Facile Synthesis of Graphene Supported $FeSn_2$ Nanocrystals with Enhanced Li-Storage Capability

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Experimental Section

Synthesis of G-$FeSn_2$ Nanohybrid. Typically, 20 mg graphene oxide (GO) and 5 g poly (vinyl pyrrolidone) (PVP) were dispersed in 50 mL diethylene glycol (DEG) in a three-necked flask, and then 0.3 mmol $SnCl_2 \cdot 2H_2O$ and 0.15 mmol $FeCl_3 \cdot 2H_2O$ were added to the solution. After the solution was heated to 170 ^oC, 10 mL DEG of 1 M $NaBH_4$ was added, and the solution was maintained at 170 ^oC for 1 h. The entire reaction was protected under N_2 flow. Finally, the resulting product was washed with distilled water and ethanol, and then dried at 80 ^oC under vacuum. For comparison, bare $FeSn_2$ nanocrystals were obtained through the same approach but without GO matrix.

Characterization. The morphology, composition, and structure of the samples were characterized by transmission electron microscopy (TEM, Hitachi H-7650, 120

kV), scanning electron microscopy (SEM, JEOL JSM-7600F), high-resolution transmission electron microscopy (HRTEM, JEOL JEM-2010F, 200 kV) coupled with energy-dispersive X-ray spectrometer (EDX, Thermo Fisher Scientific). X-ray powder diffraction (XRD) measurements were performed with Model D/max-rC diffractometer using Cu-Kα radiation (λ=0.15406 nm) and operating at 45 kV and 100 mA.

Electrochemical Measurements of G-$FeSn_2$ Nanohybrid. Electrochemical measurements were performed by 2025 type coin cells which were assembled in an Ar-filled glove box (IL-2GB, Innovative Technology). The anode was made as follows: 80 wt % G-$FeSn_2$ nanohybrid, 10 wt % Super P carbon black, and 10 wt % polyvinylidene fluoride (PVDF) in N-methyl-2-pyrrolidene (NMP) were mixed, then the slurry was coated on copper foams (12 mm in diameter) and dried under vacuum at 120 ^{o}C for 12 h. The counter electrode was lithium foil (15 mm in diameter), and the electrolyte solution was 1 M $LiPF_6$ in ethylene carbonate (EC) and dimethyl carbonate (DMC) (1:1 by volume). Finally, the cells were aged for 12 h before measurements. A galvanostatic cycling test of the assembled cells was carried out on a Land CT2001A system in the potential range of 0.01-2 V. Cyclic voltammtery (CV) measurements were recorded on a CHI 660C electrochemical workstation in the potential range of 0.0-2.0 V at a scan rate of 0.1 mV s^{-1}. The voltages mentioned herein were referred to Li^{+}/Li redox couple.

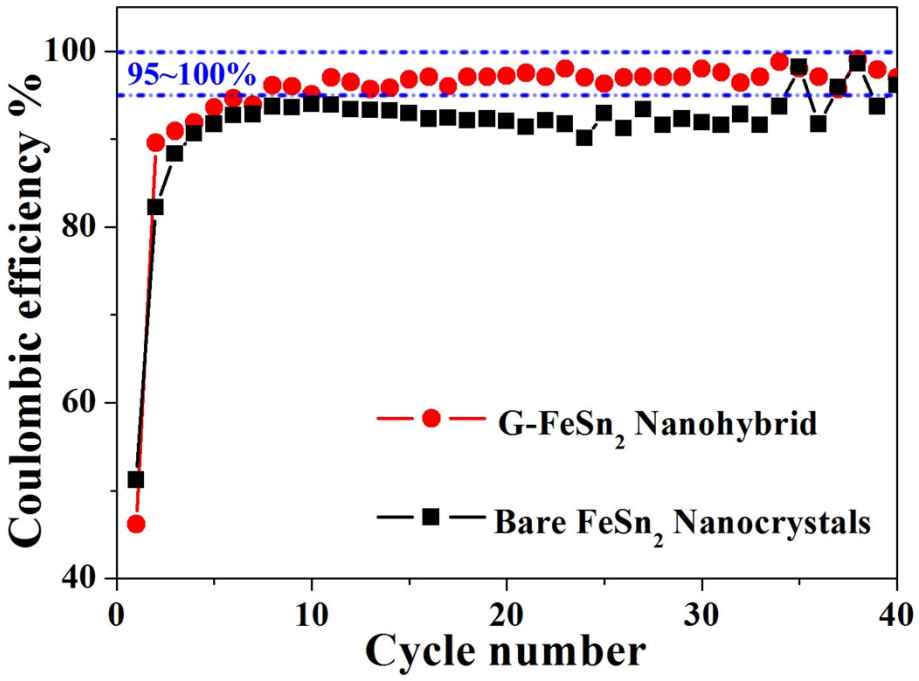

Fig. S1 Coulombic efficiencies versus cycle number for bare $FeSn_2$ nanocrystals and G-$FeSn_2$ nanohybrid in the potential range of 0.01-2 V at a current density of 100 mA g^{-1}.

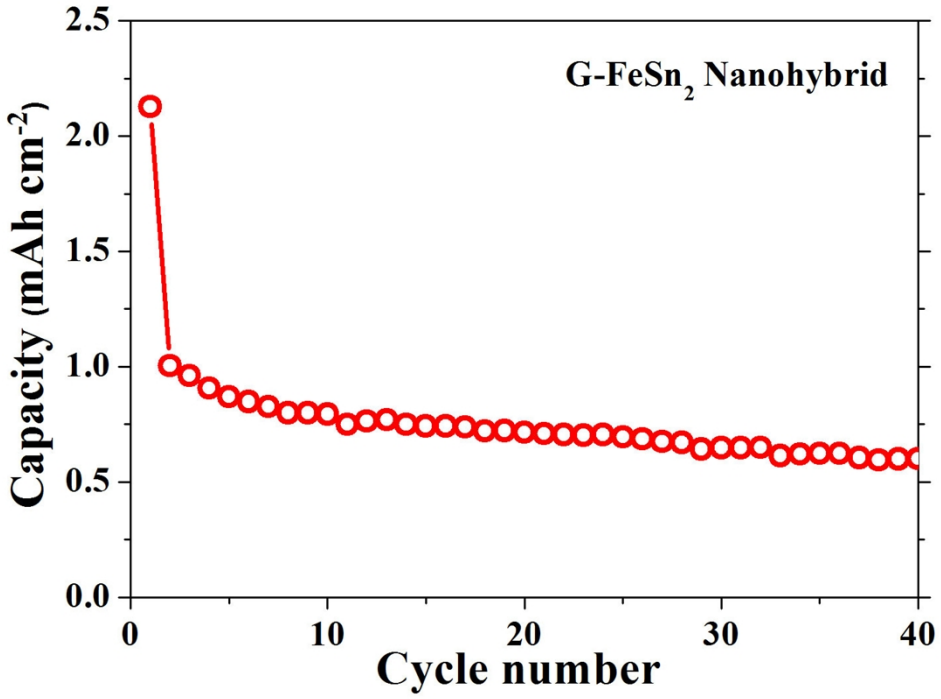

Fig. S2 Areal capacity versus cycle number for G-$FeSn_2$ nanohybrid in the potential range of 0.01-2 V at a current density of 100 mA g^{-1}.