Supporting Information

Efficient photocatalytic hydrogen evolution under visible light by ternary composite CdS@NU-1000/RGO

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# P. P. Bag and X. –S. Wang contributed equally to this work.

Synthesis of 1,3,6,8-tetrakis(p-benzoic acid)pyrene 1,3,6,8-tetrakis(pbenzoic acid) pyrene (TBAPy).

Scheme S1. Synthetic procedure of TBAPy.

The synthesis was performed according to the previous literature.15 (The ref. belongs to main draft)
**Figure S1.** The XRD pattern of NU-1000.

**Figure S2.** The thermogravimetric graph of NU-1000 under nitrogen atmosphere.
Figure S3. The PXRD of CdS contained composites.

Figure S4. The Raman spectra of GO and RGO.
Figure S5. The hydrogen production activity of (a) CdS@NU-1000/1%RGO; (b) CdS@NU100/1.5%RGO; (c) CdS@NU-1000/0.5%RGO; (d) CdS@NU-1000; (e) NU-1000; (f) RGO; (g) CdS@NU-1000/1%RGO in the dark.

Figure S6. The PXRD patterns of (a) fresh CdS@NU-1000/1%RGO and (b) CdS@NU-1000/1%RGO after water splitting reaction without the addition of sacrificial agents.
Figure S7 The N$_2$ adsorption/desorption isotherms.

Figure S8 Pore width of NU-1000.
Figure S9. The TEM and HRTEM image of (a) H-CdS@NU-1000/1%RGO and (b) L-CdS@NU-1000/1%RGO.

Figure S10. PXRD pattern of all three composite materials.
Figure S11. (a) The SEM graph of CdS@NU-1000 and (b) The SEM graph of CdS@NU-1000/1%RGO.

Figure S12. The diffraction reflectance spectra: (a) NU-1000; (b) CdS@NU-1000/0.5%RGO; (c) CdS@NU-1000; (d) CdS@NU-1000/1%RGO; (e) CdS@NU-1000/1.5%RGO.

Table S1 The weight ratio of CdS and NU-1000 and their activity

<table>
<thead>
<tr>
<th>Samples</th>
<th>CdS:NU-1000 (wt/wt)</th>
<th>Activity (µmol h⁻¹)</th>
<th>CdS wt%</th>
<th>Activity (mmol g⁻¹ h⁻¹) / Times of activity over CdS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-CdS@NU-1000/1%RGO</td>
<td>1 : 12.5</td>
<td>5.9</td>
<td>7.39</td>
<td>1.60/8.0</td>
</tr>
<tr>
<td>CdS@NU-1000/1%RGO</td>
<td>1 : 9.1</td>
<td>12</td>
<td>9.93</td>
<td>2.42/12.1</td>
</tr>
<tr>
<td>H-CdS@NU-1000/1%RGO</td>
<td>1 : 4.8</td>
<td>8.55</td>
<td>17.36</td>
<td>0.99/4.95</td>
</tr>
</tbody>
</table>
Quantum efficiency calculations.

In the following we describe the QE determination at $\lambda_0=420$ nm for CdS@NU-1000/1% RGO. The catalyst solution was irradiated by a 300W Xe lamp applying a $\lambda\pm7.5$ nm band-pass filter for 4 hours. The average intensity of irradiation was determined to be 163.7 mW·cm$^{-2}$ by a light intensity meter, and the irradiation area was 18.09 cm$^2$. The number of incident photons ($N$) is $2.25\times10^{22}$ as calculated by equation (1). The amount of $H_2$ molecules generated per hour was 2.56 µmol. The quantum efficiency is calculated from equation (2).

$$N = \frac{E\lambda}{hc} \quad (1)$$

$$QE = 2 \times \frac{\text{the number of evolved } H_2 \text{ molecules}}{\text{the number of incident photons}} \times 100 \% \quad (2)$$

**Table. S2**

<table>
<thead>
<tr>
<th>CdS@NU-1000/1% RGO</th>
<th>Activity (µmol/h)</th>
<th>QE</th>
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<tbody>
<tr>
<td>420 nm</td>
<td>2.56</td>
<td>0.0137%</td>
</tr>
<tr>
<td>450 nm</td>
<td>2.24</td>
<td>0.0114%</td>
</tr>
<tr>
<td>475 nm</td>
<td>1.63</td>
<td>0.0073%</td>
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</table>

**Table. S3 The mass fraction of CdS in the composite**

<table>
<thead>
<tr>
<th>Samples</th>
<th>Cd wt% (ICP)</th>
<th>S wt% (Elemental Analysis)</th>
<th>CdS wt%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CdS@NU-1000</td>
<td>5.72</td>
<td>4.46</td>
<td>10.18</td>
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<tr>
<td>CdS@NU-1000/1% RGO</td>
<td>5.67</td>
<td>4.26</td>
<td>9.93</td>
</tr>
<tr>
<td>L-CdS@NU-1000/1% RGO</td>
<td>4.14</td>
<td>3.25</td>
<td>7.39</td>
</tr>
<tr>
<td>M-CdS@NU-1000/1% RGO</td>
<td>11.77</td>
<td>5.59</td>
<td>17.36</td>
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</tbody>
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