Supporting Information for
One-step hydrothermal synthesis of SnS₂/graphene composites as anode material for high efficient rechargeable lithium ion batteries

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Experimental Details

Materials Synthesis

Graphite oxide (GO) was synthesized from natural graphite powder (Shanghai Colloid Chemical Plant, China) according to the reference. The as-prepared GO was transferred from the as-made suspension into a 200 ml beaker, and then diluted to 30 ml with DI water. After ultrasonication for about 2 hours, 0.5 mmol tin (IV) chloride pentahydrate (SnCl₄·5H₂O) was added and stirred for 5 hours. Then 4 mmol thioacetamide (TAA) were dissolved into the above solution and the pH value was adjusted to 6.5 using 1 M NaOH solution. The mixture was then transferred into a 50 ml Teflon-lined stainless steel autoclave, sealed tightly, and heated at 240 °C for 24 h. After cooling naturally, the black precipitates were collected by centrifugation, washed with DI water and ethanol, and dried in a vacuum oven at 80 °C for 12 h. Other two samples with different ratio of graphene to SnS₂ were also prepared in order to investigate the effect of graphene on Li-ion storage. The pristine SnS₂ nanoplates were prepared through the chosen method employing SnCl₄·5H₂O and TAA as starting materials except for GO. Graphene nanosheets were synthesized by a hydrothermal method employing GO and TAA as starting materials.

Materials Characterizations

Powder X-ray diffraction (XRD) was performed on a Rigaku D/MAX-2500 diffractometer. The
morphologies of the materials were analyzed by the scanning electron microscope (SEM Hitachi S-4800). Transmission electron microscope (TEM) and selected area electron diffraction (SAED) were recorded on a Tecnai G20 operating at 200 kV for the detailed microstructure information of the sample. The weight percentage of carbon content was analyzed by Elemental Analyzer (VarioEL).

**Electrochemical Measurements**

The electrochemical tests were measured using two-electrode cells assembled in an argon-filled glove box. Li sheet served as the counter electrode and reference electrode, and a polypropylene film (Celgard-2300) was used as a separator. The electrolyte was a 1.0 M LiPF$_6$ solution in a mixture of EC/DMC (1:1 in volume). The working electrodes were prepared by a slurry coating procedure. The slurry consisted of 75 wt.% active materials, 15 wt.% acetylene black and 10 wt.% polyvinylidene fluorides dissolved in N-methyl-2-pyrrolidinone. This slurry was spread on copper foil, which acted as a current collector. The electrodes were dried at 80 °C for 12 h in vacuum and then pressed. Galvanostatic charge/discharge cycles were carried out on a battery tester between 0.01-3.00 V at various current densities on a LAND CT2001A cell test instrument (Wuhan Kingnuo Electronic Co., China). Cyclic voltammetry measurements were carried out on an electrochemical workstation (Zahner IM6ex) over the potential range of 0.01-3.00 V vs. Li/Li$^+$ at a scan rate of 0.5 mV/s. Electrochemical impedance spectroscopy (Zahner IM6ex) was carried by applying an AC voltage of 5 mV in the frequency range of 100 KHz to 0.01Hz.

**Supplementary Figures**

![Fig. S1 SEM image of pristine SnS$_2$ nanoplates.](image)

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Fig. S2 a) SEM image of SnS$_2$/GNS composites and b–d) elemental mapping with EDS showing SnS$_2$ nanosheets are homogeneously distributed in carbon matrix.

Fig. S3. The first two charge and discharge curves of GNS at a current density of 100 mA g$^{-1}$, which were synthesized by the chosen method employing GO and TAA as starting materials.

**Table S1** The effect of ratio of graphene to SnS$_2$ on Li-ion storage

<table>
<thead>
<tr>
<th>Sample</th>
<th>Amount of GO suspension in the preparation (mL)</th>
<th>Discharge capacity (retention) mAh g$^{-1}$ (at a current density of 100 mA g$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1$^{st}$ Cycle</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>1367</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2.5</td>
<td>1286</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>7.5</td>
<td>1520</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

The as-prepared sample 1 contains 9.95% carbon, which was studied carefully in this work.

**References**