Supplementary information

Morphology control of SnO and application in lithium-ion batteries

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1. EXPERIMENTAL SECTION

1.1. Matrrials. Synthesis of Tin oxide nanoparticles was carried out using commercially available reagents. Tin (II) oxalate (SnC_2O_4, 98%), 1-octylamine (98%), oleic acid (OA, 90%) were purchased from Alfa Aesar.

Preparation of SnO thin sheets (sample 1). In a typical synthesis, 1-octylamine (3.0 mL) and OA (0.66 mL) were formed a transparent solvent at room temperature, and then tin (II) oxalate (0.167 g) were dissolved in the above solution using intense ultrasonic treatment. The mixture was then transferred into a glass tube (length: 40 cm), and then directly placed the glass tube in a vertical tube furnace which was already preheated to 360 ^{o}C and maintained the temperature for 30 min. And then the glass tube was taken out from the tube furnace and instantly added ethanol. After cooling to room temperature, the products were wash with alcohol several times. The

SnO moderate sheets (sample 2) and SnO cubes (sample 3) were synthesized using a similar method except for the amount of OA (SnO moderate sheets (1.32 mL), SnO cubes (2 mL).

Characterization. The as-prepared products were characterized by the powder X-ray diffraction (XRD) pattern (Panalytical X-pert diffractometer with Cu Kα radiation) to acquired the composition and phase information. The size, morphology and crystal structure were examined by field emission scanning electron microscopy (SEM, S4800), and transmission electron microscopy (TEM, JEM-2100) with an acceleration voltage of 200 kV. Sample for TEM were prepared by dropping the sample on a carbon film coated copper grid. The surface areas (S) of three samples were characterized by the Brunauer-Emmett-Teller (BET) method using nitrogen adsorption and desorption isotherms on a Micrometrics ASAP 2020 system

Electrochemical measurements. Before the measurement of Li-ion batteries, the samples were aged at 400 °C for 6 h to achieve stabilization and remove organic absorbents. The SnO samples were mixed with active materials and acetylene black with a weight ratio of 75:15:10. Cu metal was used as the current collector and lithium metal was used as the counter electrodes and $LiPF_6$ (1 M) dissolved in a mixture of ethyl methyl carbonate (EMC), dimethyl carbonate (DMC), and ethylene carbonate (EC) (1:1:1 by volume). The electrochemical capacity and cycle life of the working electrode were measured by a galvanostatic method at the charge/discharge current density of 50 $mA \cdot g^{-1}$(1 C) by using a LAND-CT2001A instrument. The

cut-off potentials for charge and discharge were set at 2.0 and 0.01 V (vs. Li^+/Li), respectively.

2. EXPERIMENTAL RESULT

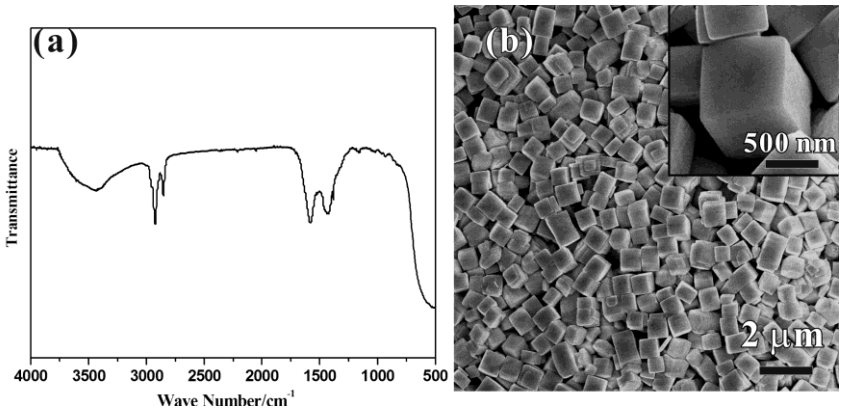

Fig. S1 (a) FT-IR spectrum of sample, (b) SEM image of SnO nanoparticles using 3 mL OA.

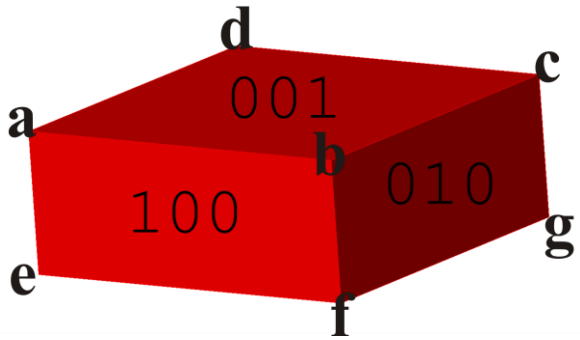

Fig. S2 Schematic model of an ideal SnO nanosheet enclosed with {001}, {100} and {010} facets

From Figure S1, we can calculate that

S(001) = ab * bc $\approx ab^2$; S(100) = ab * ae; S(010) = bc * bf = bc * ae

$$S(001)\% = \frac{S(001)}{S(001)+S(100)+S(010)} * 100 = \frac{ab^2}{ab^2 + ab*ae + bc*ae};$$

$$S(100)\% = \frac{S(100)}{S(001)+S(100)+S(010)} * 100 = \frac{ab*ae}{ab^2 + ab*ae + bc*ae};$$

$$S(010)\% = \frac{S(010)}{S(001)+S(100)+S(010)} * 100 = \frac{bc*ae}{ab^2 + ab*ae + bc*ae}$$

The lengths of ab, bc and ae have been estimated by gathering statistics of one

hundred of particles, and then calculated the average values. The inaccuracy has been labeled after the value.

