

## Supporting Information

### **Constructing Multi-functional Composite Separator of PVDF- HFP/h-BN supported Co-CNF membrane for Lithium-Sulfur Batteries**

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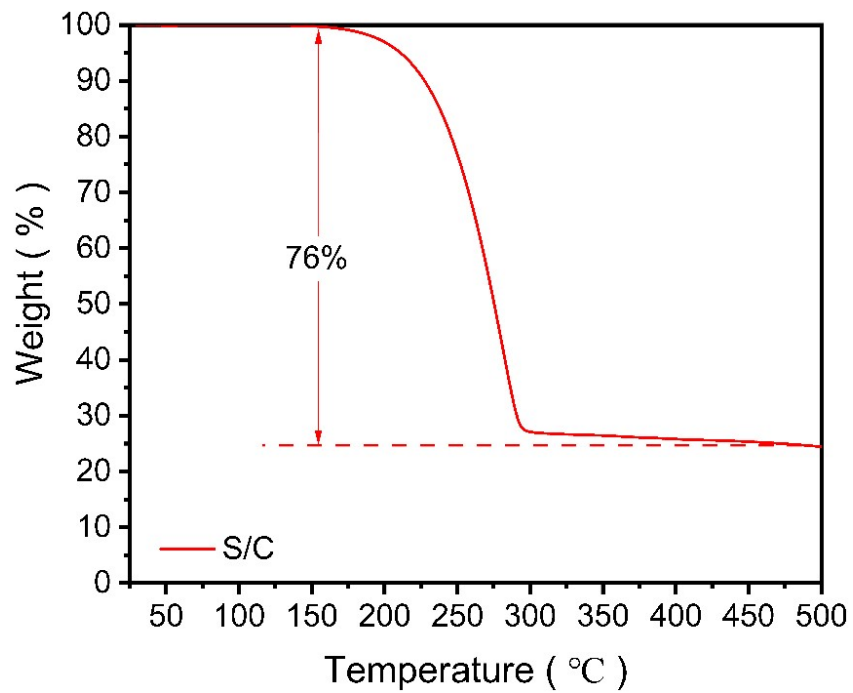


Figure S1. TGA curve for S/C composite.



Figure S2. The photographs of the membrane after electrospun, presinter and further carbonization.

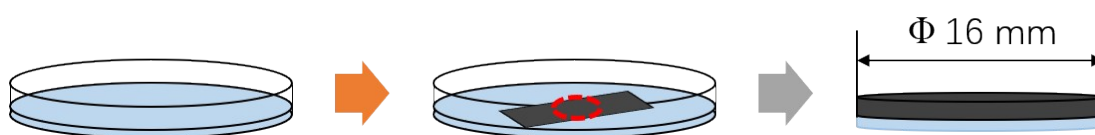


Figure S3. Schematic diagrams of the synthetic procedure of PHB/Co-CNF.

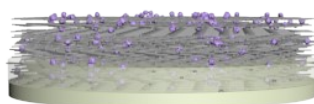


Figure S4. Schematic diagram of PHB/Co-CNF.

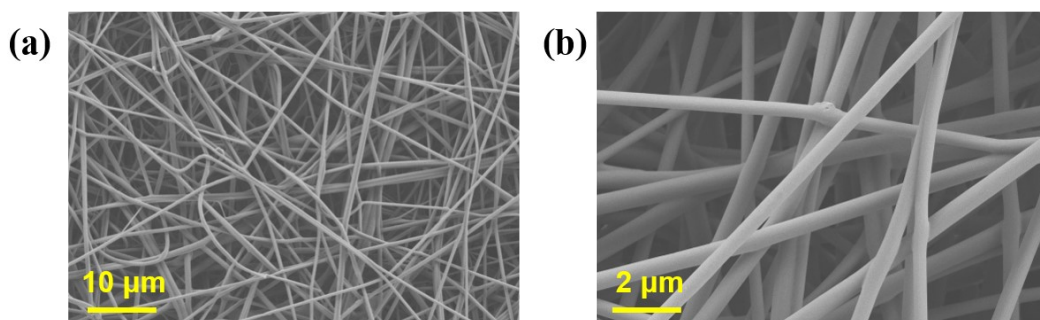


Figure S5. SEM images of PAN/Co(NO<sub>3</sub>)<sub>2</sub> at different magnification: (a) 1000 times and (b) 5000 times.

