Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Electronic Supplementary Information

Construction of strongly coupled 2D-2D SnS_2/CdS S-Scheme heterostructures for photocatalytic hydrogen evolution

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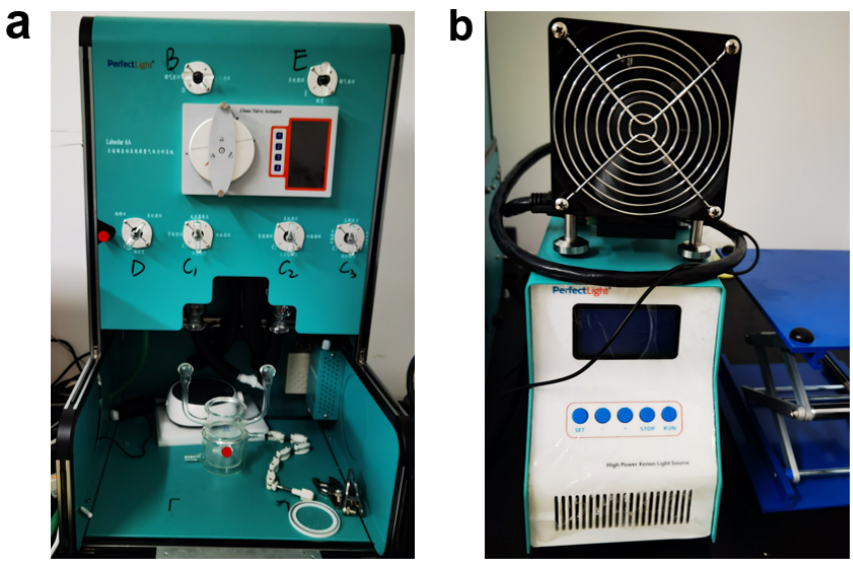

Fig. S1. (a) PerfectLight Labsolar 6A and (b) PerfectLight PLS-SXE300/300UV.

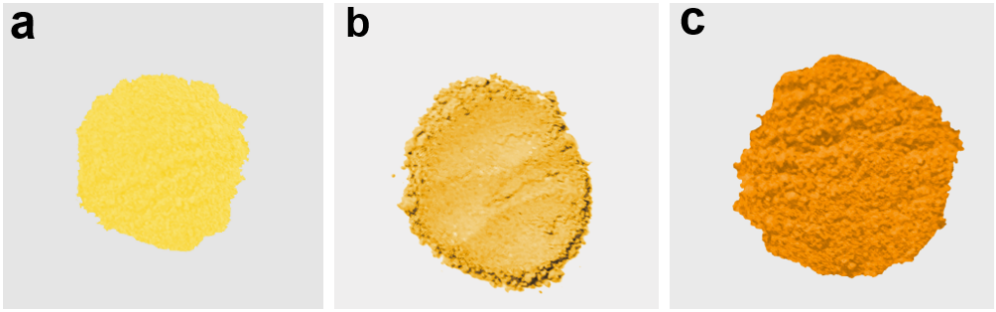

Fig. S2. Optical photos of (a) CdS nanosheets, (b) 2D-2D SnS_2/CdS heterostructures and (C) SnS_2 nanosheets.

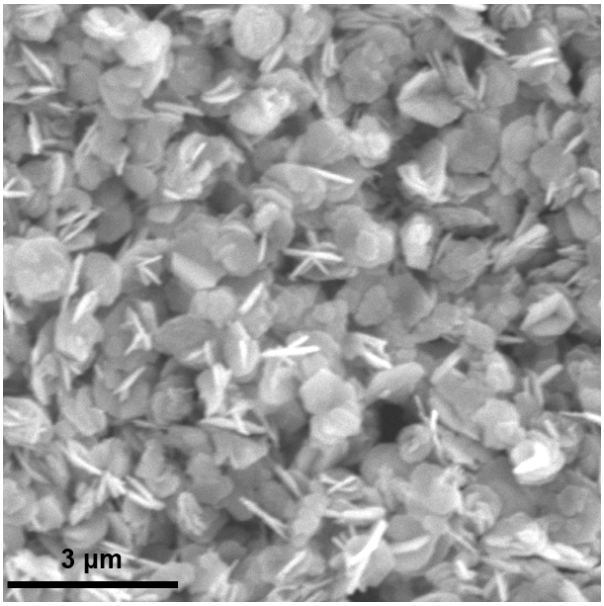

Fig. S3. SEM image of pure SnS_2 nanosheets.

