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Supporting Information

Direct Growth of Mesoporous Sn-doped TiO_2 Thin Films on Conducting Substrates for Lithium-ion Battery Anodes

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Methods

Synthesis of the pristine TiO_2 and Sn-doped TiO_2 mesoporous thin films. Ordered mesoporous TiO_2 films on Ti foil were synthesized via a spin-coating method on the basis of the ligand-assisted EISA process, followed by a two-step pyrolysis process. An acetylacetone (AcAc)-coordinated Ti precursor (Ti(AcAc)) and a tri-block copolymer P123 ($EO_{20}PO_{70}EO_{20}$, Mw = 5800, Sigma-Aldrich Co., USA) were used as the precursor and the template, respectively. For a typical synthesis, 0.075 g of P123 was first dissolved in 2.45 g of tetrahydrofuran (THF) to make a solution containing 3 wt% of the template. Meanwhile, another Ti(AcAc) solution was prepared by dissolving 0.30 g of titanium(IV) isopropoxide ($Ti(OCH(CH_3)_2)_4$, TIPO, 98+%) in 0.45 g of AcAc. These two solutions were mixed and stirred at room temperature for 30 min. Then, 0.30 g of concentrated hydrochloric acid (36 wt%) was added into the mixed solution, which was stirred at room temperature for another 30 min. The solution was coated onto a Ti foil substrate at 500 rpm for 9 s to form a transparent thin film. The Ti foil with the thin film was placed horizontally on a glass plate at room temperature for 2 min and then transferred to a furnace to age at 40 °C for 24 h, followed by further aging at 100 °C for 24 h to form the as-deposited composite films. The as-deposited films were pyrolyzed at 500 °C for 3 h in nitrogen and then at 450 °C for 2 h in air, resulting in the pristine TiO_2 mesoporous thin film.

For the synthesis of Sn-doped TiO_2 mesoporous thin films, 2.25 g of $SnCl_2 \cdot 2H_2O$ was first mixed with 5.25 g of AcAc for 30 min to form the Sn(AcAc) precursor, which was subsequently added into the coating solution containing Ti(AcAc) and P123. A similar coating-calcination process was employed to obtain the Sn-doped TiO_2 film. The percentage of Sn doping was tuned

by the Sn/Ti ratio in the precursor solution, while the actual Sn/Ti atomic ratio in the final product was quantified by the inductively coupled plasma (ICP) measurement.

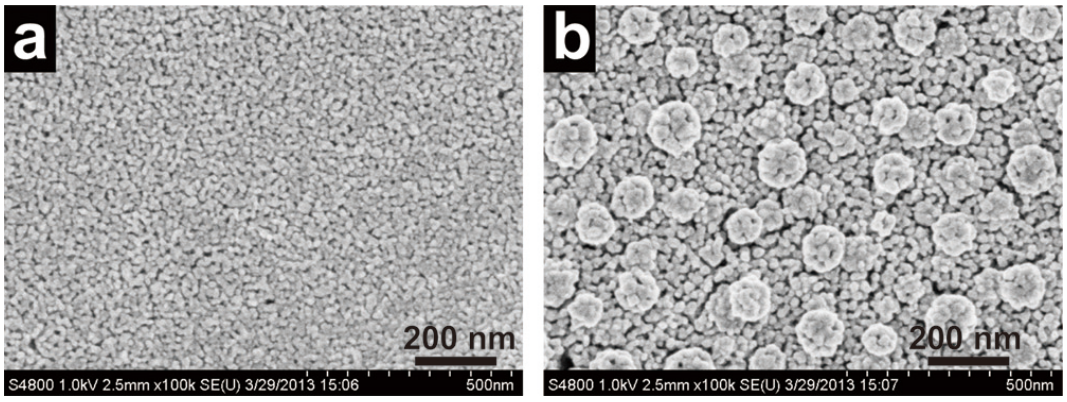

Fig. S1. SEM images of (a) the 15%-Sn-doped and (b) the 25%-Sn-doped mesoporous TiO_2 thin films.

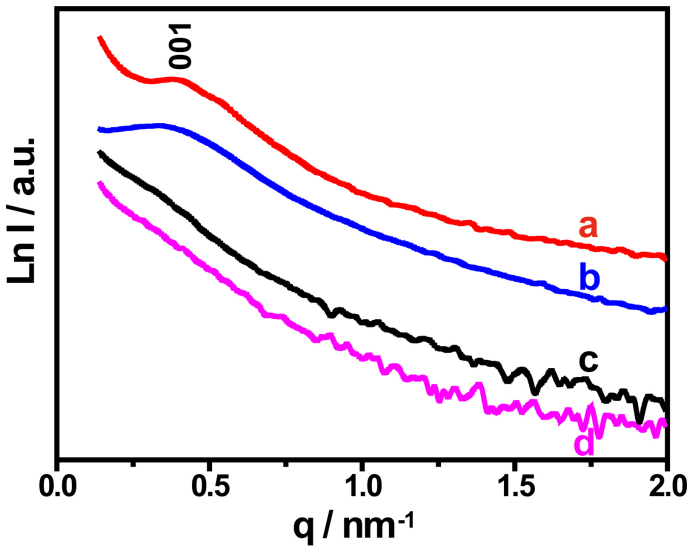

Fig. S2. Small-angle X-ray Scattering (SAXS) patterns of (a) pristine mesoporous TiO_2 films, (b) 6%-Sn-doped, (c) 15%-Sn-doped and (d) 25%-Sn-doped mesoporous TiO_2 thin films.

