Supplementary Information

Vertical Co₉S₈ hollow nanowall arrays grown on Celgard separator as a multifunctional polysulfide barrier for highperformance Li-S batteries

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Fig. S1 Photographs of as-prepared MOF-Celgard separator: (a) Front side, (b) back side, and (c) folded; (d) scalable production of MOF-Celgard separator.



Fig. S2 Photographs of Co₉S₈-Celgard separator.



Fig. S3 (a) XRD patterns of MOF, Celgard, and MOF-Celgard separators. (b, c and d) Top-surface morphology of MOF-Celgard at various magnifications. The inset shows a digital photo. (e, f and g) Cross-sectional morphologies of MOF-Celgard, and the corresponding elemental mapping images of (h) cobalt and (i) carbon.



Fig. S4 SEM images of Celgard separator.



Fig. S5 (a) SEM image of Co_9S_8 -Celgard separator from top surface and the corresponding elemental mapping images of (b) sulfur, (c) cobalt, and (d) carbon. (e) EDX spectrum of Co_9S_8 -Celgard separator from top surface.



Fig. S6 (a) The specific surface area and (b) pore size distribution of MOF and Co_9S_8 .



Fig. S7 Photographs of (a) Co_9S_8 -Celgard and (b) MOF-Celgard separator with repeatedly bending 50 times.



Fig. S8 SEM images of the sulfur cathode.



Fig. S9 CV curves of the Li-S batteries with Co_9S_8 -Celgard separator at 0.1 mV s⁻¹ at 1.8 - 2.8 V.



Fig. S10 Charge/discharge curve of Co_9S_8 at 0.1 C rate, the specific capacity is calculated by the weight of Co_9S_8 .



Fig. S11 SEM images of (a) fresh Li foil, (b) cycled Li foil in the cell with the Co_9S_8 -Celgard separator, (c) cycled Li foil in the cell with the MOF-Celgard separator, and (d) cycled Li foil in the control cell with bare Celgard separator after 200 cycles.



Fig. S12 (a, b) SEM images of Co_9S_8 -Celgard separator from top surface after 200 cycles and the corresponding elemental mapping of (c) cobalt, (d) sulfur, (e) fluorine, and (f) oxygen. (g) EDX spectrum of Co_9S_8 -Celgard separator top surface after 200 cycles.



Fig. S13 SEM images of Co_9S_8 -Celgard separator from top surface at (a) discharge and (b) charge states.



Fig. S14 SEM images of the MOF-Celgard separator from the top surface after 200 cycles.



Fig. S15 Cycling performances of Li-S cells with high sulfur loading cathodes with Co_9S_8 -Celgard separators.



Fig. S16 EIS plots of the fresh cells with Celgard, MOF-Celgard, and Co_9S_8 -Celgard separators.



Fig. S17 IR spectra of the MOF-Celgard separators before and after the electrochemical process.