Supporting Information

Lithium Storage Improvement from Hierarchical Double-Shelled SnO_2 Hollow Spheres

Shilong Jing,[†] Feng Gu,[,†,‡] Junhua Kong,[‡] Chunrong Ma,[†] Pooi See Lee,[*,‡] and Chunzhong Li[*,†]*

Experimental Section

Synthesis of CH-SnO_2*:*The chemicals used in this study were of analytic grade and used as received (Aldrich).The approach of mesoporous silica preparing, remodeling and nanochain-loading has been reported previously. [1-3] In a typical synthesis, 125 mg remodeled-MS (rMS) was first dispersed in 30 ml of ethanol/water mixture with 37.5 % ethanol (vol %). 0.90 g of urea and 0.10 g of potassium stannate trihydrate were added to the above mixture. Then, the turbid suspension was transferred into 50 ml Teflon-lined stainless-steel autoclave, which was then heated in an airflow electric oven at 170 °C for 24 h. After the autoclave cooled down naturally, the product was harvested by centrifugation and washed with deionized water and ethanol before drying at 80 °C overnight. Coating SnO_2 onto as-synthesis SnO_2 nanochains loaded rMS was simply obtained by repeating the above hydrothermal process for 36 h. The rMS templates were finally removed by HF (2 wt %) after calcined at 600 °C for 5 h in air.

The CH-SnO_2 (80 wt %), conducting additive (10 wt %, Super-P carbon black), and polyvinylidene fluoride (PVDF, 10 wt %) binder in N-methylpyr-rolidone (NMP) were mixed into homogeneous slurry. The slurry was then applied to a copper disk current collector and dried in vacuum at 120 °C. Electrochemical test cells were assembled in an argon-filled glovebox using the coated copper disk as the working electrode, lithium metal foil as the counter/reference electrode, and 1 M solution of $LiPF_6$ in a 50:50 w/w mixture of ethylene carbonate (EC) and dimethyl carbonate (DMC) as the electrolyte. The cells were charged and discharged galvanostatically at the rates of 100 mA g^{-1} in the fixed voltage window from 5 mV to 2 V on a Neware CT - 3008W battery tester at room temperature.

Capacity calculation of SnO_2 *loose aggregates network:*
Since the CH-SnO_2 structure was consisted of H-SnO_2 shell and SnO_2LAs network inside, the specific capacity of CH-SnO_2could be expressed by the following equation:

$$C_{CH} = (C_{LA} * P_{LA}) + (C_H * P_H) \quad (1)$$

Where C_{CH}, C_{LA} and C_H are the specific capacity of CH-SnO_2, SnO_2 LAs network and H-SnO_2 (mAh g^{-1}) respectively, P_{LA} and P_H are the mass fraction (%) of SnO_2 LAs network and H-SnO_2. As the SnO_2-synthesis procedure of CH-SnO_2 could be divided into SnO_2 Las-synthesis (S_{LA}) and SnO_2 shell-synthesis (S_H), the mass-increase of S_{LA} and S_H have been measured and were almost the same, we define:

$$P_{LA} = P_H = 50\% \quad (2)$$

Since C_{CH} (1885 mAh g^{-1}) and C_H (1192 mAh g^{-1}) has been measured by galvanostatic measurement, the value of C_{LA} could be calculated using equation (1), namely 2578 mAh g^{-1}.

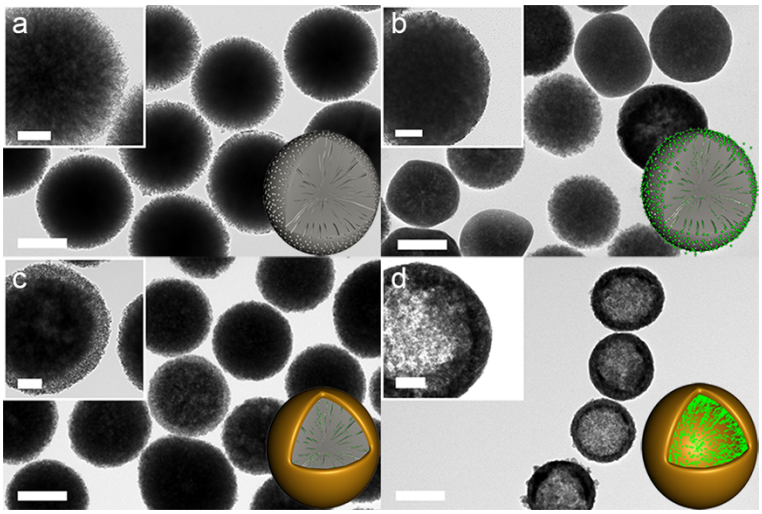

Figure S1.TEM images of rMSs (a), SnO_2 NCs loaded rMSs (b), CH-SnO_2 before (c) and after (d) removing rMSs.The insets of a-d are corresponding magnified TEM images and schematics respectively.The scale bars in a-d = 500 nm, in insets of a-d = 200 nm.

