**Supporting Information**

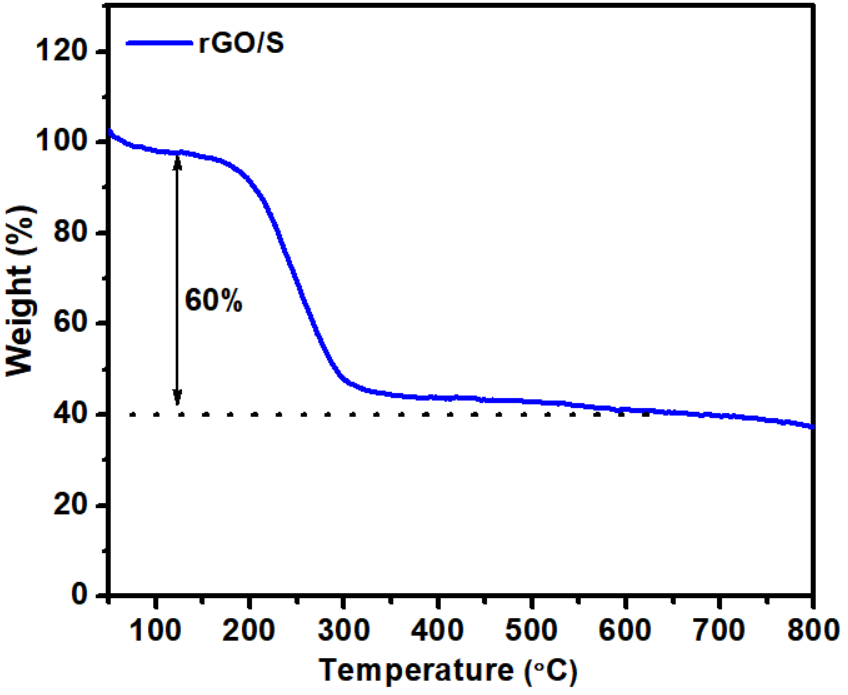
**Synergistic adsorption and electrocatalytic effect of Mott-Schottky heterostructures functionalized separators for lithium-sulfur batteries**

Jiapei Gu1, Chenxu Dong1, Cheng Zhou1, Chunli Shen1, Yuqiang Pi2\*, Xu Xu1\*

1 State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, International School of Materials Science and Engineering, Wuhan University of Technology, Wuhan 430070, P. R. China

2 School of Chemistry and Materials Science, Hubei Engineering University, Xiaogan 432000, P. R. China

\*E-mail addresses: xq0502@163.com (Dr. Y. Pi), xuxu@whut.edu.cn (Dr. X. Xu).



**Figure S1** TGA curve for sulfur cathode.



**Figure S2** (a) SEM image, (b) TEM image, (c-e) TEM elemental mapping images of Bi, Mo and O of Bi2MoO6 nanosheets. (f) HRTEM image.



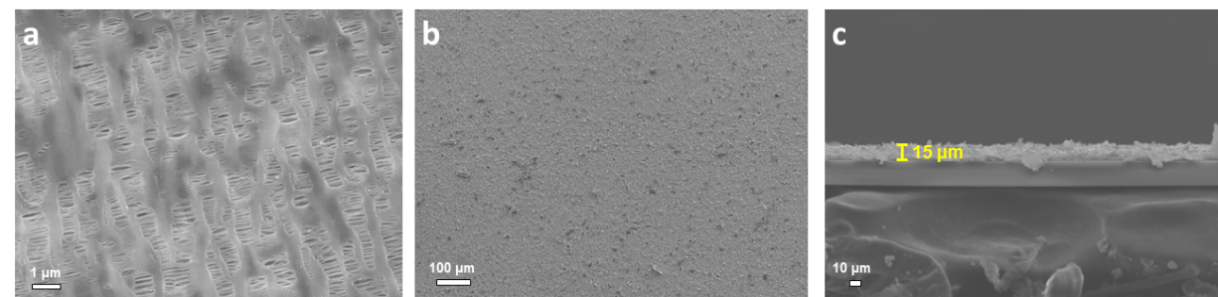
**Figure S3** TGA curves for Bi2MoO6 and Bi2MoO6-PPy.



