Supplementary Information

Comparison between SnSb-C and Sn-C composites as anode materials for Li-ion batteries

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Synthesis of SnO$_2$ precursor

The SnO$_2$ precursor was prepared by a hydrothermal method. In a typical synthesis, 2 mmol SnCl$_4$·5H$_2$O were added to a 40 mL mixture of ethanol and water (1/1; v/v) under magnetic stirring. When the mixture was dispersed to form a homogeneous solution, 8ml 1M NaOH solution was dropwise added to the above solution under magnetic stirring . After 1h stirring, the mixture was transferred into a Teflon-lined stainless steel autoclave with a capacity of 60 mL for hydrothermal treatment at 180 °C for 24 h. Finally, the product was collected and washed with with deionized water and ethanol for several times and then dried under vacuum at 50 °C for 12 hour.

SnO₂ nanocomposite precursor characterization

Figure S1. (a) XRD pattern, (b) SEM and (c) TEM image of the SnO$_2$ nanoparticles.

Fig. S1a show the XRD pattern of the SnO$_2$ nanoparticles precursor. All the identified diffraction peaks can be assigned to the tetragonal phase of cassiterite SnO$_2$ (JCPDS card No. 41-1445). The size and morphology of the as prepared SnO$_2$ nanoparticles precursor were investigated by SEM (Figure S1b) and TEM (Figure S1c).

Sn-C composite characterization

Figure S2. (a) XRD pattern, (b) Raman spectrum, (c) SEM image, (d) TEM image of the Sn-C composite.

Figure S2a show the XRD pattern of the Sn-C composite. All the identified diffraction peaks can be assigned to the body-centered cubic (bcc) Sn (JCPDS card No.86-2265). Raman spectra (Figure S2b) confirmed the presence of carbon in the sample as two peaks locating at 1305 and 1580 cm^{-1} are detected for the characteristic D-band and G-band of graphite, which originate from disordered and ordered graphitic carbon, respectively. The morphology of the as prepared Sn-C composite was investigated by SEM (Figure S2c) and TEM (Figure S2d).

Figure S3. (a) bright-field STEM image of SnSb-C composite after 120 charge/discharge cycles at 100 mA g^{-1}, (b-d) EDX maps of Sn, Sb, and C, respectively;

Figure S4 AC impedance of the electrodes composed of SnSb-C and Sn-C composite.

Table. S1 Comparison of SnSb-C (this work) and various reported SnSb-C or SnSb-graphene composites.

Material	Reversible capacity/mAh g^{-1}	Rate (mA g^{-1})	Initial efficiency	Ref.
SnSb-C composite	672.2/120th cycles	100	71%	This work
SnSb/carbon nanotube	860/40th cycles	1C	79%	[35]
Porous SnSb/C nanocomposites	420/50th cycles	100	65%	[33]
Graphene supported Sn–Sb@carbon core-shell particles	896/30th cycles	80	65.3%	[32]
Sn/SnSb negative electrodes	560 /40th cycles	200	52%	[38]
Nanosized SnSb Alloy	500/35th cycles	--	70%	[22]
SnSb/Carbon Nanotube	480/50th cycles	100	48.3%	[23]
SnSb/MCMB/carbon core–shell composite	422.5/100th cycles	100	83%	[36]
SnSb nanoparticles into hollow carbon nanofibers	659/150th cycles	50	66%	[37]
Nanostructured SnSb/MOx (M= Al or Mg)/C composites	498/150th cycles	100	77.3%	[41]
SnSb/C nanocomposite	550/300th cycles	100	45%	[39]