Supporting Information

Effective trapping of polysulfides using functionalized thin-walled porous carbon nanotubes as sulfur host for lithium-sulfur batteries

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The supporting information consists of the following content:

Materials

Divinyl benzene (80%) (DVB) and boron trifluoride diethyl etherate complex were purchased from Aladdin Reagent Company, and 4-vinylbenzylchlorid (90%) (VBC) was purchased from J&K Chemical Reagent Company. All other reagents were AR grade and provided by commercial suppliers and used without further purification. The synthesis and sulfonation of poly (divinyl benzene) nanotubes (PNTs) are obtained according to the previous reported methods. [1, 2]

Materials characterization

X-ray diffraction (XRD, Bruker D8 advance with Cu Kα radiation) was used to characterize the phase compositions. Morphologies and structures of products were researched by using field emission scanning electron microscope (FESEM Hitachi S-4800), transmission electron microscope (TEM Hitachi H-600) and a high resolution transmission electron microscope (HRTEM JEOL JEM-2010F). Raman spectra were measured by a Bruker Senterra R200-L spectrometer (532 nm). Bruker VERTEX 70 spectrometer was used to record Fourier transform infrared (FT-IR) spectra. Thermal gravimetric curves (TG, TG-DTA 6200LAB SYS) were used to evaluate the content of sulfur in the S/C composites.

Electrochemical measurement

The electrochemical data were measured with CR2032 button cell, and lithium metal was served as the contrast electrode. 80 wt% active materials, 10 wt% carbon black and 10 wt% poly (vinylidene fluoride) binder were mixed in N-methyl-2-pyrrolidone to form a slurry, which was

smeared on the Al foil and dried at 60 ℃ for 12 h in vacuum. Cells were assembled in an argon-filled glove box, in which both the moisture and oxygen contents were controlled to be less than 0.1 ppm. Celgard 2400 membrane as the separator. The electrolyte was 1 M lithium bis-(trifluoromethanesulfonyl) imide (LiTFSI) and 1 wt% lithium nitrate ($LiNO_3$) in 1,3-dioxolane and 1,2-dimethoxy-ethane (volume ratio 1:1). Galvanostatic charge–discharge tests were carried out by using a Land (CT2001A China) between 1.7 V and 2.8 V (versus Li^+/Li). Specific capacities were calculated based on the mass of the sulfur.

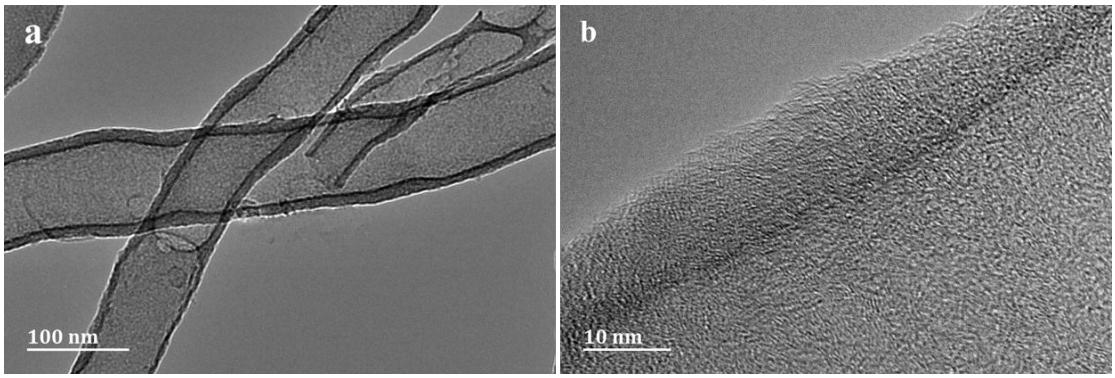

Figure S1. TEM (a) and HRTEM (b) images of HOCNTs.

