Supporting Information

Ferromagnetic photocatalysts of FeTiO$_3$-Fe$_2$O$_3$ nanocomposites

Baizhi Gao$^a$, Caiping Yang$^a$, Jun Chen$^a$, Yuxing Ma$^a$, Jiachen Xie$^a$, Hao Zhang$^a$

Lujun Wei$^b$, Qi Li$^a$,*, Jun Du$^{b,c,*}$, and Qingyu Xu$^{a,c,*}$

$^a$ School of Physics, Southeast University, Nanjing 211189, China

$^b$ School of Physics, Nanjing University, Nanjing 210093, China

$^c$ National Laboratory of Solid State Microstructures, Nanjing University, Nanjing 210093, China

The crystallite size of xFTO-(1-x)FO nanocomposites

Table S1. The crystallite sizes of xFTO-(1-x)FO nanocomposites from (110) peak using Scherrer’s relation.

<table>
<thead>
<tr>
<th>Samples (xFTO-(1-x)FO)</th>
<th>x=0.00</th>
<th>x=0.20</th>
<th>x=0.40</th>
<th>x=0.60</th>
<th>x=0.80</th>
<th>x=1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystallite sizes</td>
<td>60.0 nm</td>
<td>40.7 nm</td>
<td>41.8 nm</td>
<td>66.6 nm</td>
<td>43.0 nm</td>
<td>53.8 nm</td>
</tr>
</tbody>
</table>

The fitting results for Fe and Ti using XPS.

Table S2. The fitted results of XPS, in comparison with the EDX data. The calculated $x$ is determined by the relative concentrations of Fe$^{2+}$ and Fe$^{3+}$ from FTO and FO.

<table>
<thead>
<tr>
<th>Samples (xFTO-(1-x)FO)</th>
<th>x=1.00</th>
<th>x=0.80</th>
<th>x=0.60</th>
<th>x=0.00</th>
<th>Annealed at 300 °C</th>
<th>Annealed at 700 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitted peak area of Fe (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe$^{2+}$</td>
<td>68.3</td>
<td>31.7</td>
<td>58.0</td>
<td>42.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe$^{3+}$</td>
<td>2.15</td>
<td>1.38</td>
<td>0.53</td>
<td>0.13</td>
<td>0.52</td>
<td>0.04</td>
</tr>
<tr>
<td>Ti$^{3+}$/Ti$^{4+}$</td>
<td>2.16</td>
<td>2.00</td>
<td>33.3</td>
<td>66.7</td>
<td>2.23</td>
<td>/</td>
</tr>
<tr>
<td>Fitted peak area of Ti (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ti$^{3+}$</td>
<td>31.6</td>
<td>68.4</td>
<td>33.3</td>
<td>66.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ti$^{4+}$</td>
<td>2.23</td>
<td>0.90</td>
<td>0.55</td>
<td>0.00</td>
<td>0.55</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Calculated $x$ (XPS) | 1.00 | 0.89 | 0.58 | 0.00 | 0.57 | / |

Measured $x$ (EDX) | / | 0.90 | 0.55 | 0.00 | 0.55 | 0.55 |
The BET surface area of $x=0.60$ and $1.00$ nanocomposites.

Figure S1. The BET surface area of $x=0.60$ and $1.00$ samples. The surface area is 14.966 m$^2$/g for $x=0.60$ and 24.554 m$^2$/g for $x=1.00$.

The photocatalytic performance of physically mixed xFTO-(1-x)FO ($x=0.60$)

Figure S2. The photocatalytic performance of physically mixed xFTO-(1-x)FO ($x=0.60$).
**XRD patterns of annealed xFTO-(1-x)FO (x=0.60)**

Figure S3. (a) The XRD patterns of xFTO-(1-x)FO (x=0.60) annealed at various temperatures, insets shows the corresponding images of the samples. (b) The magnified view of (110) peaks of the annealed samples.

**SEM images of annealed xFTO-(1-x)FO (x=0.60)**

Figure S4. SEM images of xFTO-(1-x)FO (x=0.60) (a) as-prepared, and annealed at (b) 300 °C, (c) 400 °C, (d) 500 °C and (e) 700 °C, respectively.
Raman spectra of annealed xFTO-(1-x)FO (x=0.60)

Figure S5. Raman spectra of xFTO-(1-x)FO (x=0.60) annealed at different temperatures.

XPS of annealed xFTO-(1-x)FO (x=0.60)

Figure S6. The XPS of annealed xFTO-(1-x)FO (x=0.60) at 300 °C and 700 °C.
Photocatalysis of annealed xFTO-(1-x)FO (x=0.60)

Figure S7. (a) Photo-decolonization ratios of RhB under visible light irradiation, using annealed xFTO-(1-x)FO (x=0.60). (b) Fitting using Pseudo-first-order model.

Magnetic hysteresis loops of annealed xFTO-(1-x)FO (x=0.60)

Figure S8. (a) Magnetic hysteresis loops of annealed xFTO-(1-x)FO (x=0.60), inset shows the dependence of $M_{\text{sat}}$ on annealed temperatures. (b) Magnified view of M-H curves at low field region.