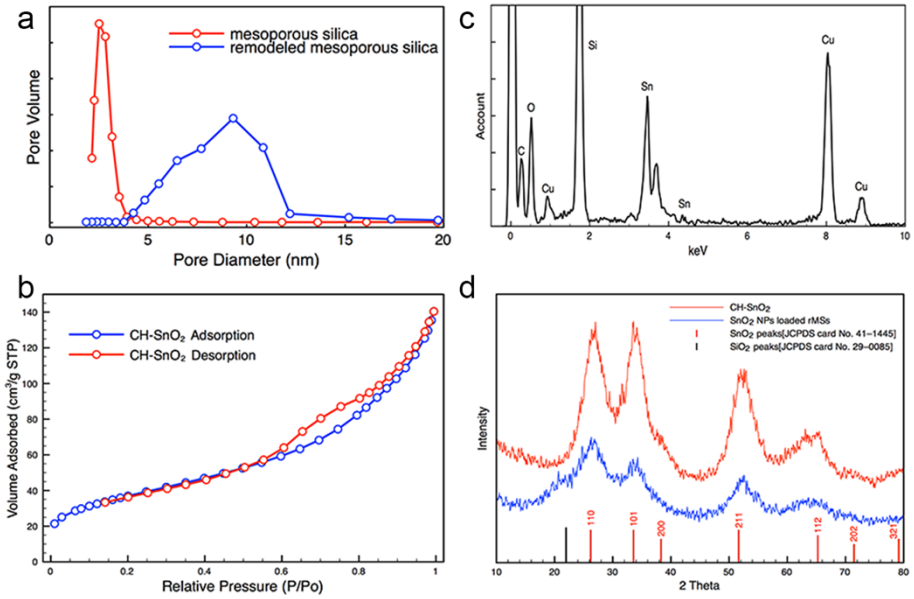

Figure S2. a) Pore diameter distribution of MS before and after remodeled; b) N_2 adsorption - desorption isotherm of CH-SnO_2; c) EDS patterns of SnO_2 nanochains loaded rMSs; d) XRD patterns of SnO_2 nanochains loaded rMSs (blue curve) and CH-SnO_2 (red curve); e,f) HRTEM image of SnO_2 nanochains loaded rMSs; g) HRTEM image of CH-SnO_2 shell; h) TEM image of CH-SnO_2; i) FESEM image of a broken H-SnO_2.

