

Journal Name

COMMUNICATION

Controlled Synthesis of Mesoporous Hollow SnO₂ Nanococoons with Enhanced Lithium Storage Capability

Lu Li, Bo Guan, Lingyu Zhang, Zhongmin Su, Haiming Xie* and Chungang Wang*

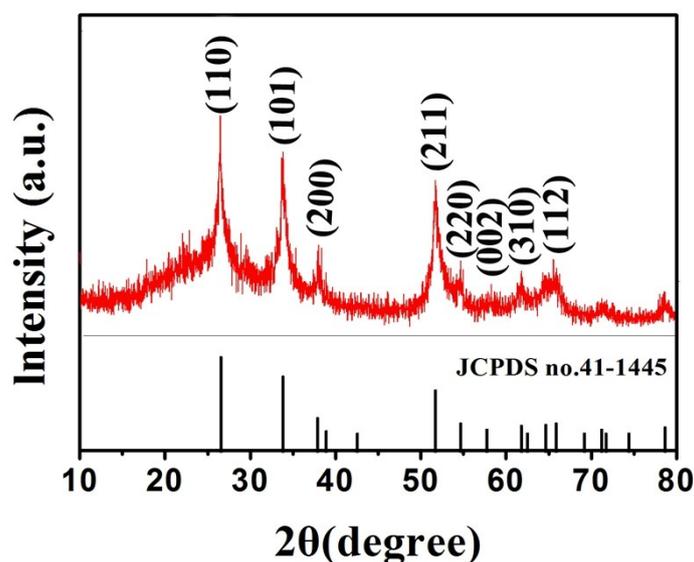


Fig. S1 XRD pattern of the SnO₂ hollow nanococoons.

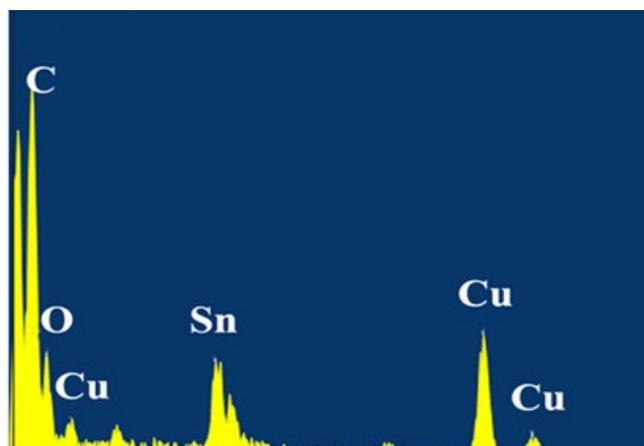


Fig. S2 EDX spectrum of the SnO₂ hollow nanococoons.

