Electronic Supplementary Material (ESI) for ChemComm.

Electronic Supporting Information (ESI) for

Facile synthesis of symmetric bundle-like Sb_2S_3 micron-structures and their application in lithium-ion batteries anode

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Experimental section

Synthesis of Sb-S-MS

The synthesis of Sb-O-SW was referred to the reported references.[24-25] In a typical synthetic process, 1.16 g of polyvinyl pyrrolidone (PVP, M*w* = 40000) was first dissolved in 80 mL deionized water under continuous ultrasonication for 0.5 h. Subsequently, 1.2 mL of ethylenediamine (EA) was poured into. Then, 0.3 g of commercial Sb powder was added into the mixture under vigorous stirring. After continuous stirring for 12 h at room temperature, the white products were collected by centrifugation, washed thoroughly by deionized water and absolute ethyl alcohol, and finally dried in a vacuum oven at 60 °C overnight. To fabricate the Sb-S-MS, 0.1 g of as-prepared Sb-O-SW and 0.2836 g of cysteine were dispersed in 15 mL of deionized water. After vigorous stirring for 0.5 h, the mixture was transferred to a 45 mL Teflon-lined autoclave, maintained at 200 °C for 10 h and cooled naturally to room temperature. Then, the black products were collected, washed, and finally dried.

Characterization

Powder X-ray diffraction (XRD) patterns of as-prepared products were collected by using a Bruker D8 Focus power X-ray diffractometer with copper target at a scan rate of 4 ^{o} min^{-1}. The surface morphology and X-ray spectroscopy (EDS) element mapping were characterized by scanning electron microscope (SEM, HITACHI S-4800, Japan) at an acceleration voltage of 10 kV. Transmission electron microscopy (TEM) and high resolution transmission electron microscopy (HRTEM) were performed on a FEI Tecnai G2 S-Twin instrument with a field emission gun operating at 200 kV.

Electrochemical measurements

The working electrode was prepared by coating the N-methy1-2-pyrrolidone (NMP) slurry containing active material (bundle-like and rod-like Sb_2S_3), acetylene black (as the conductive agent), and polyvinylidene fluoride (PVDF, as the binder agent) with a weight ratio of 70:15:15 onto a copper foil and drying in a vacuum oven at 60 ^{o}C for 12 h. The thickness of the active material layer was about 15 μm, and the mass loading of the active material for the testing electrodes was about 1.75 mg. Then, the cells were assembled by using CR 2025 coin-type cell configuration with pure lithium as the counter electrode, a Celgard 2400 membrane as the separator, and 1 M $LiPF_6$ dissolved in ethylene carbonate and diethylene carbonate (1:1 in volume) with 5% fluoroethylene carbonate (FEC) additive as the electrolyte. Note that this process was carried out in a glove box filled with highly pure argon gas. The charge-discharge performance was tested between 0.01 V and 3.0 V using a programmable battery testing system (LAND CT2001A) at room temperature. The cyclic voltammogram (CV) measurements were performed on a BioLogic VMP3 Electrochemical Workstation.

Fig.S1. the optical photograph of the rice straw-tied bundle.

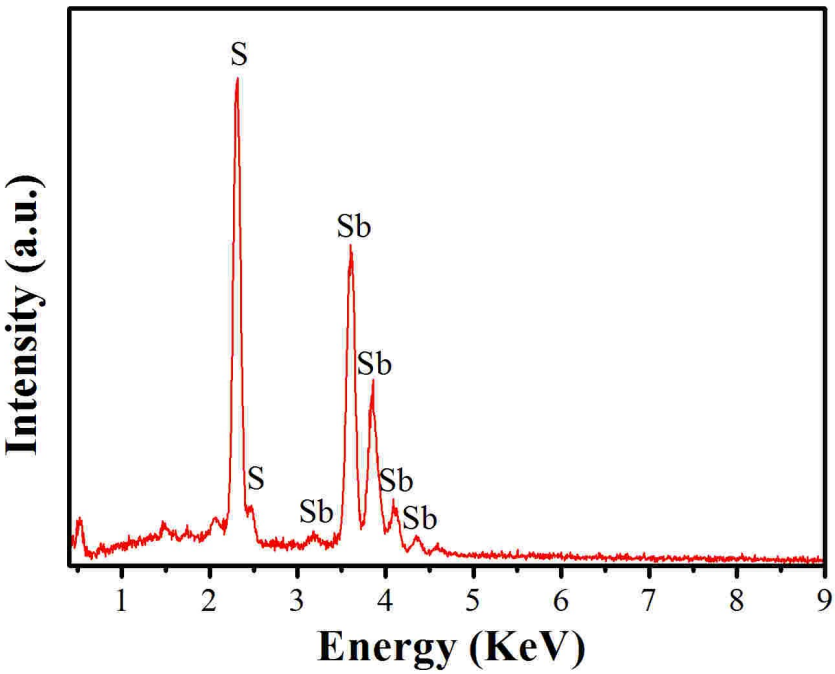

Fig. S2. The EDS spectrum of the Sb_2S_3 bundle.