Sample No	ab (nm)	ae (nm)	bc (nm)
Sample 1	800（± 10)	100 (± 5)	800（± 10)
Sample 2	800 (± 15)	500 (± 5)	800 (± 15)
Sample 3	800 (± 10)	800 (± 10)	800((± 10)

Base on the above formula and the lengths of ab , bc and ae, the percentage of each facet can be calculated, and the inaccuracy has been labeled after the value

Sample No	001	100	010
Smple 1	80.0% (± 3)	10% (± 1.5)	10% (± 1.5)
Smple 2	44.4% (± 5)	27.8% (± 2.5)	27.8% (± 2.5)
Smple 3	33.3% (± 3)	33.3% (± 1.5)	33.3% (± 1.5)

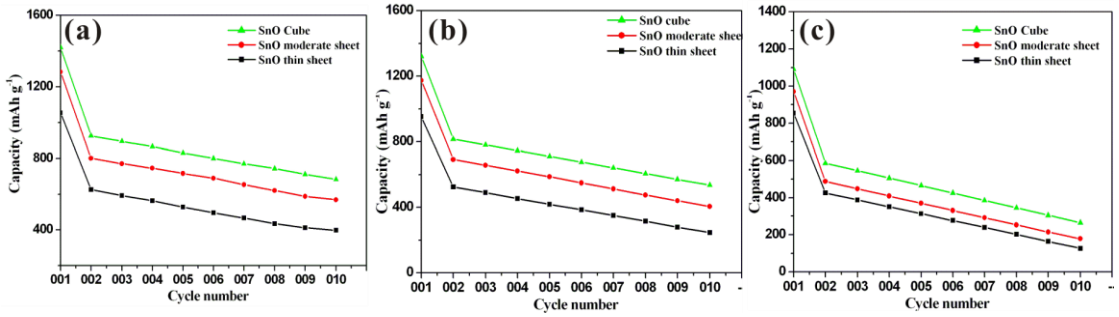

Fig. S3 Cycling performance at various current densities (a) 50 mA/g, (b) 100 mA/g, (c) 250 mA/g.

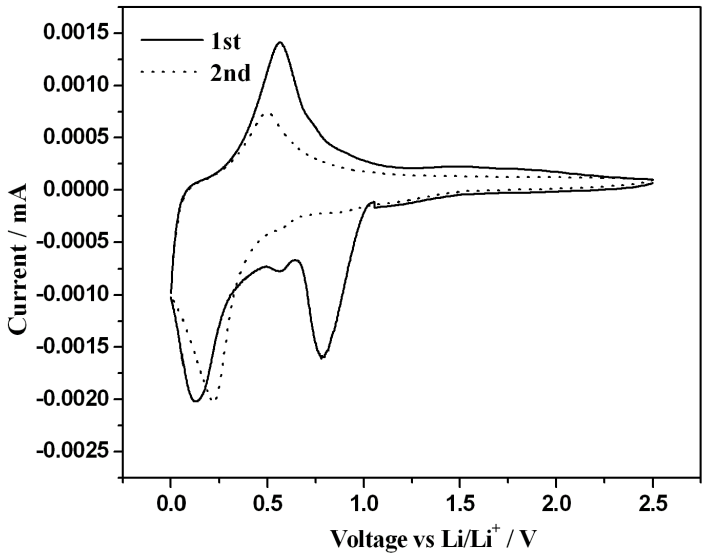

Fig. S4 CV curves of SnO cube (Sample 3) between 2.5 and 0 V with a scan rate of 0.1 mV s^{-1}

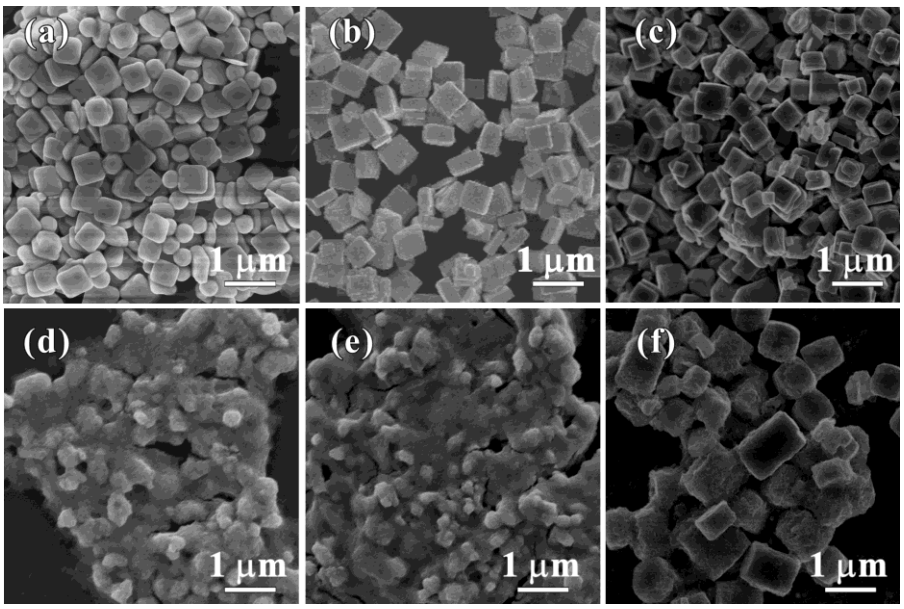

Fig. S5 SEM images of Sample1 (a, d), Sample 2 (b, e) and Sample 3 (c, f) after 1st (a, b, c), 5th (d, e, f) discharge-charge cycle at 50 mA•g^{-1}.