Supporting Information

Even-distributed Sulfur-doped Nickel Zinc Hydroxyl Carbonate Dispersed Structure for All-solid-state Asymmetric Supercapacitors with Enhanced Performances

Shaohua Wang, Xuemeng Wang, Zepei Bao, Xijia Yang, Lin Ye and Lijun Zhao*

Key Laboratory of Automobile Materials (Jilin University), Ministry of Education and School of Materials Science and Engineering, Jilin University, Changchun, 130022, P. R. China

*Corresponding author:
E-mail: lijunzhao@jlu.edu.cn; Fax: +86-0431-85095876

As shown in Fig. S1a, C 1s spectrum can be easily decomposed into three components as shown: 284.7 (C=C), 286.2 (C-O) and 289 (C=O) eV, indicating the presence of citric acid and CO$_3^{2-}$. The high resolution O 1s spectrum in Fig. S1b can be fitted into three distinct peaks named as O1, O2 and O3, respectively. The O1 peak at 531.7 eV attribute to spin–orbit doublet characteristics of OH$^-$; the O2 peak at 532.2 eV indicates carbonyl carbon (C=O); the O3 peak at 533.7 eV represents the physi- and chemisorbed water.
Fig. S2 FESEM images of NZSC-4 at different magnifications.

Fig. S3 TEM image of NZC.
Fig. S4 (a) N\textsubscript{2} adsorption-desorption isotherms and (b) corresponding BJH pore-size distribution curves of the NZSC-4.

The amount of electricity required for electrolysis is 1 mol of the active material is 1F, equal to 96485 C. For NiS\textsubscript{33.3}Zn\textsubscript{32.3}, the molar mass is 3238.23 g mol\textsuperscript{-1}, however, the element involved in the Faraday oxidation-reduction reaction is nickel (Zn would not to be covered), molar mass is 90.76 g mol\textsuperscript{-1}, so the theoretical Faraday capacitance is calculated as follows:\textsuperscript{5}

\[ C = \frac{Q}{U} = \frac{96485 \times 1/90.76}{U} \]

Where U is the voltage window, Q is electrical energy per 1 gram. When U is 0.45V in charge/discharge measurement, the theoretical faradaic capacitance is about 2362.4 F g\textsuperscript{-1}.

Fig. S5 (a) CV and (b) GCD curves of NZC
Fig. S6 FESEM images of (a) ZSC and (b) NSC; (c) CV curves of ZSC and NSC electrodes at a scanning rate of 10 mV s\(^{-1}\); (d) GCD curves of ZSC and NSC at current density of 2 A g\(^{-1}\).
Fig. S7 (a) CV curves of AC; (b) GCD curves of NZSC-4 from -1.15 to 0 V at different current densities and (c) specific capacitance is calculated from the GCD curve.

Fig. S8 (a) CV curves NZC//AC; (b) GCD curves of NZC//AC.
Fig. S9 (a) leakage current curve and (b) self-discharge curve of the NZSC-4//AC supercapacitor.

Table S1

<table>
<thead>
<tr>
<th>Electrodes</th>
<th>specific capacitance (F g⁻¹)</th>
<th>retention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 A g⁻¹</td>
<td>2 A g⁻¹</td>
</tr>
<tr>
<td>NZC</td>
<td>1320</td>
<td>1122</td>
</tr>
<tr>
<td>NZSC-1</td>
<td>580</td>
<td>560</td>
</tr>
<tr>
<td>NZSC-2</td>
<td>1377</td>
<td>1211</td>
</tr>
<tr>
<td>NZSC-4</td>
<td>1634</td>
<td>1562</td>
</tr>
</tbody>
</table>

“Retention” means the specific capacitance at 20 A g⁻¹ as compared with 1 A g⁻¹.

References