Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Electronic Supplementary Information (ESI)

Direct Z-scheme CdS-NiPc heterojunctions as noble metal-free photocatalysts for enhanced photocatalytic hydrogen evolution

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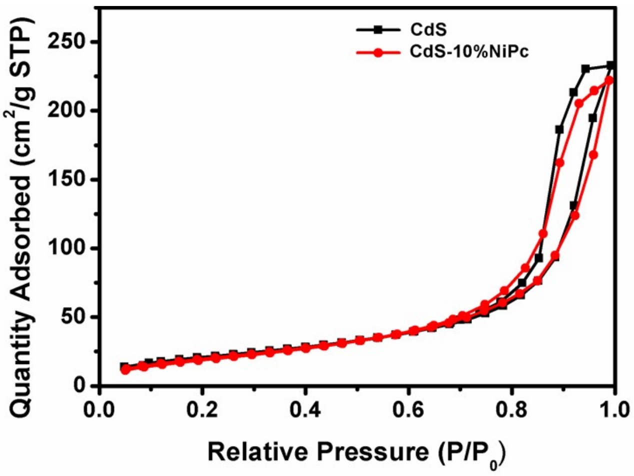

Fig. S1 N_2 adsorption-desorption isotherms of pure CdS and CdS-10%NiPc

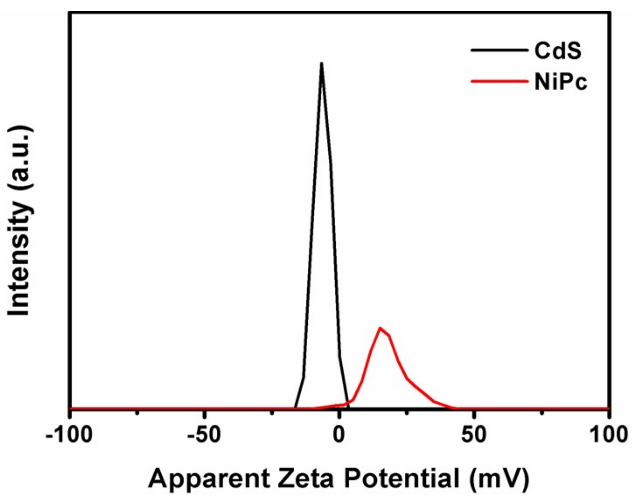

Fig. S2 Zeta potentials of CdS and NiPc in pure water

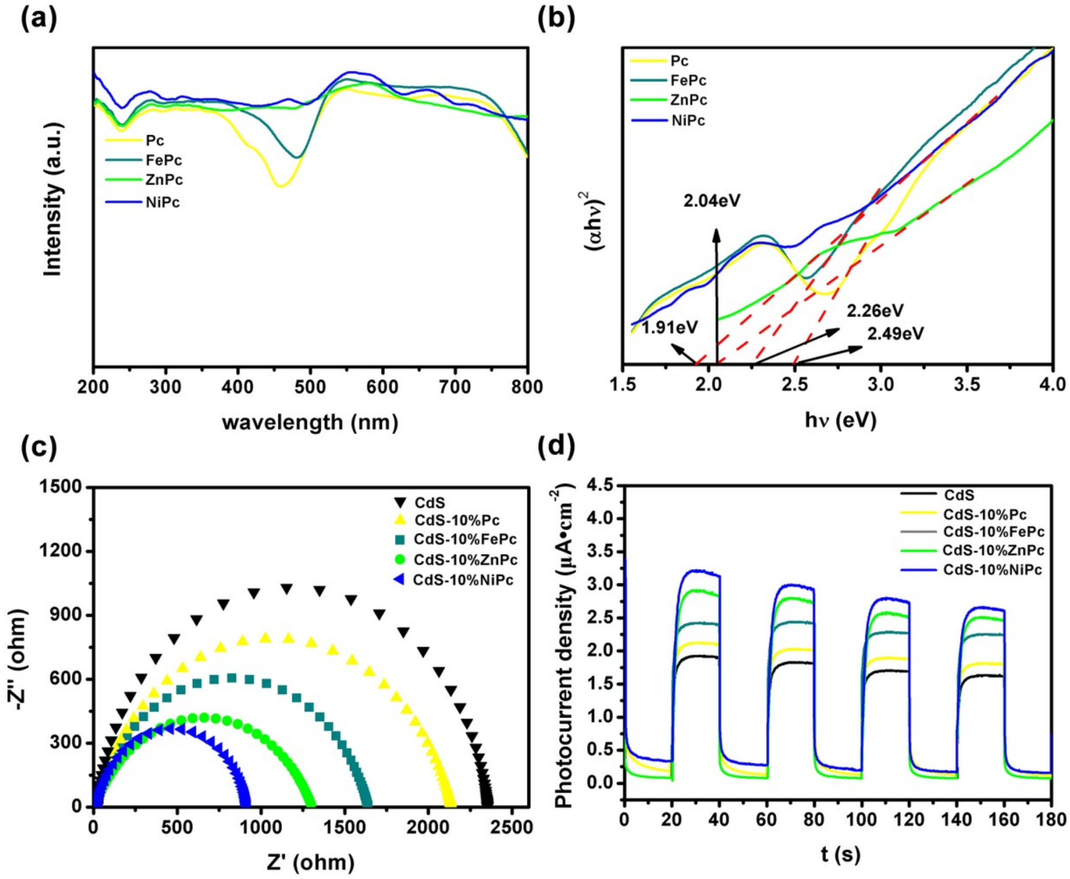

Fig. S3. (a) UV–vis absorption spectra and (b) tauc-plots of the UV–vis spectra of Pc, FePc, ZnPc and NiPc; (c) EIS spectra and (d) transient photocurrent response of CdS, CdS-10%Pc, CdS-10%FePc, CdS-10%ZnPc and CdS-10%NiPc

