, the fibers calcinated at 400 °C exhibited excellent cyclic stability, namely the capacity at the 200th cycle was 730 mAhg⁻¹ at a current density of 0.2Ag⁻¹, which was 76% of its capacity at the 2nd cycle. In addition, this material also displayed excellent rate performance, delivering 327 mAhg⁻¹ at 3.2Ag⁻¹ after 60 cycles. These values were superior to those calcinated at 600°C, Because of its reduced volume, the carbon matrix provides a large surface area and a short diffusion length in the treated ATO fibers. provided by the carbon matrix in the 400°C-treated ATO fibers. These results revealed the importance of combining the buffering carbon phase with the nano-fibrous structure for the improvement of SnO₂-based electrode, and would pave the way for further enhancing the performance of anodes for LIBs.

Keywords: Antimony tin oxide; Hollow nanofibers; Anode; Li-ion battery

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