Electronic Supplementary Information (ESI) for

SnO_2-Carbon-RGO Materials with Enhanced Anode Performances in Lithium Ion Batteries

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Experimental Section

Preparation of SCG: Graphite oxide was prepared from purified natural graphite according to Hummers method reported in Ref. [S1, S2]. Graphite oxide (100 mg) and water (200 mL) was ultrasonicated for 2 h. An aqueous solution (50 mL) of $SnCl_4$ (3506 mg) and Polyvinylpyrrolidone (PVP, MW= 40000, 150 mg) were added to the aqueous suspension. The mixture was stirred for 4 h to complete ion-exchange. Aqueous solution (20 mL) of Glucose (1500 mg) and Urotropine (1671 mg, 1.0 equ.) was added into the above mixture. The mixture was kept stirring for a further 1 h and then transferred into an autoclave (500 mL) and then heated to 200 °C for 48 h. After cooled to room temperature naturally, the resulted solid was washed with water and dyied at 140 °C. After calcined to 500 °C with a heating rate of 10 °C/min in Ar flow, SCG was obtained.

Characterization: Fourier transform infrared (FT–IR) spectra measurements were carried out on a NICOLET 560 Fourier transform infrared spectrophotometer. Raman spectrum was recorded on a Renishaw RM–1000 with excitation from the 514 nm line of an Ar–ion laser with a power of about 5 mW. The phase structure of as–prepared products were characterized with X–ray diffraction (XRD, Bruker D8 advance) with Cu Kα λ=1.5418 Å). X–ray photoelectron spectrum (XPS) were recorded on a PHI quantera SXM spectrometer with an Al K_α = 280.00 eV excitation source, where binding energies were calibrated by referencing the C1s peak (284.8 eV) to reduce the sample charge effect. The morphology of as–prepared products was studied by using transmission electron microscope (TEM, Hitachi H–7650B, operating at 80.0 kV) and high resolution TEM (HRTEM, JEOL JEM–2010F electron microscope, operating at 200 kV). For atom force microscopy (AFM) measurement, the samples were coated on Si surface and AFM studies were performed using a Digital Instruments Dimension 3100 microscope in the tapping mode. N_2 adsorption–desorption was tested on TriStar II 3020 (Micromeritics Instrument Corporation, USA). The current–voltage (*I–V*) curves were obtained at the Shanghai Chenhua CHI660B type electrochemical working station using the compressed pellets with a diameter of 12.5 mm, which were produced in a stainless steel mould with 12 MPa pressure from 115 mg of SCG, and SnO_2 samples, respectively.

Lithium ion batteries (LIBs) performance was determined using CR 2032 type coin cells assembled in an argon–filled glove box (MBRAUN). The working electrodes prepared by mixing the SCG and Carboxymethyl Cellulose Sodium (CMC, 3 *wt.* %) at a weight ratio of 90:10 were pasted on pure Cu foil (15 μm). Celgard 2400 was used as a separator. Lithium foil was used as the counter electrode. The electrolyte consisted of a solution of $LiPF_6$ (1 M) containing vinylene carbonate (2 *wt.* %) in ethylene carbonate/dimethyl carbonate/diethyl carbonate (1:1:1, volume ratio). A galvanostatic cycling test of the assembled cells was carried out on a BS-9300K system in the voltage range of 0.001–3.0 V (vs. Li^+/Li) at current density of 0.2 C (200 mA g^{-1}), 0.5 C, 1.0 C, 2.0 C, and 5.0 C, respectively. The weight of SCG in the working electrode was used to estimate the specific discharge capacity of the battery, which was expressed in mA hg^{-1} of SCG.

References

[S1] W. S. Hummers and R. E. Offeman, *J. Am. Chem. Soc.*, 1958, **80**, 1339–1339.

[S2] B. J. Li and H. Q. Cao, *J. Mater. Chem.*, 2011, **21**, 3346–3349.

