

Supplementary Information

Controllable Synthesis of SnO₂@C Yolk-Shell Nanospheres as a High-Performance Anode material for Lithium Ion Batteries

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1. Experimental details for measurements and characterization.

X-ray diffraction (XRD) patterns were recorded on a Bruker D8 X-ray diffractometer (Germany) with nickel-filtered Cu K α radiation (40 kV, 40 mA). Field-emission scanning electron microscopy (FESEM) images were obtained on a Hitachi S-4800 microscope (Japan). Transmission electron microscopy (TEM) and High-resolution TEM (HRTEM) measurements were carried out on a JEM 2100F microscope (Japan) operated at 200 kV. The samples for TEM and HRTEM measurements were suspended in ethanol and dropped onto holey carbon films supported on Cu grids. Nitrogen sorption isotherms were measured at -196 °C with a Micromeritics Tristar 3020 analyzer (USA). Before measurements, the samples were degassed under vacuum at 180 °C for 6 h. The Brunauer–Emmett–Teller (BET) method was utilized to calculate the specific surface areas, using adsorption data in a relative pressure range from 0.04 to 0.2. The pore volumes and pore size distributions were derived from the adsorption branches of isotherms, using the non-local density functional theory (NLDFT) model. The total pore volume was estimated from the amount adsorbed at a relative pressure P/P₀ of 0.995. Thermogravimetric analysis (TGA) was conducted on a Mettler Toledo TGA-SDTA851 analyzer (Switzerland) from 30 to 900 °C under air with a heating rate of 5 °Cmin⁻¹. Raman spectrum was recorded with a Renishaw inVia Reflex Raman spectroscope by using an exciting wavelength of 632.8 nm from a He–Ne laser.

2. Supporting figures.

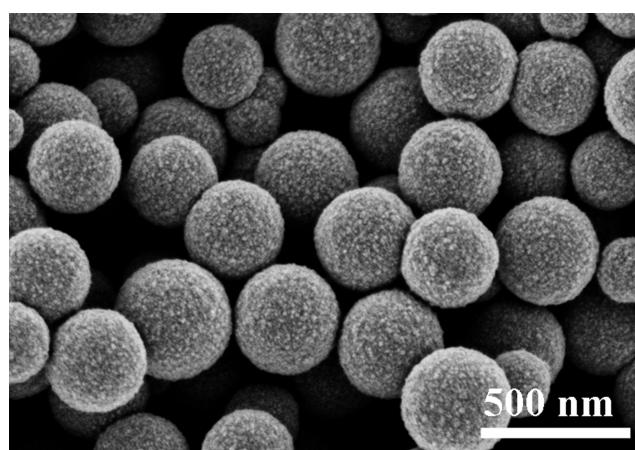


Fig. S1 The FESEM image of the hollow SnO_2 nanoparticles prepared through a solvothermal method by using potassium stannate as the precursor in a mixed solvent of ethanol/water at 150 °C for 24 h.

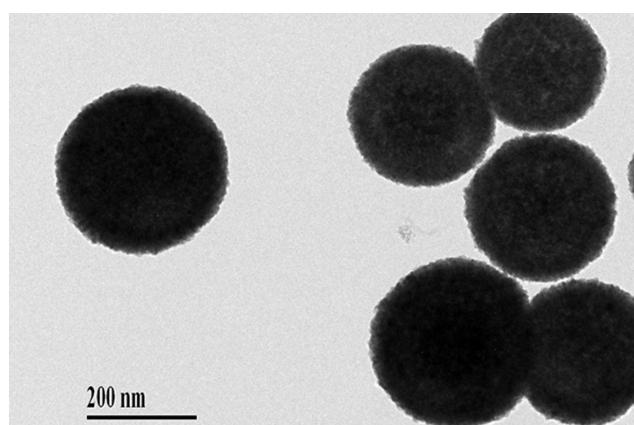


Fig. S2 The TEM image of the hollow SnO_2 nanoparticles prepared through a solvothermal method by using potassium stannate as the precursor in a mixed solvent of ethanol/water at 150 °C for 24 h.

