

Electronic supplementary information

Z-scheme CdS/Co₉S₈-RGO for Photocatalytic Hydrogen Production

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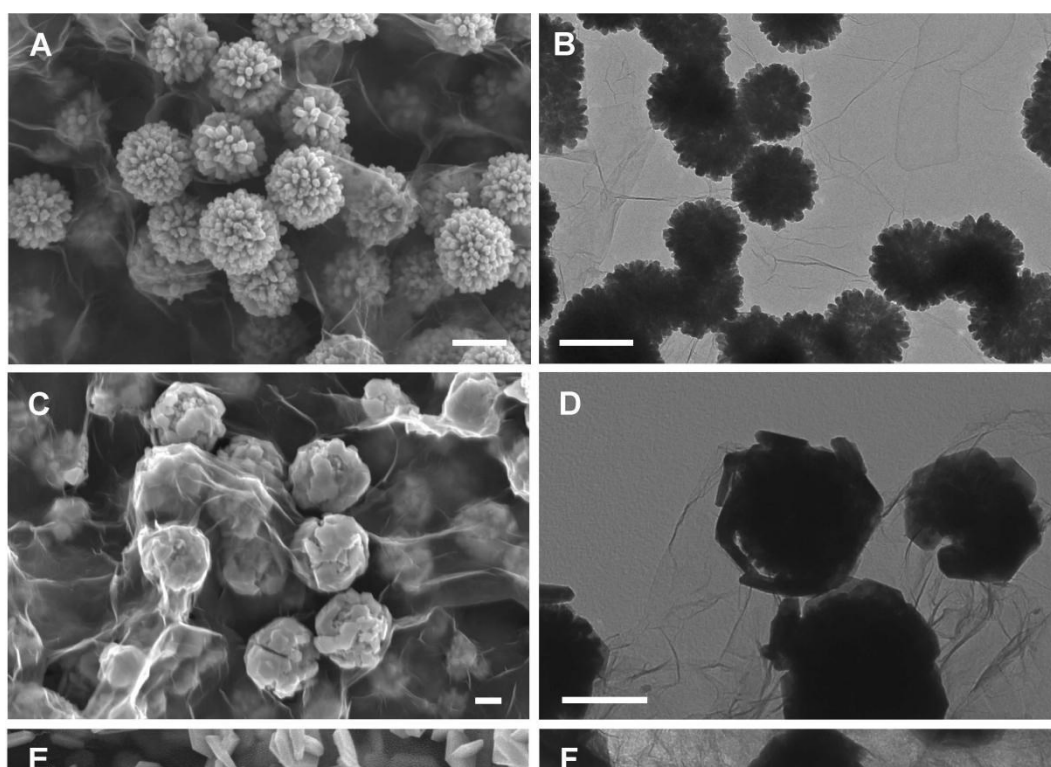


Figure S1. FESEM and TEM images of (A, B) CdS-RGO, (C, D) CdS/CoS-RGO ($M_{\text{Cd:Co}}=5:5$), and (E,F) CoS-RGO. Scale bars: (A,C-F) 200 nm, (B) 250 nm.

