

Sporting information

1. The calculation method of apparent quantum efficiency (AQE)

The AQY of the H₂ generation for the photocatalyst was tested using monochromatic light (420, 450, 500, and 550 nm) with 300 W Xenon lamp.

The AQY was estimated according to the formula as follows:

$$\begin{aligned} \text{AQY} &= \frac{\text{number of reacted electrons}}{\text{number of incident photons}} \times 100\% \\ &= \frac{\text{number of evolved H}_2 \text{ molecules} \times 2}{\text{number of incident photons}} \times 100\% \\ &= \frac{n_{\text{H}_2} \times N_A \times 2}{E\lambda/hc} \times 100\% \end{aligned}$$

Where n_{H_2} , N_A , E and $h\nu$ refer to H₂ production yield, the Avogadro constant, light energy, and photon energy, respectively.

2. Figure

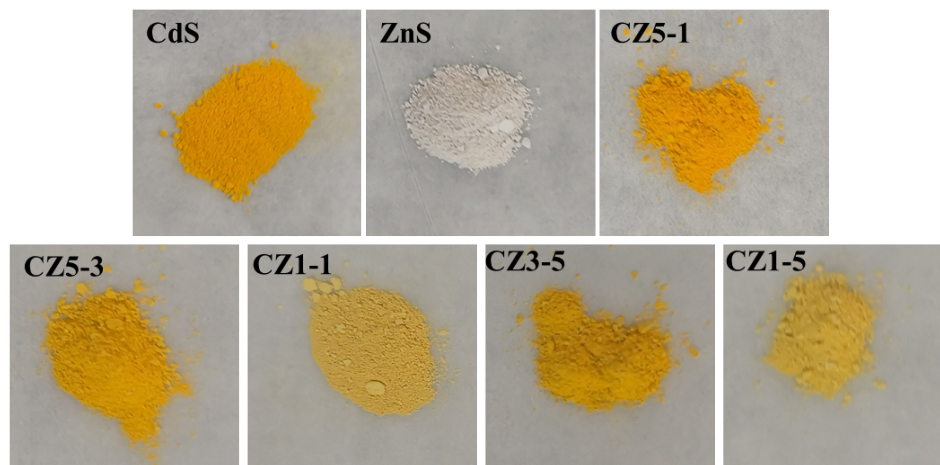


Fig. S1 Optical photos of catalyst samples of hexagonal CdS pyramids, ZnS nanoparticles, CZ5-1 heterojunction, CZ5-3 heterojunction, CZ1-1 heterojunction, CZ3-5 heterojunction, CZ1-5 heterojunction.