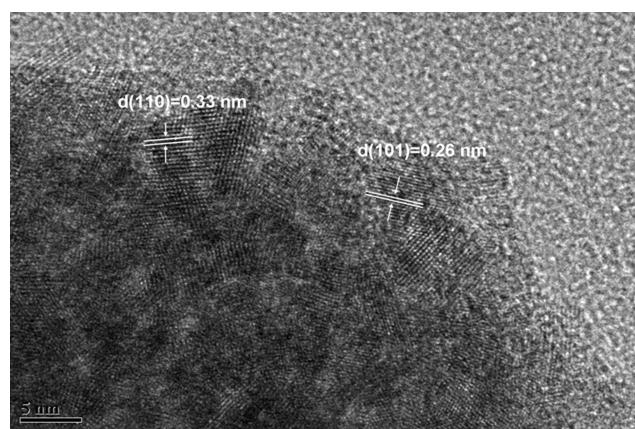


Fig. S3 The HRTEM image of the hollow SnO_2 nanoparticles prepared through a solvothermal method by using potassium stannate as the precursor in a mixed solvent of ethanol/water at $150\text{ }^\circ\text{C}$ for 24 h.

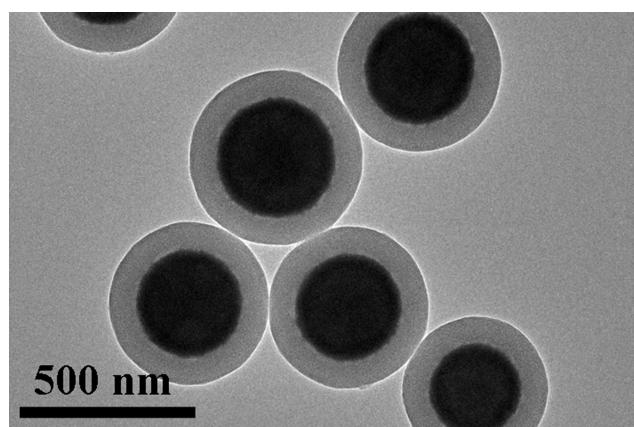


Fig. S4 The TEM image of the $\text{SnO}_2@\text{SiO}_2$ core-shell nanospheres prepared through a sol-gel coating process by using TEOS as a silica source.

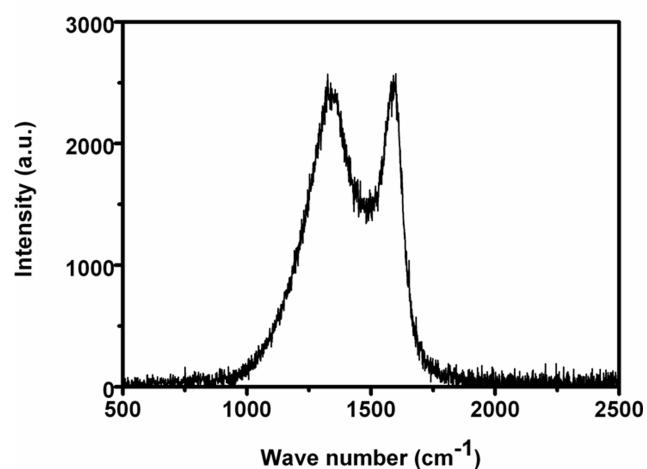


Fig. S5 Raman spectrum of the $\text{SnO}_2@\text{SiO}_2@\text{C}$ core-shell nanospheres before the removal of the silica layer.

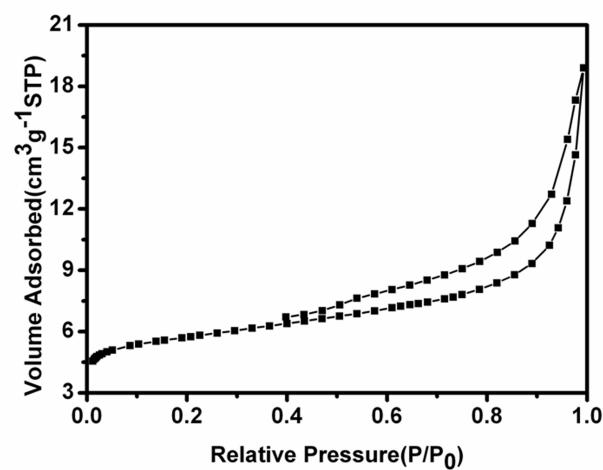


Fig. S6 N₂ sorption isotherms of the SnO₂@SiO₂@C core-shell nanospheres before the removal of the silica layer.

