Electronic Supplementary Information for

Triggering inert desert sand toward a low-cost and efficient cocatalyst for photocatalytic hydrogen evolution reactions

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Table S1 Desert sand sampling sites in various regions of Ningxia

Entry	Sampling point	Sample name	Altitude (m)	Fe content (wt.%)
1	Ulan Buh Desert (39°41.879N; 106°41.459E)	UBD	1065	1.43
2	Yueliang Lake (38°30.563N; 105°19.694E)	YLL	1282	1.52
3	Shapotou Tourist Attraction (37°26.641N; 105°57.250E)	STA	1394	1.53
4	Pingluo Yaofu Town (38°44.334N; 106°30.22E)	PYF	1091	1.87
5	Shanghai Miao Town (38°20.955N; 106°35.076E)	SHM	1229	1.88
6	Dawukou Binhe Avenue (38°46.216N; 106°36.407E)	DBA	1091	1.99
7	Ningxia Technical College of Wine and Desertification Prevention (38°19.260N; 106°09.460E)	NTCWDP	1113	2.23
8	Shahu Nature Reserve (38°49.942N; 106°22.518E)	SHR	1091	2.36

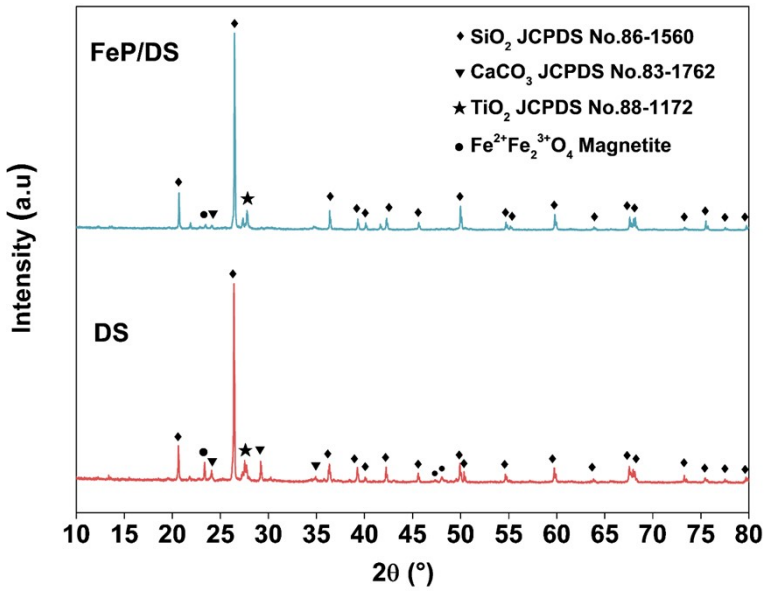

Fig. S1 XRD patterns of DS and FeP/DS.

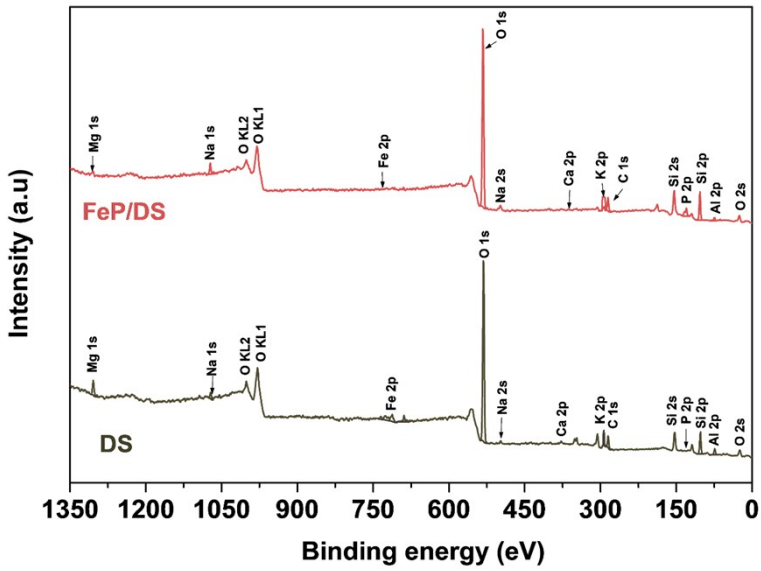

Fig. S2 XPS survey spectra of DS and FeP/DS.

