Supporting Information

Noble metal-free 0D-1D NiS_x/CdS nanocomposite toward highly efficient photocatalytic contaminations removal and hydrogen evolution under visible light

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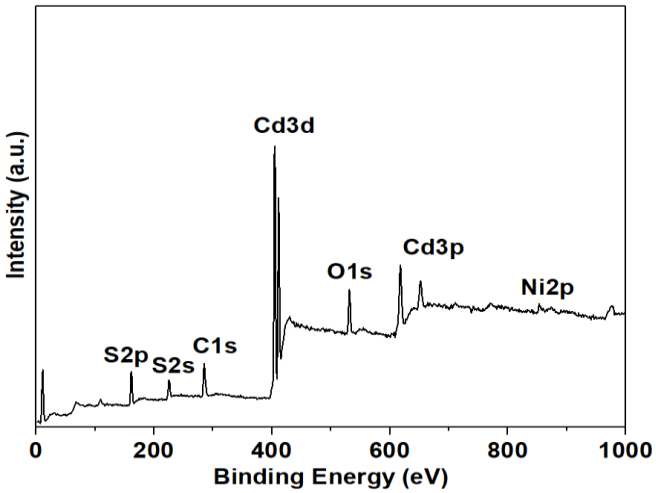

Figure S1. XPS survey spectrum of the 1.5% NiS_x/CdS-NRs.

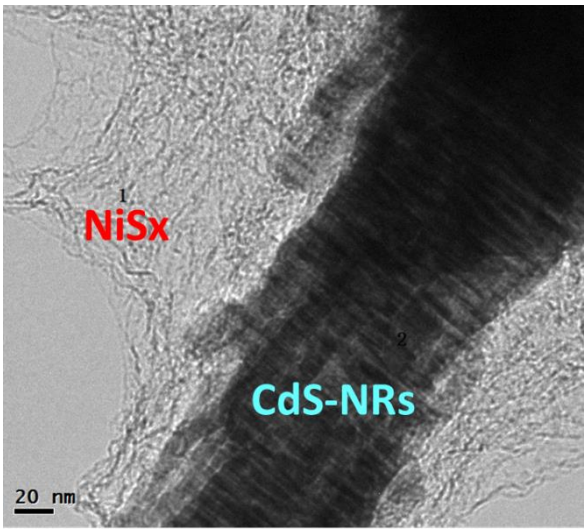

Figure S2. TEM image of the 10% NiS_x/CdS-NRs.

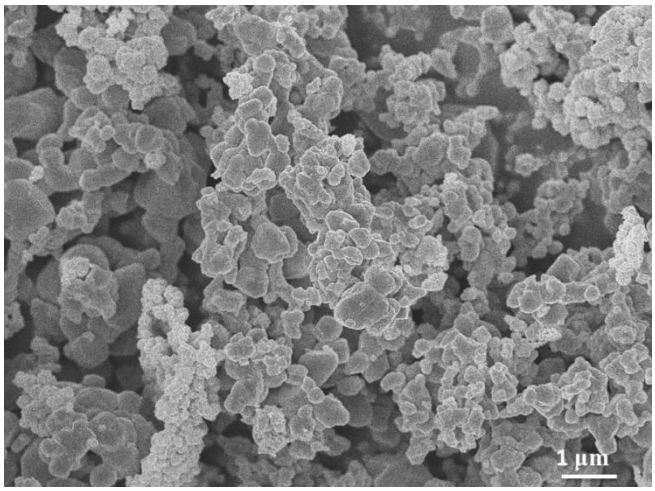

Figure S3. SEM image of the CdS-C.