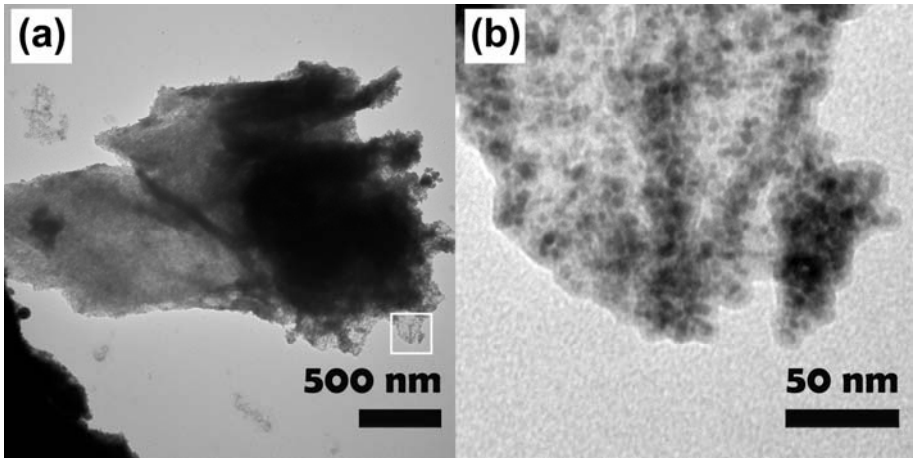

Figure S1 TEM images of SCG (Hitachi H–7650B operating at 80.0 kV).

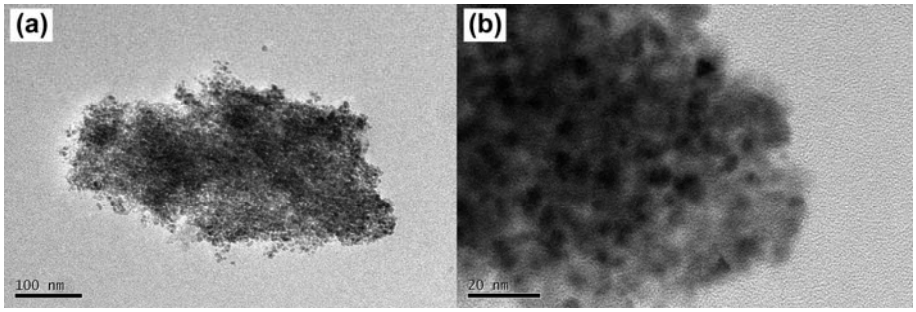

Figure S2 HRTEM images of SCG (JEOL JEM–2010F electron microscope operating at 200 kV).

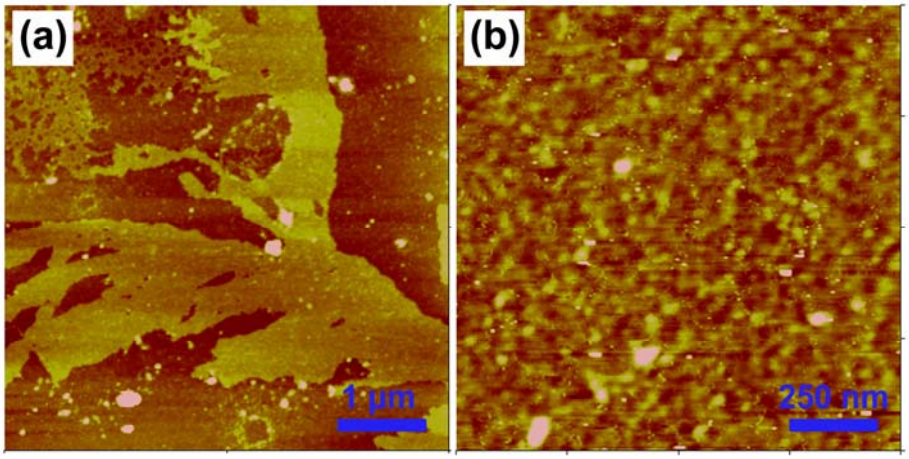

Figure S3 (a) AFM images of SCG.

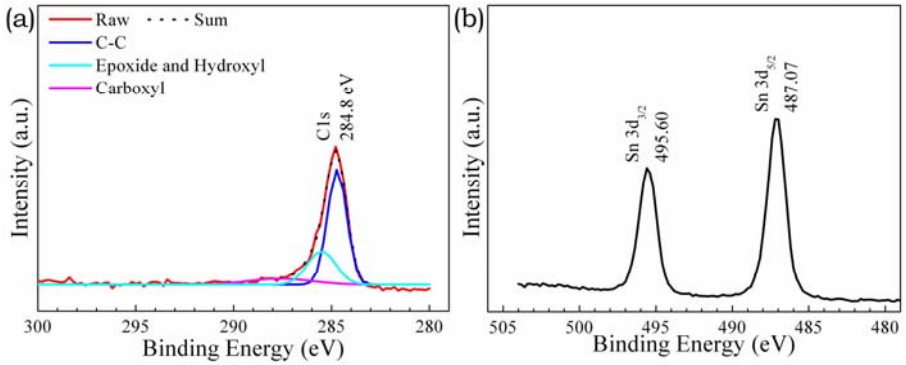

Figure S4 The fine scanning XPS spectra of (a) C1s, and (b) Sn3d.