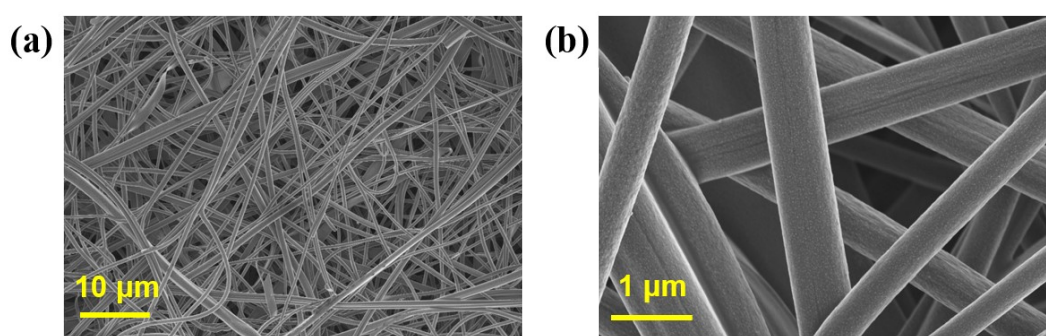


Figure S6. SEM images of Co-CNF at different magnification: (a) 1000 times and (b) 10000 times.

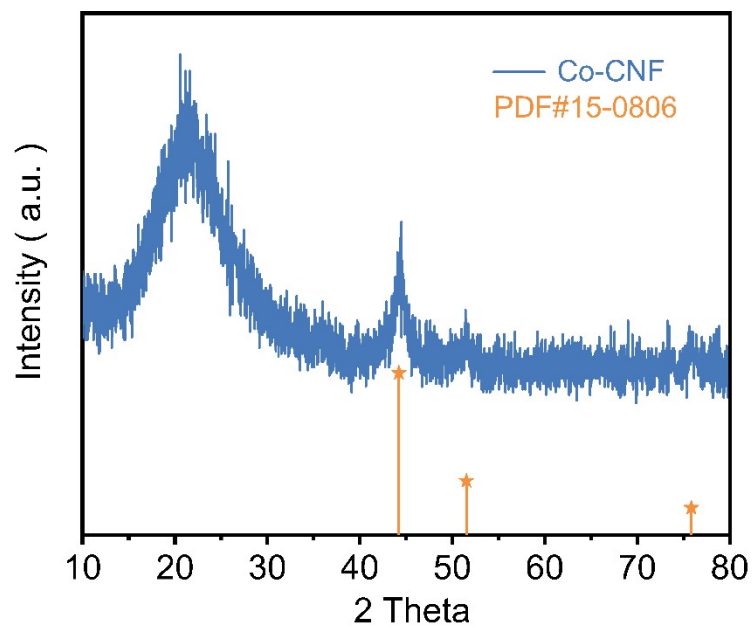


Figure S7. XRD pattern of the as-prepared Co-CNF.

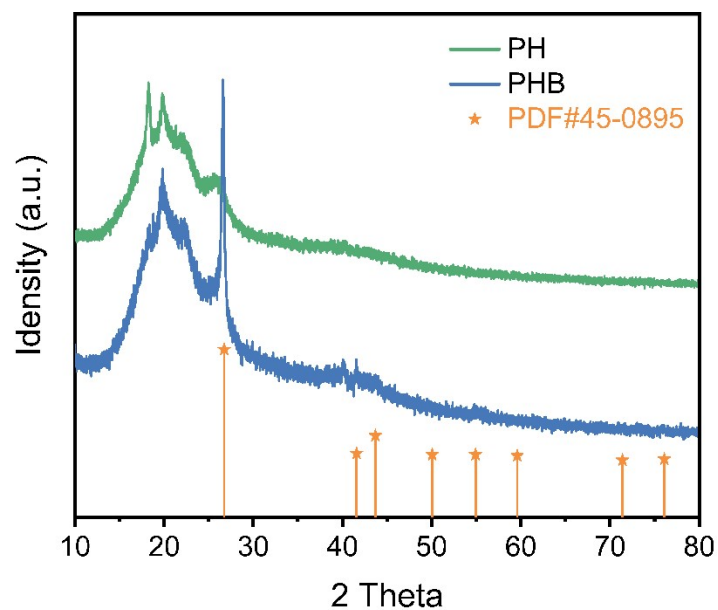


Figure S8. XRD patterns of PH and PHB.