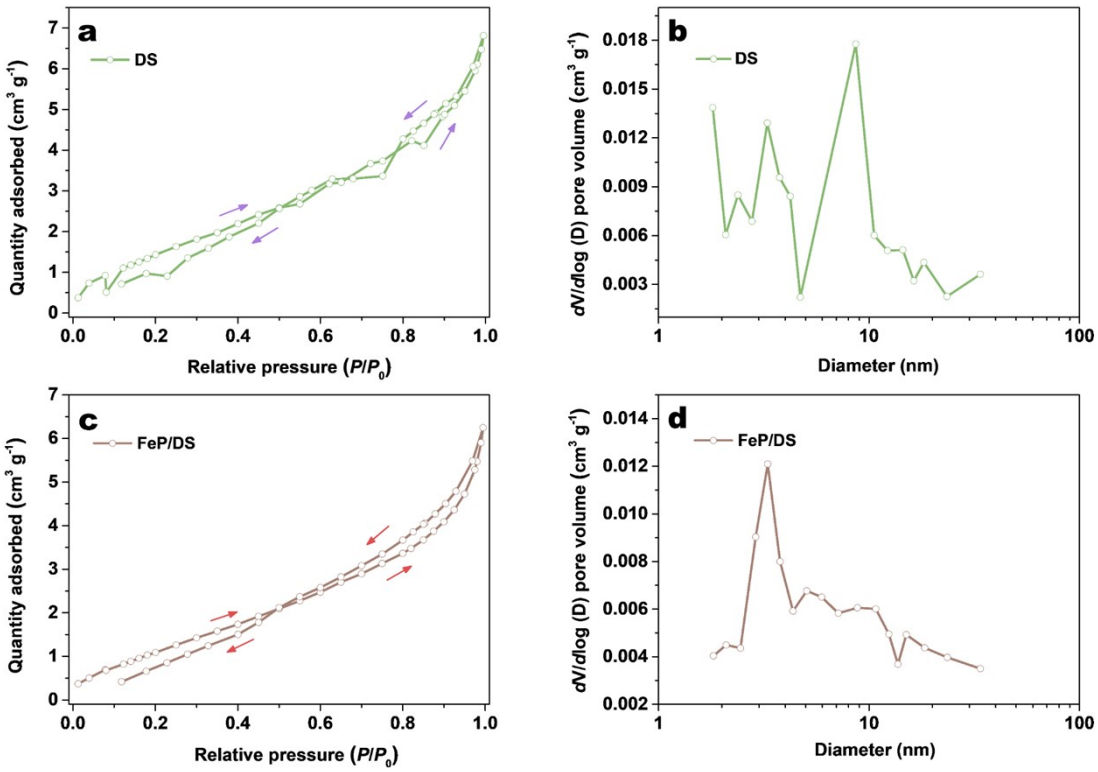

Fig. S3 (a) N_2 adsorption-desorption isotherms and (b) the corresponding pore size distribution curves of DS. (c) N_2 adsorption-desorption isotherms and (d) the corresponding pore size distribution curves of FeP/DS.

