Supporting Information

Core-shell TiO$_2$@C nano-architecture: facile synthesis, enhanced visible photocatalytic performance and electrochemical capacitance

Linrui Hou,*$^a$ Hui Hua, Hui Cao,$^a$ Siqi Zhu,$^a$ and Changzhou Yuan* $^{a,b}$

$^a$ School of Materials Science and Engineering, Anhui University of Technology, Ma’anshan, 243002, P. R. China
Email: houlr629@163.com (L. R. Hou); ayuancz@163.com (C. Z. Yuan)

$^b$ Chinese Academy of Science (CAS) Key Laboratory of Materials for Energy Conversion, Hefei, 230026, P. R. China
Fig. S1 FT-IR spectra of the Rutin and Rutin-Ti as indicated
Table S1 Assignments of the IR bands of Rutin and Rutin-Ti

<table>
<thead>
<tr>
<th>Compound</th>
<th>$\nu$(C=O)/cm$^{-1}$</th>
<th>$\nu$(C-O-C)/cm$^{-1}$</th>
<th>$\nu$(C=C)/cm$^{-1}$</th>
<th>$\nu$(Ti-O)$^1$/cm$^{-1}$</th>
<th>$\nu$(Ti-O)$^2$/cm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutin</td>
<td>1655$^{[1-3]}$</td>
<td>1295$^{[1-3]}$</td>
<td>1599$^{[1-3]}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutin-Ti</td>
<td>1638</td>
<td>1273</td>
<td>1601</td>
<td>638$^{[4]}$</td>
<td>499$^{[5]}$</td>
</tr>
</tbody>
</table>

Note: $\nu$(Ti-O)$^1$ and $\nu$(Ti-O)$^2$ corresponding to the Ti-O stretching bend associated with titanium glycolate or amorphous materials, and the anatase TiO$_2$, respectively.


Thermal behavior of the core-shell TiO$_2$@C nanohybrids was investigated by thermogravimetric (TG) analysis (Fig. S2). As shown in Fig. S2, the mass loss below ~200 °C should be the loss of superficial water loss, and chemically, bond water in the sample. And the loss above 200 °C should be ascribed to the decomposition and loss of amorphous carbon in the nanohybrid. And the content of carbon in the nanohybrid is estimated to be ~3 wt.% for the core-shell nanohybrids.

**Fig. S2** TG data of the core-shell TiO$_2$@C sample
As noted in Fig. S3, the Ti, O and C co-exist in the as-fabricated core-shell TiO$_2$@C nanohybrid.
Fig. S4 EIS spectra of the TiO$_2$ and TiO$_2$@C electrodes as indicated

The intersection of the plot at the X-axis represents solution resistance ($R_s$), which includes the following three terms: the resistance of the Na$_2$SO$_4$ aqueous solution, the intrinsic resistance of the electroactive materials themselves and the contact resistance at the interface between electroactive materials and current collector. As seen from the inset, $R_s$ can be found to be only ~0.4 Ohm, smaller than that of the TiO$_2$ (~1.2 Ohm), revealing the good electronic conductivity of the as-resulted TiO$_2$@C electrode. And at the high-medium frequency region, a semicircle can be found and the diameter stands for the charge-transfer resistance ($R_{ct}$) in the electrochemical process. And the $R_{ct}$ is calculated as ~0.6 and ~1.3 Ohm for the core-shell TiO$_2$@C and TiO$_2$, respectively, indicating the smaller charge-transfer resistance of the TiO$_2$@C in the electrochemical process.