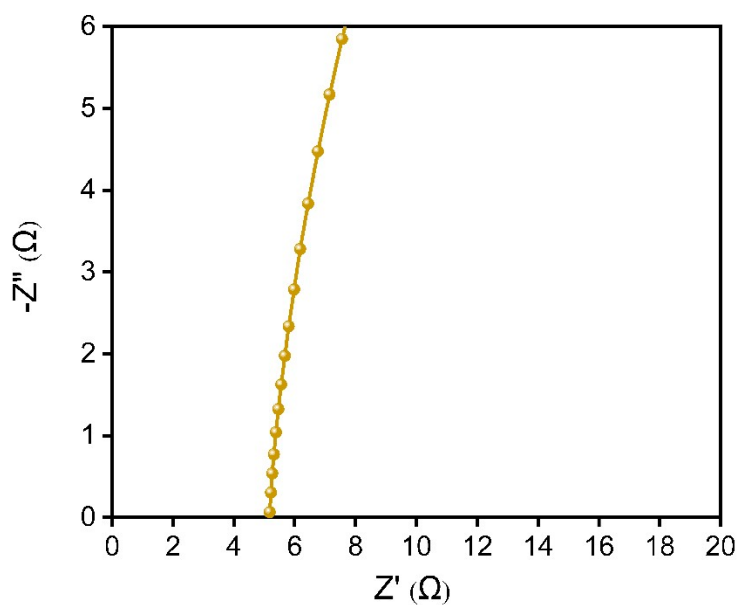


Figure S9. Nyquist plot of PHB/Co-CNF after absorbing electrolyte.

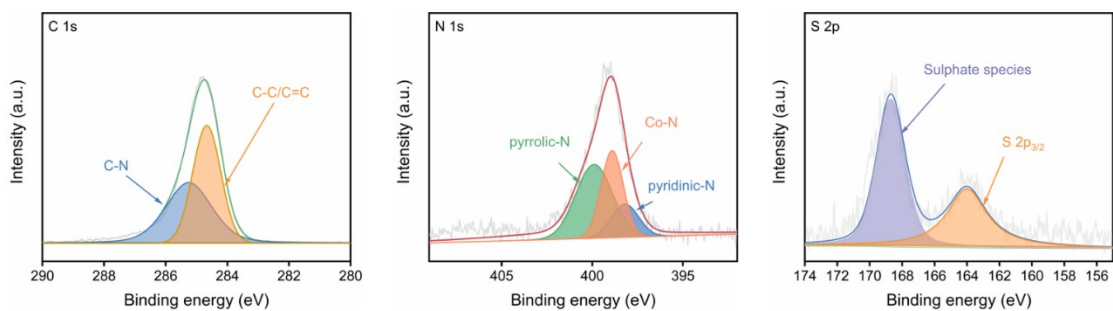


Figure S10. C, N, S XPS spectrum of PHB/Co-CNF after polysulfide diffusion test.

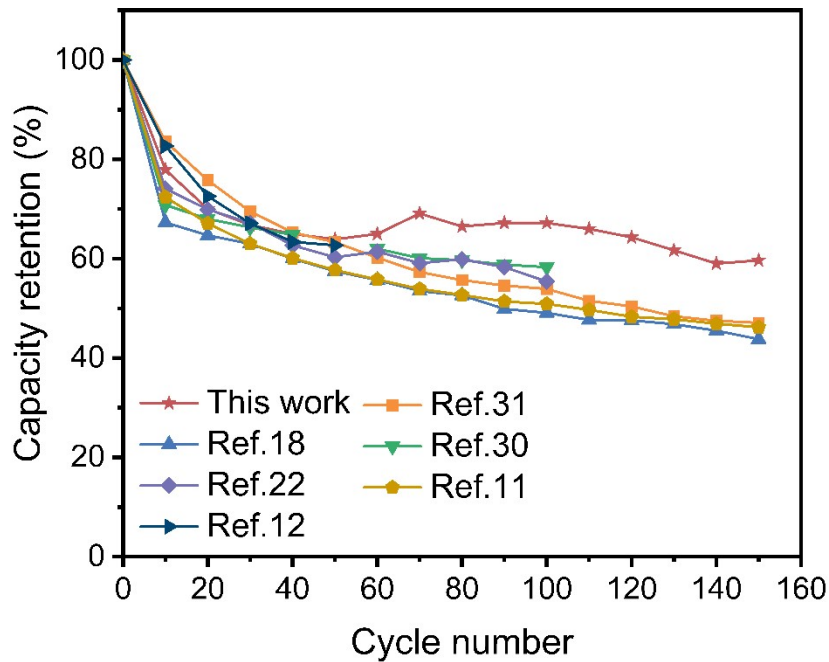


Figure S11. C, N, S XPS spectrum of PHB/Co-CNF after polysulfide diffusion test.

Table S1. Comparisons with recent reported works on Li-S batteries with different separators.

