*Supplementary Materials*

# The LiTFSI/COFs Fiber as Separator Coating with Bifunction of Inhibition of Lithium Dendrite and Shuttle Effect for Li-$SeS_2$ Battery

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$Li^+$ transfer number was calculated according to the following formula:

$$t_+ = \frac{I_s(\Delta V - I_0 R^0)}{I_0(\Delta V - I_s R^s)} \quad (1)$$

In this formula, $t^+$ represents the ion transfer number; $Is$ is the current magnitude when constant voltage polarization is stable; constant voltage polarization is stable; $\Delta V$ is the applied voltage; $R^s$ is the interface impedance after constant voltage polarization; $I_0$ is the starting current of constant voltage polarization; $R^0$ is the interface impedance before constant voltage polarization. The $Li^+$ diffusion coefficient is calculated from the data provided by cyclic voltammetry. The calculation formula is as follows:

$$I_p = 2.69 \times 10^5 n^{1.5} A D_{Li+}^{0.5} c_{Li+} v^{0.5} \quad (2)$$

$I_p$ is the peak current of the corresponding oxidation peak or reduction peak; $n$ is the number of transferred electrons; $A$ is the area of the positive electrode plate; $D_{Li+}$ is the diffusion coefficient of $Li^+$; $c_{Li+}$ is the concentration of $Li^+$; and $v$ is the scanning speed.