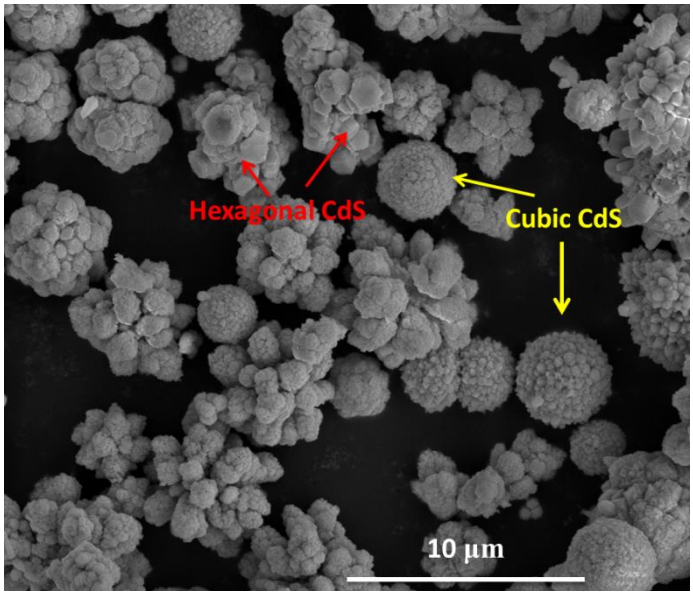

Figure S4. SEM image of the CdS-NPs.

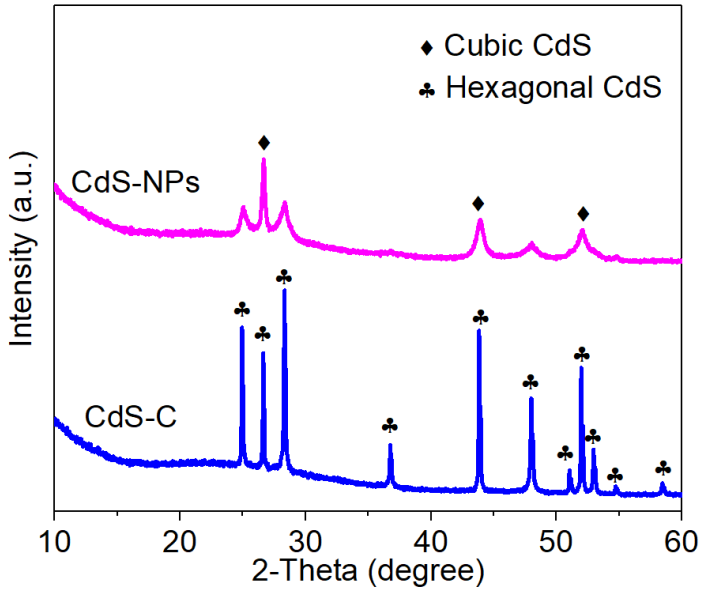

Figure S5. XRD patterns of the CdS-C and CdS-NPs.

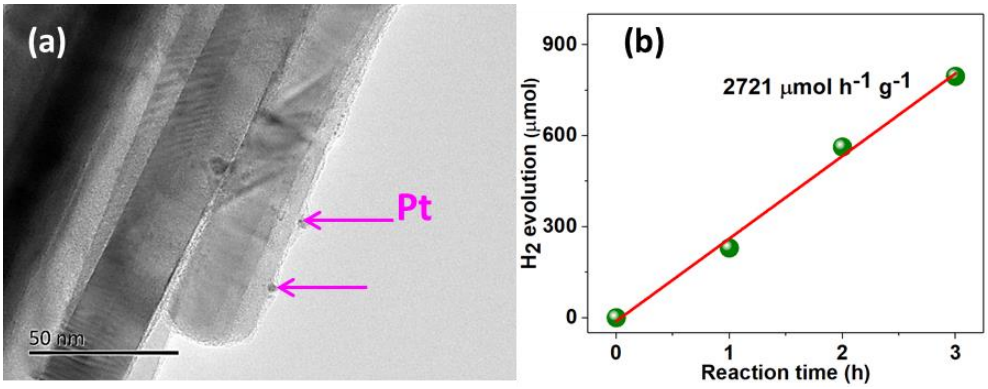

Figure S6. (a) TEM image and (b) H_2-evolution photocatalytic activity of the 1.5% Pt/CdS-NRs sample.

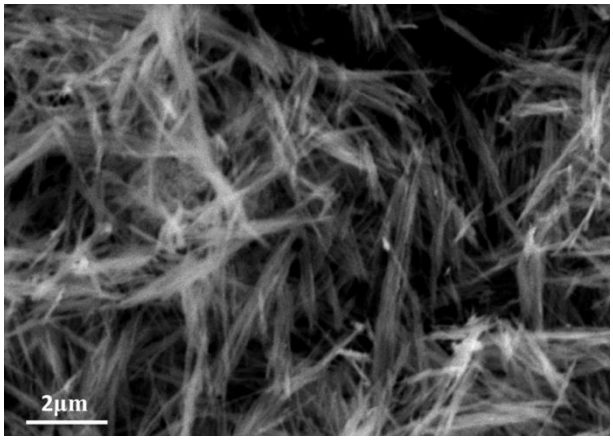

Figure S7. SEM image of the used 1.5% NiS_x/CdS-NRs.