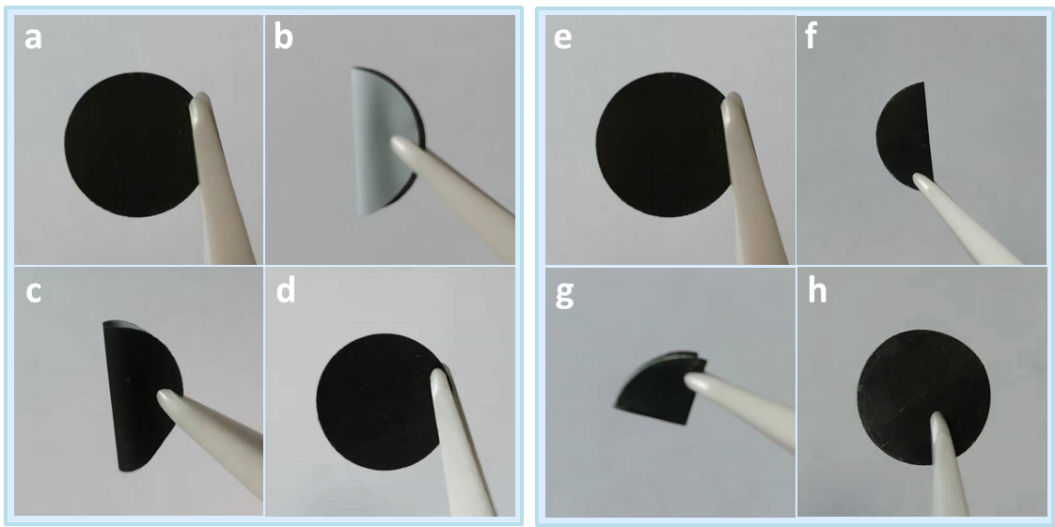
**Figure S4** (a) Full XPS profiles, and XPS spectra of (b) Bi 4f, (c) Mo 3d, (d) O 1s and (e) N 1s of Bi2MoO6 and Bi2MoO6-PPy.



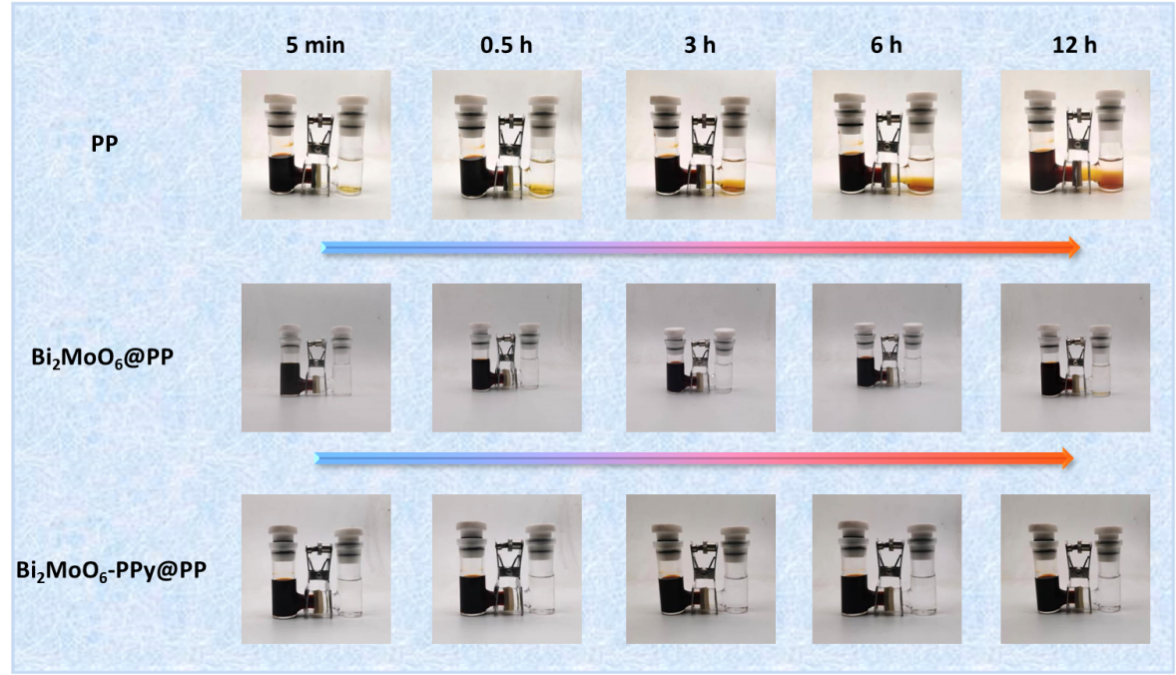
**Figure S5** N2 adsorption-desorption isotherm for Bi2MoO6 and Bi2MoO6-PPy.



