Fabrication of C/S Cathodes with Super-High Sulfur Content

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The theoretical capacity of the S/Li_2S redox couple is 1675 mAh g^{-1}, but the actual capacity of a sulfur cathode (sulfur+binder+carbon) is much less than that due to the large content of carbons to promote conductivity and anchor polysulfides [1]. In order to obtain higher sulfur ratio in the cathodes, it is necessary to design a conductive framework with light weight and highly porous structures. Herein, we report the fabrication of hollow carbon spheres with high surface area and remarkably large pore volumes that enable as much as 90 wt% sulfur in the C/S composite, as well as 75 wt% sulfur in the cathodes.

Figure 1a shows the transmission electron microscopy (TEM) image of a single carbon sphere. The diameter of the sphere is ~380 nmm, and the average shell thickness is ~60 nm. N^2 adsorption analysis indicates it has a large specific Brunauer Emmett Teller (BET) surface of 1500 m^2 g^{-1}, and high total pore volume of 4.4 cc g^{-1}, which are mainly contributed by the highly mesoporous shells. Moreover, nitrogen/sulfur co-doping was achieved during the preparation to enhance the adsorption of polysulfides [2].

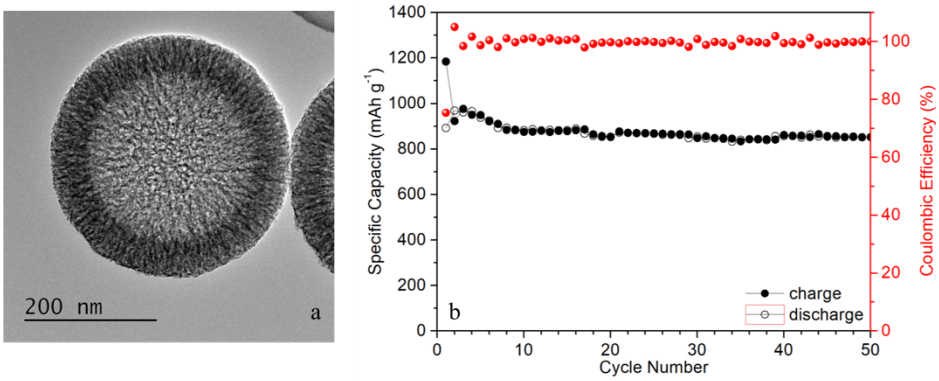

Figure 1. TEM image and capacity/cycling performance of the hollow carbon spheres

The C/S composites were obtained by different melt diffusion method [3] with high sulfur content of 90 wt%, and the overall sulfur ratio in the electrodes is ~75 wt% with binder and Super P. As shown in Figure 1b, the cell delivers a high initial capacity of 1200 mAh g^{-1}, and stable cycling at 900 mAh g^{-1} over 50 cycles. The practical high sulfur fraction and high capacities of the cell make the hollow carbon spheres a promising conductive framework for sulfur cathodes.

References:

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