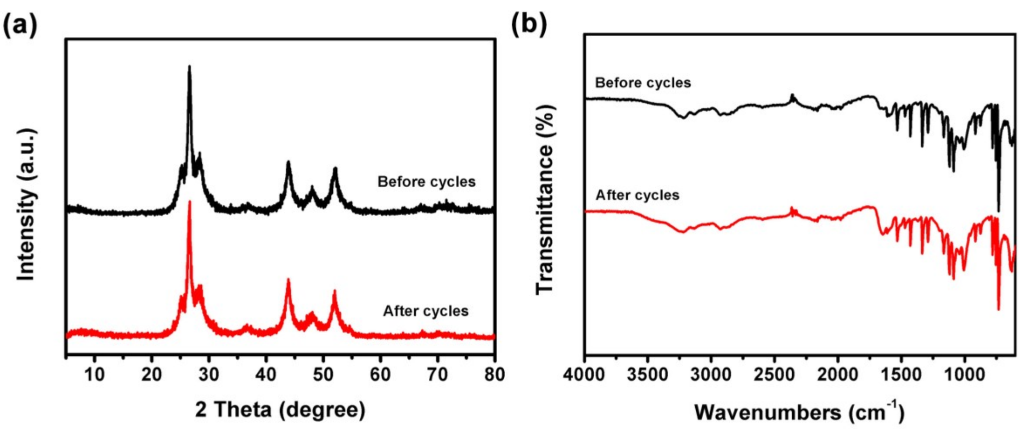

Fig. S4. (a) XRD patterns of CdS-10%NiPc before and after five cycles; (b) FT-IR spectra of CdS-NiPc composites before and after five cycles

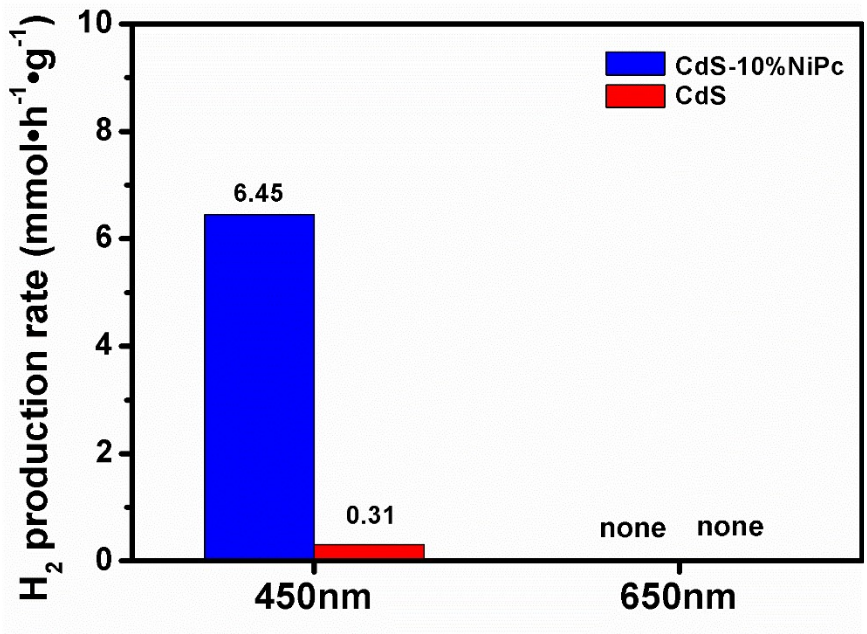

Fig. S5. Photocatalytic H_2 generation rates for CdS-10%NiPc and CdS under 450 nm and 650 nm wavelength illumination.