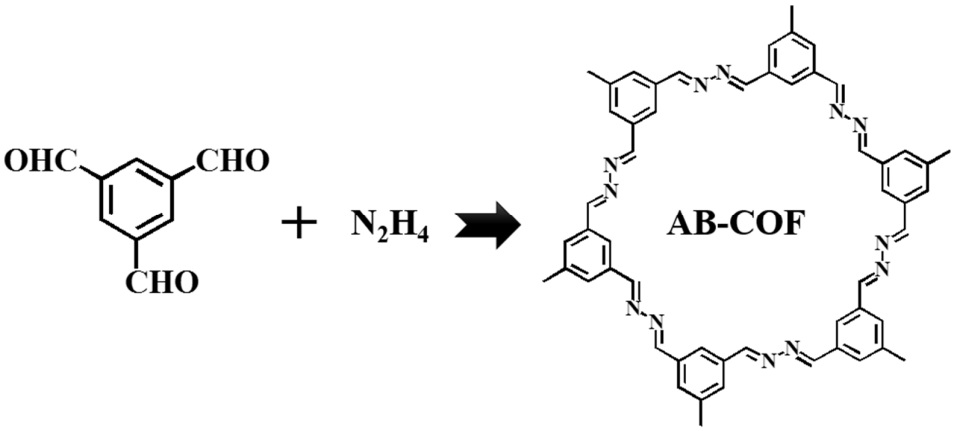


**Figure S1.** The structure of AB-COF.

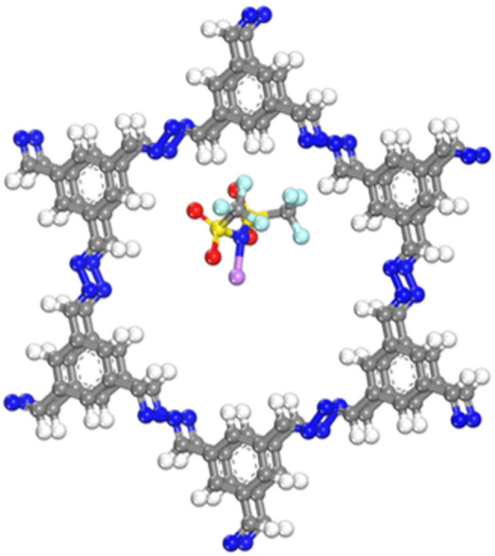

**Figure S2.** DFT calculation of LiTFSI/AB-COF.

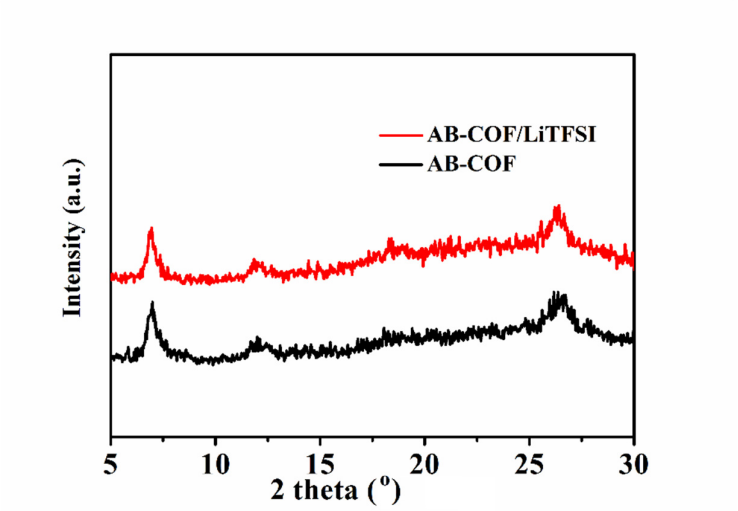


**Figure S3.** XRD spectrum of AB-COF and LiTFSI/AB-COF.

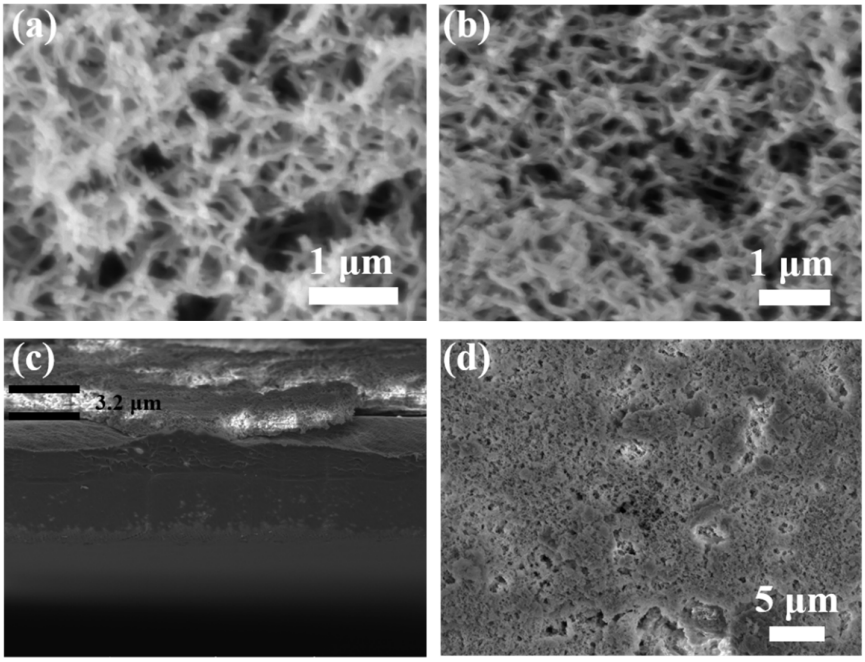


**Figure S4.** SEM pictures of (a) AB-COF and (b) LiTFSI/AB-COF. SEM of AB-COF/PP: (c) side view and (d) top view.

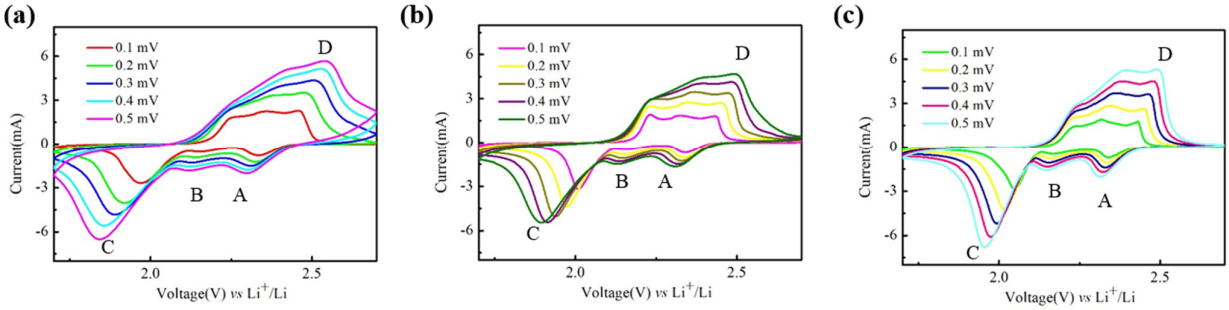


**Figure S5.** Cyclic voltammograms of Li-$SeS_2$ battery with (a) ATFG-COF/PP, (b) AB-COF/PP (c) PP separator at different sweep speeds.