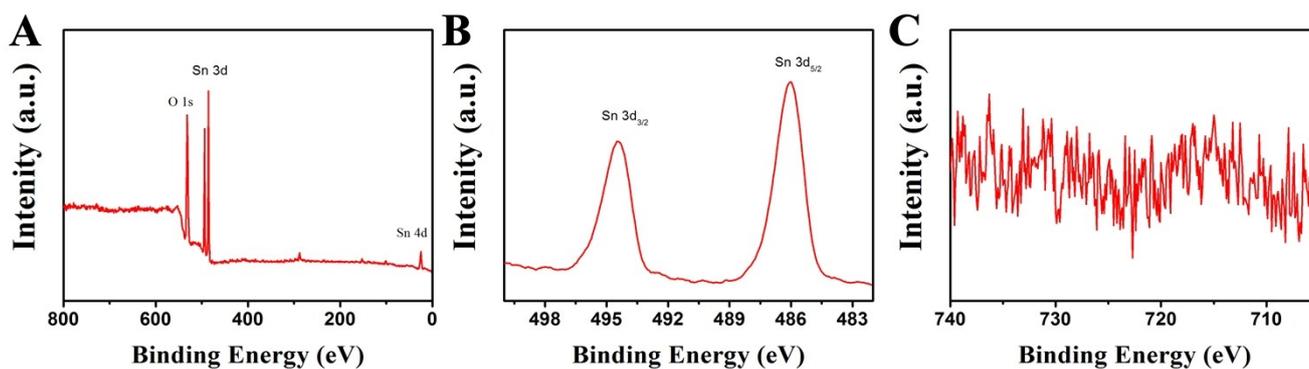


Fig. S3 (A) XPS spectra of the SnO₂ hollow nanococoons and the corresponding Sn 3 d (B) and Fe 2p (C) fine spectrum.

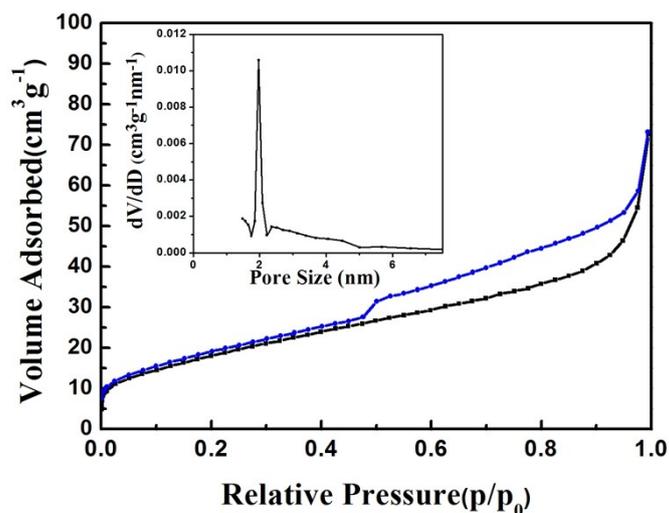


Fig. S4 Nitrogen adsorption–desorption isotherms of the as-synthesized SnO₂ hollow nanococoons. Inset: The pore size distribution.

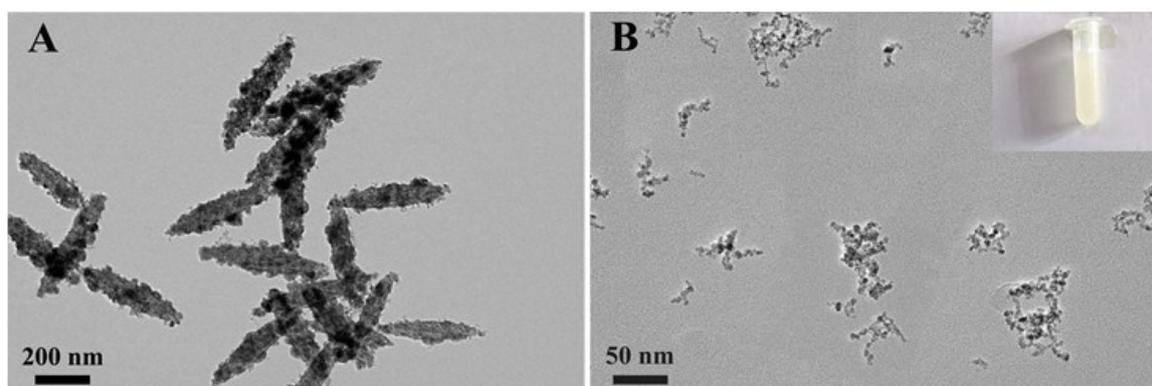


Fig. S5 Control experiments showing the effect of Sn⁴⁺ and Sn²⁺ ions on the formation of SnO₂ nanococoons. Without (A) Sn²⁺ and (B) Sn⁴⁺.