Table S1. Comparison of H_2 evolution performance among different NiS_x/CdS composite photocatalysts.

Morphology of CdS	Shape of NiS_x	AQE at 420 nm (%)	Reaction Temperture (˚C)	Ref.
Polyhedral	Nanoparticles	60.4	35	[1]
plate	Nanoparticles	16.8	20	[2]
1D nanorod	2D nanosheets	69.9	10	This work

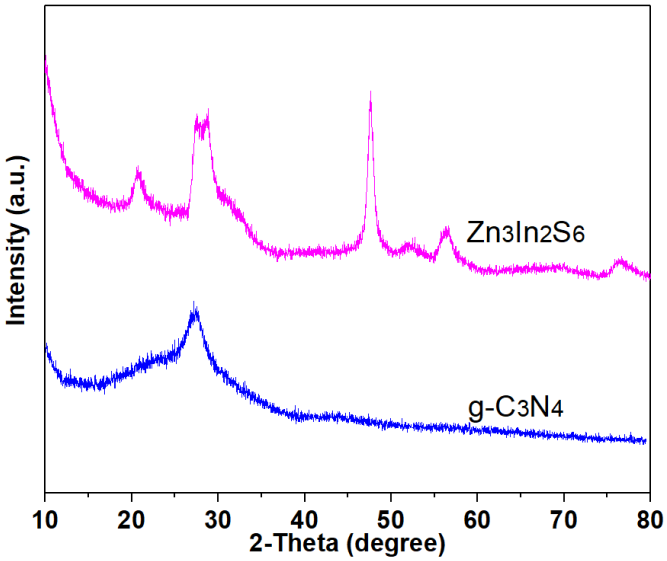

Figure S8. XRD patterns of g-C_3N_4 and $Zn_3In_2S_6$.

The g-C_3N_4 powders were synthesized by heating urea in a tube furnace. A certain amount of melamine was put into the alumina crucible, which was heated at 520 ℃ for 2 h with a temperature rise rate of 5 ℃ min^{-1}. After the reaction, the alumina crucible was cooled naturally to room temperature.

$Zn_3In_2S_6$ was prepared by a hydrothermal method. In a typical procedure, 2 mmol $InCl_3 \cdot 4H_2O$, 3 mmol $ZnSO_4 \cdot 7H_2O$ and a double excess of CH_3CSNH_2 were dissolved in 70 mL of deionized water. The mixed solution was further transferred into a 100 mL Teflon-lined autoclave. The autoclave was sealed and heated at 160 ℃ for 12 h, and then cooled down to room temperature. A light yellow precipitate was washed with absolute ethanol and deionized water for several times. Finally, the obtained product was dried in a vacuum oven at 60 ℃.

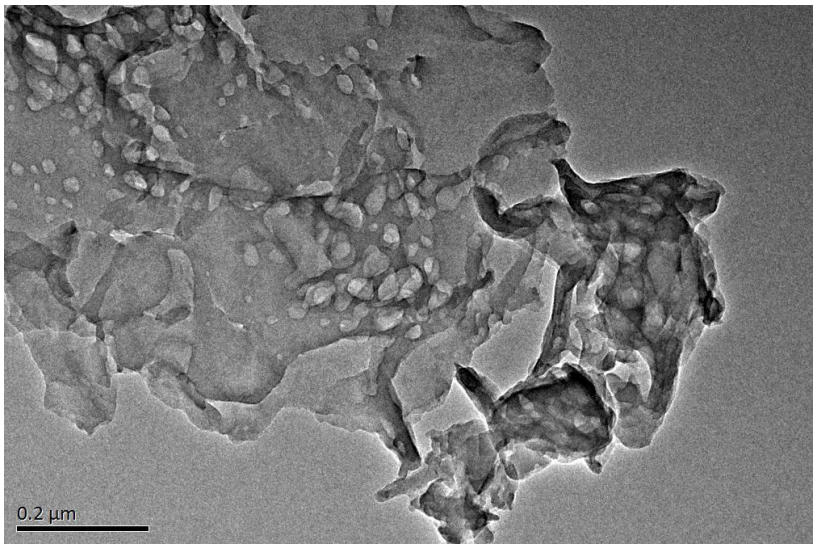

Figure S9. TEM image of g-C_3N_4.