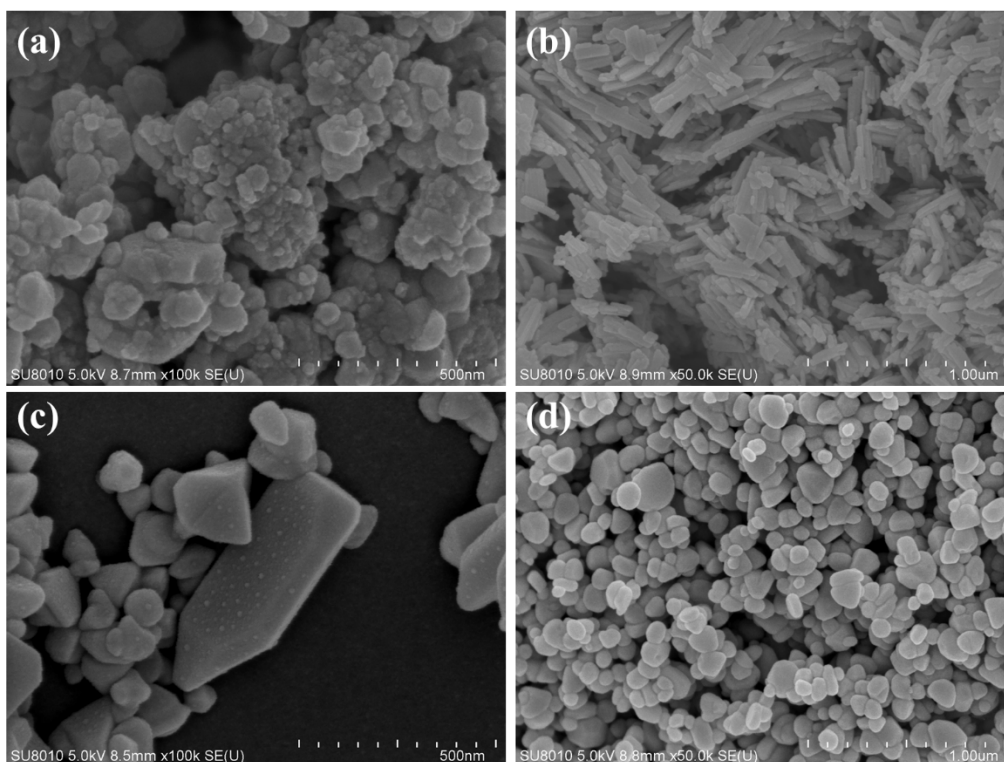


Fig. S2 SEM images of (a) CdS nanoparticles, (b) CdS nanorods, (c) hexagonal CdS pyramid and (d) ZnS nanoparticles.

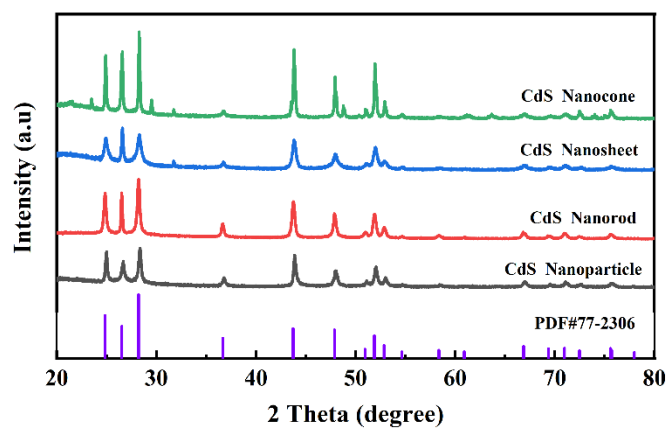


Fig. S3 XRD patterns of CdS with different morphologies.

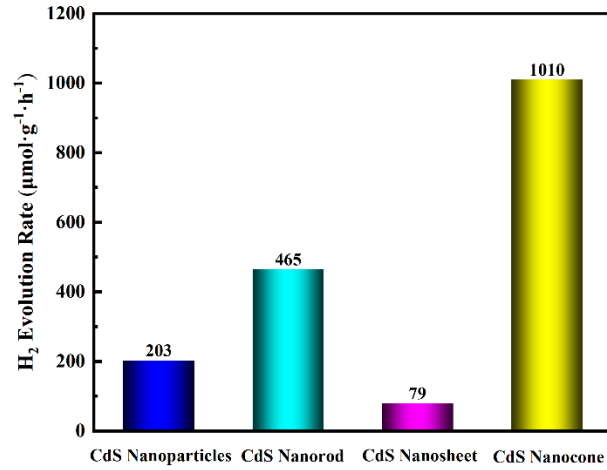


Fig. S4 Photocatalytic hydrogen evolution rates of CdS with different morphologies.

