Electronic Supplementary Information

Sulfonic groups modified carbon nanotubes: the decorative strategy for enhancing the performance of lithium-sulfur batteries

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Preparation of polymer nanotubes (PNTs)

A solution of divinyl benzene (3 g) and vinylbenzyl chloride (1 g) in n-heptane (100 g) were added boron trifluoride diethyl etherate complex (100 mg) at room temperature. After reacting for 10 min by ultrasonic waves, a large quantity of precipitation was produced. Then the reaction was terminated by dropping ethanol. The white fibers were filtered and washed with ethanol. After drying in a vacuum oven, and the obtained polymer nanotubes were labeled as PNTs.

Preparation of sulfonated polymer nanotubes (SPNTs)

0.2 g of PNTs were immersed in 30 mL of concentrated sulfuric acid and stirred at 50°C for 12 h. The mixture was diluted by a large amount of deionized water, and the sample was collected by suction filtration and washed with water and ethanol. The obtained sulfonated polymer nanotubes were labeled as SPNTs.

Preparation of thin-walled porous carbon nanotubes (TCNTs)

First, 200 mg SPNTs was added into 15 mL of ethanol and treated by ultrasound for 10 min. Second, 5 mL of ethanol and 10 mL of tetraethyl orthosilicate were added. After stirring for 8 h at room temperature, it is centrifugated. The residue was dispersed into 10 mL of ethanol, and ammonium hydroxide was added drop by drop to adjust the pH at 9 - 10. The mixture was stirred for 1 h, and 5 mL of water was instilled; the reaction continues for another 5 h. SPNT/SiO_2 was obtained through the centrifugation and drying at 80°C in air. Then, the obtained SPNT/SiO_2 was respectively calcined at 900°C (5°C min^{-1}) in N_2 for 3 h, leading to the formation of the CNT/SiO_2 hybrid. To remove the SiO_2, the calcinate was etched with hydrofluoric acid at 60°C, and the obtained thin-walled carbon nanotubes were labeled as TCNTs.

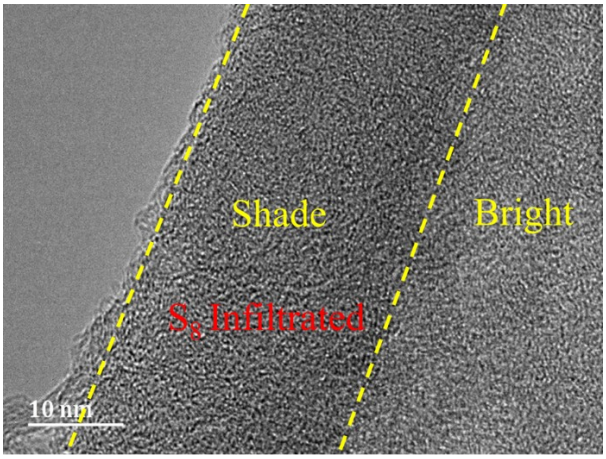

Figure S1 HRTEM image of S-TCNTs/S.