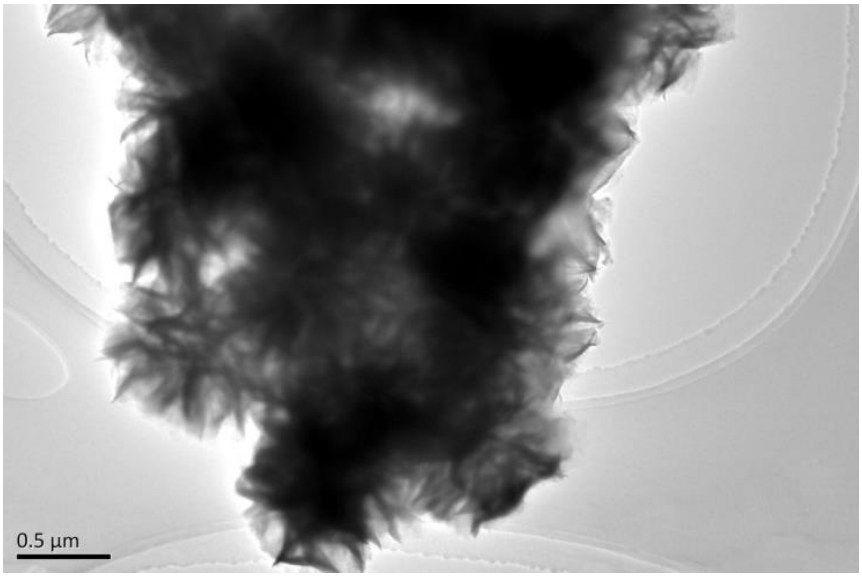

Figure S10. TEM image of $Zn_3In_2S_6$.

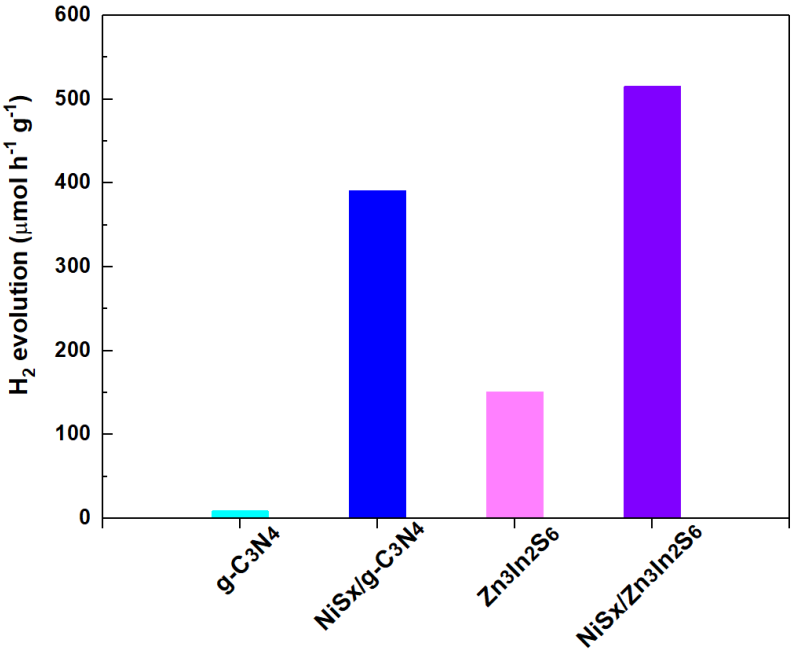

Figure S11. H_2 evolution rates of different samples.

Reaction conditions for g-C_3N_4 and 1.5% NiS_x/g-C_3N_4: 0.1 g photocatalyst, 110 mL of aqueous solution of triethanolamine (10 mL), 300 W Xe-lamp with 365 nm cutoff filter. Reaction conditions for $Zn_3In_2S_6$ and 1.5% NiS_x/$Zn_3In_2S_6$: 0.1 g photocatalyst, 110 mL of aqueous solution of lactic acid (1.22 M), 300 W Xe-lamp with 400 nm cutoff filter.