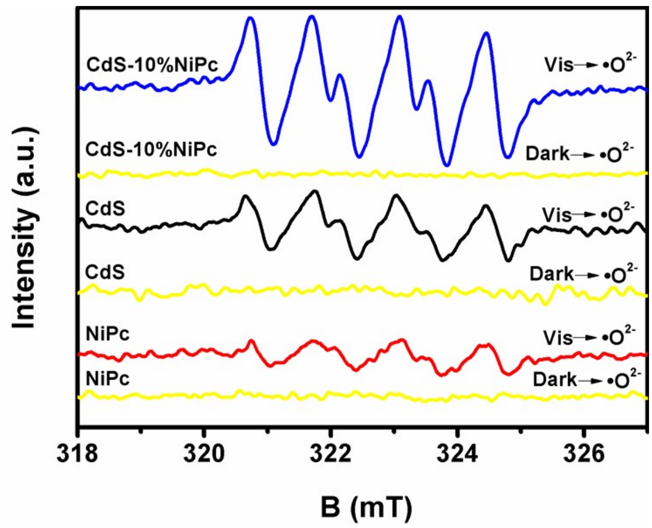

Fig. S6 DMPO spin-trapping ESR spectra of CdS, NiPc, and CdS-10%NiPc composite

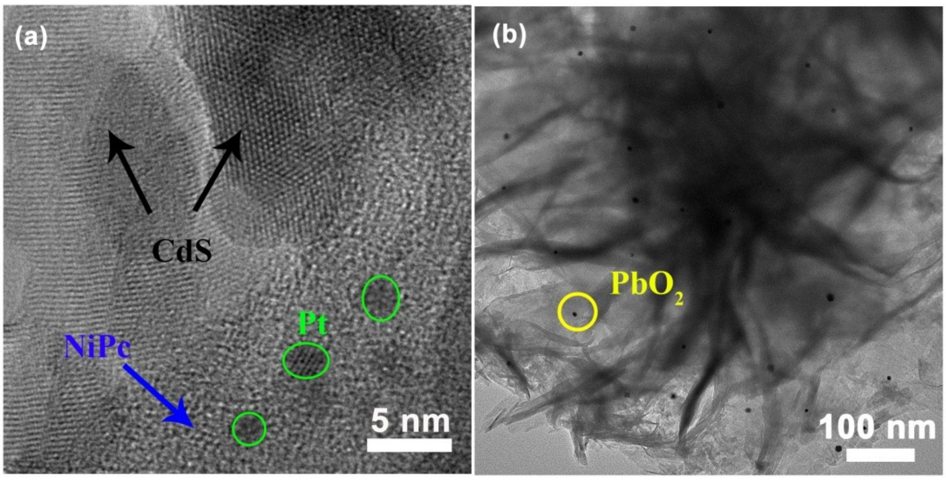

Fig. S7 TEM images of photodeposition of (b) Pt and (b) PbO_2 nanoparticles on the CdS-10%NiPc composite

Table S1 Comparisons of the H_2 evolution rate and AEQ over the CdS-NiPc composite with different contents of NiPc

Photocatalyst	Light source	Activity (mmol g^{-1} h^{-1})	AQE (%) (450 nm)	Ref.
CdS-10%NiPc	300 W Xe-lamp, λ≥ 420 nm	17.74	4.86	This work
CdS	300 W Xe-lamp, λ≥ 420 nm	0.93	0.26	This work
CdS-1%NiPc	300 W Xe-lamp, λ≥ 420 nm	4.65	1.27	This work
CdS-5%NiPc	300 W Xe-lamp, λ≥ 420 nm	8.78	2.4	This work
CdS-8%NiPc	300 W Xe-lamp, λ≥ 420 nm	11.29	3.09	This work
CdS-12%NiPc	300 W Xe-lamp, λ≥ 420 nm	14.57	3.99	This work
CdS-15%NiPc	300 W Xe-lamp, λ≥ 420 nm	13.24	3.63	This work

Table S2 Comparisons of the H_2 evolution rate and AEQ over the CdS-10%NiPc and other materials

Photocatalyst	Light source	Activity (mmol g^{-1} h^{-1})	AQE (%)	Ref.
CdS-10%NiPc	300 W Xe-lamp, λ≥ 420 nm	17.74	4.86 (λ=450nm)	This work
RGO/SiPc/Pt	150 W Xe-lamp	~4.5	0.56 (λ=420 nm)	[1]
MnPcG/Pt	150 W Xe-lamp λ > 400 nm	8.46	1.9 (λ=420 nm)	[2]
CdS/CTF-1	300 W Xe-lamp, λ≥ 420 nm	11.43	11.1 (λ=420 nm)	[3]
CdS/g-C_3N_4	300 W Xe-lamp, λ⩾ 420 nm	4.15	4.3 (λ=420 nm)	[4]
CdS/ZnO	500W Xe lamp (λ⩾ 400 nm)	0.85	3 (λ=420 nm)	[5]
MoS_2/TpPa-1-COF	300 W Xe-lamp, λ⩾ 420 nm	5.59	0.76 (λ=420 nm)	[6]
g-C_3N_4/MoS_2	300 W Xe-lamp, λ⩾ 420 nm	1.03	2.1 (λ=420 nm)	[7]

Table S3 The fluorescence lifetimes and electron transfer rate constants (k_{ET}) of CdS-NiPc composites with different contents of NiPc

Sample	Average fluorescence lifetimes (ns)	Transfer rate constants k_{ET} (s^{-1})
CdS	3.18	/
CdS-1%NiPc	3.07	1.1×10^7
CdS-5%NiPc	2.98	2.1×10^7
CdS-8%NiPc	2.91	2.9×10^7
CdS-10%NiPc	2.75	4.9×10^7
CdS-12%NiPc	2.81	4.1×10^7
CdS-15%NiPc	2.84	3.7×10^7

References:

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