Electronic Supplementary Material (ESM)

Environmentally sustainable synthesis of CoFe$_2$O$_4$-TiO$_2$/rGO ternary photocatalyst: A highly efficient and stable photocatalyst for high production of hydrogen (Solar Fuel)

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Table S1. Photocatalytic H$_2$ production comparison with existing TiO$_2$ based materials
Section S1: Apparent Quantum Yield (A.Q.Y) efficiency Calculation

We have calculated the quantum efficiency in order to compare the photocatalytic activity of photocatalysts by using 400 nm band pass filter.

A.Q.Y Calculation details

The energy of one photon \( E_{\text{photon}} \) with wavelength of \( \lambda_{\text{inc}} \) (nm) is calculated using the following equation.

\[
E_{\text{photon}} = \frac{hc}{\lambda_{\text{inc}}}
\]

Total energy of the incident light \( E_{\text{total}} \)

\[
E_{\text{total}} = P St
\]

Therefore,

Quantum yield (Q.Y.)

\[
Q.Y(\%) = \frac{\text{Number of reacted electrons}}{\text{Number of incident photons}} \times 100
\]

Or

\[
A.Q.Y(\%) = \frac{2 \times (\text{Number of } H_2 \text{ molecules evolved})}{\text{Number of incident photons}} \times 100
\]

\[
A.Q.Y(\%) = \frac{2 \times M \times N_A \times h \times c}{P \times S \times t \times \lambda_{\text{inc}}} \times 100
\]

Where

\[
M = \text{Amount of hydrogen produced in } \frac{\text{mol}}{\text{time}} = 2732 \mu\text{mol/h}
\]

\[
N_A = \text{Avogadro Number} = 6.022 \times 10^{23}
\]

\[
c = \text{Speed of light} = 3 \times 10^8 \text{ m/s}^{-2}
\]

\[
h = \text{Planck’s constant} = 6.626 \times 10^{-34} \text{ Js}
\]

\[
P = \text{Power density of the incident monochromatic light} = 100 \text{ mW/cm}^2
\]

\[
S = \text{Irradiated area to produce } M \text{ (mol) of hydrogen} = 35 \text{ cm}^2
\]

\[
t = \text{Irradiated time} = 1 \text{ h} = 3600 \text{ s}
\]

\[
\lambda_{\text{inc}} = \text{wavelength of the incident monochromatic light} = 400 \text{ nm} = 400 \times 10^{-9} \text{ m}
\]
A.Q.Y (%) = \frac{2 \times 2732 \times 10^{-6} \times 6.022 \times 10^{23} \times 6.626 \times 10^{-34} \times 3 \times 10^8}{100 \times 10^{-3} \times 35 \times 3600 \times 400 \times 10^{-9}} \times 100

A.Q.Y (%) = 12.97 %

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<table>
<thead>
<tr>
<th>Photocatalysts</th>
<th>Co-catalysts</th>
<th>Hole Scavengers</th>
<th>Irradiation Source</th>
<th>H₂ production (μmol g⁻¹ h⁻¹)</th>
<th>Ref (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO₂</td>
<td>CoFe₂O₄/rGO</td>
<td>Glycerol</td>
<td>250 Xe Lamp</td>
<td>76559</td>
<td>This</td>
</tr>
</tbody>
</table>
REFERENCES