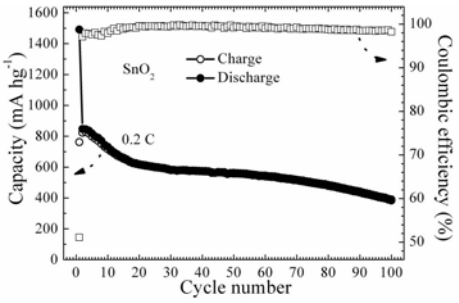

Figure S5 Cyclic performances of electrode fabricated with SnO_2 at current rate of 0.2 C.

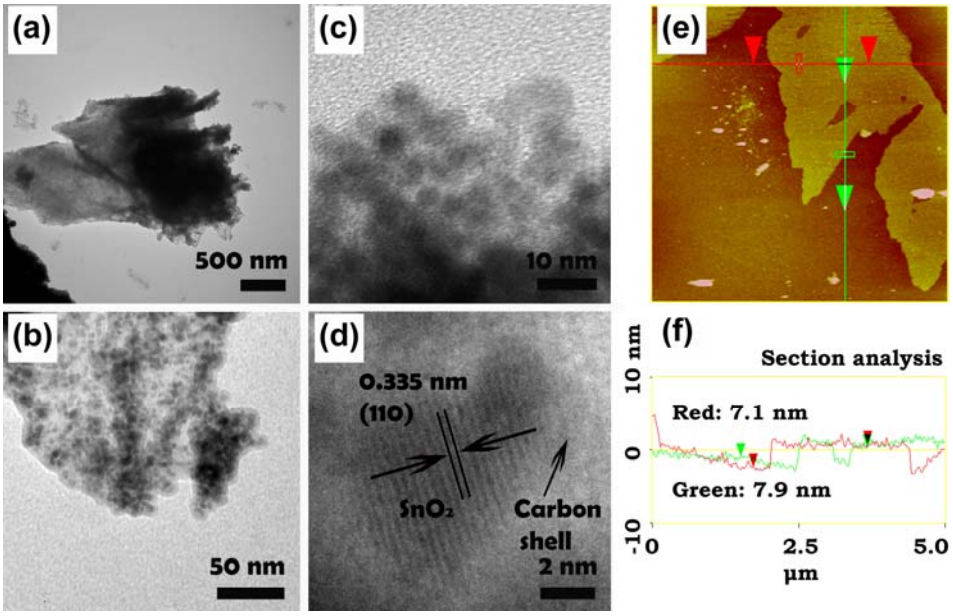

Figure S6 The enlarged version of (a, b) TEM images, (c, d) HRTEM images, (e) AFM image of SCG, and (f) its section analysis.

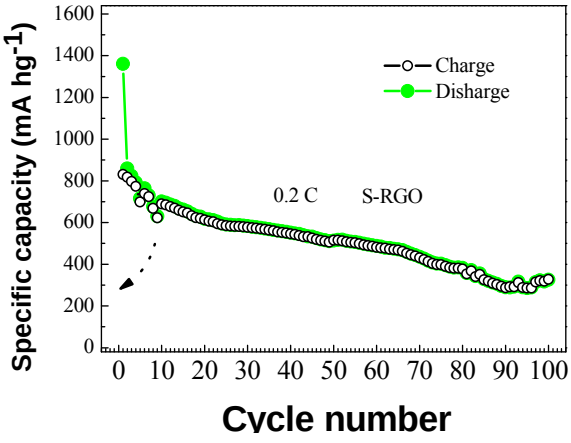

Figure S7 The cyclic performances of electrodes fabricated by SnO_2 nanoparticles anchored on RGO sheets without the carbon encapsulating layer (i.e., S-RGO) at current rate of 0.2 C.