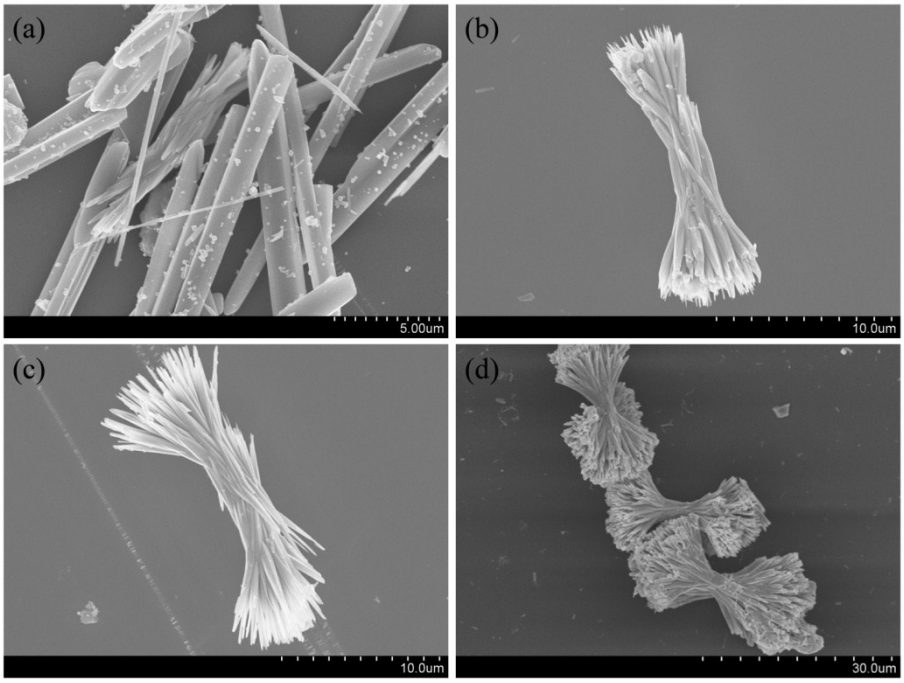

Fig. S3. The formation process of the bundle-like Sb_2S_3 with different heating times (a) 0.5 h, (b) 1 h, (c) 2 h and (d) 5 h.

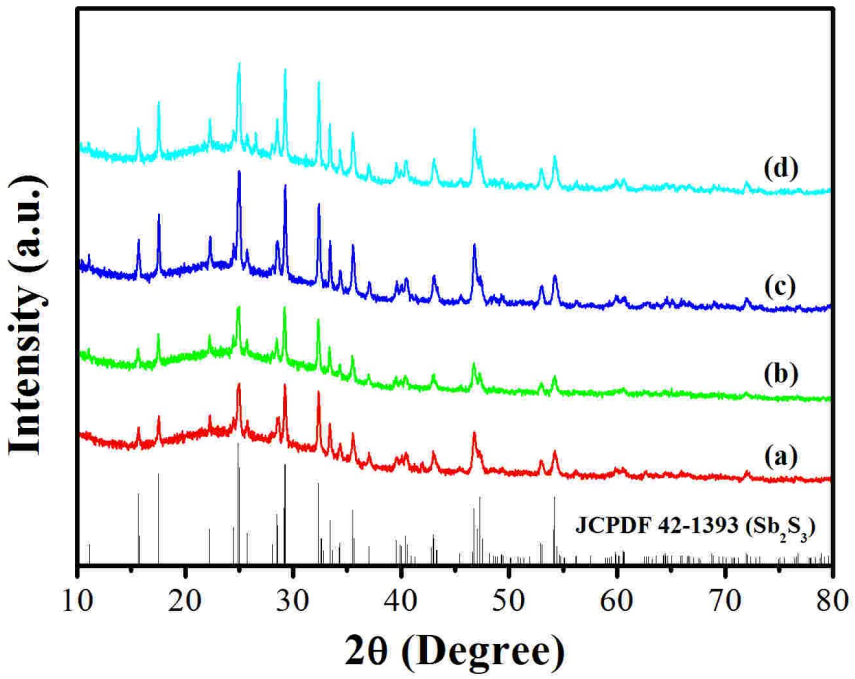

Fig. S4. The corresponding XRD patterns of the Sb_2S_3 obtain at different heating times (a) 0.5 h, (b) 1 h, (c) 2 h and (d) 5 h.