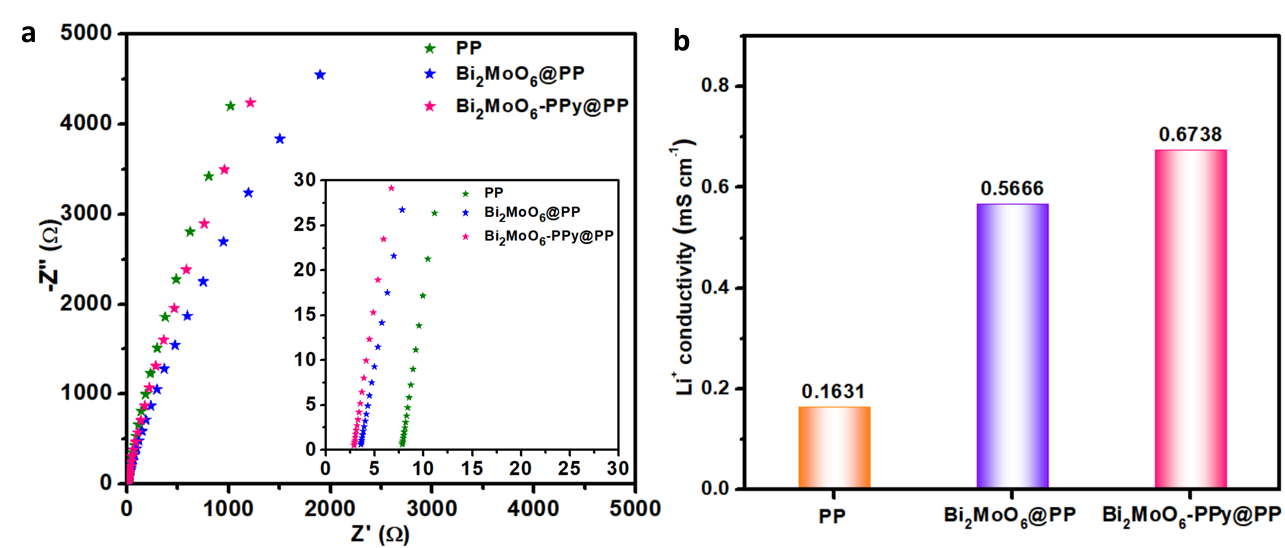
**Figure S6** (a) SEM image of PP separator. (b) SEM image of the surface and (c) the cross-sectional SEM image of Bi2MoO6@PP separator.



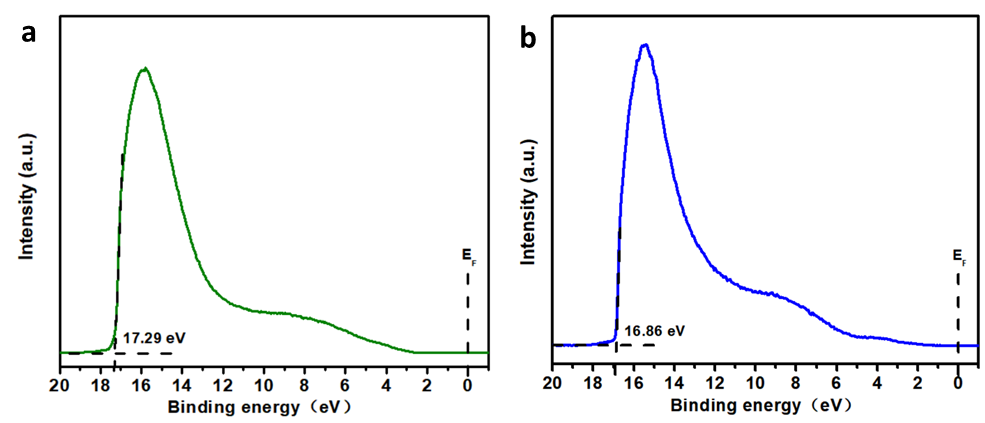
**Figure S7** Digital photographs of the Bi2MoO6-PPy@PP separator before and after repeated folding (a-d) or curving (e-h).