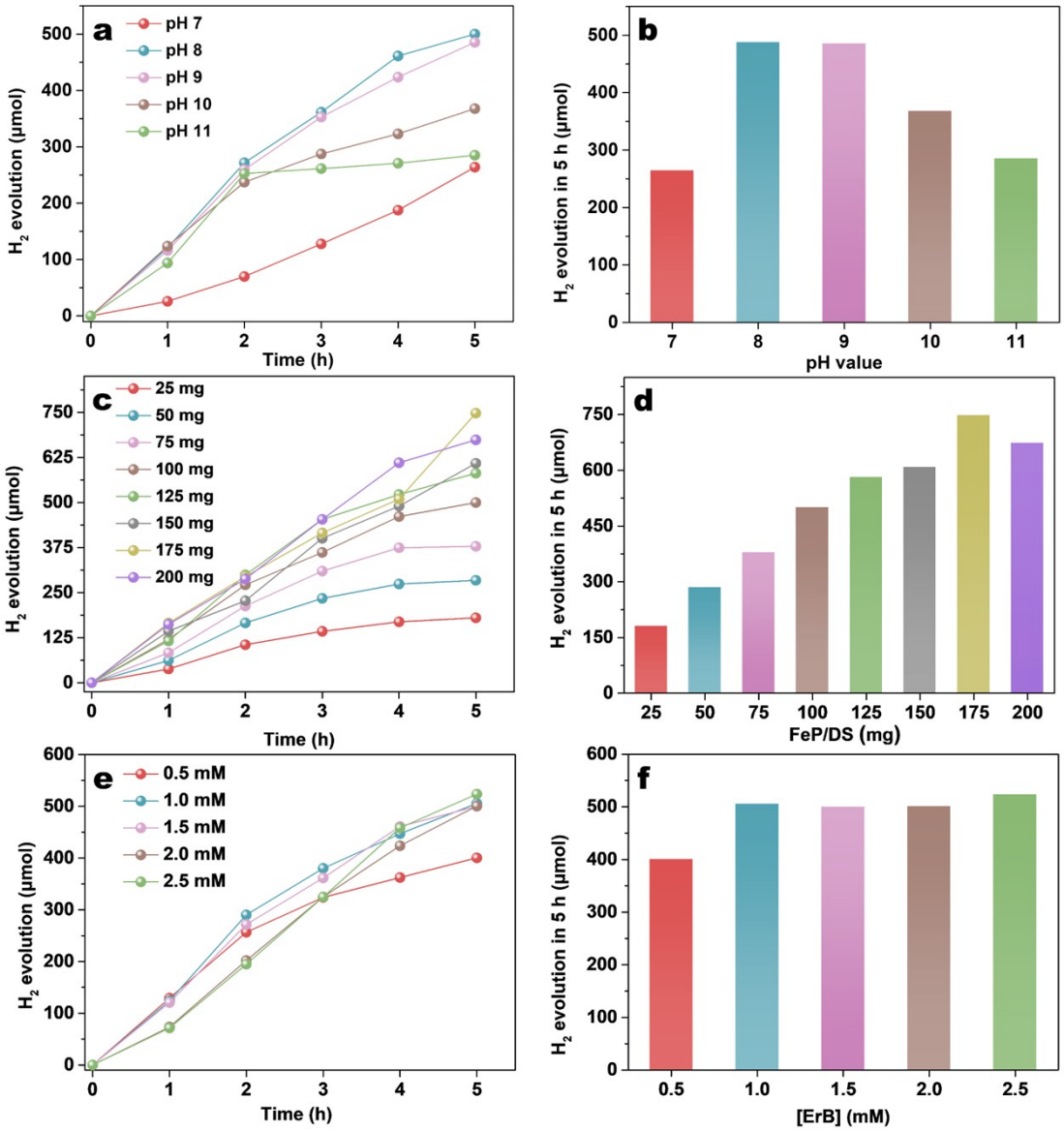

Fig. S4 Photocatalytic H_2 evolution catalyzed by FeP/DS from ErB-TEOA system as a function of (a, b) pH value of TEOA solution, (c, d) FeP/DS concentration, and (e, f) ErB concentration. Reaction conditions: light source, white LED lamp, 380 nm≤λ≤780 nm; TEOA solution, 25 mL, 10 vol%.