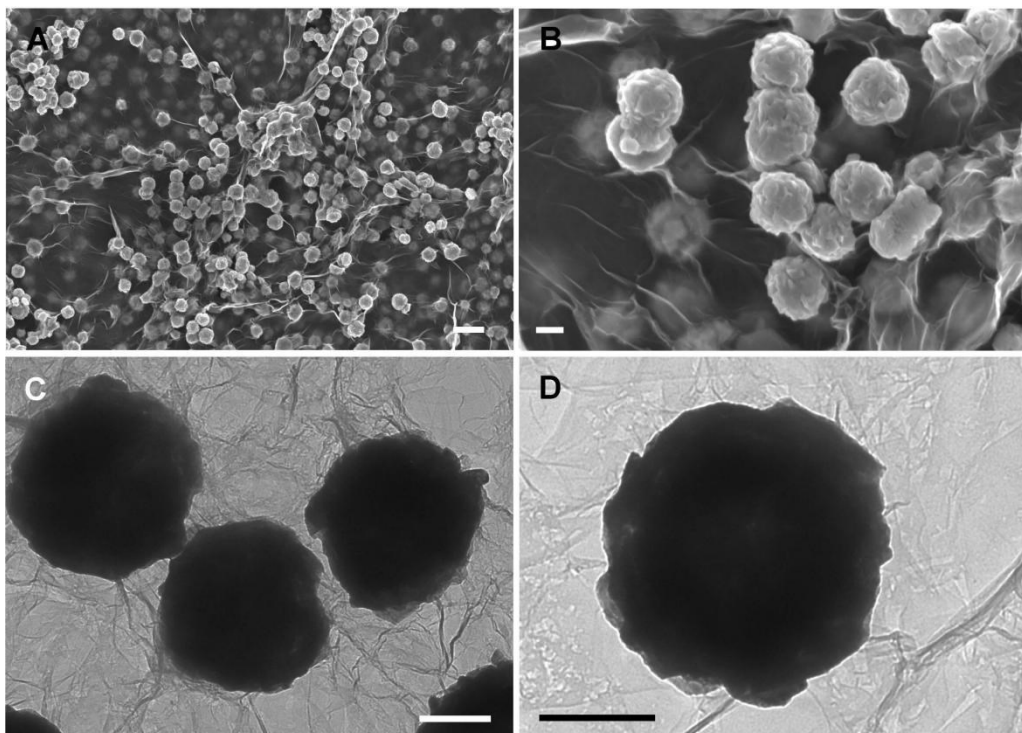


Figure S2. FESEM (A, B) and TEM (C, D) images of CdS/CoS-RGO with $M_{\text{Cd:Co}}=2:8$.
Scale bars: (A) 1 μm , (B-D) 200 nm.

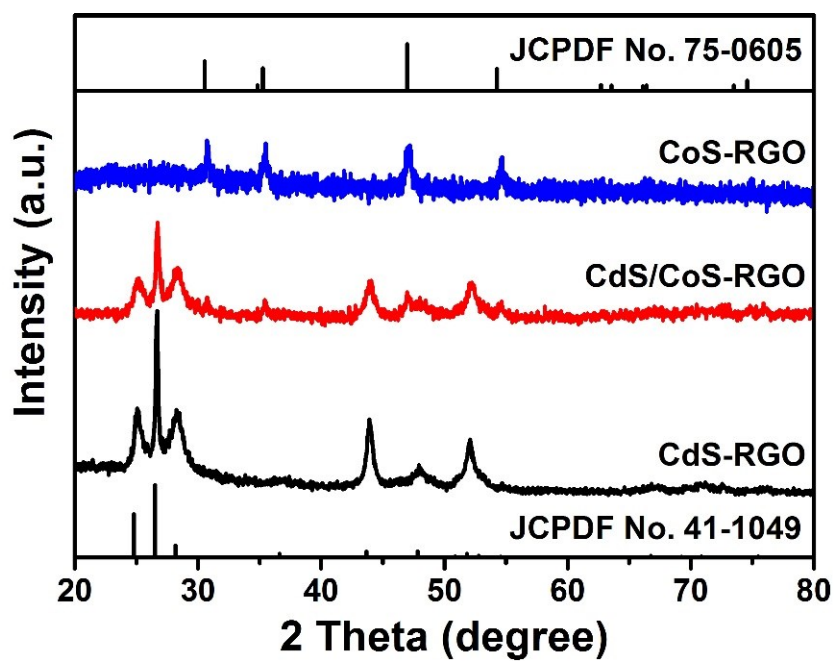


Figure S3. XRD patterns of CdS-RGO, CdS/CoS-RGO, and CoS-RGO.