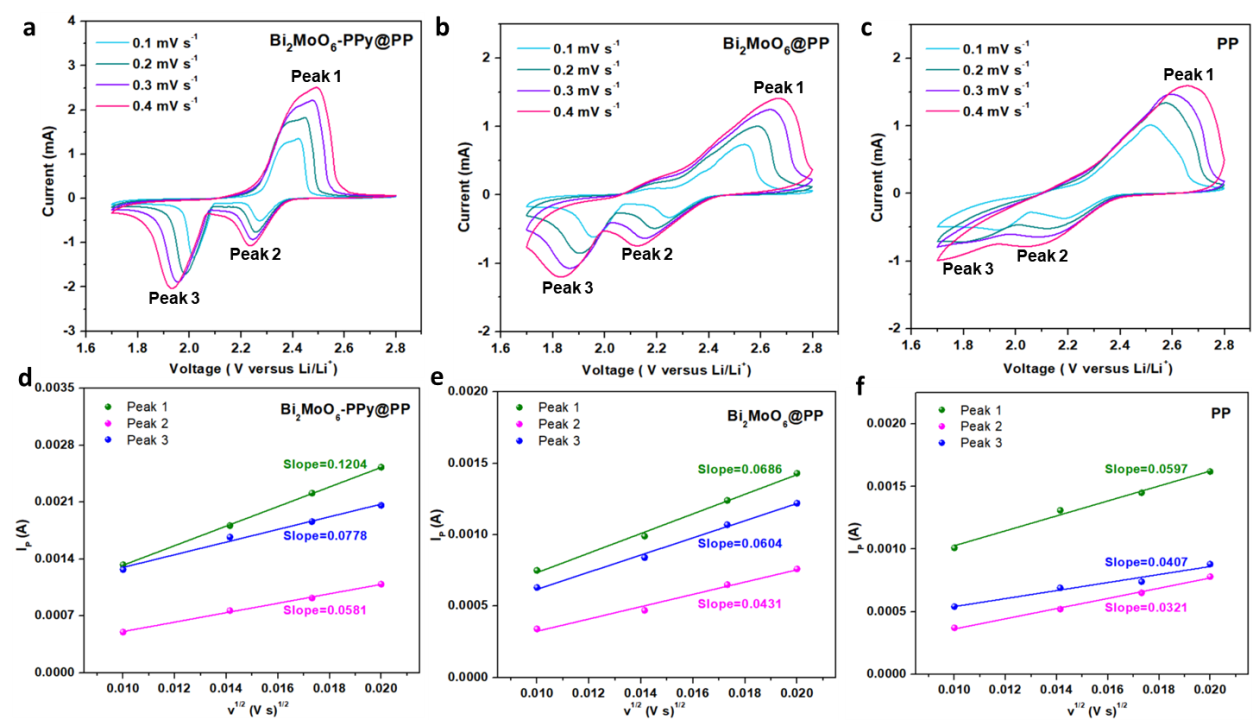
**Figure S8** Permeation experiments with a double-L device for PP, Bi2MoO6@PP and Bi2MoO6-PPy@PP separators.



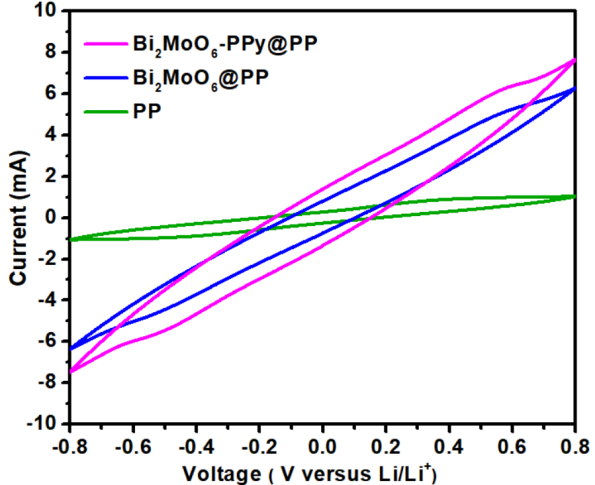
**Figure S9** (a) The Impedance plots and (b) the lithium-ion conductivity of the Li-S cell with pristine PP, Bi2MoO6@PP, and Bi2MoO6-PPy@PP separators.