Table S2 Comparison of the photocatalytic HER activity of FeP/DS cocatalyst in the dye-sensitized systems and when combined with CdS with previously reported Fe-P-based cocatalysts

Entry	Catalysts	Photosensitizer	H_2 evolution rate ($\mu mol \cdot g^{-1} \cdot h^{-1}$)	Light sources	Sacrificial agents	Ref.
1	$NiTiO_3$/Fe_2P	EY	5980	5-W white LED lamp	TEOA	1
2	MSI Pt-Fe_2P	EY	6000	300-W Xe lamp ($\lambda \geq 420$ nm)	TEOA	2
3	Fe_2P/CGS	ErB	810	10-Wwhite LED lamp (380 nm$\leq\lambda\leq$780 nm)	TEOA	3
4	Fe_2P/ATP	ErB	966	10-W white LED lamp (380 nm$\leq\lambda\leq$780 nm)	TEOA	4
5	CDs/FeP	No	33.85	100-W LED lamp (420 nm$\leq\lambda\leq$700 nm)	Ultrapure water	5
6	Cu_2O/Fe_2P/Ni_3P	No	108.68	300-W Xe lamp	MeOH	6
7	FeP/TiO_2	No	190	200W He (Xe) lamp	MeOH	7
8	Fe_2P/g-C_3N_4	No	214	300-W Xe lamp ($\lambda \geq 420$ nm)	TEOA	8
9	Fe_2P–Co_2P/g-C_3N_4	No	347	300-W Xe lamp (λ=420 nm)	TEOA	9
10	PCN/Fe_2P/RP	No	429	300-W Xe lamp ($\lambda \geq 420$ nm)	Ultrapure water	10
11	GO/Fe_2P/In_2S_3	No	485.92	10-W white LED lamp (400 nm$\leq\lambda\leq$700 nm)	ascorbic acid aqueous solution	11
12	PMCSFP	No	2937.11	300-W Xe lamp ($\lambda \geq 420$ nm)	Lactic acid	12
13	FeP/DS	ErB	999.94	10-W white LED lamp (380 nm$\leq\lambda\leq$780 nm)	TEOA	**This work**
14	CdS-FeP/DS	No	2704.8	300-W Xe lamp ($\lambda \geq 420$ nm)	Lactic acid	**This work**

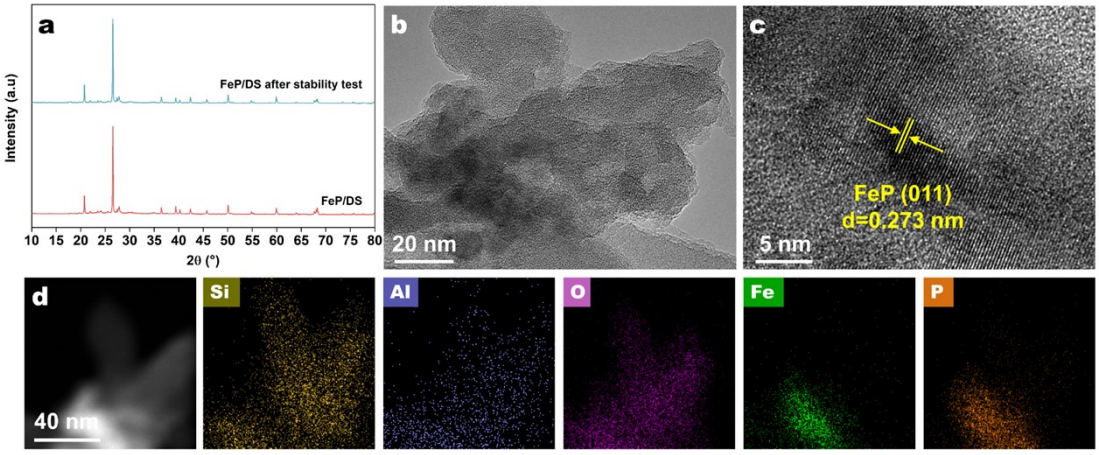

Fig. S5 (a) XRD patterns of FeP/DS before and after stability test. (b) TEM, (c) HRTEM, (d) HAADF-STEM, and the corresponding EDX mapping images of FeP/DS after stability test.