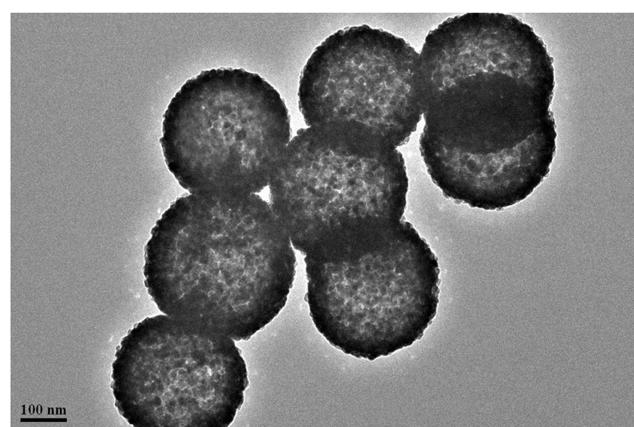


Fig. S7 The TEM image of the pure hollow SnO₂ particles obtained after the calcination under N₂ at 600 °C for 2 h.

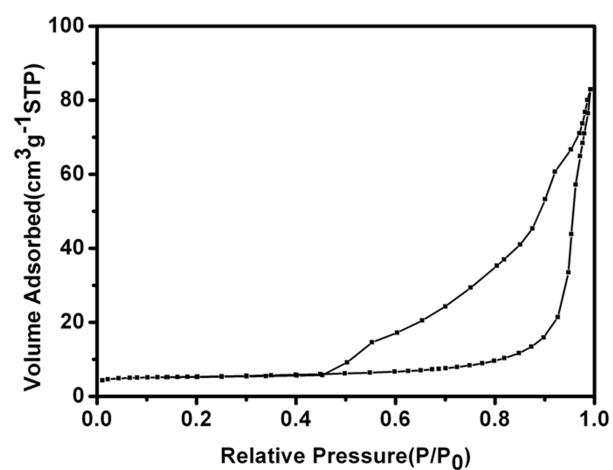


Fig. S8 N₂ sorption isotherms of the pure hollow SnO₂ particles obtained after the calcination under N₂ at 600 °C for 2 h.

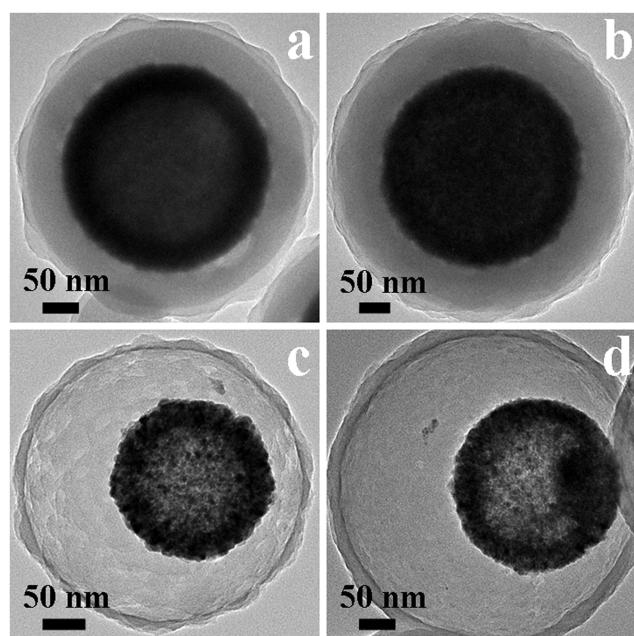


Fig. S9 TEM images of the $\text{SnO}_2@\text{SiO}_2@\text{C}$ core-shell nanospheres synthesized with different amount of TEOS: 0.5 (a) and (b) 0.75 mL; TEM images of the $\text{SnO}_2@\text{C}$ yolk-shell nanospheres synthesized with different amount of resorcinol: 0.15 (c) and (d) 0.20 g.