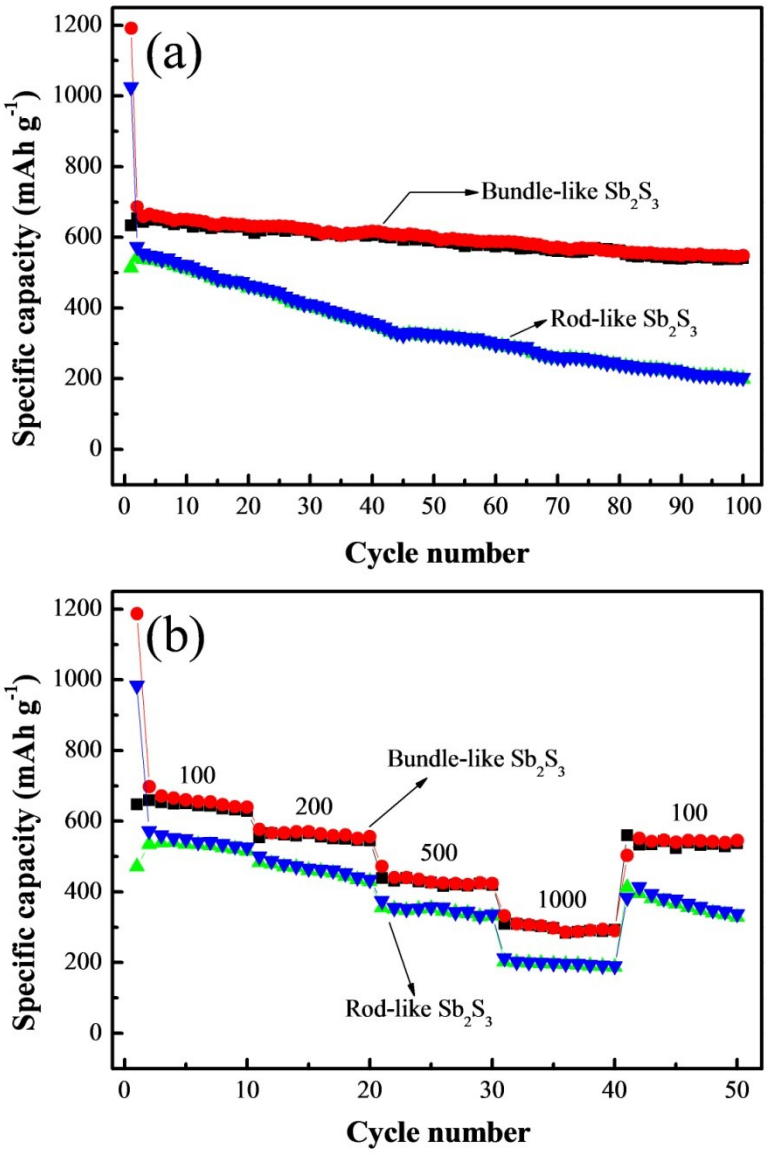

Fig. S5. Comparison of the cycle performances of the bundle-like and rod-like Sb_2S_3 as anode materials for lithium ion batteries, (a) at a current density of 100 mA g^{-1} and (b) at the current density ranging from 100 to 1000 mA g^{-1}.

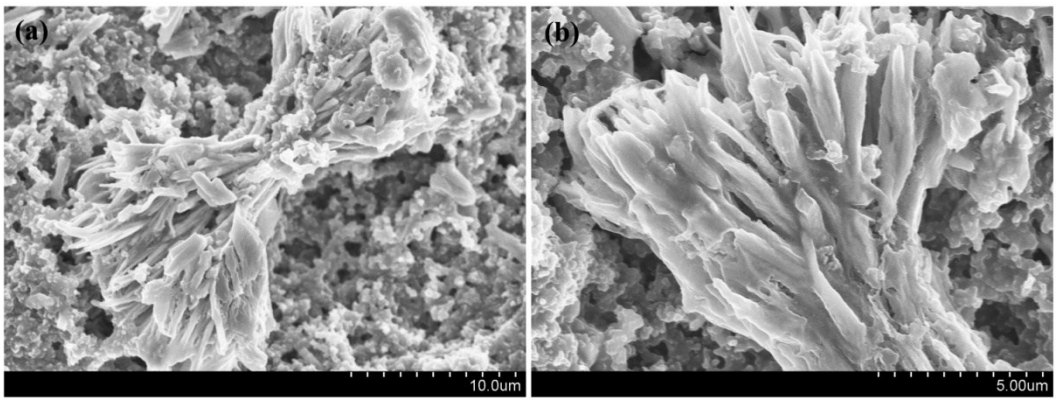

Fig. S6. (a-b) SEM images of bundle-like Sb2S3 structures after 100 cycles testing.