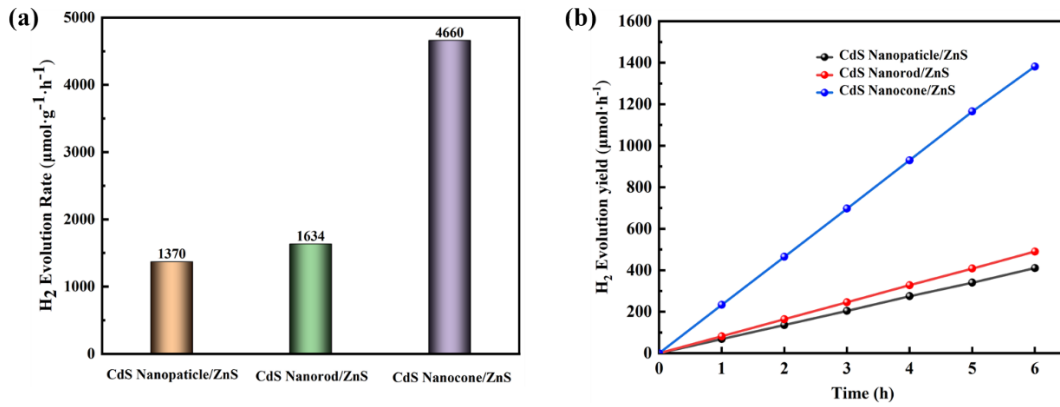


Fig. S5 Different morphologies with 1:1 ratio of the Cd source to Zn source, (a) photocatalytic hydrogen production rates and (b) the 6 hours photocatalytic yields.

3. Performance comparison of CdS-based photocatalysts recently reported.

Samples	Mass (g)	Light source	Incident light	Sacrificial agents	H ₂ (mmol/g/h)	AQE (%)	Ref.
ZnS/CdS	0.02	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	2.348	-----	[1]
CdS/ZnS	0.02	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	0.055	-----	[2]
CdS/ZnS	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	0.831	-----	[3]
ZnO/ZnS/CdS	0.1	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	2.64	-----	[4]
ZnS / CdS /γ-TaON	0.1	300W Xe	≥420 nm	Lactic acid	0.839	-----	[5]

Zn _{1-x} Cd _x S/CdS	0.2	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	2.7	3.84	[6]
Zn _{0.9} Cd _{0.1} S	0.1	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	4.4	-----	[7]
Zn _{0.5} Cd _{0.5} S/ ZnIn ₂ S ₄	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	1.78	1.17	[8]
Zn _x Cd _{1-x} S	0.02	300W Xe	≥420 nm	NiCl ₂ ·6H ₂ O	0.313	15.9	[9]
CdS/ZnS	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	0.856	-----	[10]
PdS/CdS/ZnS	0.05	350W Xe	≥405 nm	Na ₂ S-Na ₂ SO ₃	2.6	23	[11]
Ag/Cu/ZnO/ZnS	0.05	300W Xe		Na ₂ S-Na ₂ SO ₃	0.769	-----	[12]
g-STO/ZnS	0.05	300W Xe	≥420 nm	Methanol	1.79	2.1	[13]
Cu ₂ S/ZnS	0.02	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	1.01	17.6	[14]
ZnS/SnO ₂	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	2.17	-----	[15]
Cu/ZnS/COF	0.02	350W Xe	≥420 nm	Methanol	0.278	-----	[16]
rGO/ZnS	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	0.108	-----	[17]
N/ZnS	0.2	300W Xe	≥420 nm	Methanol	0.243	-----	[18]
Pt/CdS	-----	LED	455 nm	Sulfite	0.003	9.6	[19]
Bi ₂ O ₇ I/CdS	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	0.456	-----	[20]
CdS/Ti ₃ C ₂	0.05	300W Xe	≥420 nm	Lactic acid	2.407	35.6	[21]
CdS/g-C ₃ N ₄	0.05	300W Xe	≥400 nm	Na ₂ S-Na ₂ SO ₃	0.392	-----	[22]
CdS/WS ₂ /graphene	0.05	300W Xe	≥400 nm	Na ₂ S-Na ₂ SO ₃	1.84	21.2	[23]
ZnS/CdS	0.05	300W Xe	≥420 nm	Na ₂ S-Na ₂ SO ₃	4.66	-----	This work

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