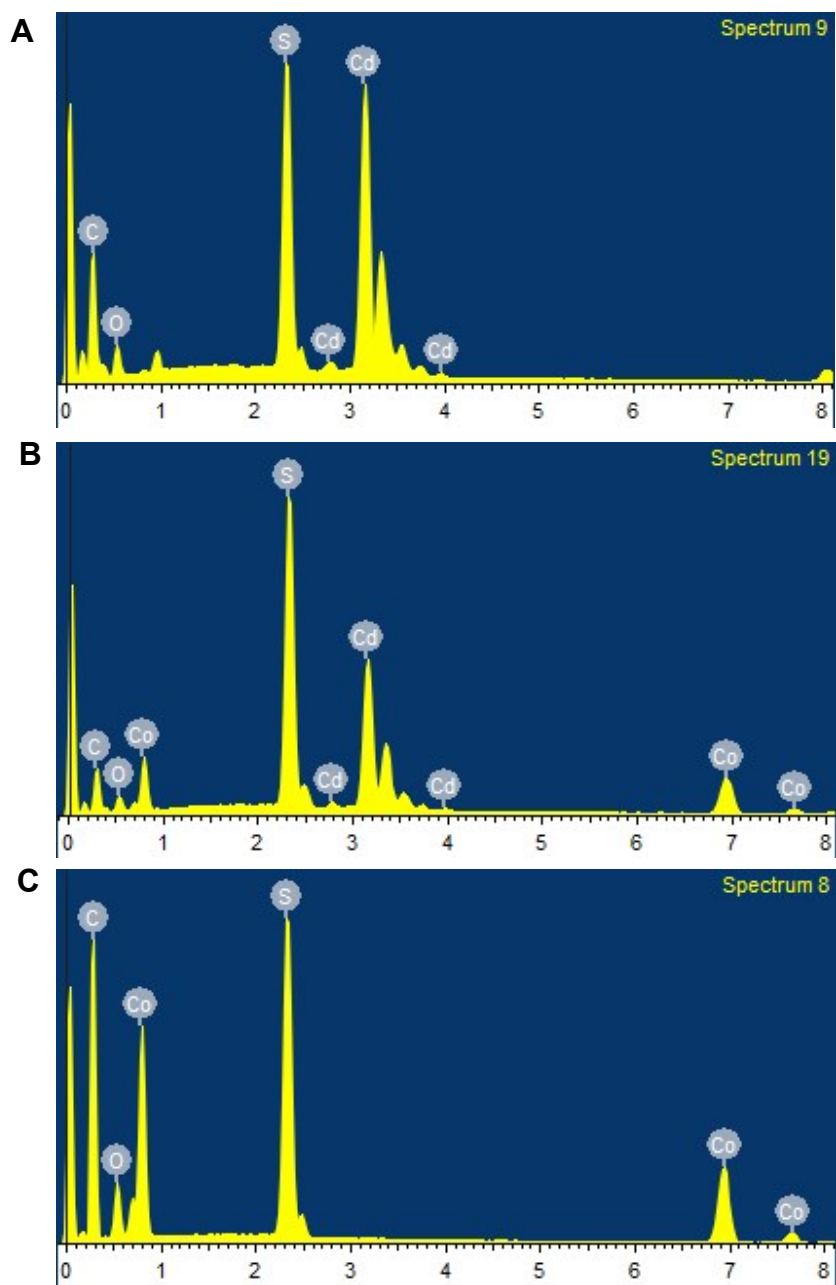


Figure S4. EDX spectra of CdS-RGO (A), CdS/CoS-RGO (B), and CoS-RGO (C).

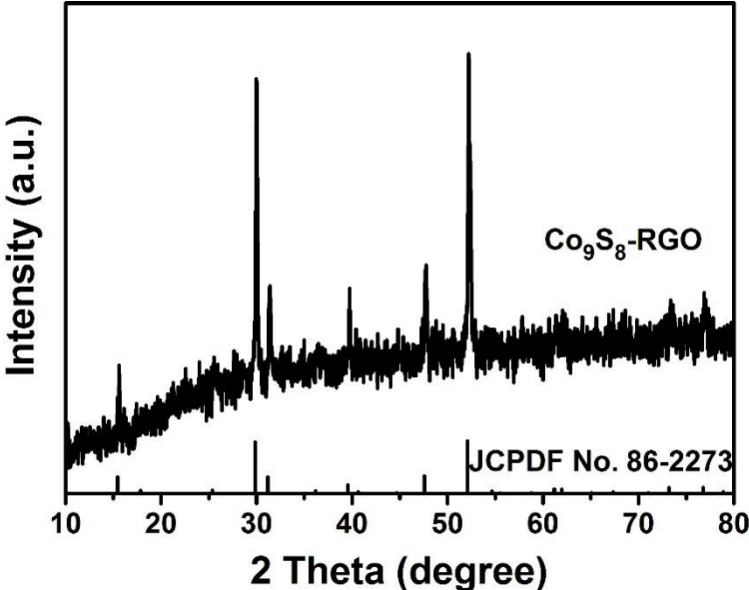


Figure S5. XRD pattern of Co₉S₈-RGO heterostructures.