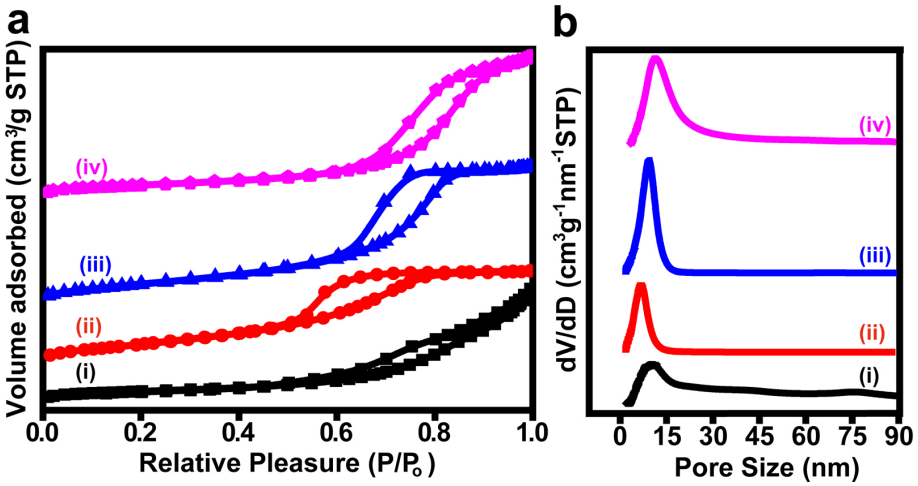

Figure S3. (a) N_2 adsorption-desorption isotherms of (i) pristine mesoporous TiO_2 films, (ii) 6%-Sn-doped, (iii) 15%-Sn-doped and (iv) 25%-Sn-doped mesoporous TiO_2 thin films. (b) Corresponding pore size distributions of the four samples in (a).

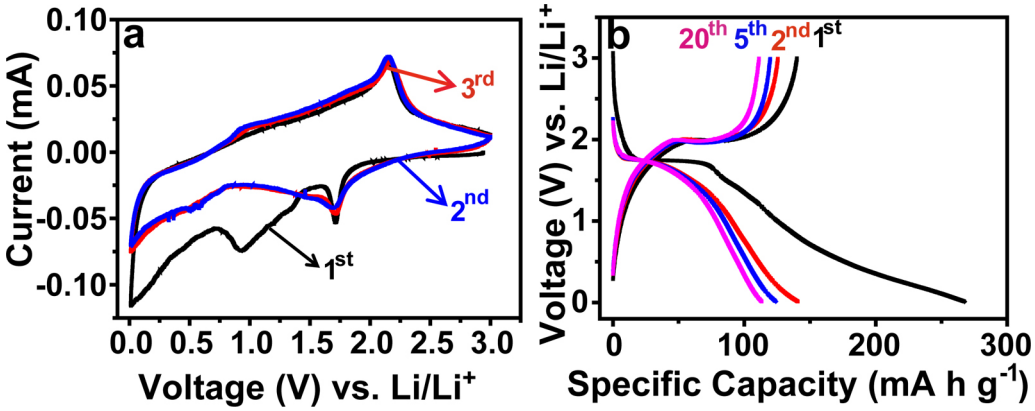

Figure S4. (a) Cyclic voltammograms of mesoporous TiO_2 films for the 1st, 2nd, and 3rd cycles. (b) Charge-discharge profiles of mesoporous TiO_2 films at a current rate of 84 mA g^{-1} (0.5C based on TiO_2 theoretical capacity) for the 1st, 2nd, 5th, and 20th cycles.

Table S1. Surface area, pore volume and pore size data of the pristine mesoporous TiO_2 films, 6%-Sn-doped TiO_2 films, 15%-Sn-doped TiO_2 films and 25%-Sn-doped TiO_2 films.

	Surface area (S_{BET}) m^2/g	Pore Size nm	Pore volume (V_{total}) cm^3/g
TiO_2	68.19	9.60	0.2031
6%-Sn-doped TiO_2	93.43	5.81	0.1376
15%-Sn-doped TiO_2	93.93	8.31	0.1984
25%-Sn-doped TiO_2	71.24	11.28	0.2027