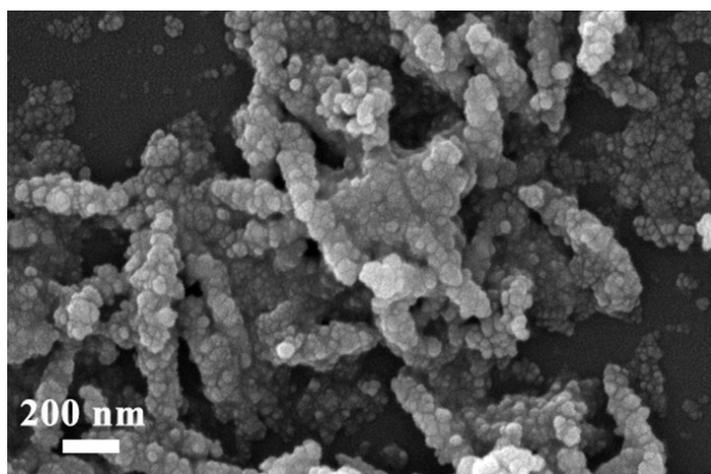


Fig. S6 SEM image of mh-SnO₂ NCs synthesized with 20 mg SnCl₄.

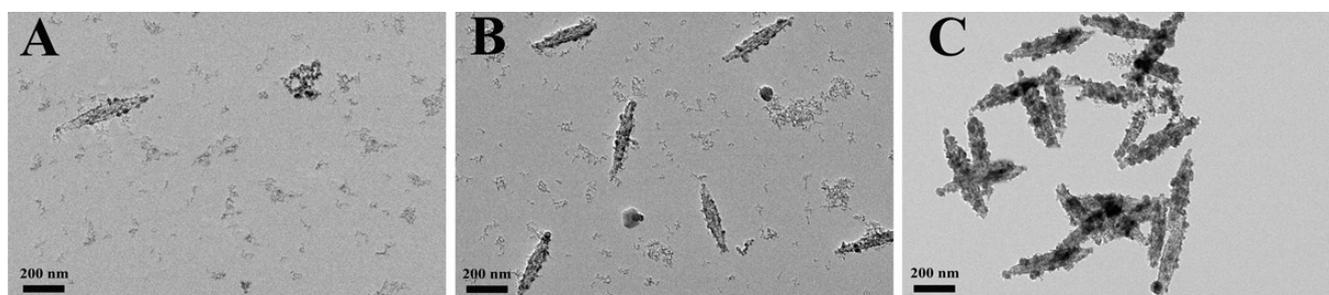


Fig. S7 TEM image of SnO₂ nanococoons after the text of cycling performance: (A) 5 mg SnCl₄; (B) 10 mg SnCl₄; (C) 15 mg SnCl₄.