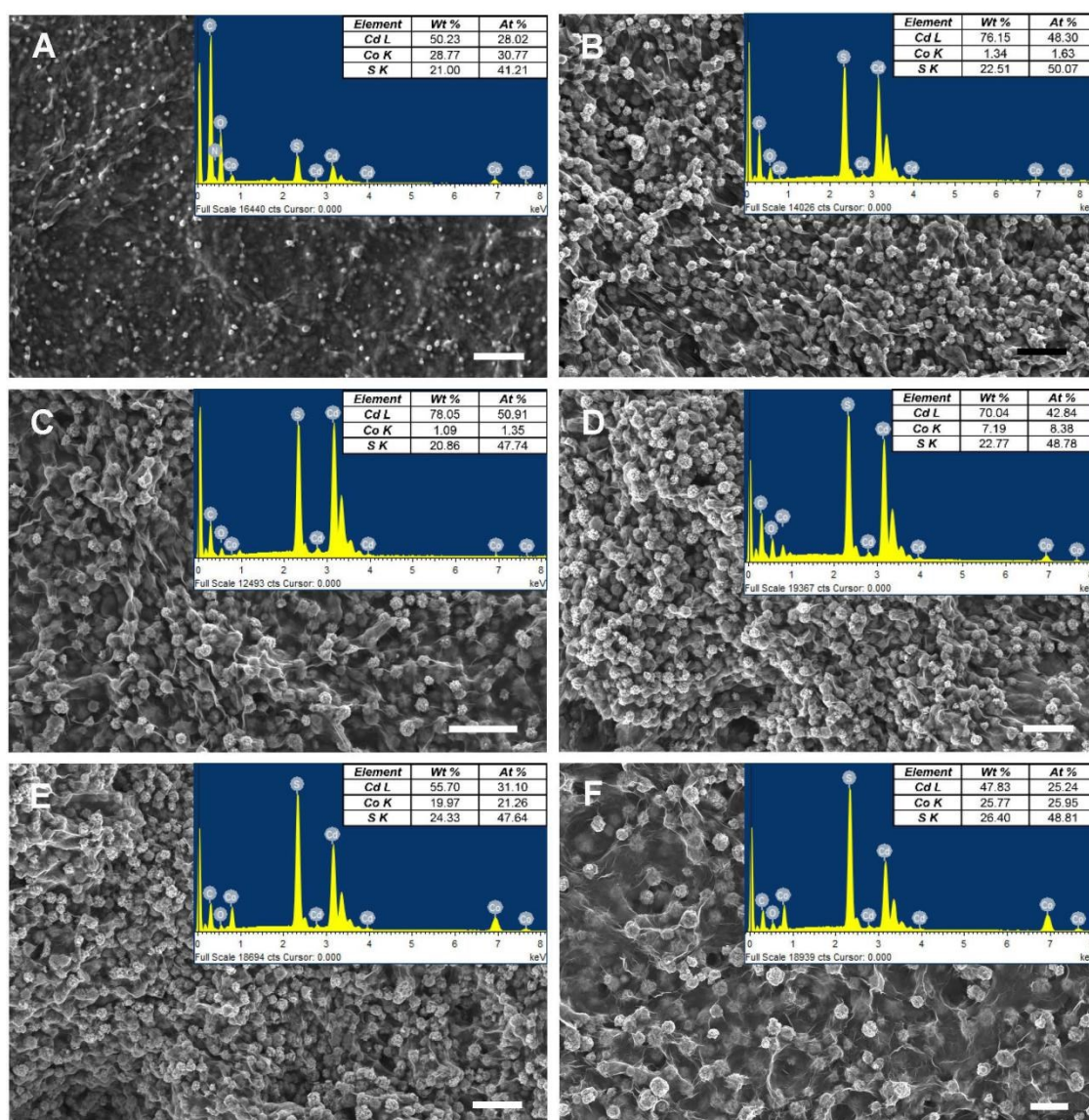


Figure S6. FESEM images and EDX spectra of CdS/CoS-RGO intermediates collected at different reaction stages at 180 °C for (A) 0 h, (B) 0.5 h, (C) 1 h, (D) 2 h, (E) 6 h, (F) 12 h. Scale bars: 1 μm for all.

