Electronic supporting information (ESI) for

The synthesis of Ag–ZnO nanohybrid with plasmonic photocatalytic activity under visible-light: the relationship between tunable optical absorption, defect chemistry and photocatalytic activity

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ESI-1

The chemical formula of Rhodamine B (RhB) and Methyl Orange (MO) are given in Scheme S1.

![Chemical formula of Rhodamine B (RhB) and Methyl Orange (MO).](image)

**Scheme S1**: Chemical formula of Rhodamine B (RhB) and Methyl Orange (MO).

Prior to illumination, the suspension was magnetically stirred in the dark for 2 h to ensure the establishment of an absorption–desorption equilibrium of rhodamine B on the sample surface. 25 mg of the as prepared samples dissolve in a 50 mL of $2 \times 10^{-5}$ M rhodamine B aqueous solution. $C/C_0$ vs t plot (Fig. S1) clearly shows that there was no significant change in concentration of RhB after 60 min.
Fig. S1 Changes in the concentration of RhB in contact with Ag-ZnO (R=0.05) nanohybrid as a function of time in the dark.
**ESI-2**

*N₂ sorption analysis*

The N₂ adsorption-desorption of pure ZnO and Ag-ZnO (R=0.05) nanohybrid are shown in Fig. S2.

![Fig. S2 N₂ adsorption-desorption of (a) pure ZnO and (b) Ag-ZnO (R=0.05) nanohybrid.](image)
Photocatalytic studies

The photocatalytic activity of the ZnO and Ag-ZnO (R=0.05) nanohybrid in the decomposition of Methyl Orange (MO) has been studied. The corresponding data are reported in Fig. S3.

**Fig. S3** (a) Absorbance changes of MO solution after different irradiation times in the presence of the Ag-ZnO (R=0.05) sample: equilibrium (black). (b) Kinetic of the degradation of MO. (c) ln[C₀/C] as a function of the irradiation time.
**Fig. S4** Effect of pH values on the degradation ratio of RhB for Ag-ZnO (R=0.05).
**Table. S1** The recycling data comparison of Ag-ZnO nanohybrid with those of other catalysts reported in literatures.

<table>
<thead>
<tr>
<th>Number</th>
<th>Catalysts</th>
<th>Recycle times</th>
<th>Preserved activity</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ag-ZnO nanohybrid</td>
<td>5</td>
<td>80%</td>
<td>This work</td>
</tr>
<tr>
<td>2</td>
<td>Ag/ZnO nanocomposites</td>
<td>No reported</td>
<td></td>
<td>Reference¹</td>
</tr>
<tr>
<td>3</td>
<td>Ag/ZnO nanorod</td>
<td>No reported</td>
<td></td>
<td>Reference²</td>
</tr>
<tr>
<td>4</td>
<td>Ag/ZnO heterostructure</td>
<td>4</td>
<td>95%</td>
<td>Reference³</td>
</tr>
<tr>
<td>5</td>
<td>Ag/ZnO heterostructures</td>
<td>No reported</td>
<td></td>
<td>Reference⁴</td>
</tr>
<tr>
<td>6</td>
<td>Ag/ZnO nanorods</td>
<td>No reported</td>
<td></td>
<td>Reference⁵</td>
</tr>
<tr>
<td>7</td>
<td>ZnO</td>
<td>3</td>
<td>90%</td>
<td>Reference⁶</td>
</tr>
<tr>
<td>8</td>
<td>SnO₂–ZnO Heterojunction</td>
<td>4</td>
<td>99%</td>
<td>Reference⁷</td>
</tr>
<tr>
<td>9</td>
<td>Ag/ZnO flower</td>
<td>3</td>
<td>80%</td>
<td>Reference⁸</td>
</tr>
</tbody>
</table>
Fig. S5 N\textsubscript{2} adsorption-desorption of Ag-ZnO nanohybrid (R=0.05) before (a) and after (b) photocatalytic degradation reaction.

Table S2. BET values of Ag-ZnO (R=0.05) before and after photocatalytic degradation reaction.

<table>
<thead>
<tr>
<th>Photocatalyst</th>
<th>$S_{\text{BET}}$ (m\textsuperscript{2} g\textsuperscript{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag-ZnO (R=0.05) before photocatalytic degradation reaction</td>
<td>4.2±0.5</td>
</tr>
<tr>
<td>Ag-ZnO (R=0.05) after photocatalytic degradation reaction</td>
<td>4.3±0.5</td>
</tr>
</tbody>
</table>

Fig. S6 Ag content of Ag-ZnO (R=0.05) nanohybrids measured by ICPAES before (a) and after (b) photocatalytic degradation reaction.
Fig. S7 XPS spectra of Ag-ZnO (R=0.05) after photocatalytic degradation reaction: whole scanning spectra (a) and high resolution regional spectra of Ag 3d (d).
Reference