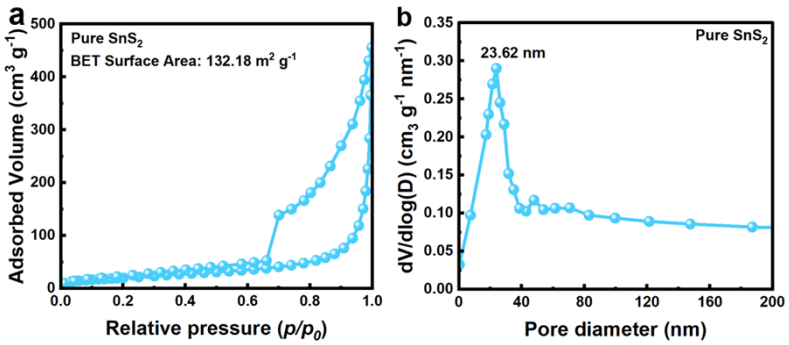

Fig. S4. Nitrogen sorption isotherms and the corresponding Barrett-Joyner-Halenda (BJH) pore size distribution plots of pure SnS_2 nanosheets.

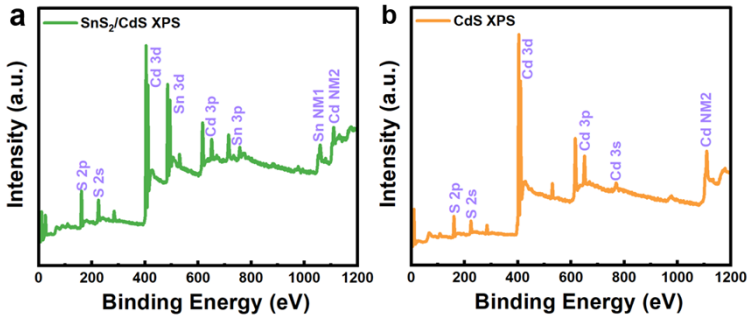

Fig. S5. XPS survey spectra of SnS_2/CdS and pure CdS.

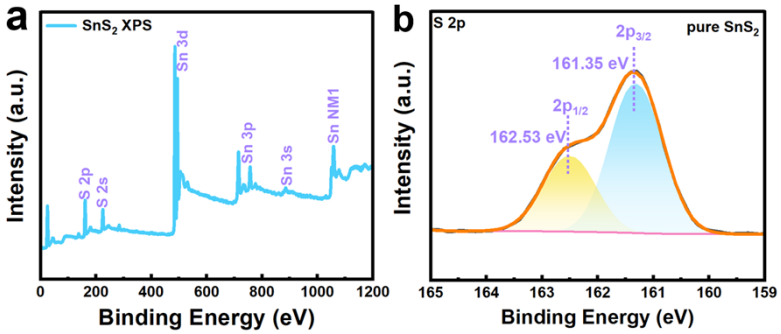

Fig. S6. XPS survey spectra and S 2p XPS peaks of pure SnS_2 nanosheets.

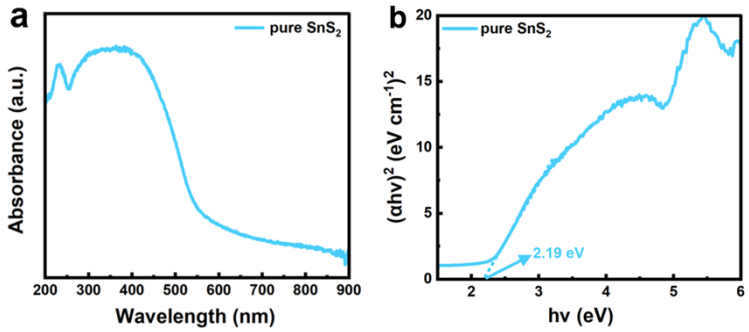

Fig. S7. (a) UV-vis absorption spectrum and (b) optical band gap of pure SnS_2.

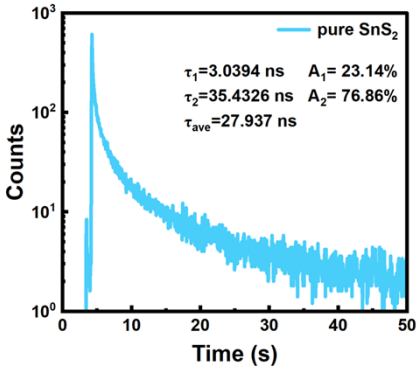

Fig. S8. Time-resolved transient photoluminescence decay spectra of the pure SnS_2 nanosheets.

