Supporting Information

Melamine-Assisted Synthesis of Porous V_2O_3/N-doped Carbon Hollow Nanospheres for Efficient Sodium-Ion Storage

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Figure S1. (a) SEM and (b) TEM images of V$_2$O$_3$ HSs.
**Figure S2.** TEM image of the M-VOOH HSs.
Figure S3. SEM image of the V₂O₃/NC HSs.
Figure S4. TEM image of the V$_2$O$_3$/NC HSs.
Figure S5. The XRD patterns of M-VOOH HSs and VOOH HSs.
Figure S6. The XRD patterns of the remaining sample after TG test.
Figure S7. XPS full-spectrum analysis of the $V_2O_3$/NC HSs.
Figure S8. The XRD patterns of the products with hydrothermal reaction time of 1h, 2h, 4h and 6h.
Figure S9. (a-d) TEM, (e-h) SEM images and (i) the corresponding XRD patterns of the products without adding melamine at the hydrothermal reaction time of 1h, 2h, 4h and 6h.
Figure S10. SEM image of hydrothermal reaction products at 160 °C for 4 hours, other conditions were the same as the experimental conditions.
**Figure S11.** SEM images of the hydrothermal reaction products prepared by adding (a) 40 mg and (b) 60 mg melamine.
Figure S12. SEM image of the sample synthesized with the help of glucose.
**Figure S13.** The Nyquist plots of $\text{V}_2\text{O}_3$/NC HSs electrode (the illustration shows the equivalent circuit model of the $\text{V}_2\text{O}_3$/NC HSs electrode).

The equivalent circuit model of the $\text{V}_2\text{O}_3$/NC HSs electrode is composed of series resistance ($R_s$), constant phase element (CPE), charge transfer resistance ($R_{ct}$) and Warburg impedance ($Z_w$) element.
**Figure S14.** TEM images of V$_2$O$_3$/NC HSs (a) before 1000 cycles, (b) after 1000 cycles. It can be seen that V$_2$O$_3$/NC HSs still maintain their original hollow sphere structure after 1000 cycles. It was further confirmed that V$_2$O$_3$/NC HSs showed excellent mechanical properties and could resist large volume changes caused by sodium insertion/extraction during the cycle.
In this work and previous research, the performance of batteries using V$_2$O$_3$-based materials as SIBs anodes is compared.

<table>
<thead>
<tr>
<th>V$_2$O$_3$-based anode materials</th>
<th>Synthesis method</th>
<th>Rate performance (mAh g$^{-1}$)</th>
<th>Cycle performance (mAh g$^{-1}$)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>V$_2$O$_3$/NC HSs</td>
<td>hydrothermal method</td>
<td>395.4 (0.05 A g$^{-1}$) 277 (1 A g$^{-1}$)</td>
<td>263.8 (1 A g$^{-1}$, 1000 cycles)</td>
<td>this work</td>
</tr>
<tr>
<td>V$_2$O$_3$/NG nanobelt</td>
<td>low-temperature hydrothermal method</td>
<td>193 (100 mA g$^{-1}$) 130 (1000 mA g$^{-1}$)</td>
<td>154 (500 mA g$^{-1}$, 500 cycles)</td>
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<td>V$_2$O$_3$⊂C-NTs⊂rGO</td>
<td>the cetylamine-assisted self-scrolling method electrostatic interaction</td>
<td>165 (20 A g$^{-1}$)</td>
<td>175 (5 A g$^{-1}$, 15000 cycles)</td>
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<tr>
<td>V$_2$O$_3$@rGO</td>
<td>hydrothermal protocol</td>
<td></td>
<td>402(2 A g$^{-1}$, 6000 cycles)</td>
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<tr>
<td>GF+ V$_2$O$_3$/CNTs</td>
<td>solvothermal method chemical vapor deposition</td>
<td>612 (0.1 A g$^{-1}$) 462 (10 A g$^{-1}$)</td>
<td>134(10 A g$^{-1}$, 10000 cycles)</td>
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<tr>
<td>GF+ V$_2$O$_3$</td>
<td>solvothermal method chemical vapor deposition</td>
<td>411 (0.1 A g$^{-1}$) 23 (10 A g$^{-1}$)</td>
<td>115(2 A g$^{-1}$, 6000 cycles)</td>
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<td>V$_2$O$_3$/C composite</td>
<td>sequential self-template mechanism</td>
<td>216 (100 mA g$^{-1}$) 176 (1000 mA g$^{-1}$)</td>
<td>173 (1000 mA g$^{-1}$, 2000 cycles)</td>
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<tr>
<td>V$_2$O$_3$ porous nanotubes</td>
<td>reduction process</td>
<td>284 (100 mA g$^{-1}$) 167 (1000 mA g$^{-1}$)</td>
<td>280 (2000 mA g$^{-1}$, 5300 cycles)</td>
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<td>porous V$_2$O$_3$/carbon nanocomposite</td>
<td>hydrothermal approach</td>
<td>270.8 (100 mA g$^{-1}$)</td>
<td>145 (1000 mA g$^{-1}$, 1000 cycles)</td>
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<tr>
<td>porous shuttle-like V$_2$O$_3$/C</td>
<td>self-template approach</td>
<td>242 (100 mA g$^{-1}$)</td>
<td>133 (2000 mA g$^{-1}$, 1000 cycles)</td>
<td>8</td>
</tr>
</tbody>
</table>
REFERENCES