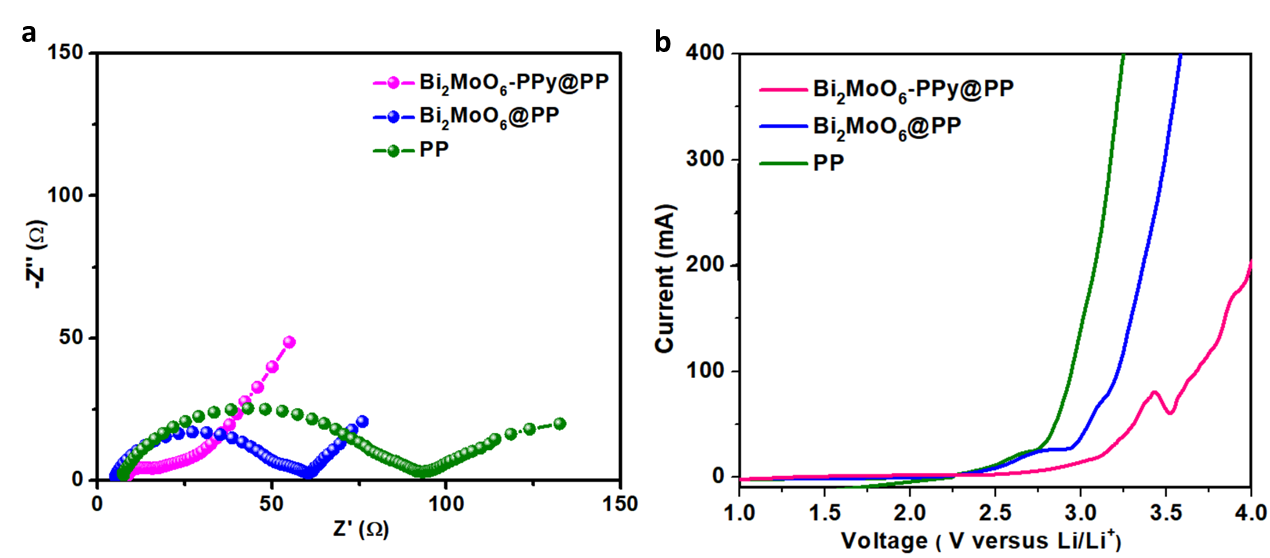
**Figure S10** UPS spectra of a) Bi2MoO6 and b) PPy. The work function (Φ) of Bi2MoO6 and PPy samples were determined by the equation of Φ = 21.22 eV - (Ecutoff - EF) as 3.93 and 4.36eV, respectively.



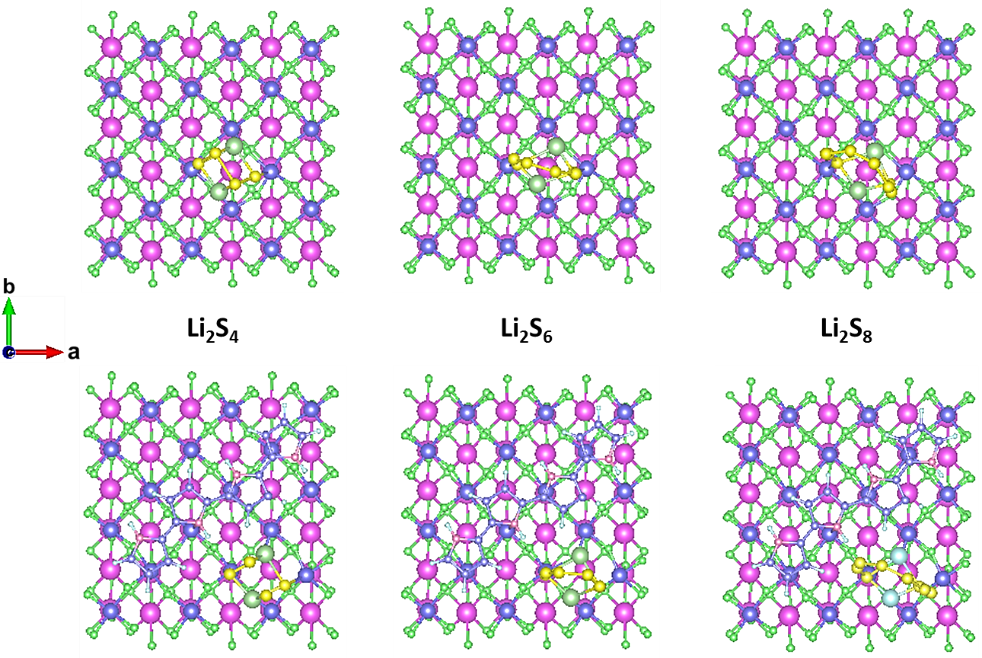
**Figure S11** The CV curves of the Li-S cell with different separators at 0.1-0.4 mV/s scan rate and the corresponding linear relation of peak current (Ip) versus the square root of scan rate: (a, d) Bi2MoO6-PPy@PP; (b, e) Bi2MoO6@PP; (c, f) PP.



