Supplementary Information

Acetylene black derived hollow carbon nanostructure and its application in lithium-sulfur batteries

Jingjing Tang, Juan Yang and Xiangyang Zhou

School of Metallurgy and Environment, Central South University, Lushan South Road 932, Changsha, China. Fax: +86 731 8871017; Tel: +86 731 88836329; E-mail: hncsyjy308@163.com

1. Experiment

1.1 Preparation of hollow carbon nanostructure (HCS)

Hollow carbon nanostructure was obtained via one-pot acid steaming process. Typically, 1 g pristine acetylene black (p-AB) powder (TIMCAL, Sweden) were placed on the SiO_2 griddle of a sand core funnel, and then put into a Teflon-vessel, to the bottom of which 20 ml concentrated HNO_3 (65-68 wt%) has been added. The Teflon-vessel was subsequently sealed into a stainless steel autoclave and then moved to an oven at a temperature of 150℃ for 8h. After cooled to room temperature, the obtained powder was washed with deionized water and dried at 120℃ overnight.

1.2 Preparation of HCS/S composite

First, Sodium thiosulphate and Sodiumbisulfite was dissolved in dilute H_2SO_4 solution. Then, a certain amount of as-prepared HCS was dispersed into the above solution by ultrasonication. The result solution was transferred to a sealed Teflon-lined autoclave to carry out hydrothermal reaction at 130-150℃ for 2 h. After cooled to room temperature, HCS-S product was obtained by washing and drying at 55℃. For comparison, p-AB-S was synthesized under the same hydrothermal reaction.

2. Material Characterization

The crystal structures of samples were measured by X-ray powder diffraction (XRD, Rigaku-TTRIII, Cu Kα) at a scanning rate of 8° min^{-1}. Raman spectra were obtained using a

LabRAM Hr800 from HORIBA JOBIN YVON. The functional groups on the surface of samples were investigated by Fourier transform infrared spectroscopy (FT-IR) spectroscopy (Nicolet 6700). The morphology and structure of samples were examined by field emission scanning electron microscopy (NOVA NANO SEM230) and field emission transmission electron microscopy (FETEM, JEM-2100F). The content of sulfur in the HCS-S sample was calculated based on the thermogravimetric analysis (TGA, SDTQ600) data.

3. Electrochemical Test

For preparing working electrodes, a mixture of HCS-S and PVDF binder at a weight ratio of 9:1 was dissolved in NMP to produce a slurry that was then coated on aluminum foil and dried at 55℃. Customized 2025 coin cell was assembled in an argon-filled glove box using lithium metal as the counter electrode and a microporous polyethylene separator. The electrolyte solution was 1 M $LiN(CF_3SO_2)_2$ (LITFSI) dissolved in a mixture of 1,3-dioxolane (DOL) and dimethoxymethane (DME) (1:1 by volume) with the addition of $LiNO_3$ (0.1 M). Cyclic voltammetry (CV) tests were performed on a SOLARTRON 1470E electrochemical workstation between 2.8 and 1.7 V with a scan rate of 0.1 mV s^{-1}. The charge-discharge performances of the batteries were measured galvanostatically at a charge-discharge current density of 200 mA g^{-1} of active sulfur, and the potential window was controlled between 1.7 and 2.8 V at room temperature.

4. Figure

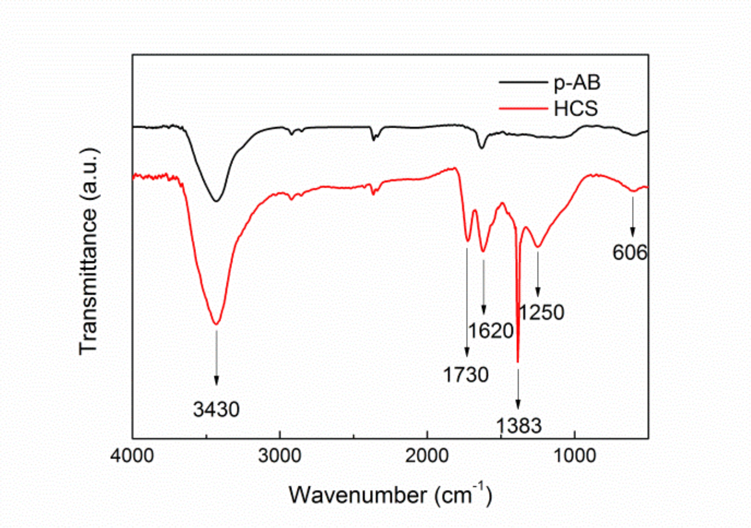

Fig. S1 FI-IR spectra of p-AB and HCS.

