Electronic Supplementary Information

S, N-Containing Co-MOFs Derived Co$_9$S$_8@$S,N-Doped Carbon Materials as Efficient Oxygen Electrocatalysts and Supercapacitor Electrode Materials

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<table>
<thead>
<tr>
<th>Sample</th>
<th>ORR 0.1M KOH</th>
<th>OER Current density of 10 mA cm$^{-2}$ at 0.1M KOH</th>
<th>ORR 0.1M KOH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>potential</td>
<td>n (electron transfer number)</td>
<td>Reference</td>
</tr>
<tr>
<td>Co$_9$S$_8$/NSPC9–45</td>
<td>0.31 V</td>
<td>0.79 V (E$_{1/2}$)</td>
<td>3.94 at 0.3 V</td>
</tr>
<tr>
<td>Co-C@Co$_9$S$_8$DSNCs</td>
<td>0.96 V (onset)</td>
<td>3.9 at 0.1-0.4 V</td>
<td>2</td>
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<tr>
<td>N-Co$_9$S$_8$/G</td>
<td>0.28 V</td>
<td>0.94 V (onset)</td>
<td>3.7 ~3.9 at -0.2-0.8 V</td>
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<tr>
<td>Fe$_3$O$_4$@Co$_9$S$_8$/rGO</td>
<td>0.47 V</td>
<td>0.75 V(E$_{1/2}$)</td>
<td>3.99 at 0.2-0.6V</td>
</tr>
<tr>
<td>Co$_9$S$_8$@SNCC</td>
<td>0.33 V</td>
<td>0.84 V (onset)</td>
<td>this work</td>
</tr>
</tbody>
</table>
Table. S2 Summary of the capacitances of some other Co$_9$S$_8$-based composites reported recently.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Capacitance</th>
<th>Electrolyte</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co$_9$S$_8$/RGO/Ni$_3$S$_2$</td>
<td>2611.9 F g$^{-1}$ at 3.9 A g$^{-1}$</td>
<td>2 M KOH</td>
<td>5</td>
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<tr>
<td>Co$_9$S$_8$@Ni(OH)$_2$ core@shell structure</td>
<td>1620 F g$^{-1}$ at 0.5 A g$^{-1}$</td>
<td>2 M KOH</td>
<td>6</td>
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<tr>
<td>C@Co$_9$S$_8$ hollow structures</td>
<td>654 F g$^{-1}$ at 2 A g$^{-1}$</td>
<td>2 M KOH</td>
<td>7</td>
</tr>
<tr>
<td>Co$_9$S$_8$/NF</td>
<td>1645 F g$^{-1}$ at 3 A g$^{-1}$</td>
<td>2 M KOH</td>
<td>8</td>
</tr>
<tr>
<td>Co$_9$S$_8$ nanotubes</td>
<td>1775 F g$^{-1}$ at 4 A g$^{-1}$</td>
<td>2 M KOH</td>
<td>9</td>
</tr>
<tr>
<td>Co$_9$S$_8$@SNCC</td>
<td>429 F g$^{-1}$ at 1 A g$^{-1}$</td>
<td>6M KOH</td>
<td>this work</td>
</tr>
</tbody>
</table>

**Fig. S1** SEM image of the Co$_9$S$_8$@SNCB

**Fig. S2** (a) Koutecky-Levich plots derived from the RDE data of Co$_9$S$_8$@SNCC, (c) electron transfer number of Co$_9$S$_8$@SNCC at 0.2 V~0.6 V.
Fig. S3 (a) LSV curves of Pt/C at various rotation rates; (b) Corresponding Koutecky–Levich plots derived from the RDE data; inset of electron transfer number of Pt/C at 0.2 V~0.6 V.

Fig. S4 (a) LSV curves of Co$_9$S$_8$@SNCB at various rotation rates; (b) Corresponding Koutecky–Levich plots derived from the RDE data; inset of electron transfer number of Co$_9$S$_8$@SNCB at 0.2 V~0.6 V.

Fig. S5 XRD pattern of the Co$_9$S$_8$@SNCC composite after electrochemical test at 0.1 KOH, 250 cycles for cyclic voltammetry at a scan rate of 50 mV s$^{-1}$, illustrated that the Co$_9$S$_8$ is very stability during this electrochemical test. The Co$_9$S$_8$@SNCC was coated on the graphitic carbon paper as an electrode for electrochemical test.
Fig. S6 LSV curves of electrocatalysts of $\text{Co}_9\text{S}_8$@SNCC, SNCC for (a) ORR and (b) OER measurements.

Fig. S7 (a) Cyclic voltammogram curves at various scan rates ranging from 5 mV s$^{-1}$ to 100 mV s$^{-1}$ and (b) charge-discharge curves measured at different current densities of $\text{Co}_9\text{S}_8$@SNCC.

Fig. S8 (a) Cyclic voltammogram curves at various scan rates ranging from 5 mV s$^{-1}$ to 100 mV s$^{-1}$ and (b) charge-discharge curves measured at different current densities of $\text{Co}_9\text{S}_8$@SNCB.
Fig. S9 Nyquist plots of Co$_9$S$_8$@SNCB and Co$_9$S$_8$@SNCC electrode materials for supercapacitors

References:
6 Wen J.; Li S.; Li B.; Song Z.; Wang H.; Xiong R.; Fang G., *J. Power Sources* 2015, 284, 279-286.