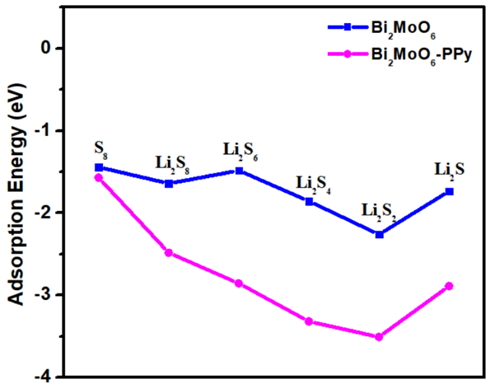
**Figure S12** CV curves of symmetric cells at 50 mV s-1.



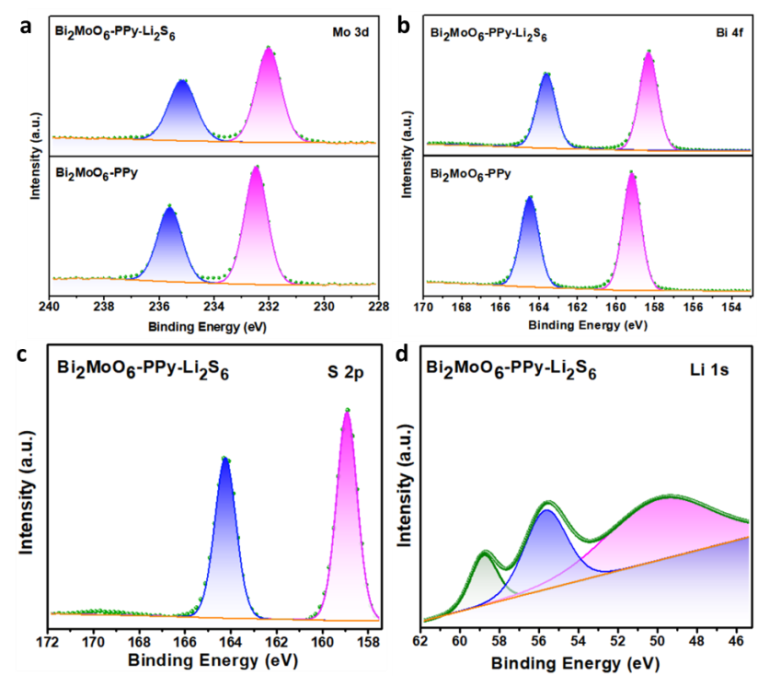
**Figure S13** (a) The EIS spectrum and (b) LSV curves of polysulfide (Li2S6) symmetric batteries.



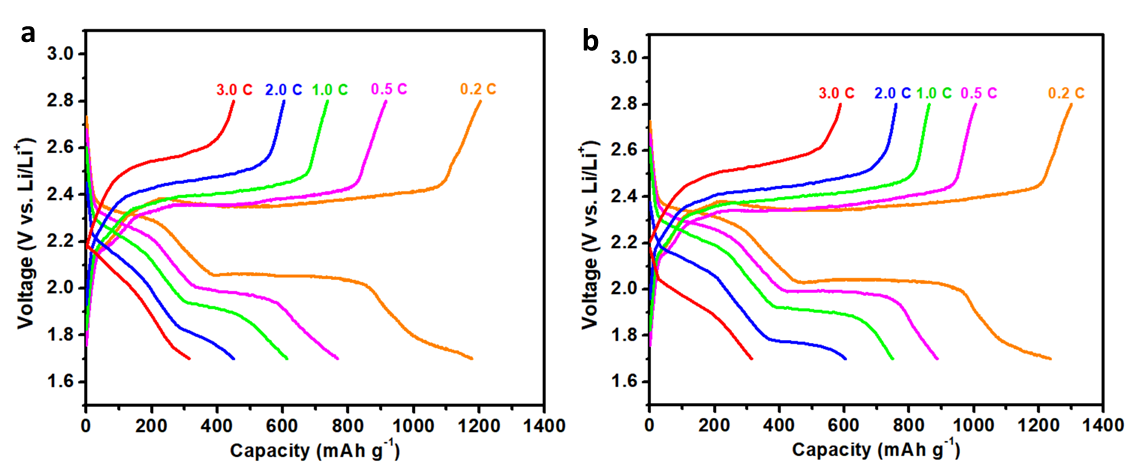
**Figure S14** Top view of the optimized configurations for the binding of long-chain Li2Sn to Bi2MoO6 and Bi2MoO6-PPy.