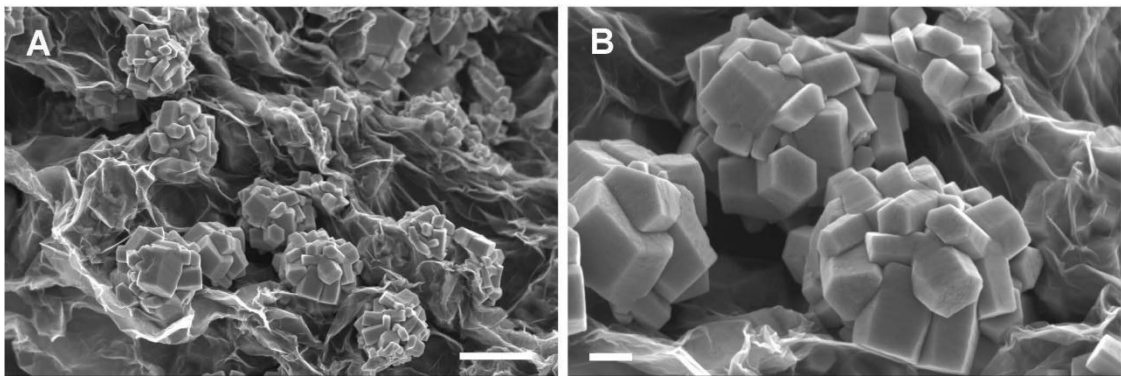


Figure S7. FESEM images of B-CdS-RGO prepared without DETA. Scale bars: (A) 1 μm , (B) 200 nm.

