Supplementary Information

A long-life Lithium-Sulphur Battery by integrating Zinc-Organic Framework based separator

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Synthesis of the Zn-MOF@GO separator

The Zn-MOF@GO separator was synthesized according to the method given in a previous report. Synthesis of Zn-HKUST-1 nanoparticles was prepared similarly: Zinc(II) nitrate hexahydrate $(Zn(NO_3)_2 \cdot 6H_2O)$ (1.190 g, 4 mmol) and 1,3,5-benzenetricarboxylic acid (0.42 g, 2 mmol) were mixed. These Zn-MOF crystalline particles were self-assembled on the surface by vacuum filtration (Millipore, 47mm, 0.2µm). In contrast, the reaction time for the Zn ions is further prolonged due to the relatively lower coordination ability. The GO layer was manufactured by vacuum filtration of a certain amount of GO suspension (0.1mg mL⁻¹). The GO laminates retained on top of the MOF membrane could not only strengthen the permeation barrier, but also provide a strong support for improving the stability as a separator. After filtration, the in-situ fabricated separator was washed thrice by anhydrous ethanol solutions and then peered off from the filter.

Characterization

The PXRD data was collected at ambient temperature on a Bruker D8 Advanced diffractometer (40 kV, 40 mA) for Cu K α (l=1.5418 Å), with a scan speed of 1 sec/step, a step size of 0.05° in 20 (5-60°). Elemental analyses (sulfur) were performed with a Vario MICRO CHNOS Elemental Analyzer. Thermal analysis was performed on a NETZSCH STA 449C instrument from room temperature to 800 °C with a heating rate of 2 °C/min⁻¹ under nitrogen flow. SEM studies analyses were conducted on a Scanning Electron Microscope of JSM6700-F, Field Emission Scanning Electron Microscope. The infrared spectra (KBr pellets) was conducted on a Bruker VERTEX70 FT-IR spectrometer in the range of 4000-400 cm⁻¹.



Fig. S1 (a) The permeation with the pristine separators (Celgard 2400 separator); (b) The permeation with the MOF@GO separators.



Fig. S2 SEM images of the GO laminates in MOF@GO separator. (After 100th charge/discharge cycles with GO separator) (Scale bar, 1μ m)



Fig. S3 Sulfur content of the CMK3@S cathode materials



Fig. S4 Zn-MOF thin film.



Fig. S5 The battery with Celgard 2400 separator at 1C over 100 cycles.



Fig. S6 PXRD spectra of the MOF based separator. Before/after cycles, it remains the intact structure with the typical ones.