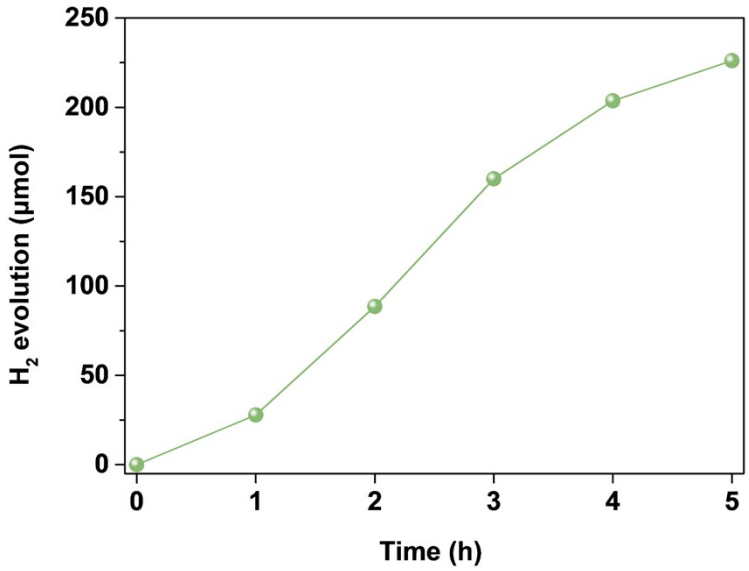

Fig. S6 The HER activity of activated FeP/DS. Reaction conditions: light source, white LED lamp, 380 nm≤λ≤780 nm; dye concentration: 1.5 mM; catalyst dosage: 100 mg; TEOA solution, 25 mL, 10 vol%, pH 8.

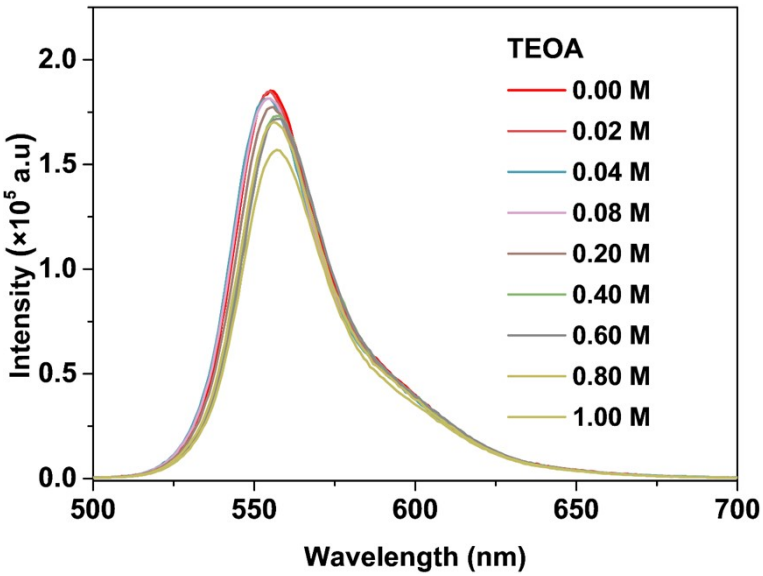

Fig. S7 PL emission quenching of ErB solution (10 mM) with TEOA.