Separator	Discharge capacity at 1st cycle ( $\text{mAh g}^{-1}$ )	Discharge capacity at 100th cycle ( $\text{mAh g}^{-1}$ )	Retention after 100 cycles (%)	Rate (C)	Ref.
PP/NbN	1277.5	650.6	50.9	0.2	9
Celgard 3501	1131	690 (50 cycles)	67.2	-	10
glass fiber   oPANVP/SnCl <sub>2</sub>	1030	700	49.1	0.5	19
Celgard- NSPCFS@CoS <sub>2</sub>	1140.7	631.6	55.4	0.5	23
PP/C-C-N-Co	1320	787	58.3	0.5	34
PP/BNCNF	972.4	833.6	53.9	0.3	35
PHB/Co-CNF	949.6	638.3	67.2	0.5	This work

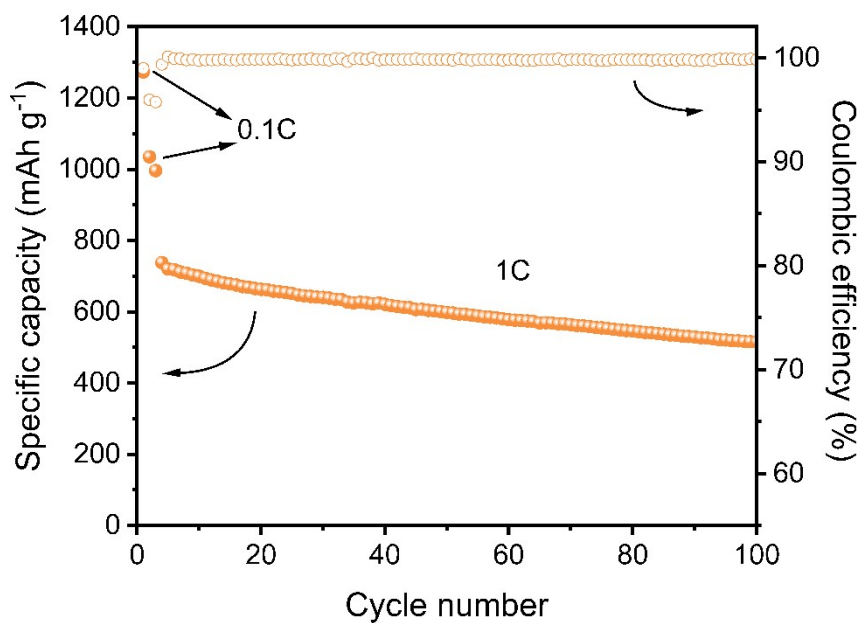


Figure S12. Cycling performance of the Li-S battery with PHB/Co-CNF separator at 1 C.

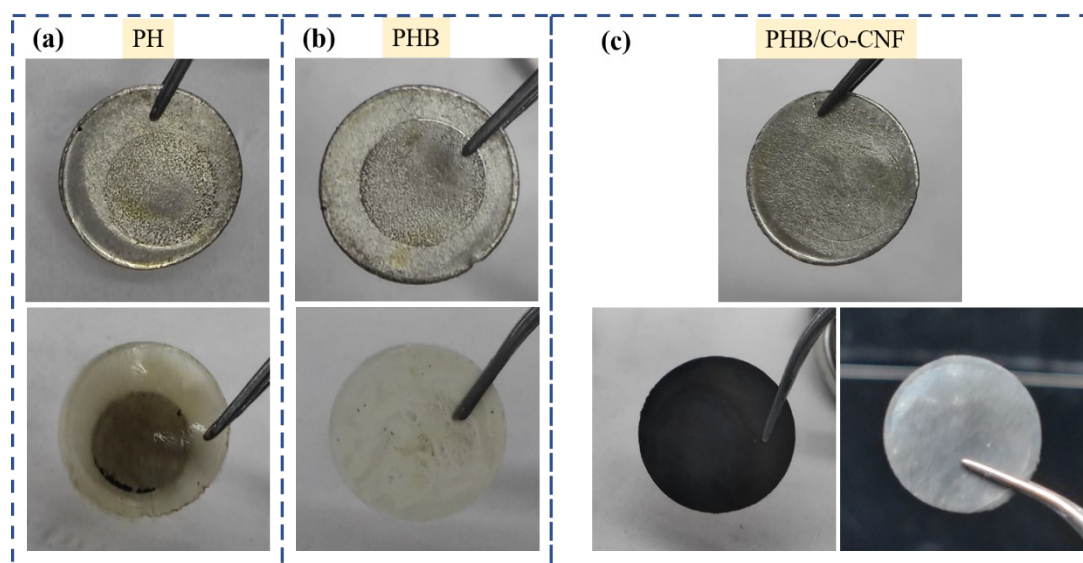


Figure S13. Photographs of the Li anodes and separators of the Li-S batteries with PH, PHB, PHB/Co-CNF separators after 50 cycles.