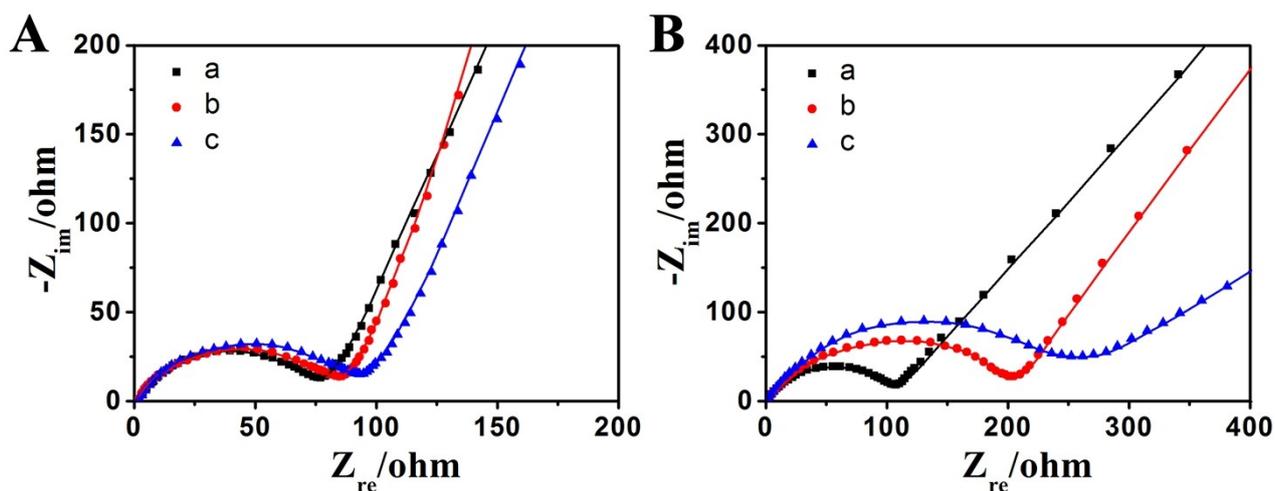


Fig. S8 Nyquist plots of mh-SnO₂ NCs synthesized with (a) 10 mg SnCl₄, (b) 15 mg SnCl₄, and (c) 5 mg SnCl₄ after one charge/discharge cycles (A) and one hundred charge/discharge cycles (B).

Experimental Section

Materials. Iron(III) chloride anhydrous (FeCl_3), tin(II) chloride dehydrate ($\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$), stannic chloride ($\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$), potassium phosphate monobasic (KH_2PO_4), and anhydrous ethanol were purchased from Sinopharm Chemical Reagent Beijing Co., Ltd and used without further purification. Deionized water was used in all experiments.

Characterization. Transmission electron microscopy (TEM) was performed on a JEOL-2100F transmission electron microscope under 200 kV accelerating voltage. Transmission electron microscopy (TEM) was performed with a JEOL-100CX electron microscope under 80 kV accelerating voltage. FE-SEM images were obtained using an XL30 ESEM-FEG field-emission scanning electron microscope (FEI Co.). X-ray diffraction (XRD) patterns were obtained on a D8 Focus diffractometer (Bruker) with Cu-KR radiation ($\lambda = 0.15405$ nm). N_2 sorption analysis was performed by an intelligent gravimetric analyzer Autosorb-iQ (Quantachrome).

Electrochemical characterization. Electrochemical performances of the active material were evaluated in Li test cells. The working electrode was made by dispersing 80 wt% active material, 10 wt% carbon black, and 10 wt% polyvinylidene fluoride (PVDF) binder in N-methylpyrrolidone (NMP) as solvent to form a homogeneous slurry. The slurry was then spread on Cu foil. The coated electrodes were dried in vacuum at 120 °C for 12 h. The electrolyte was 1 M LiPF_6 in a mixture of ethylene carbonate (EC) and dimethyl carbonate (DMC) (1:1 volume). Pure lithium foil was used as counter electrode. The cells were assembled in an argon-filled glove box. The discharge-charge cycling was performed within a voltage range of 0.01-2.0 V on a battery test instrument (CT2001A, LAND, China) at ambient temperature. Cyclic voltammetry (CV) was implemented on a CHI660E electrochemical workstation at a scan rate of 0.1 mV s^{-1} between 0.0 and 3.0 V.

Synthesis of $\alpha\text{-Fe}_2\text{O}_3$ nanospindles. 1.3 g of FeCl_3 is added into 400 mL of deionized (DI) water at 100 °C for 72 h on a magnetic stirrer. Followed by cooling to room temperature, the Fe_2O_3 nanospindles were collected by centrifugation and redispersed in water for further usage.

Synthesis of SnO_2 nanococoons. Firstly, 0.001 g of the $\alpha\text{-Fe}_2\text{O}_3$ nanospindles crystals was dissolved in deionized (DI) water (10 mL) by magnetic stirring. Then, $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ powder (0.015 g) and $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ powder (0.01 g) were added to the mixture. After ultra-sonication for about 10 minutes, the mixture was

transferred into a Teflon-lined stainless steel autoclave with a capacity of 15 mL and heated at 200 °C for 20 h. Finally, the products were collected by centrifuge and rinsed several times with water and ethanol.