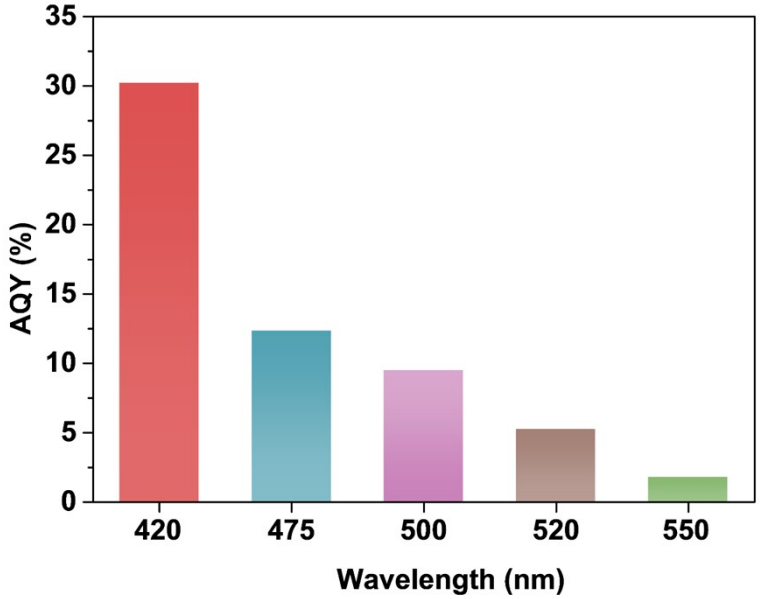

Fig. S8 AQY of H_2 evolution over CdS-FeP/DS as a function of wavelength of incident light. Reaction conditions: CdS: 100 mg; FeP/DS: 10 mg; LA solution: 100 mL, 10 vol%.

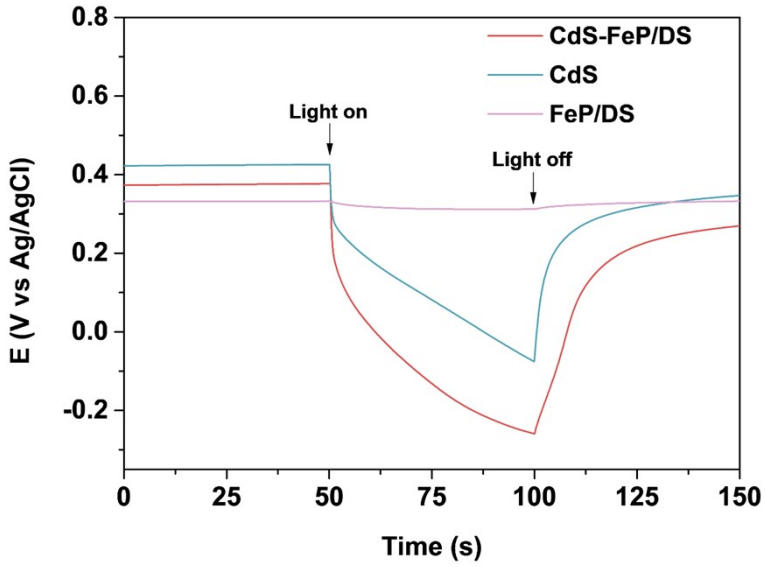

Fig. S9 Transient open-circuit voltage curves of CdS-FeP/DS, CdS, and FeP/DS.

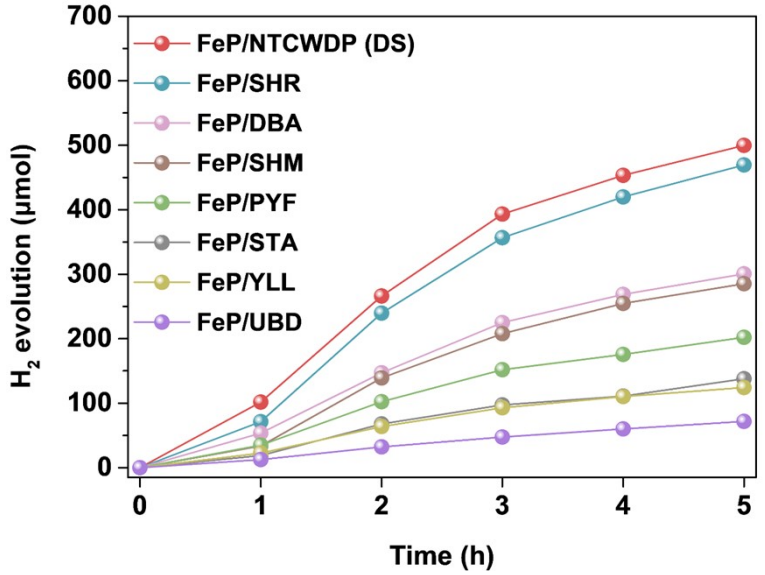

Fig. S10 Time courses of H_2 evolution catalyzed by supported cocatalysts derived from different DS samples. Reaction conditions: light source: white LED lamp, 380 nm ≤λ≤780 nm; [ErB]: 1.5 mM; cocatalyst dosage: 100 mg; TEOA solution: 25 mL, 10 vol%, pH 8.

Supplementary references

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