Supporting Information

Nitrogen-Doped TiO$_2$ nanospheres for Advanced Sodium-Ion Batteries and Sodium-Ion Capacitors Applications

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Table S1 The EIS simulation parameters of N-TiO$_2$ and commercial TiO$_2$.

<table>
<thead>
<tr>
<th>The electrodes</th>
<th>$R_s$ (Ω)</th>
<th>$R_f$ (Ω)</th>
<th>$R_{ct}$ (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-TiO$_2$</td>
<td>3.57</td>
<td>19.35</td>
<td>394.3</td>
</tr>
<tr>
<td>Commercial TiO$_2$</td>
<td>17.16</td>
<td>10.04</td>
<td>971.3</td>
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</table>
Figure S1  EDS result of the N-TiO$_2$. 
Figure S2 SEM images of N-TiO$_2$ electrodes after (a) 100 cycles (b) 1000 cycles at the current density of 1 A g$^{-1}$. 
Figure S3 Electrochemical impedance spectroscopy of NIBs employing the N-TiO$_2$ and commercial TiO$_2$ anodes, and the inset showing the Equivalent circuit model for the impedance spectra.

The semicircle in the high frequency region indicates the formation of a solid electrolyte interface (SEI) film and the charge transfer reaction at the electrode/electrolyte interface, while the straight line appearing at lower frequency is associated with sodium ion diffusion in the active material. Inset Figure S3 and Table S1 show the equivalent circuit model and numerical values of the equivalent circuit components for the spectra. $R_s$ means the combination of electrolyte resistance and ohmic resistances of cell components. $R_t$ and $R_{ct}$ are the resistance of solid electrolyte interface (SEI) films and the charge transfer resistance of electrochemical reaction, respectively. C, Q, and W are the surface-passivating layer capacitance, double layer capacitance, and the diffusion controlled Warburg impedance, respectively. As known, the charge transfer resistance is responsible for the rate capability. Specially, the value of the charge transfer resistance for the N-TiO$_2$ is about 394 $\Omega$, which is significantly smaller than that of the commercial TiO$_2$ anode (~971 $\Omega$). The highly decreasing $R_{ct}$ value is due to the doped nitrogen element can significantly improve the electronic conductivity.
Figure S4 (a) The selected charge-discharge profile of AC cathode for NIBs, (b) Cycling performance of AC cathode at 0.2 A g⁻¹ between 2.5 and 4.0 V (vs. Na/Na⁺).
Figure S5 CV analysis of the (a) AC cathode, (b) N-TiO$_2$ anode, (c) N-TiO$_2$/AC NICs device.