Supporting Information

Photocatalytic Hydrogen Production Driven by Solar Energy: Performance under Central European Climatic Conditions

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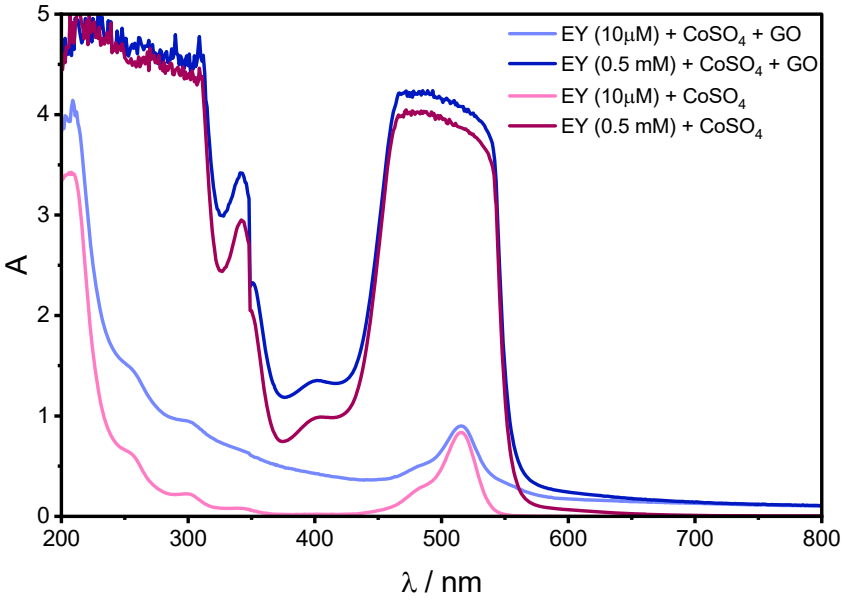


Figure S1. Absorption spectra of the complete reaction mixtures (EY–$CoSO_4$–TEOA) in the presence and absence of GO. Conditions: [EY] = 10 μM / 0.5 mM, [Co^{2+}] = 0.7 mg, [TEOA] = 0.2 M, [GO] = 0.8 mg.

UV–Vis spectra were recorded for eosin Y at two different concentrations: 10 μM and 0.5 mM. The lower concentration corresponds to the conditions used for the individual component spectra, allowing evaluation of the cumulative absorbance and potential shielding effects introduced by GO. At the higher concentration, corresponding to the actual experimental conditions, the absorbance exceeds the measurable range of the spectrophotometer (A > 3) indicating very strong light absorption. Furthermore, absorbance values above 1 are observed below approximately 554 nm, covering the majority of the UV–Vis spectrum. These results clearly indicate that eosin Y is the dominant component responsible for light absorption in the studied system.

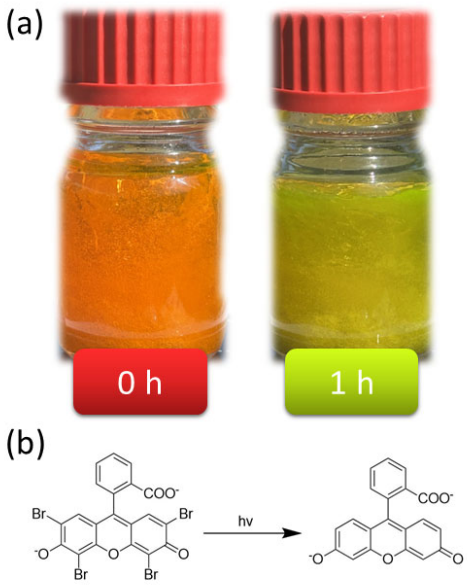


Figure S2. (a) Photographs illustrating the color change of the reaction mixture before and after irradiation. (b) Schematic illustration of the proposed reaction mechanism.

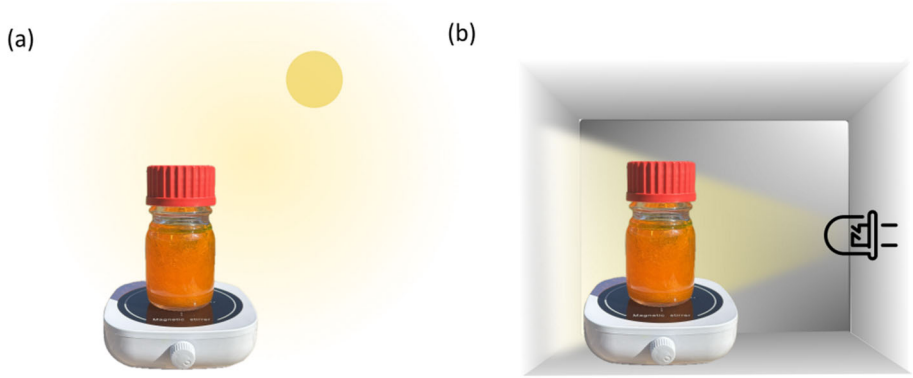


Figure S3. Schematic illustration of the experimental setups used for photocatalytic measurements: (a) outdoor setup under natural solar irradiation, performed using a portable magnetic stirrer powered by a power bank, with the reaction vessel placed at a fixed location and continuously stirred; (b) indoor setup with an artificial light source, where the reaction vessel was placed inside a reflective chamber, and the light source was positioned at a distance of 25 cm from the bottle at the height corresponding to the middle of the solution.

Table 1. Summary of selected literature reports on photocatalytic hydrogen production systems, including EY-based and other representative systems, provided for comparison with the performance of the present system.

Catalyst	Conditions	Hydrogen generation rate	Reference
Graphene QDs/TiO_2	Natural solar light	29.55 mmol g^{-1} h^{-1}	[1]
CdS QDs/thiolated graphene	300 W Xe lamp (> 420)	29.65 mmol g^{-1} h^{-1}	[2]
EY-NiSx/Graphene	300 W Xe lamp (≥ 420 nm)	12.38 mmol g^{-1} h^{-1}	[3]
EY-MoS_2	300 W Xe lamp (≥ 420 nm)	35 mmol g^{-1} h^{-1}	[4]
g-C3N4-TiO_2/rGO	250 W Xe lamp	23.1 mmol g^{-1} h^{-1}	[5]
1T MoS2	100 W halogen lamp	26 mmol g^{-1} h^{-1}	[6]
EY/$Ti_3C_2T_x$/Co^{2+}	λ = 505nm	40.1 mmol g^{-1} h^{-1}	[7]
TiO_2/ Ti_3C_2/carbon nitride nanosheet	λ > 400 nm	15.29 mmol h^{-1} g^{-1}	[8]
$Ti_3C_2T_x$/O-doped g–C_3N_4	λ = 405 nm	25.1 mmol h^{-1} g^{-1}	[9]
NP@COF	simulated sunlight	527.2 ~ 3180.7 mmol h^{-1} g^{-1}	[10]
Ni_2P/CdS NRs	λ = 450 nm	1200 mmol h^{-1} g^{-1}	[11]

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