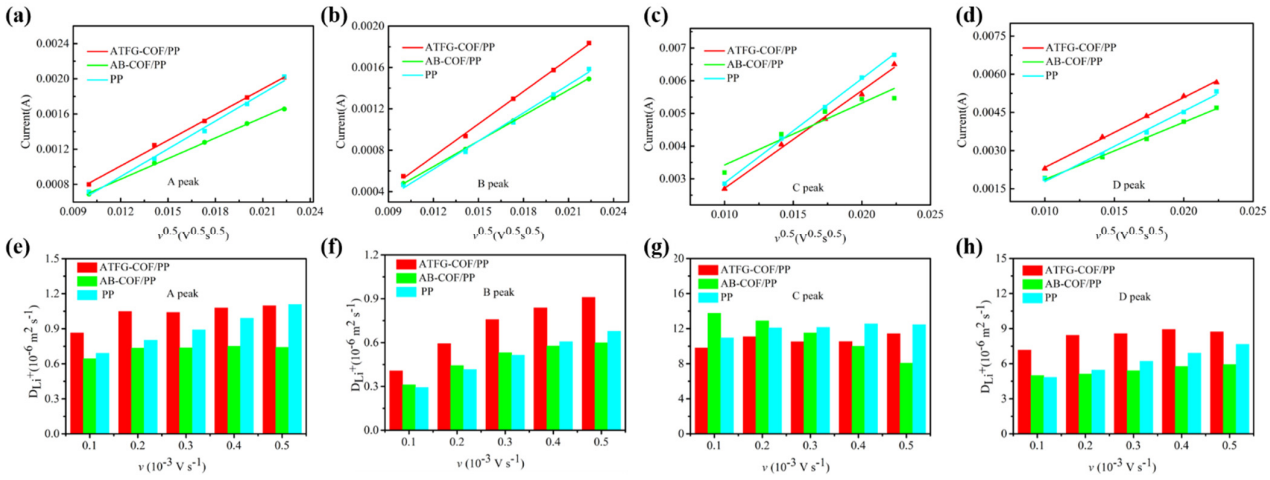


**Figure S6.** Graph of CV peak current versus scan rate, (a) and (b) correspond to the conversion of $SeS_2$ to $Li_2S_n$ and $Li_2Se_n$, respectively; (c) correspond to the conversion of $Li_2S_n$ and $Li_2Se_n$ to $Li_2S$ and

$Li_2Se$, respectively; (d) Corresponding transformation of $Li_2S$ and $Li_2Se$ to $SeS_2$. the relationship between $Li^+$ diffusion coefficient and sweep velocity V of Li-$SeS_2$ battery with ATFG-COF/PP, AB-COF/PP, PP at (e) A peak, (f) B peak, (g) C peak and (h) D peak.

