

# Developing Sn<sub>4</sub>P<sub>3</sub>/SbSn Nanocomposites for Anode Application in Sodium Ion Batteries

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## Abstract

Developing suitable anode materials for sodium ion batteries (SIBs) remains as challenging in order to enable practical application of SIBs for large scale storage. Among various material choices, Tin phosphide (Sn<sub>4</sub>P<sub>3</sub>) is a promising anode in SIBs, due to its high theoretical capacity of 1131 mA h g<sup>-1</sup> and reasonably low redox potential (~0.3-0.6 V vs. Na/Na<sup>+</sup>). However, phase pure Sn<sub>4</sub>P<sub>3</sub> suffers from poor cycle stability, which can be ascribed to the volume expansion induced stress generation/electrode pulverization and chemical instability in the electrode during charging/discharging.

In the present work, we have designed nanocomposite of Sn<sub>4</sub>P<sub>3</sub> and SbSn, aiming at creating a suitable buffer system to alleviate the stress generated and thus enhancing the cycle stability of the whole electrodes. A facile one-pot solvothermal method has been developed to synthesize Sn<sub>4</sub>P<sub>3</sub>/SbSn nanocomposites (Figure 1a). We show that introduction of SbSn to Sn<sub>4</sub>P<sub>3</sub> can improve the cycling stability of the phase pure Sn<sub>4</sub>P<sub>3</sub> electrode without sacrificing its practical capacity, although the theoretical capacity of SbSn (754 mA h g<sup>-1</sup>) is lower than that of Sn<sub>4</sub>P<sub>3</sub>. The nanocomposite anode delivers a highest capacity of 614.7 mA h g<sup>-1</sup> at a current density of 100 mA g<sup>-1</sup>, and shows superior cycle stability (Figure 1b) that pure Sn<sub>4</sub>P<sub>3</sub>. The intact interface between the Sn<sub>4</sub>P<sub>3</sub> and SbSn in the nanocomposite and their synergetic effect play important roles in enhancing the electrochemical performance of the composite electrode.

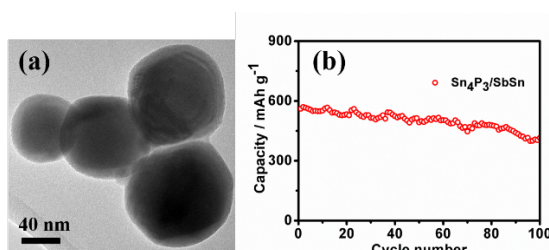


Figure 1(a) TEM image of the Sn<sub>4</sub>P<sub>3</sub>/SbSn nanocomposites, (b) cycle stability of the Sn<sub>4</sub>P<sub>3</sub>/SbSn nanocomposite anode at a current density of 100 mA/g.

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