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Supplementary Information

Effects of electrolyte concentration and synthesis methods of sulfur/carbon composites on the electrochemical performance in lithium-sulfur batteries

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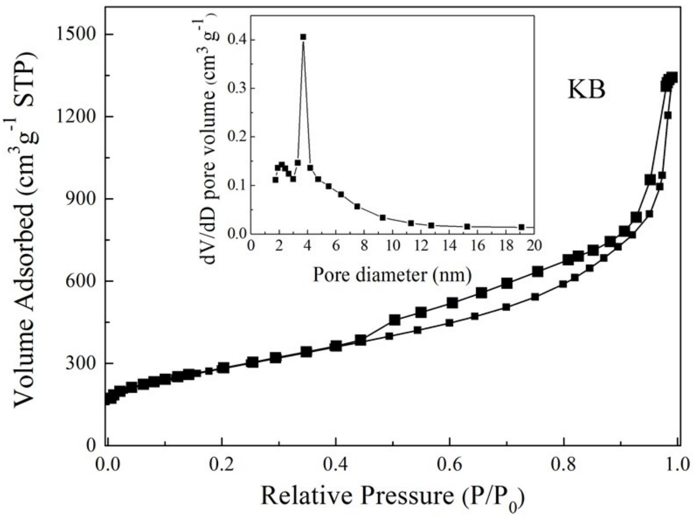

Figure S1 Nitrogen adsorption-desorption isotherms and the pore size distribution curve (the inset) of KB.

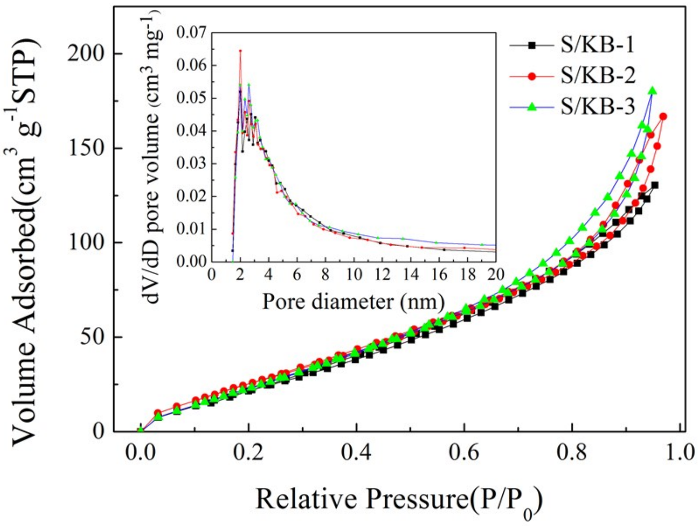

Figure S2 Nitrogen adsorption-desorption isotherms of S/KB-1, S/KB-2, and S/KB-3 composites.

Isotherms combined with hysteresis curve，presented in Fig. S1-S2, reflect the mesoporous structure of the carbon matrix and S/KB composites.

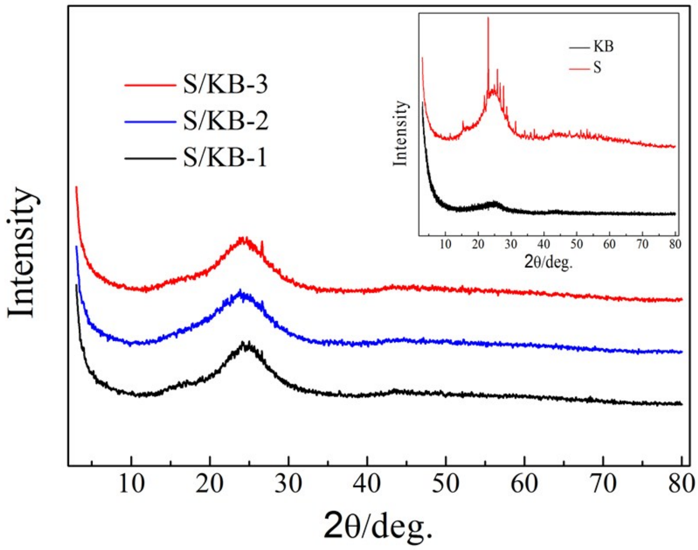

Figure S3 XRD patterns of KB, sulfur powder (the inset), and S/KB-1, S/KB-2, and S/KB-3 composites.

The image in Fig. S3 shows the XRD patterns of KB, sulfur powder, and the as-prepared S/KB composites. For S/KB-1, one broad diffraction peak located at around 24° can be observed, which is highly similar to the characteristic peaks of KB, indicating elemental sulfur with amorphous structure in the composite. Heat treatment at 155 °C is believed to enable sulfur to melt and diffuse into the pores of the carbon matrix, which is due to the lowest viscosity of sulfur at this temperature.[1,2] When the temperature was increased to 300 °C, residual sulfur on the surface of KB sublimed or is re-absorbed into the pores of the carbon matrix, resulting in a highly dispersed state of sulfur and carbon in S/KB-1. No characteristic peaks of crystalline sulfur can be observed in S/KB-2, indicating that sulfur with crystalline state in the sulfur-carbon mixture can also be transformed into amorphous state by ball-milling method. However, when the composite was heated to 155 °C, weak characteristic peaks of crystalline sulfur can be detected, suggesting that a small amount of amorphous sulphur is recrystallized onto the external surface of carbon black after cooling down to room temperature.

1. X. L. Ji, K. T. Lee and L.F. Nazar, *Nat. Mater.*, 2009, **8**, 500-506.
2. B. Zhang, X. Qin, G. R. Li and X. P. Gao, *Energy Environ. Sci.*, 2010, **3**, 1531-1537.