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Supporting Information

Unveiling the structure evolution of 1T SnS_2 anode upon lithiation/delithiation by TEM

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Supplementary Methods

Synthesis of 1T SnS_2 nanosheets

All of the chemicals were purchased and used directly without further purification. The flake-like 1T SnS_2 nanosheets were prepared by hydrothermal method. In a typical preparation, 2.1 g of $SnCl_4 \cdot 5H_2O$ and 3.0 g of thiourea (CH_4N_2S) were added to 70 mL of deionized water and magnetically stirred for 20 minutes to form a homogeneous solution. The solution was then transferred into a 100 mL Teflon-lined autoclave with a stainless steel shell, which heated at 180℃ for 15 h. Finally, the sample was washed several times with CS_2 and dried at 50℃ for 8h in a vacuum[19,20].

Cell fabrication

CR2032 coin cells were prepared to evaluate electrochemical performance. The electrode composites consisted of 80wt % active materials (1T SnS_2 or purchased SnS_2), 10wt % conductive agent (acetylene black, AB) and 10wt % binder (carboxyl methyl cellulose sodium, CMC). Copper foil was used as collector. Lithium metal was used as counter electrode and 1 mol L^{-1} $LiPF_6$ dissolved in EC:DEC (1:1 in volume ratio) as electrolyte.

Characterizations

The phase composition and crystallinity of the sample were determined by X-ray diffraction (XRD, SmartLab 9KW) using Cu Ka radiation in the range from 10° to 90°. TEM images and SAED patterns were carried out on the FEI Talos F200X with a field-emission gun and an accelerating voltage of 200 kV. The atomic resolution high-angle annular dark field (HAADF) images were obtained by using an aberration-corrected scanning TEM operated at 200 kV (FEI Titan Cubed Themis G2 300). Scanning electron microscopy (SEM) images were revealed by the FEI verios 460L. The electrochemical performance was carried out on LAND CT2001A battery test system. The impendance was carried out by electrochemical impedance spectroscopy (EIS) in the range of 10^{-2} to 10^5 Hz with AC voltage of 5 mV. Cyclic voltammetry (CV) was analysed by an electrochemical workstation (CHI 760E Shanghai, China) in the cut-off potential of 0.01-3.0 V at a scanning rate of 0.1 mV s^{-1}.

Supplementary Figures

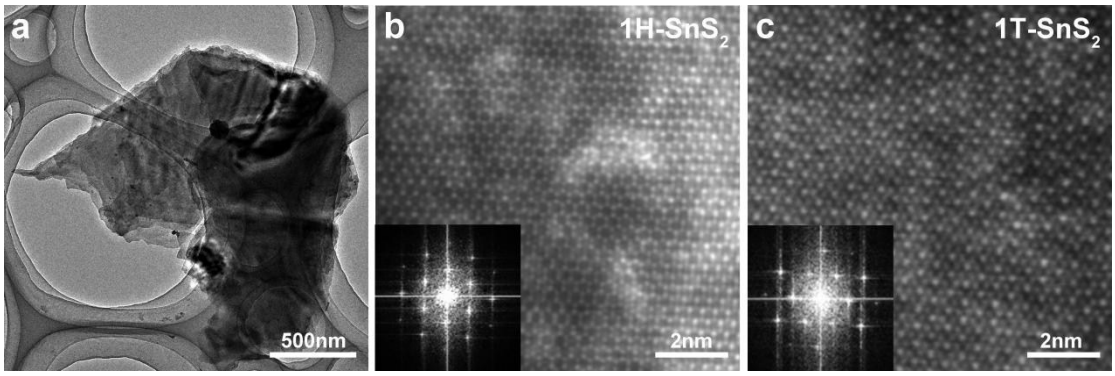

Fig. S1 (a) The low magnification images of purchased SnS_2. (b) 1H atomic resolution HADDF of purchased SnS_2. (c) 1T atomic resolution HADDF of purchased SnS_2.

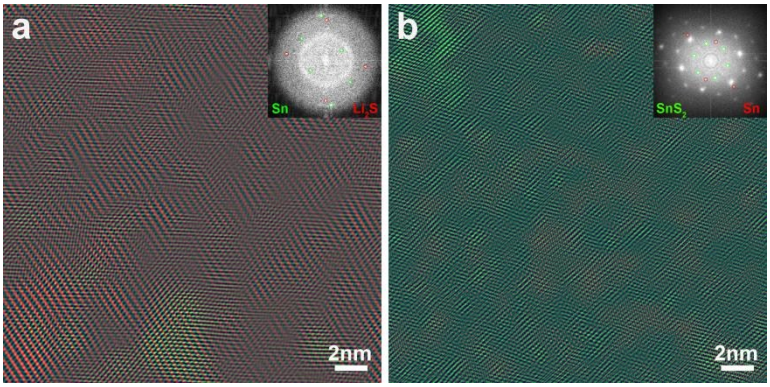

Fig. S2 HRTEM of SnS_2 electrode sheets during lithiation. (a) 0.39 V of discharge state. (b) 2.33 V of charge state.