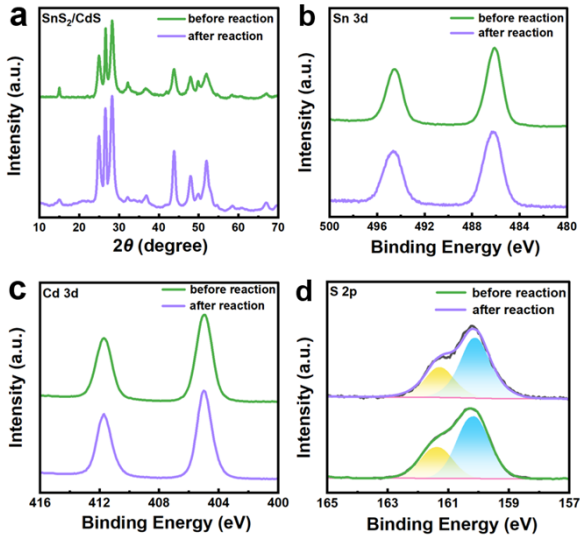

Fig. S9. (a) XRD pattern, (b) Sn 3d XPS peaks, (c) Cd 3d XPS peaks, and (d) S 2p XPS peaks of SnS_2/CdS heterostructures before and after reaction.

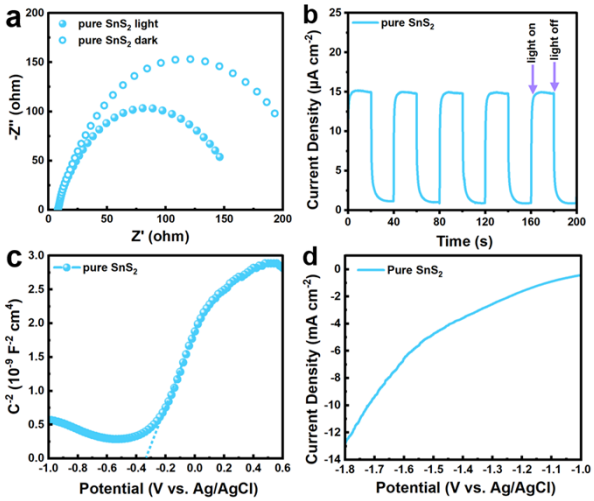

Fig. S10. (a) EIS Nyquist plots, (b) chronoamperometry curves, (c) Mott-Schottky plots, (d) linear sweep voltammogram curves of pure SnS_2 nanosheets.

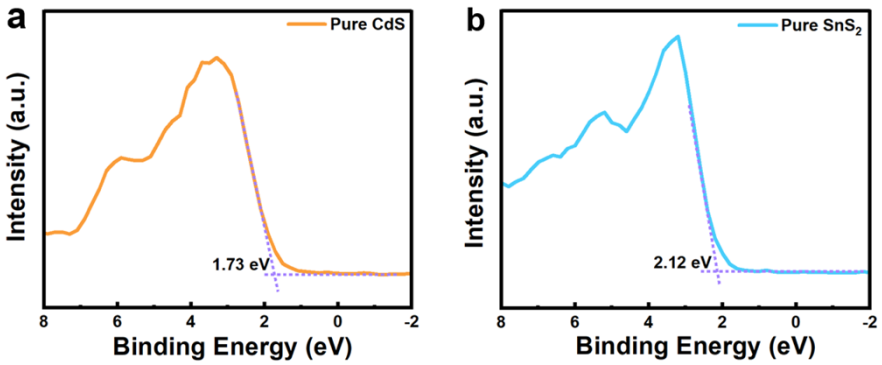

Fig. S11. XPS valance of (a) pure CdS and (b)pure SnS_2.

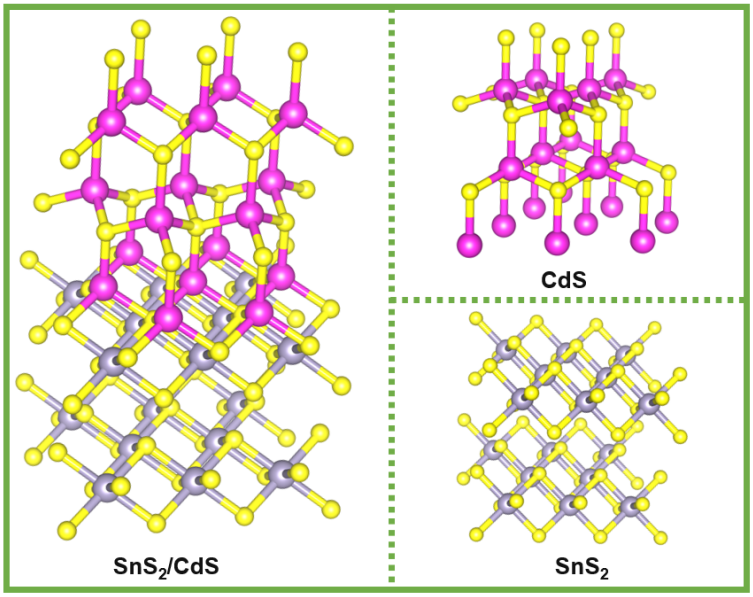

Fig. S12. models of CdS (002), SnS_2 (100), and SnS_2/CdS heterostructures.