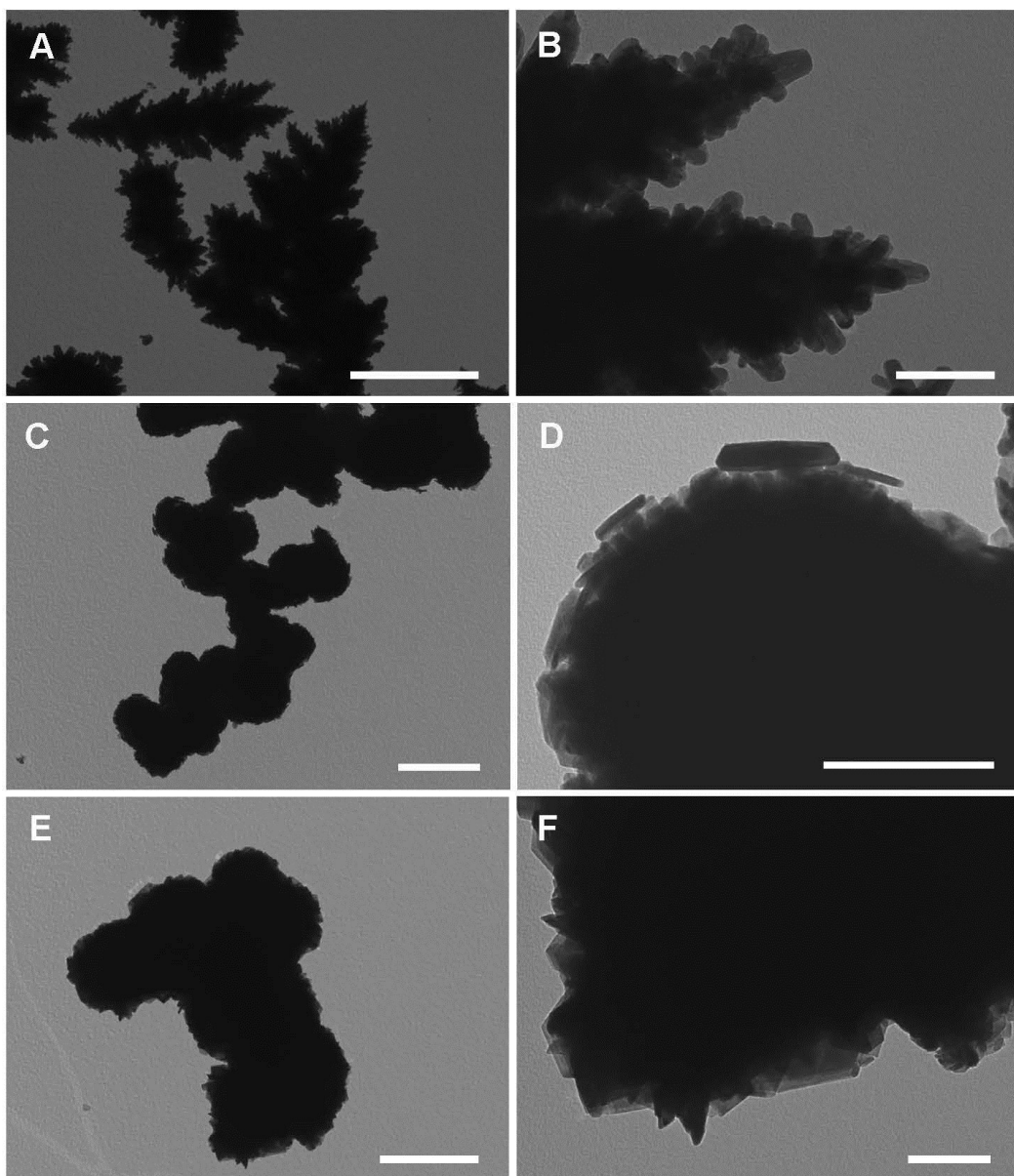


Figure S8. TEM images of (A, B) CdS, (C, D) CdS/CoS, and (E, F) CoS prepared without graphene. Scale bars: (A, C, E) 1 μm , (B, D, F) 200 nm.

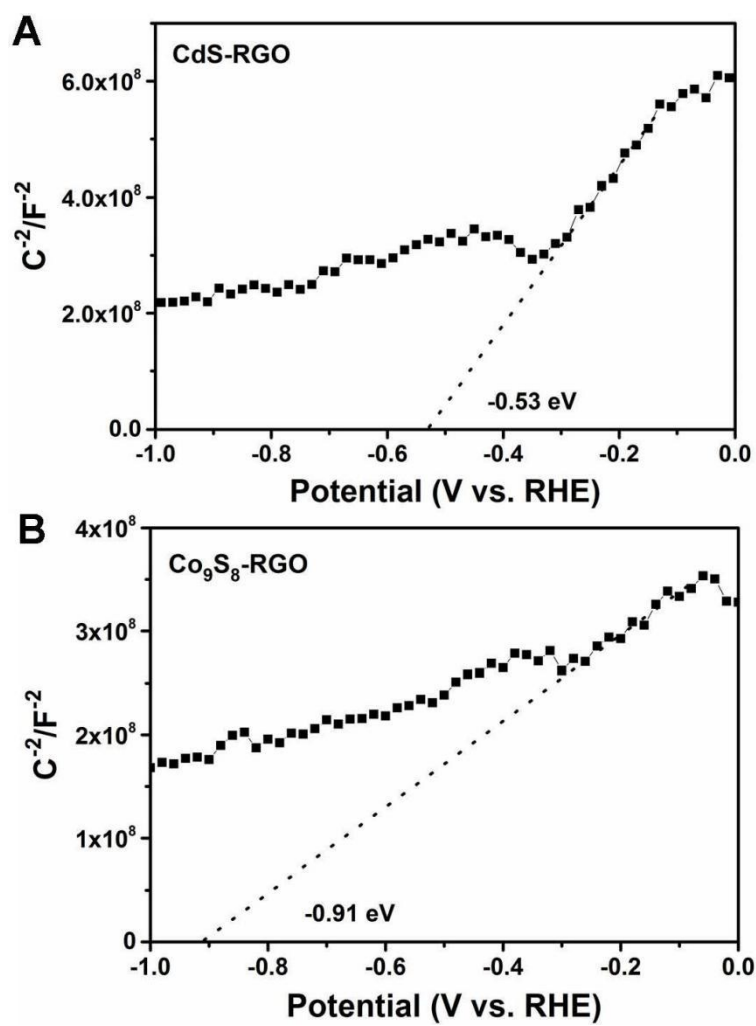


Figure S9. Mott–Schottky plots of (A) CdS-RGO and (B) Co₉S₈-RGO.