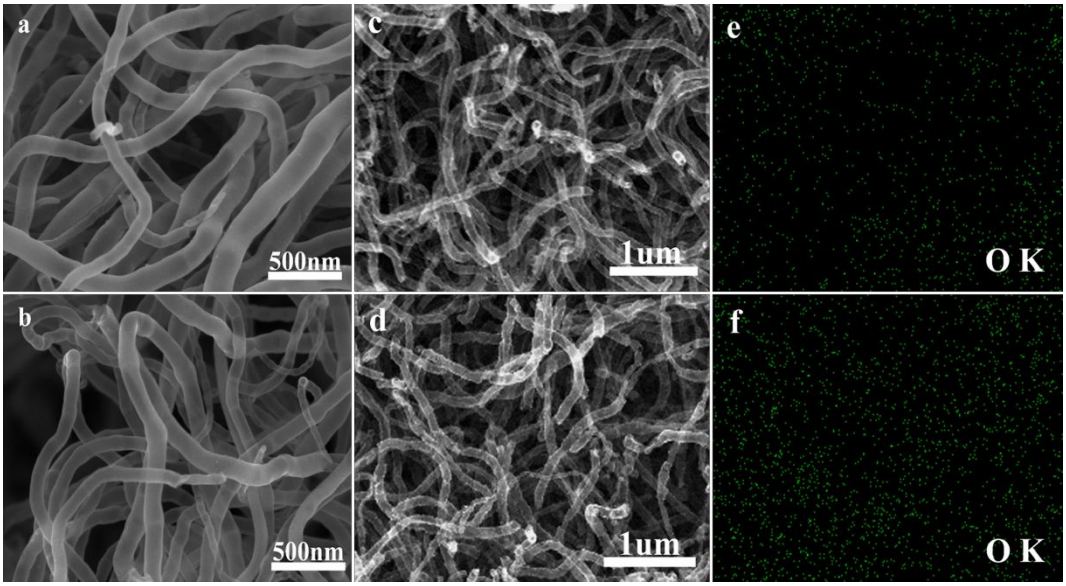

Figure S2. SEM images of HCNTs (a, c) and HOCNTs (b, d), the corresponding oxygen element mapping images of HCNTs (e) and HOCNTs (f).

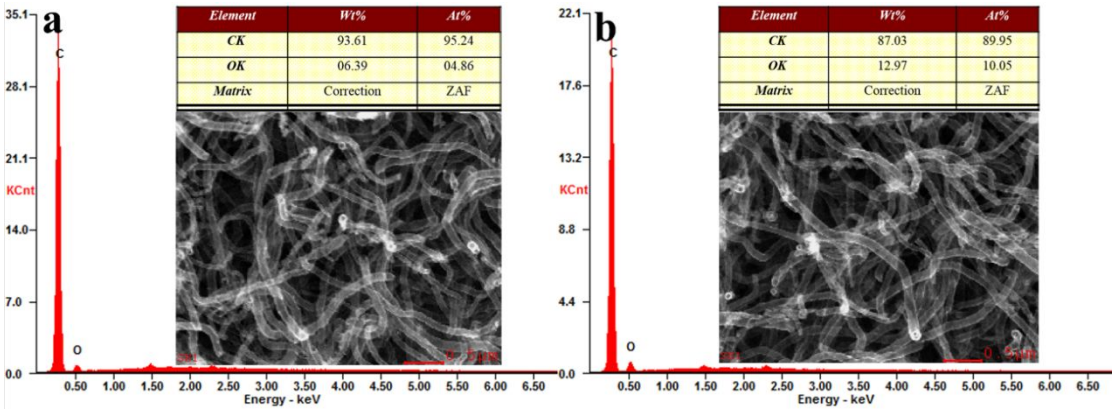

Figure S3. SEM images and EDS patterns of HCNTs (a) and HOCNTs (b).

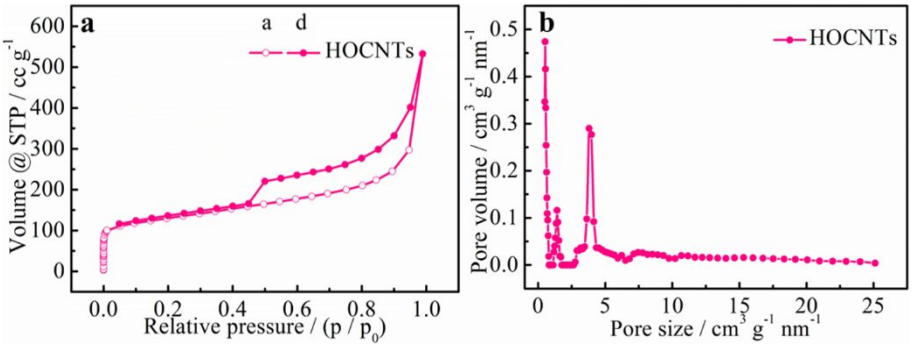

Figure S4. Nitrogen adsorption−desorption isotherm (a) and pore size distribution curve (b) of HOCNTs.

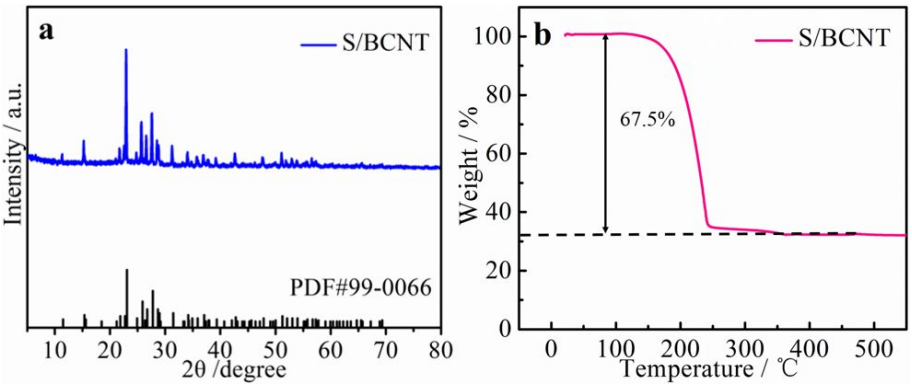

Figure S5. XRD pattern (a) and TG curve (b) of S/BCNT.

