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## Protective interlayer for trapping polysulfides and conducting host for sulfur: Dual role of candle soot carbon for the development of high performance Lithium-Sulfur battery

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## **Supporting information**

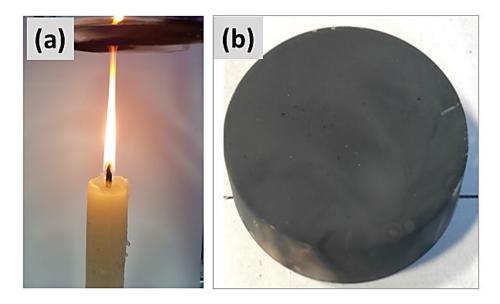


Fig. S1 (a) Collecting candle soot from the tip of the flame (b) collected candle soot.

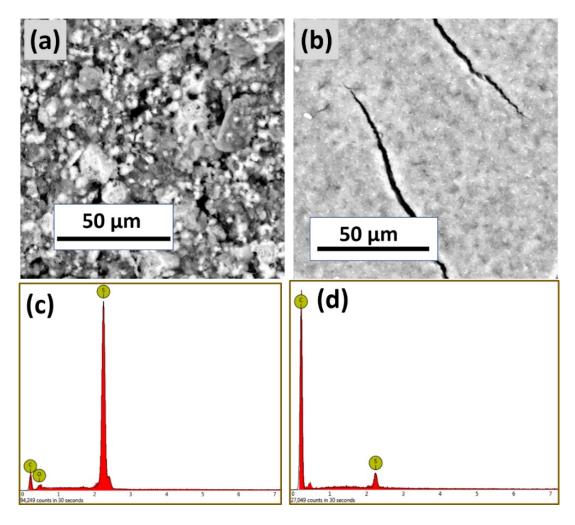


Fig. S2 SEM image of (a) SC (b) C-SC; EDAX analysis of (c) SC (d) C-SC.

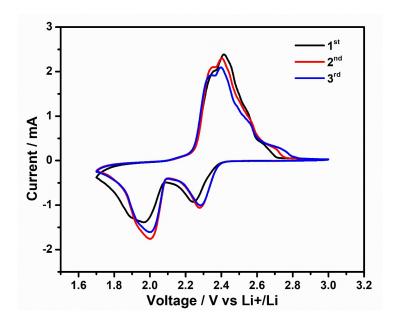
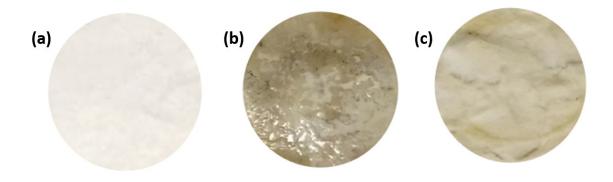


Fig. S3 CV of C-SC at the scan rate of 0.1 mV.s<sup>-1</sup>.



**Fig. S4** Digital image of glass fiber separator (a) before cycling (b) after cycling [100 cycles] using SC as cathode; (c) after cycling [200 cycles] using C-SC as cathode.

## **Equation S1:** Set of possible interaction between higher order polysulfides and carbon interlayer:

A. Possible interactions of  $Li_2S_4$ 

I. 
$$\text{Li}_2\text{S}_4 + \text{C} \rightarrow \text{C-Li}_2\text{S}_4$$

II. 
$$\text{Li}_2\text{S}_6\text{-C} + \text{Li}_2\text{S}_4 \rightarrow \text{Li}_2\text{S}_6\text{-C-Li}_2\text{S}_4$$

III. 
$$\text{Li}_2\text{S}_8\text{-C} + \text{Li}_2\text{S}_4 \rightarrow \text{Li}_2\text{S}_8\text{-C}\text{-Li}_2\text{S}_4$$

B. Possible interactions of Li<sub>2</sub>S<sub>6</sub>

I. 
$$\text{Li}_2\text{S}_6 + \text{C} \rightarrow \text{C-Li}_2\text{S}_6$$

II. 
$$\text{Li}_2\text{S}_4\text{-C} + \text{Li}_2\text{S}_6 \rightarrow \text{Li}_2\text{S}_4\text{-C-Li}_2\text{S}_6$$

III. 
$$\text{Li}_2\text{S}_8\text{-C} + \text{Li}_2\text{S}_6 \rightarrow \text{Li}_2\text{S}_8\text{-C-Li}_2\text{S}_6$$

C. Possible interactions of  $Li_2S_8$ 

I. 
$$\text{Li}_2\text{S}_8 + \text{C} \rightarrow \text{C-Li}_2\text{S}_8$$

II. 
$$\text{Li}_2\text{S}_4\text{-C} + \text{Li}_2\text{S}_8 \rightarrow \text{Li}_2\text{S}_4\text{-C-Li}_2\text{S}_8$$

III. 
$$\text{Li}_2\text{S}_6\text{-C} + \text{Li}_2\text{S}_8 \rightarrow \text{Li}_2\text{S}_6\text{-C-Li}_2\text{S}_8$$