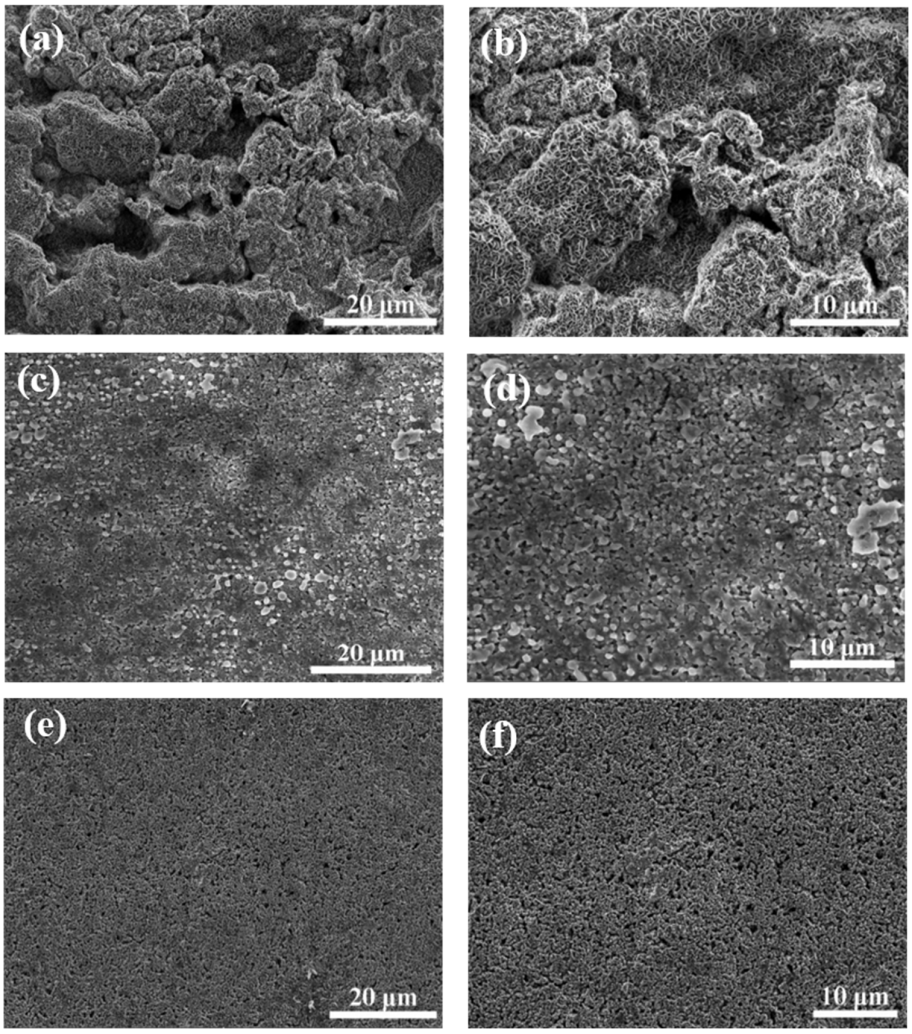


**Figure S7.** SEM images of lithium metal anodes of the Li-$SeS_2$ cells with different separators after cycles. (a, b) PP, (c, d) AB-COF/PP, (e, f) ATFG-COF/PP separator.

**Table S1.** The comparison of the performance of the ATFG-COF/PP with the reported materials in Li-$SeS_2$ batteries.

| Materials | Application | SeS2 content | Current density (A $g^{-1}$) | Cycle number | Specific Capacity (mAh/g) | Reference |
|---|---|---|---|---|---|---|
| ATFG-COF/PP separator | Separator | 80 wt% | 0.5C | 200 | 509 | This work |
| SAZ-AF Janus separator | Separator | 80 wt% | 1.1 | 200 | 446.4 | [1] |
| $CoS_2$ @LRC/$SeS_2$ | cathode | 70wt% | 0.5 | 400 | 470 | [2] |
| CMK-3/$SeS_2$ @PDA | cathode | 70 wt% | 2 | 500 | 350 | [3] |
| TiN/GO | separator | 70 wt% | 1 | 500 | 511 | [4] |

## References


1. Song, C.-L.; Li, Z.-H.; Ma, L.-Y.; Li, M.-Z.; Huang, S.; Hong, X.-J.; Cai, Y.-P.; Lan, Y.-Q. Single-Atom Zinc and Anionic Framework as Janus Separator Coatings for Efficient Inhibition of Lithium Dendrites and Shuttle Effect. *ACS Nano* **2021,** *15*, 13436–13443.
2. Zhang, J.; Li, Z.; Lou, X.W. A Freestanding Selenium Disulfide Cathode Based on Cobalt Disulfide-Decorated Multichannel Carbon Fibers with Enhanced Lithium Storage Performance. *Angew. Chem. Int. Ed.* **2017,** *56*, 14107–14112.
3. Li, Z.; Zhang, J.; Wu, H.B.; Lou, X.W. An Improved Li–$SeS_2$ Battery with High Energy Density and Long Cycle Life. *Adv. Energy Mater.* **2017,** *7*, 1700281.
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