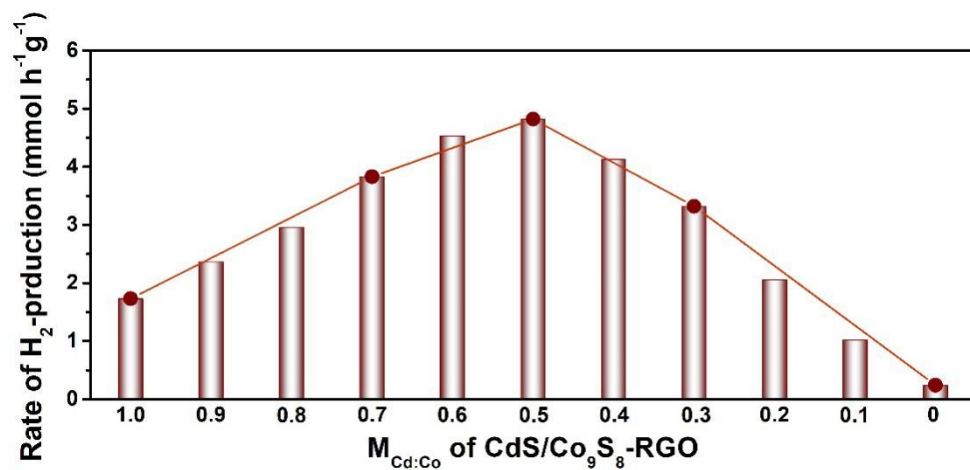


Figure S10. H₂ production rate under visible light irradiation of CdS/Co₉S₈-RGO with different Cd/Co molar ratio (M_{Cd:Co}) for 1 h.

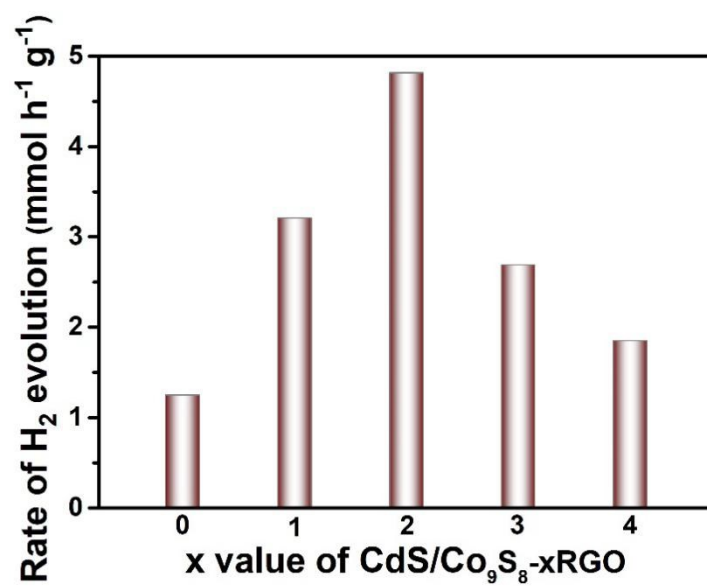


Figure S11. H₂ production rate under visible light irradiation of CdS/Co₉S₈-RGO with different volumes (x value) of GO added for 1 h.

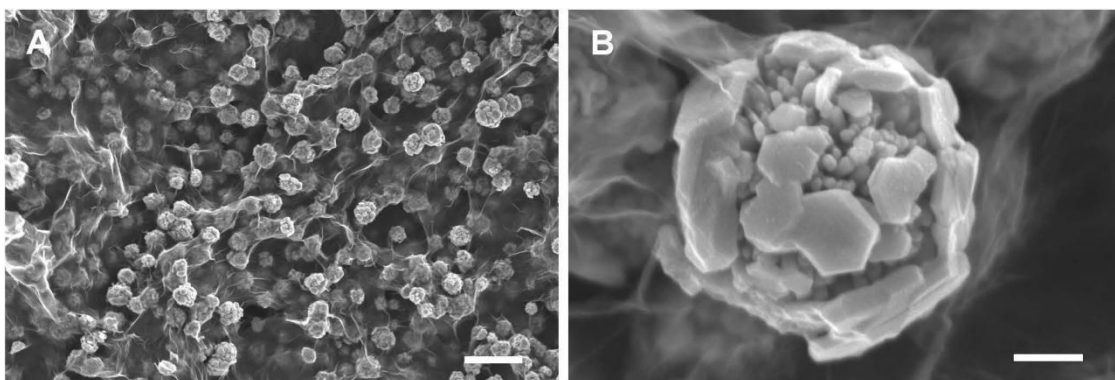


Figure S12. FESEM images of CdS/Co₉S₈-RGO after 20 h photocatalytic hydrogen evolution. Scale bars: (A) 1 mm, (B) 100 nm.

