Supporting Information for

One-step hydrothermal synthesis of SnS_2/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.[1] 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 ($SnCl_4{\cdot}5H_2O$) 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 ^oC 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 ^oC for 12 h. Other two samples with different ratio of graphene to SnS_2 were also prepared in order to investigate the effect of graphene on Li-ion storage. The pristine SnS_2 nanoplates were prepared through the chosen method employing $SnCl_4{\cdot}5H_2O$ 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 ^{o}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

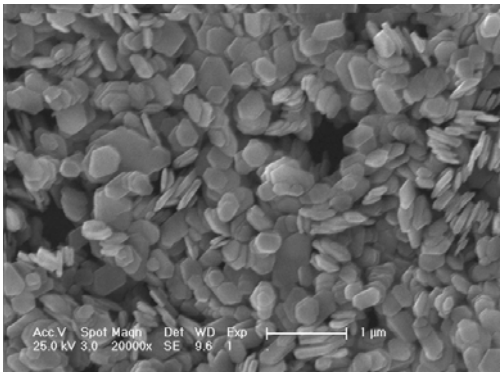

Fig. S1 SEM image of pristine SnS_2 nanoplates.

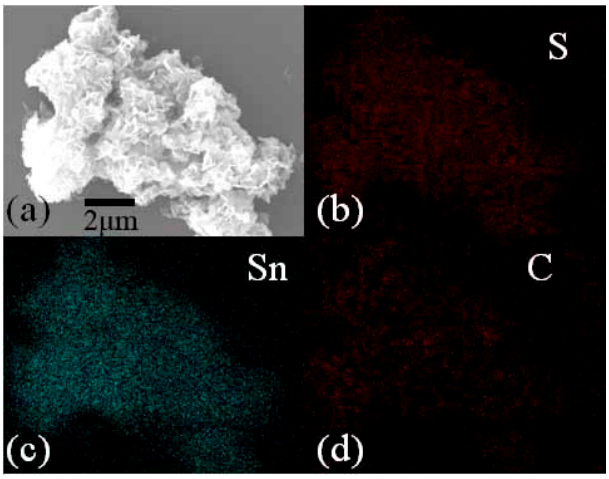

Fig. S2 a) SEM image of SnS_2/GNS composites and b–d) elemental mapping with EDS showing SnS_2 nanosheets are homogeneously distributed in carbon matrix.

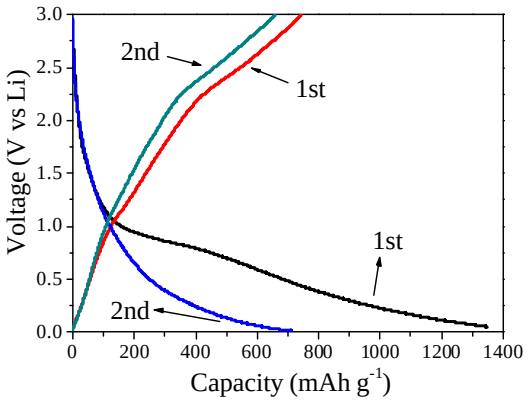

Fig. S3**.** The first two charge and discharge curves of GNS at a current density of 100 mA g^{-1}, which were synthesized by the chosen method employing GO and TAA as starting materials.

Table S1 The effect of ratio of graphene to SnS_2 on Li-ion storage

Sample	Amount of GO suspension in the preparation (mL)	Discharge capacity (retention) mAh g^{-1} (at a current density of 100 mA g^{-1})			
		1st Cycle	2nd Cycle	10th Cycle	30th Cycle
1	5	1367	1158	1102 (95%)	1114 (96%)
2	2.5	1286	1105	950 (86%)	773 (70%)
3	7.5	1520	1151	1025 (89%)	895 (77%)

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

References

1. D. C. Marcano, D. V. Kosynkin, J. M. Berlin, A. Sinitskii, Z. Z. Sun, A. Slesarev, L. B. Alemany, W. Lu and J. M. Tour, *Acs Nano*, 2010, **4**, 4806-4814.