

Electronic Supplementary Information for

SnO₂ nanosheets grown on graphene sheets with enhanced lithium storage properties

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Experimental section

Materials Preparation

The graphene oxide (GO) sheets were first synthesized by a modified Hummers' method.¹⁻² In a typical synthesis of G-SnO₂ NSs, 3 mg of GO sheets was dispersed into 40 mL of 10 mM mercapto acetic acid solution by ultrasonication for 30 minutes. 0.3 mL of HCl solution (37 wt%, Sigma-Aldrich) was added to mercapto acetic acid solution. After stirring for 10 minutes, 100 mg of tin(II) chloride dihydrate (SnCl₂·2H₂O; 99%, Sigma-Aldrich) and 0.5 g of urea were added. After stirring for 5 minutes, the reaction solution was then transferred to a 60 mL Teflon-lined stainless steel autoclave and kept in an electric oven at 120 °C for 6 h. The autoclave was then taken out from the oven and left to cool down to room temperature. The black precipitate was collected by centrifugation, washed thoroughly with ethanol, and dried at 80 °C for 12 h. The as-prepared GO-SnO₂ NSs were further treated at 400 °C in the atmosphere of 5% H₂ balanced by N₂ for 2 h with a heating rate of 1 °C min⁻¹ to obtain the G-SnO₂ NSs.

Material Characterizations

The product morphology was examined using field-emission scanning electron microscopy (FESEM; JEOL, JSM-6700F, 5 kV) and transmission electron microscopy

(TEM; JEOL, JEM-2100F, 200 kV). Crystallographic information for the samples was collected using powder X-ray diffraction (XRD; Bruker, D8 Advance X-ray diffractometer, Cu $K\alpha$ radiation, $\lambda = 1.5406 \text{ \AA}$). The nitrogen adsorption was performed using a Quantachrome Instrument (Autosorb AS-6B). Thermogravimetric analysis (TGA) was carried out under a flow of air with a temperature ramp of $5 \text{ }^\circ\text{C min}^{-1}$.

Electrochemical Measurements

The electrochemical measurements were carried out using two-electrode Swagelok cells (X2 Labwares, Singapore) with pure lithium metal as both the counter and the reference electrodes at room temperature. The working electrode consisted of active material (e.g., G@SnO₂ NSs), a conductive agent (carbon black, Super-P-Li), and a polymer binder (poly(vinylidene difluoride), PVDF, Aldrich) in a 70:20:10 weight ratio. The electrolyte used was 1.0 M LiPF₆ in a 50:50 (w/w) mixture of ethylene carbonate and diethyl carbonate. Cell assembly was carried out in an Ar-filled glovebox with concentrations of moisture and oxygen below 1.0 ppm. Cyclic voltammetry (0.005–2.5 V, 0.5 mV s^{-1}) was performed using an electrochemical workstation (CHI 660C). The charge/discharge tests were performed using a NEWARE battery tester at different current rates with a voltage window of 0.01–1.2 V.

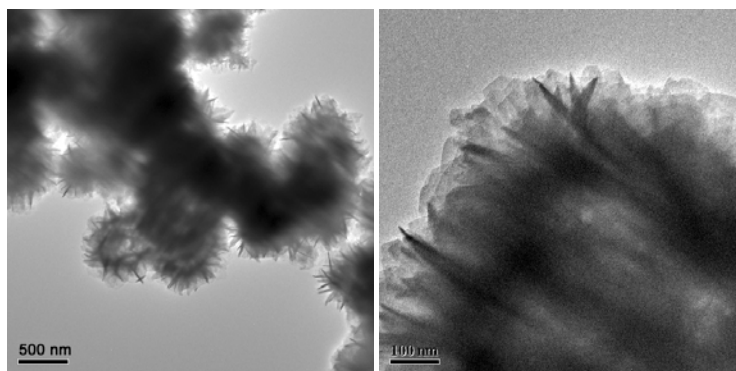


Figure S1. TEM images of SnO₂ nanosheets synthesized without the addition of GO.

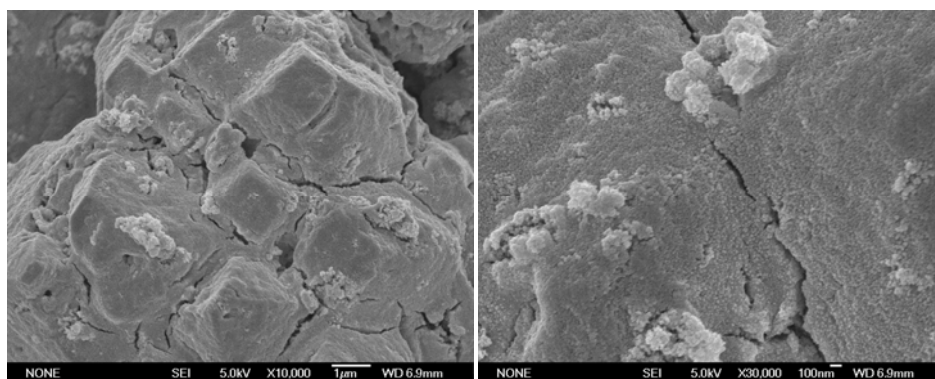


Figure S2. SEM images of SnO₂ nanoparticles synthesized without the addition of GO and mercapto acetic acid.

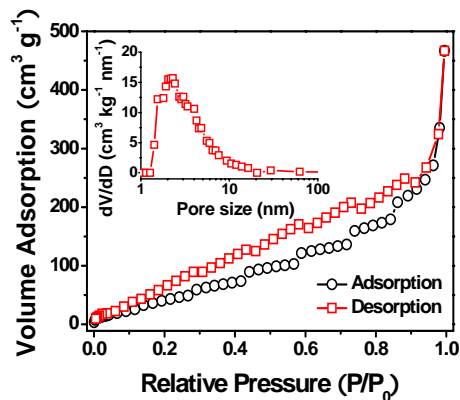


Figure S3. N₂ adsorption-desorption isotherm of G-SnO₂ NSs. The inset shows the pore size distribution calculated from the desorption branch.

Reference

- (1) Hummers, W. S.; Offeman, R. E., *J. Am. Chem. Soc.* **1958**, *80*, 1339-1339.
- (2) Liang, Y. Y.; Wang, H. L.; Casalongue, H. S.; Chen, Z.; Dai, H. J., *Nano Res.* **2010**, *3*, 701-705.