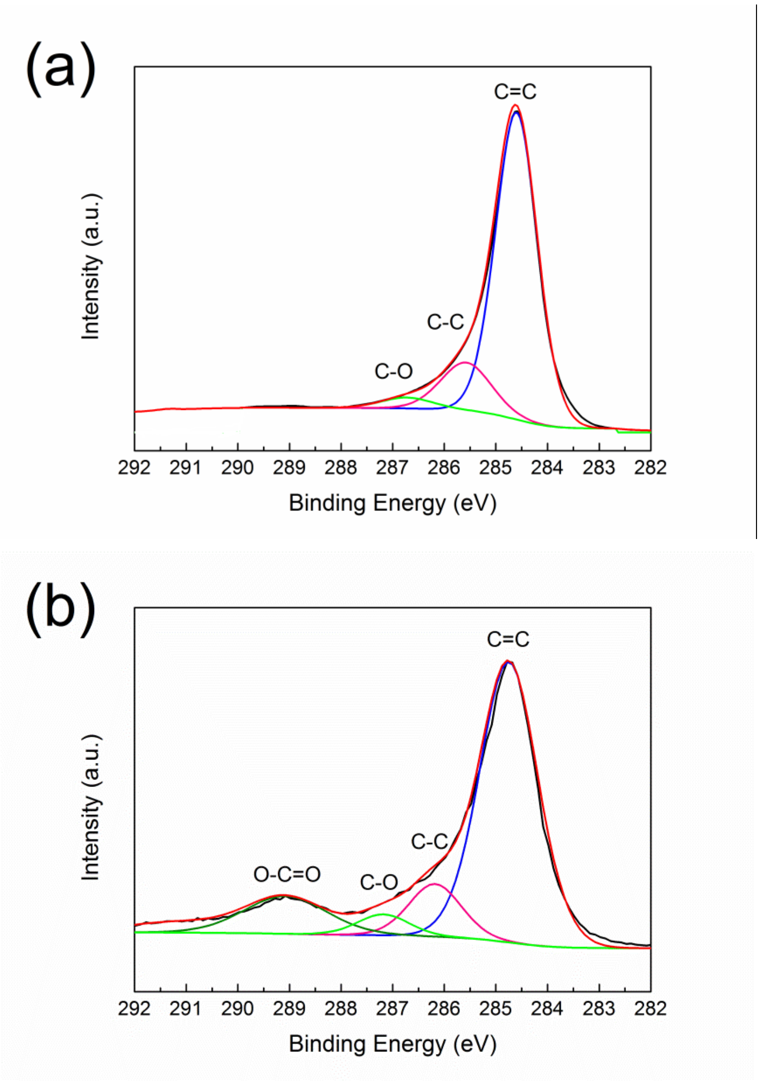

Fig. S2 C 1s XPS spectra of (a) p-AB and (b) HCS.

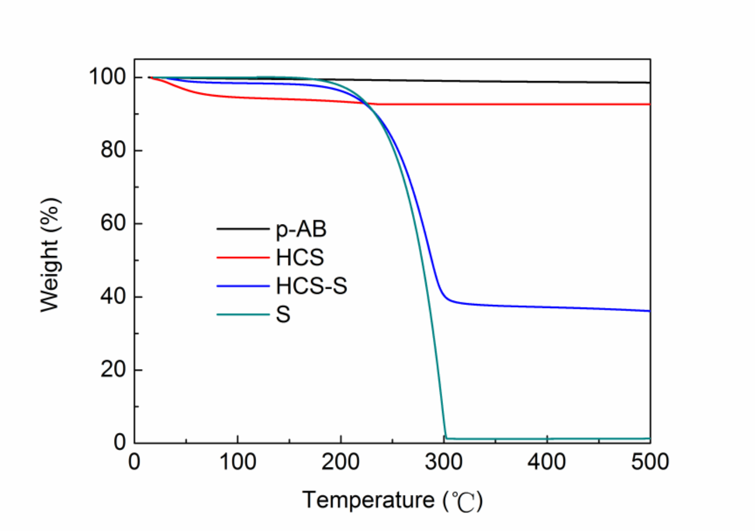

Fig. S3 TGA curves of samples.

5. Table

Table S1. Physical properties derived from XRD patterns.

Sample	(002) /°	d_{002}* /nm	Peak FWHM /°	Lc (002)** /nm
p-AB	24.74	0.358	5.876	2.886
HCS	25.11	0.353	3.786	4.518