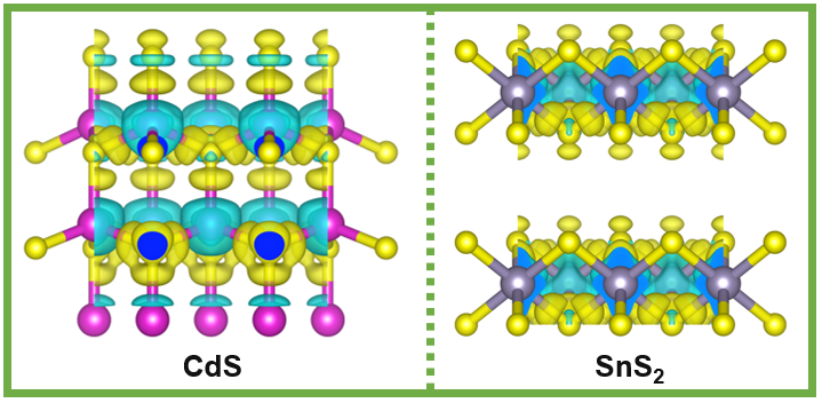

Fig. S13. charge density difference diagram of CdS (002), SnS_2 (100), and SnS_2/CdS heterostructures.

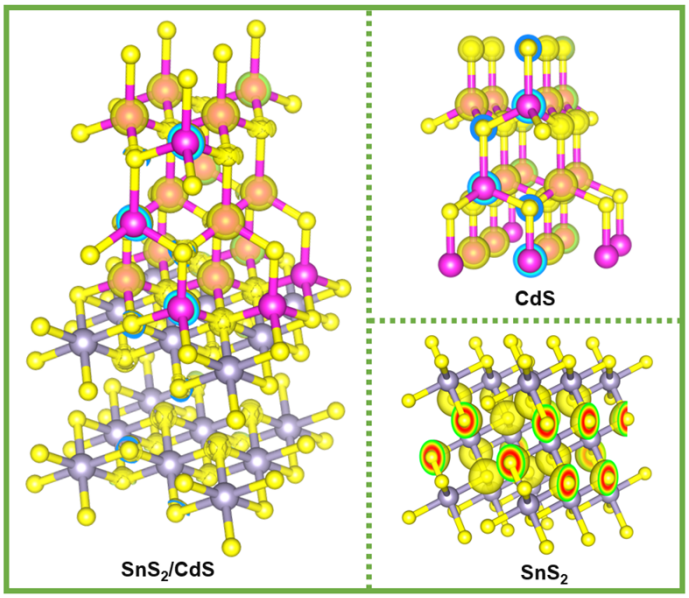

Fig. S14. charge density diagram of CdS (002), SnS_2 (100), and SnS_2/CdS heterostructures.

Table S1. Time-resolved PL decay curve parameters obtained by double-exponential function simulation.

samples	τ_1 (ns)	τ_2 (ns)	A_1(%)	A_2 (%)	τ_{ave}(ns)
CdS	0.8202	3.8416	67.53	32.47	1.80
SnS_2/CdS	1.3303	3.7453	67.17	32.83	2.12
SnS_2	3.0394	35.4326	23.14	76.86	27.94

Table S2. Photocatalytic hydrogen production performance (AQE) of photocatalysts reported in literatures.

Photocatalysts	AQE (420 nm)	Noble metal	Sacrificial agent	Ref.
CdS/RGO	22.5%	0.5 wt% Pt	10 wt% lactic acid solution	1
CdS/ZnS	9.3%	none	0.5 M Na_2S and 0.5 M Na_2SO_3	2
MoS_2/CdS	14.7%	none	10 wt% lactic acid solution	3
CdS/TiO_2	11.9%	0.5 wt% Pt	0.35 M Na_2S and 0.25 M Na_2SO_3	4
FeP/CdS	11.2%	none	10 wt% lactic acid solution	5
CuS/CdS	19.7	none	10 wt% lactic acid solution	6
$PtNi_x$/CdS	51.2%	2 wt% Pt	0.35 M Na_2S and 0.25 M Na_2SO_3	7
CdS/WS_2/graphene	21.2%	none	0.35 M Na_2S and 0.25 M Na_2SO_3	8
Ni_2P/MCdS-DETA	26.4%	none	0.35 M Na_2S and 0.25 M Na_2SO_3	9
CDs/CdS-S	11.8%	none	10 wt% lactic acid solution	10
SnS_2/CdS	**59.3**	**none**	**10 wt% lactic acid solution**	**This work**

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