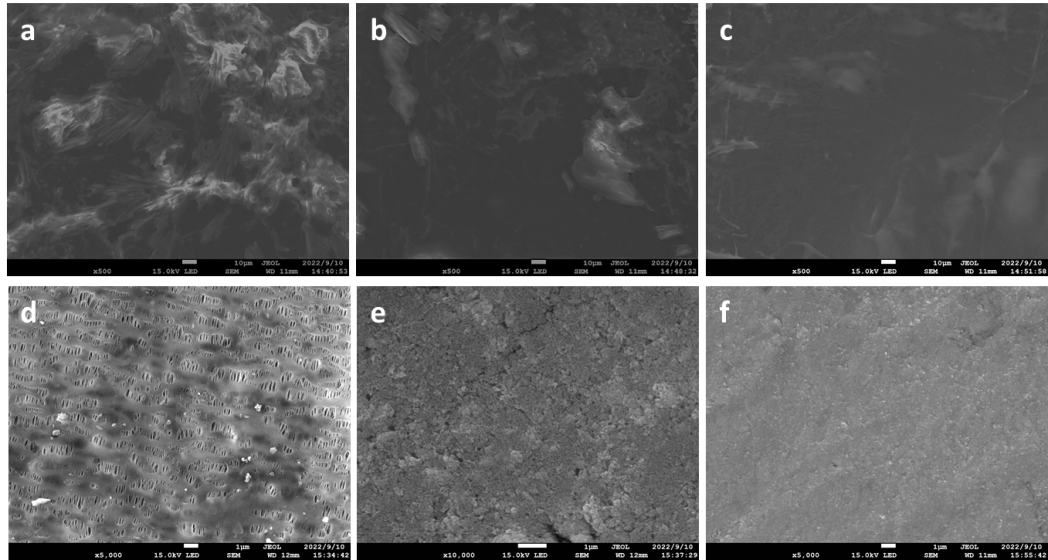
**Figure S15** The binding energy of LiPSs to Bi2MoO6 and Bi2MoO6-PPy.



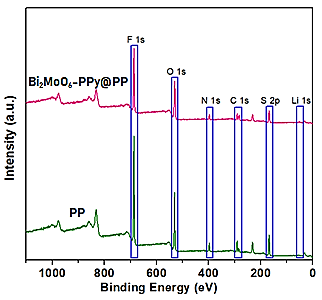
**Figure S16** XPS spectra of a) Bi 4f, b) Mo 3d, c) S 2p and d) Li 1s of Bi2MoO6-PPy before and after Li2S6 adsorption.



**Figure S17** The constant current charge/discharge voltage curves of different rate for (a) PP separator and (b) Bi2MoO6@PP separator.

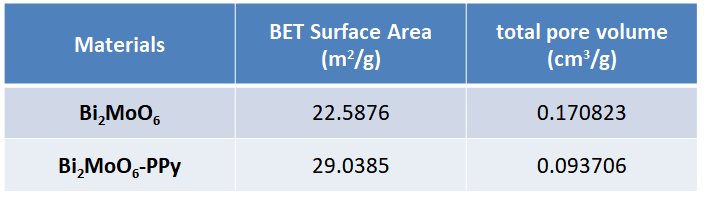


**Figure S18** SEM images of the Li anodes (top) and the separators (bottom) for Li-S batteries after cycling at 2 C with the (a, d) PP, (b, e) Bi2MoO6@PP and (c, f) Bi2MoO6-PPy@PP separators.