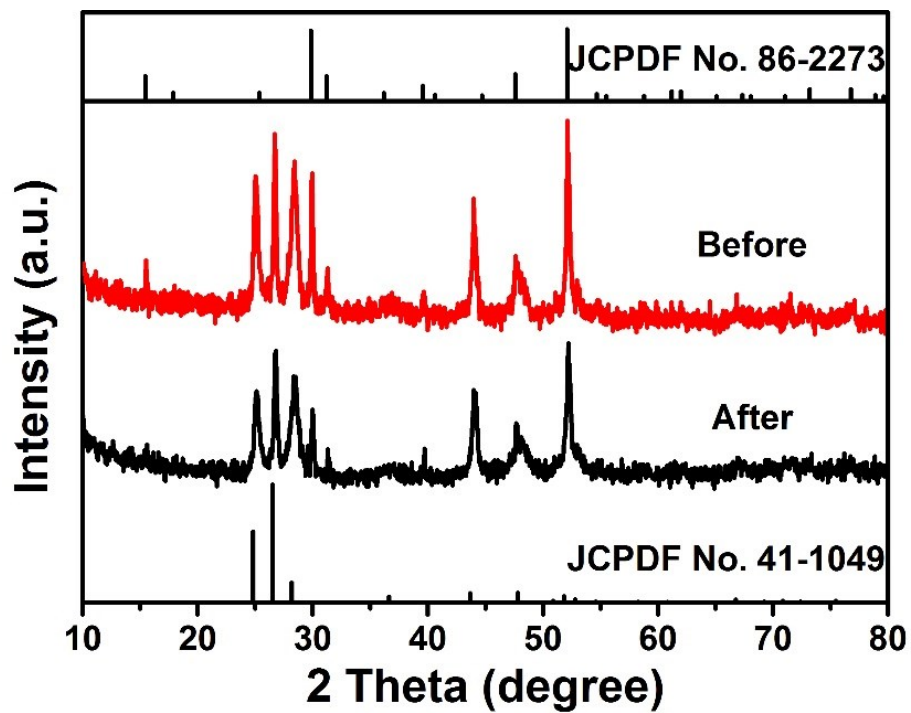


Figure S13. XRD patterns of CdS/Co₉S₈-RGO before and after the 20 h photocatalytic hydrogen evolution test.

Table S1. The comparison of H₂ production performance between CdS/Co₉S₈-RGO and related Co based CdS photocatalytic composite materials.

Photocatalyst	Light Source	Catalyst Amount (mg)	Scavenger	H ₂ Evolution Rate (mmol/g/h)	Refs.
CdS/Co ₉ S ₈ -RGO	300 W Xe lamp (λ > 420 nm)	10	Na ₂ S + Na ₂ SO ₃	4.58	This work
CdS/Co ₉ S ₈	300 W Xe lamp (AM 1.5 G)	20	Na ₂ S + Na ₂ SO ₃	1.061	S1
CdS/Co(OH) ₂	500 W Xe lamp	100	Ethanol	0.61	S2
CdS/Co(OH) ₂	350 W Xe lamp (λ = 420 nm)	50	Lactic acid	1.958	S3
CdS/Co ₃ O ₄				3.014	
CdS/CoS				1.232	
CdS/CoO				0.480	
CdS/Co ₃ O ₄	300 W Xe lamp (λ > 420 nm)	50	Na ₂ S + Na ₂ SO ₃	0.236	S4
CoO _x -loaded TiO ₂ /CdS	300 W Xe lamp (λ ≥ 400 nm)	10	Na ₂ S + Na ₂ SO ₃	0.66	S5
CdS-CoS	300 W Xe lamp (λ ≥ 420 nm)	300	lactic acid	1.05	S6

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