One-dimensional CdS nanowires-CeO₂ nanoparticles composites with boosted photocatalytic activity

Xin Zhang,¹ Nan Zhang,¹,b Yi-Jun Xu,¹,b and Zi-Rong Tang⁰*

¹ College of Chemistry, New Campus, Fuzhou University, Fuzhou, 350108, P. R. China.
² State Key Laboratory of Photocatalysis on Energy and Environment, College of Chemistry, Fuzhou University, Fuzhou, 350002, P. R. China.
* To whom correspondence should be addressed.

E-mail: zrtang@fzu.edu.cn

Experimental Section

Synthesis of CdS nanowires (CdS NWs).

Uniform CdS NWs were prepared according to a method described earlier.¹⁻² Briefly, 1.124 g of cadmium diethyldithiocarbamate (Cd(S₂CNEt₂)₂), which was prepared by precipitation from a stoichiometric mixture of sodium diethyldithiocarbamate trihydrate and cadmium chloride in deionized water, was added to a Teflon-lined stainless steel autoclave with a capacity of 50 mL. After that, the autoclave was filled with 40 mL of ethylenediamine to about 80% of the total volume and maintained at 180 °C for 24 h. The resulting composites were separated by centrifugation and washed with absolute ethanol and deionized water to remove residue of organic solvents. After drying at 60 °C for 12 h, the CdS NWs were obtained.
Scheme S1. The schematic illustration for synthesis of CdS NWs-CeO$_2$ NPs composites via a facile method at room temperature.

Fig. S1 Photograph of the experimental setup for photocatalytic reduction of aromatic nitro compounds.
**Fig. S2** Photograph of the experimental setup for photocatalytic water-splitting to hydrogen.

**Fig. S3** Photographs of the samples of CdS NWs (A) and CdS NWs-1% CeO$_2$ NPs composite (B).
**Fig. S4** The plots of transformed Kubelka-Munk function versus the energy of light for CeO$_2$ NPs (A), CdS NWs and CdS NWs-CeO$_2$ NPs composites (B).

**Fig. S5** Bar plots showing the remaining concentration fraction of 4-nitroaniline (4-NA) after a certain time of visible light irradiation over CeO$_2$ NPs.
**Fig. S6** Time-dependent UV-vis spectral variation during the photocatalytic reduction of 4-nitroaniline (4-NA) to *p*-phenylenediamine (PPD) over CdS NWs-1%CeO$_2$ NPs composite under visible light irradiation (λ > 420 nm) with the addition of ammonium formate as a quencher for photogenerated holes and N$_2$ purge at room temperature in the aqueous phase. The peak located at 380 nm is attributed to 4-NA and the peaks at 300 nm and 240 nm are ascribed to PPD.

**Fig. S7** Photoluminescence (PL) spectra of CeO$_2$ NPs, CdS NWs and CdS NWs-1%CeO$_2$ NPs composite with an excitation wavelength of 380 nm.
Fig. S8 Mott–Schottky plots for CeO$_2$ NPs and CdS NWs in 0.2 M Na$_2$SO$_4$ aqueous solution (pH = 6.8).

Fig. S9 Nyquist impedance plots of CeO$_2$ NPs, CdS NWs and CdS NWs-1% CeO$_2$ NPs composite under visible light irradiation ($\lambda > 420$ nm).
**Table S1.** Summary of the Brunauer-Emmett-Teller (BET) surface area and pore volume of CeO$_2$ NPs, CdS NWs and CdS NWs-1%CeO$_2$ NPs composite.

<table>
<thead>
<tr>
<th>Samples</th>
<th>$S_{\text{BET}}$ (m$^2$/g)</th>
<th>Total pore volume (cm$^3$/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeO$_2$ NPs</td>
<td>8.2</td>
<td>0.02</td>
</tr>
<tr>
<td>CdS NWs</td>
<td>28.9</td>
<td>0.15</td>
</tr>
<tr>
<td>CdS NWs-1% CeO$_2$ NPs</td>
<td>24.5</td>
<td>0.12</td>
</tr>
</tbody>
</table>

**References**