Supporting Information

Co$_9$S$_8$@Carbon Porous Nanocages Derived from a Metal-Organic Framework: A Highly Efficient Bifunctional Catalyst for Aprotic Li-O$_2$ Batteries

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Figure S1. XRD pattern of ZIF-67 polyhedrons.
Figure S2. TGA curve of the synthesized Co₉S₈@CPNs under air flow with a temperature ramp of 10 °C min⁻¹. The content of carbon in Co₉S₈@CPNs was determined by following equation:

30 - 150 °C: \( \text{H}_2\text{O(ads)} \rightarrow \text{H}_2\text{O(g)} \)  

150 - 435 °C: \( \text{Co}_9\text{S}_8@\text{CPNs} + \text{O}_2(g) \rightarrow \text{CoSO}_4 + \text{CO}_2(g) \)  

435 - 850 °C: \( \text{CoSO}_4 + \text{O}_2(g) \rightarrow \text{Co}_3\text{O}_4 + \text{SO}_3(g) \)
Figure S3. Rate capability of Super P cathode in the 1.0 M LiTFSI/TEGDME electrolyte at different current densities from 50 mA g$^{-1}$ to 300 mA g$^{-1}$. 
**Figure S4.** Cycling performance of Super P cathodes in the 1.0 M LiTFSI/TEGDME electrolyte at capacity limits of 500 mAh g\(^{-1}\) and the current density of 100 mA g\(^{-1}\).
Figure S5. Voltage of the terminal discharge and variation in the discharge/charge capacity vs. the cycle number of Super P cathode at the current density of 100 mA g$^{-1}$. 
Figure S6. Nyquist plots at different discharge/charge status of Super P cathode in the frequency range of $10^5$ to 0.1 Hz.
Figure S7. SEM image of the discharged Super P cathode with a current density of 100 mA g\textsuperscript{-1}. 

Table S1. Comparison of the cycling performances of various sulfide-based catalysts used in aprotic Li-O2 batteries.

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>Cycling performance</th>
<th>Measurement conditions</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowerlike NiS</td>
<td>30 cycles</td>
<td>900 mAh/g at 75 mA/g</td>
<td>[1]</td>
</tr>
<tr>
<td>N. S co-doped FeS</td>
<td>100 cycles</td>
<td>500 mAh/g at 0.3 mA/cm²</td>
<td>[2]</td>
</tr>
<tr>
<td>MoS₂</td>
<td>30 cycles</td>
<td>500 mAh/g at 0.1 mA/cm²</td>
<td>[3]</td>
</tr>
<tr>
<td>Co₃S₄ nanoparticals@graphene</td>
<td>20 cycles</td>
<td>500 mAh/g at 200 mA/g</td>
<td>[4]</td>
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<tr>
<td>Co₃S₄</td>
<td>25 cycles</td>
<td>500 mAh/g at 100 mA/g</td>
<td>[5]</td>
</tr>
<tr>
<td>MoS₂@gold nanoparticals</td>
<td>50 cycles</td>
<td>1000 mAh/g at 300 mA/g</td>
<td>[6]</td>
</tr>
<tr>
<td>MoS₂Se</td>
<td>30 cycles</td>
<td>730 mAh/g at 50 mA/g</td>
<td>[7]</td>
</tr>
<tr>
<td>Co₉S₆@CPNs</td>
<td>110 cycles</td>
<td>500 mAh/g at 100 mA/g</td>
<td>This work</td>
</tr>
</tbody>
</table>

References