Supporting Information

Heterostructured Bi$_2$S$_3$-Bi$_2$O$_3$ Nanosheets with a Built-In Electric Field for Improved Sodium Storage

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Figure S1 XRD pattern of Bi$_2$S$_3$ sheets.
Figure S2 High resolution XPS spectra of (a) C 1s and (b) O 1s of BS-BO heterostructures. The C 1s spectrum can be fitted into three peaks at 284.8, 286.2 and 288.8 eV, which correspond to the binding energies of C−C, C−N and C=O, respectively. The O 1s XPS spectrum can be fitted by three peaks at binding energies of 533.1, 531.2 and 529.8 eV, which can be ascribed to adsorbed H$_2$O (OH$_2$O), C−O and Bi−O, respectively. These results suggest the existence of other components such as CTAB and H$_2$O species adsorbed on the surface of BS-BO sample.
**Figure S3** SEM images of Bi$_2$O$_3$ sheets at low (a) and high (b) magnifications.

**Figure S4** SEM images of Bi$_2$S$_3$ sheets at low (a) and high (b) magnifications.
Table S1. CHNS elemental analysis results of BS-BO heterostructured sheets. Measurements were conducted twice times to eliminate deviation. The average mass percentage of sulfur element in BS-BO is determined to be 14.83 wt%.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mass (mg)</th>
<th>N(%)</th>
<th>C(%)</th>
<th>H(%)</th>
<th>S(%)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS-BO sheets</td>
<td>5.4150</td>
<td>0.25</td>
<td>4.48</td>
<td>0.382</td>
<td>14.933</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.9170</td>
<td>0.26</td>
<td>4.61</td>
<td>0.417</td>
<td>14.725</td>
<td><strong>14.83 wt%</strong></td>
</tr>
</tbody>
</table>
Figure S5 Cyclic voltammograms for the first three cycles of BS-BO electrode in SIBs at a scan rate of 0.1 mV s\(^{-1}\).
Figure S6 Cyclic voltammograms for the first three cycles of Bi$_2$O$_3$ electrode in SIBs at a scan rate of 0.1 mV s$^{-1}$. During the sodiation process, a weak peak located at 0.61 V and a broad intense peak at 0.27 V are observed. And these two peaks can be attributed to the reduction process of Bi$_2$O$_3$ to Bi, Bi and Na alloying process, respectively. During de-sodiation process, four anodic peaks at 0.61, 0.78, 1.81 and 2.48 V can be detected. The major anodic peaks are determined to locate at 0.61 V and 0.78 V. The CV results are in consistent with previous Bi$_2$O$_3$ based SIBs reports.\cite{S-2}
Figure S7 Cyclic voltammograms for the first three cycles of Bi$_2$S$_3$ electrode in SIBs at a scan rate of 0.1 mV s$^{-1}$. Upon sodiation, three weak peaks at 1.49 V, 0.64 V and 0.33 V can be detected. The peaks at 1.49 V and 0.64 V may be ascribed to Bi$_2$S$_3$ conversion process, and a sharp peak at 0.33 V are probably due to the alloying of Bi and Na. Upon de-sodiation, the Na$_3$Bi is de-alloyed into Bi and it is characterized by two sharp peaks at 0.62 V and 0.79 V. And the Bi might not fully recovers to Bi$_2$S$_3$ in our SIBs, [S-3, S-4] as evidenced by a weak peak at 1.84 V.
Figure S8 The typical charge/discharge profiles of Bi$_2$S$_3$ sheets at the current density of 100 mA g$^{-1}$ for the initial three cycles.
Figure S9 The typical charge/discharge profiles of Bi$_2$O$_3$ sheets at the current density of 100 mA g$^{-1}$ for the initial three cycles.
Figure S10 Nyquist plots of electrodes containing BS-BO, Bi$_2$S$_3$ sheets and Bi$_2$O$_3$ sheets. The equivalent circuit is inset.

References in Supporting Information:


