Water evaporating Route to mesoporous SnO₂ nanospheres with superior anodes for lithium-ion batteries

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Experimental section

Synthesis of SnO₂ mesoporous materials

In a typical synthesis, 0.45 g of Na₂SnO₃·3H₂O was introduced into 5 mL of distilled water in an open container. After Na₂SnO₃·3H₂O was completely dissolved, 25 mL oleic acid was added to the Na₂SnO₃ solution. Then the solution foamed immediately and turned into ivory-yellow spumescence-like mixture. After that, the container was maintained at 150 °C for 5 h at ambient pressure, and then cooled to room temperature naturally. The ivory-yellow solid was washed thoroughly with ethanol, and dried at 60 °C for 12 h. Some of the as-prepared oleic acid-coated SnO₂ samples were further treated at 300 °C in air for 2 h to obtained SnO₂ mesoporous nanomaterials. As comparison, in control experiments, one reaction was performed in a 50 mL Teflon-lined stainless steel autoclave and kept in the same temperature and time. In another reaction, the synthetic condition is the same as that for SnO₂ mesoporous spheres but without adding oleic acid.

Characterization

The transmission electron microscope (TEM) images were taken with a Hitachi model
H-800 transmission electron microscope, with an accelerating voltage of 200 kV. High-resolution transmission electron microscope (HRTEM) photographs were obtained on a JEOL-2010 transmission electron microscope. Scanning electron microscope (SEM) images and energy-dispersive X-ray spectroscopy (EDX) pattern were realized on Hitachi S4800. X-Ray diffraction (XRD) analysis was performed on a Rigaku D/max Diffraction System using a Cu Kα source (λ = 0.15406 nm). Fourier transform infrared (FTIR) spectra of the samples were recorded using a WQF-410 Fourier transform infrared spectrophotometer (Beijing Secondary Optical Instruments, China).

**Electrochemical Measurements**

The electrochemical properties of the samples treated at 300 °C were evaluated using CR2016-type coin cells. The active materials were mixed with carbon black and carboxyl methyl cellulose (CMC) in a weight ratio of 80: 10: 10 with water as a dispersant. A Celgard 2400 microporous polypropylene membrane was used as a separator. The electrolyte consisted of a solution of 1 M LiPF₆ in ethylene carbonate/dimethyl carbonate/diethyl carbonate (1: 1: 1, in wt %). CR 2016 coin-type cells were assembled in an argon-filled glove box with water and oxygen contents less than 1 ppm. The discharge and charge measurements were carried on an Arbin BT2000 system at the voltage window of 0.01-2 V. The cyclic voltammograms (CVs) experiment was also tested at room temperature on the Arbin battery test system (0-3 V, 0.5 mV s⁻¹).
**Fig. S1** TEM images of SnO$_2$ samples synthesized at Teflon-lined stainless steel autoclave.

**Fig. S2** SEM images of SnO$_2$ samples synthesized without adding oleic acid.
**Fig. S3** FTIR spectra of (1) precursors and (2) SnO$_2$ mesoporous nanomaterials treated at 300 °C.

**Fig S4** EDX spectra of SnO$_2$ nanospheres treated at 300 °C.
**Fig. S5** Charge-discharge curves of the samples at a current density of 0.1 C.