Electronic Supplementary Information

Improving the performance of Li−S Batteries by reinforced PPy wrapping over acetylene black-coated sulfur

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1. Experimental

1.1 Coating of AB on sulfur

Prior the synthesis of AB/S composite, 200 mg of AB were sonicated in 5 ml ethyl alcohol for 30 mins to form a stable suspension. Uniform coating of AB on sulfur was realized by a simple chemical deposit method. Briefly, 2.5 g of $Na_2S_2O_3$ was first dispersed in 750 ml of nanopure water, then the as-prepared AB suspension was added to the $Na_2S_2O_3$ solution with magnetic stirring. The mixed solution was then stirred at room temperature for 6 hours to ensure good dispersion. Afterwards, 50 ml of HCl (0.5 M) was slowly added at the rate of 0.1 ml min^{-1}. The as-synthesized AB/S was collected by vacuum filtration and washed with nanopure water several times in order to remove residue salts and impurities. Finally, the collected samples were dried at 70°C for at least 72 hours.

1.2 Wrapping of PPy on AB/S

The as-prepared AB/S composites was dispersed in 200 ml of HCl (0.5mol/L) solution, While under vigorous stirring, 55.3 mg cetyltrimethyl ammonium bromide (CTAB) and 91 μl pyrrole (1.31 mmol) was added, followed by an addition of ammonium peroxydisulfate (3:1 equiv mole of pyrrole). The reaction temperature was controlled with 0-5 ◦ C using an ice bath and the reaction time was 4h. The as-synthesized PPy-AB/S was collected by vacuum filtration and washed with nanopure water several times in order to remove residue salts and impurities. Finally, the collected samples were dried at 70°C for at least 72 hours.

1.3 Characterization

Scanning electron microscopy (SEM) images were collected using a field emission scanning electron microscope (FESEM, JSM-6700). Transmission electron microscopy (TEM) images and energy-dispersive spectroscopy (EDS) were obtained by using a Hitachi-7650. The weight percentage of sulfur in the composite was determined by thermogravimetric analysis (TGA) using a DSC 141 Simultaneous DSC-TGA instrument (TA Instruments). Electrochemical measurements were carried out using PRINCETON 4000 and Land battery analyzers.

1.4 Preparation of Cathode and Electrochemical Evaluation

To prepare the working electrode, PPy-AB/S composite was mixed with PVDF binder in NMP to form slurry with a weight ratio of 9:1. The slurry was then coated onto aluminium foil using doctor blade method and dried to form the working electrode. The

total material loading density was 1.3~1.8 mg cm^{-2}. 2032 type coin cells were assembled in an argon-filled glove box with lithium foil as the anode. The separator was purchased from Cellgard (model 2400). The electrolyte was 0.1 M lithium nitrate and 1.0 M lithium bis-trifluoromethane sulfonylimide in 1,3-dioxolane and 1,2-dimethoxyethane (volume ratio 1:1) Galvanostatic measurements were conducted between 1.5 V and 3.0 V (vs Li^+/Li). Specific capacity values were calculated based on the mass of S in the samples.

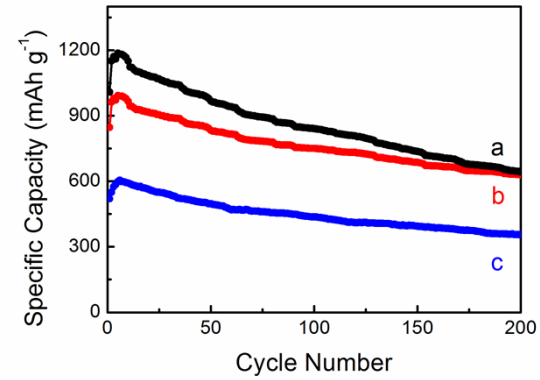

Fig. S1 Comparison of specific capacity as a function of cycle numbers for electrodes assembled with PPy-AB/S composites with various contents of sulfur (a. 33%, b. 45% and c.63%).

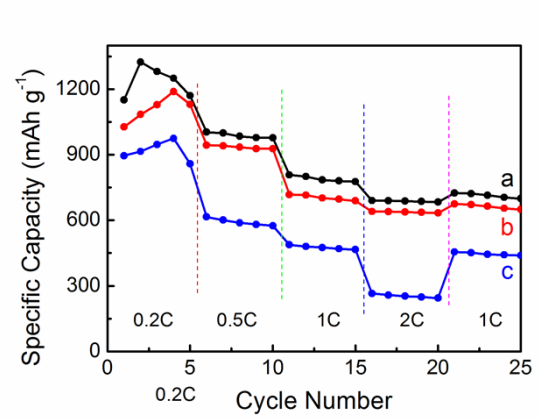

Fig. S2 Comparison of the capacity vs the current density (0.2C, 0.5C, 1C, and 2C) of the the cathodes assembled with PPy-AB/S composites with various contents of sulfur (a. 33%, b. 45% and c.63%).