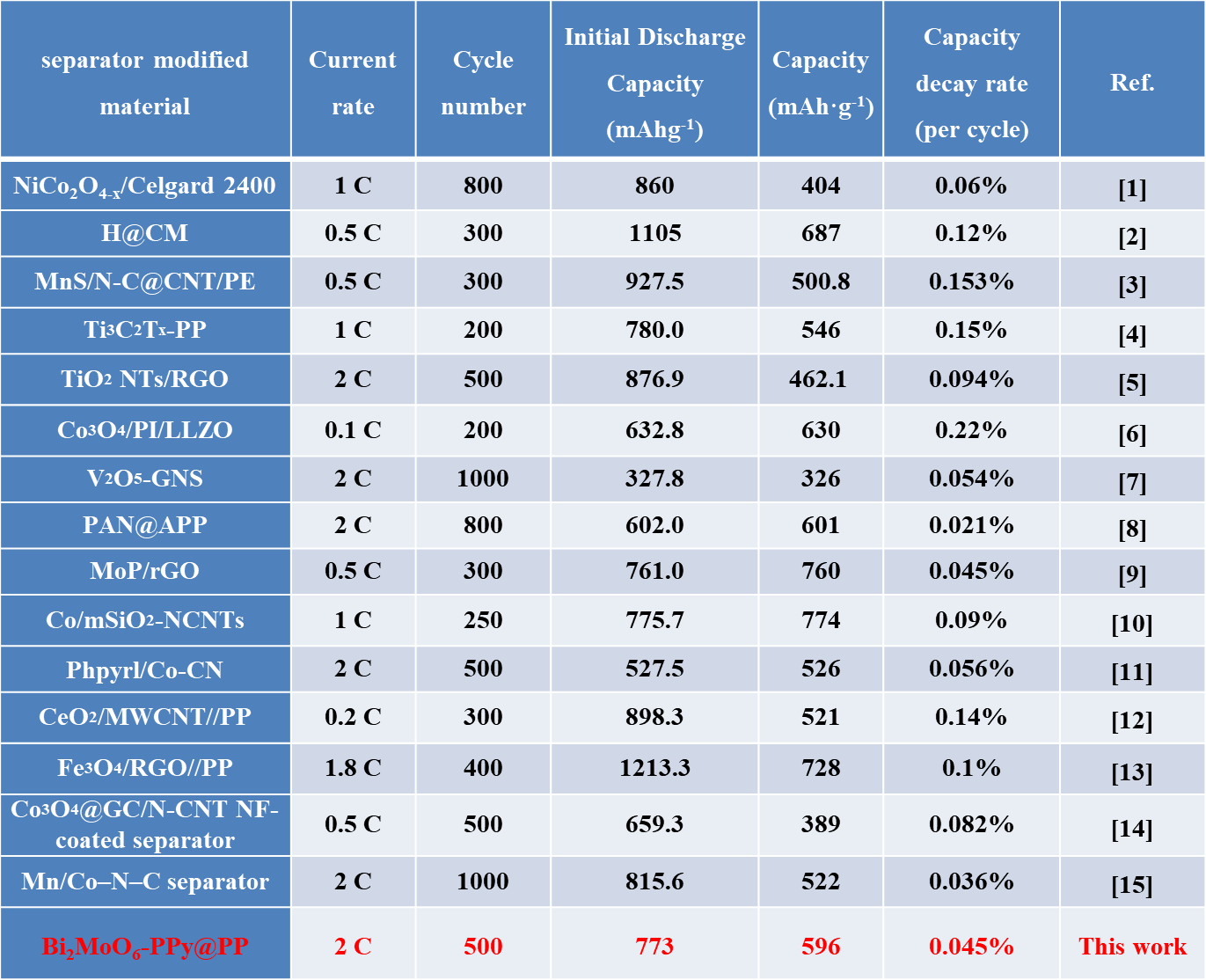


**Figure S19** Full XPS profiles of Li anodes for Li-S batteries with PP and Bi2MoO6-PPy@PP separator after cycling at 2 C.

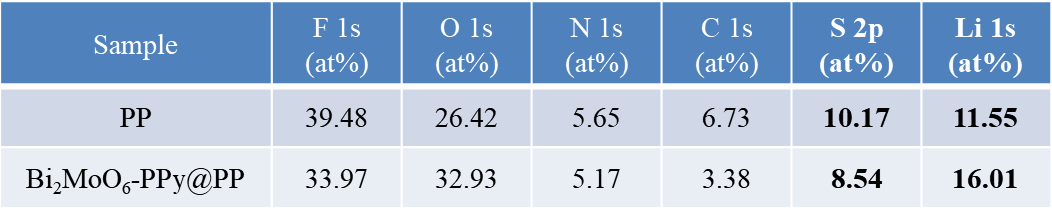
**Table S1** BET surface area and pore volume of the resulting samples.



**Table S2** Electrochemical performances of this work compared with previous works involving different separators in recently reported literature.



**Table S3** Surface species concentration by XPS for Li-S batteries with PP and Bi2MoO6-PPy@PP separator after cycling at 2 C.



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