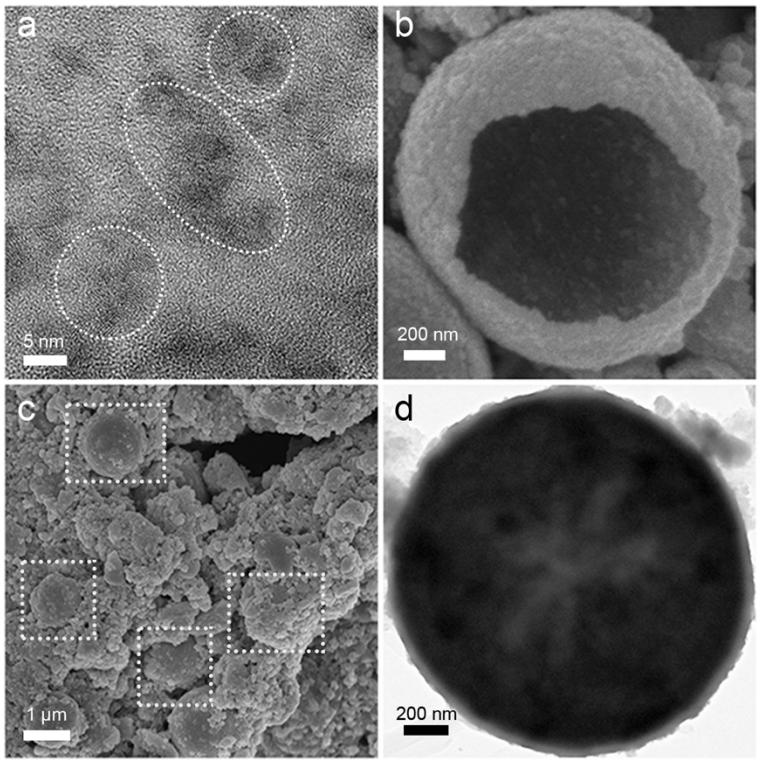

Figure S3. a) HRTEM image of SnO_2 nanochains loaded rMSs; b) FESEM image of a broken H-SnO_2; c,d) FESEM and TEM images of CH-SnO_2 after 50 cycles of charge and discharge.

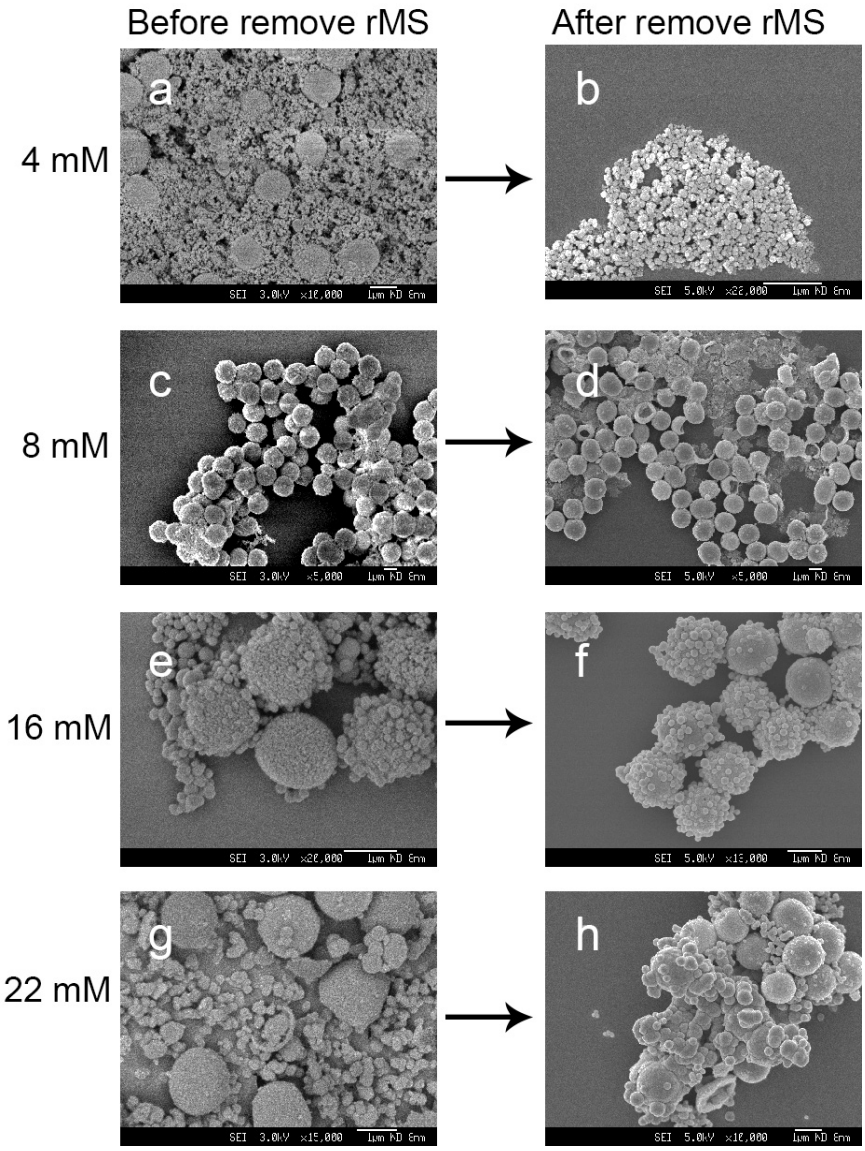

Figure S4. FESEM images of CH-SnO_2 before (left panel) and after (right panel) calcination and removel of rMSs. The concentration of stannate used in the synthesis as precursor of SnO_2 shells increased from A (4 mM) to H (22 mM).

REFERENCES

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(3) Gu, F.; Ren, X.; Zhang, J.; Shao, W.; Huang, G.; Li, C. *Ind. Eng. Chem. Res.***2011**, *50*, 12542–12547.