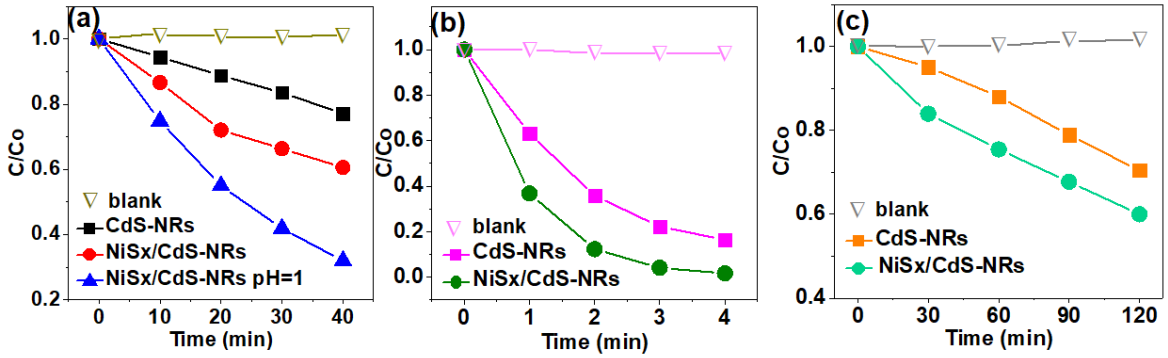

Figure S12. Concentration changes of Cr(VI), RhB and BPA as the function of the irradiation time by CdS-NRs and 1.5% NiS_x/CdS-NRs (blank presents the reaction system without photocatalyst).

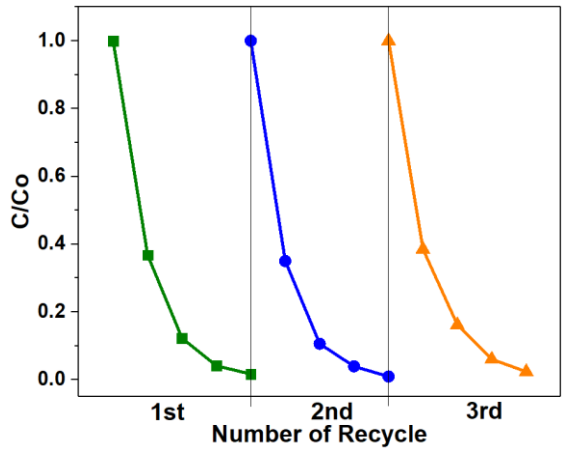

Figure S13. Photocatalytic degradation of RhB over the 1.5% NiS_x/CdS-NRs photocatalyst during repetition operation under visible light irradiation.

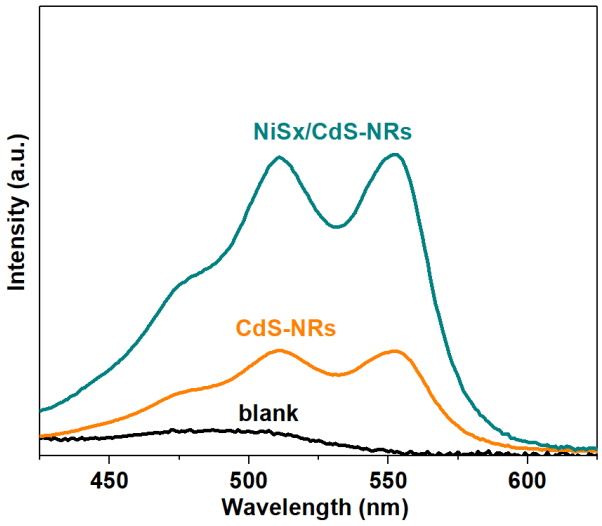

Figure S14. H_2O_2 was detected by addition of N, N-diethyl-p-phenylenediamine and horeradish peroxidase to the deionized water (blank), CdS-NRs and NiS_x/CdS-NRs aqueous solutions after 60 min visible-light irradiation.

References

[1] Z. Qin, Y. Chen, X. Wang, X. Guo and L. Guo, *ACS Appl. Mater. Interfaces*, 2016, **8**, 1264.

[2] Y. Xu, W. Tu, S. Yin, M. Kraft, Q. Zhang and R. Xu, *Dalton Trans.*, 2017, **46**, 10650.