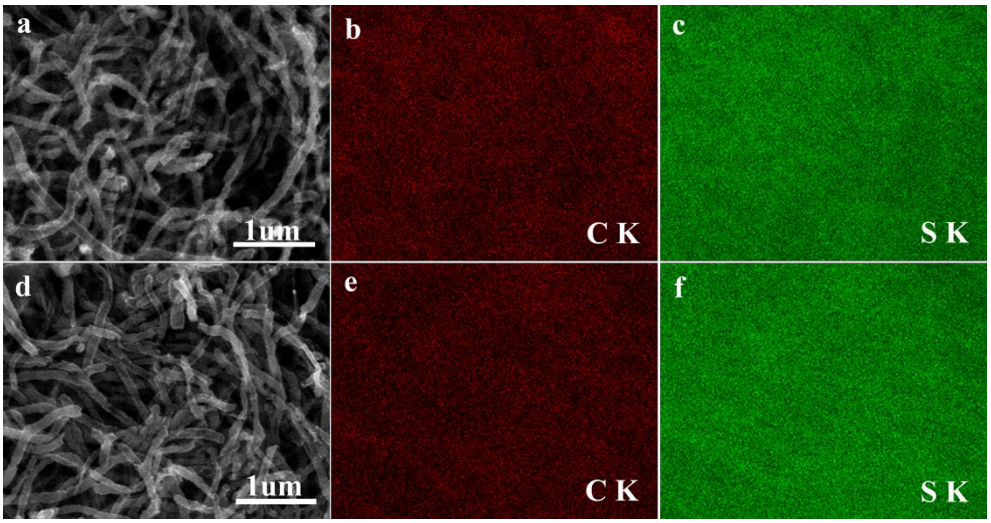

Figure S6. SEM images of S/HCNT (a) and S/HOCNT (d), corresponding carbon (b, e) and sulfur (c, f) elemental mapping.

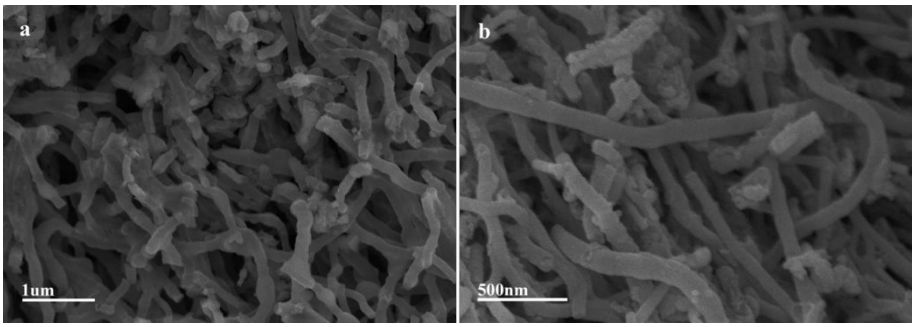

Figure S7. SEM images of S/BCNT.

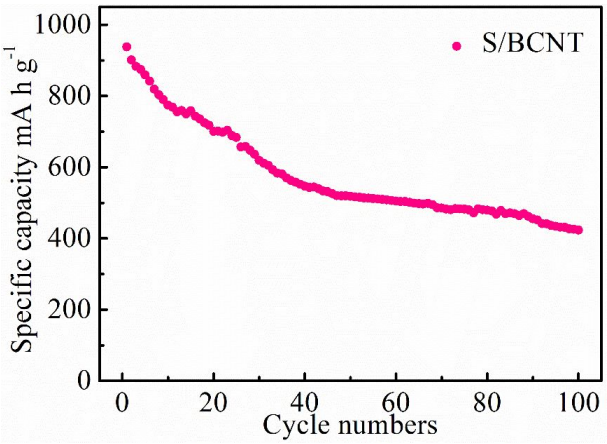

Figure S8. Cycle performance of S/BCNT at 0.2 C.

Table S1. Cycling performance and specific capacity of various S/CNT cathodes reported in the literature.

Materials	Sulfur %	Current density	Cycle numbers	Remaining capacity (mA h g^{-1})	Refs
S/Partially Unzipped CNT	51%	0.2 C	60	707.2	[3]
S/N-doped C@CNT	70%	0.2 C	100	717.6	[4]
S/N-doped C/CNT hybrids	62.5%	1 C	600	407	[5]
S/acidized CNT paper	70%	1 C	400	454	[6]
S/CO_2 oxidation CNT	80%	0.2 C	300	430.5	[7]
S/Polymer/Porous long CNT	58%	0.5 C	200	610	[8]
S/HOCNT	70%	0.2 C	100	798.5	This
		1 C	500	511.6	work

References

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