Supporting Information

Facile synthesis of $ZnIn_2S_4$@ZnS composites for efficient photocatalytic hydrogen precipitation

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Solid solution	Bandgap(eV)
ZnS	3.30
$ZnIn_2S_4$	2.32
$ZnIn_2S_4$@ZnS-0.1	2.67
$ZnIn_2S_4$@ZnS-0.2	2.79
$ZnIn_2S_4$@ZnS-0.3	2.83
$ZnIn_2S_4$@ZnS-0.4	2.80

Table S1 Forbidden bandwidths of ZnS, $ZnIn_2S_4$, and $ZnIn_2S_4$@ZnS composites

Table S2 The specific surface area of ZnS, $ZnIn_2S_4$, and $ZnIn_2S_4$@ZnS-0.3 composites

Sample	**S_{BET}（$cm^2 g^{-1}$）**
ZnS	42.4
$ZnIn_2S_4$	63.7
$ZnIn_2S_4$@ZnS-0.3	122.3

Sample	A_1	τ_1/ns	A_2	τ_2/ns	τ_A/ns
ZnS	3669.462836	4.997448382	1.504421593	46.18591969	5.152923741
$ZnIn_2S_4$	1.094521681	46.3660603	3647.438595	5.164508648	5.275209942
$ZnIn_2S_4$@ZnS-0.1	1.061505896	50.37345998	3315.746995	6.050665775	6.168483548
$ZnIn_2S_4$@ZnS-0.2	3002.544533	6.795660056	1.029964753	73.71889169	7.043769831
$ZnIn_2S_4$@ZnS-0.3	2885.268962	7.339865278	1.63060833	80.36808148	7.788993527
$ZnIn_2S_4$@ZnS-0.4	3175.184648	7.019308123	1.751626806	70.19563146	7.365927938

Table S3 Fitting results for carrier lifetimes of ZnS, $ZnIn_2S_4$, and $ZnIn_2S_4$@ZnS composites

Table S4 Comparison of the photocatalytic hydrogen production rates reported in the literature with those of the prepared $ZnIn_2S_4$/ZnS

Photocatalysts	The quality of sample	Sacrificial agent	Light source (Xe lamp)	Activity (mmol g^{-1} h^{-1})	Ref.
$ZnIn_2S_4$/ZnS	100 mg	Na_2S/ Na_2SO_3	300W (λ≥420nm)	2.873	This work
Ag_2S/$ZnIn_2S_4$/ZnS	100 mg	Na_2S/ Na_2SO_3	300W (λ≥420nm)	0.703	1
ZIF-derived ZnS/$ZnIn_2S_4$	50 mg	TEOA	300W (AM 1.5 G)	0.453	2
$ZnIn_2S_4$/ZnS	20 mg	Na_2S/ Na_2SO_3	300W	8.502	3
$ZnIn_2S_4$/CNTs/ZnS	50 mg	10 vol% Methanol	300W (λ≥420nm)	0.936	4
$ZnIn_2S_4$/ZnS	100 mg	Na_2S/ Na_2SO_3	300W (λ≥420nm)	2.633	5
ZnO/ZnS	10 mg	Na_2S/ Na_2SO_3	300W (AM 1.5 G)	2.461	6
ZnO/ZnS	50 mg	Na_2S/ Na_2SO_3	300W (AM 1.5 G)	0.500	7

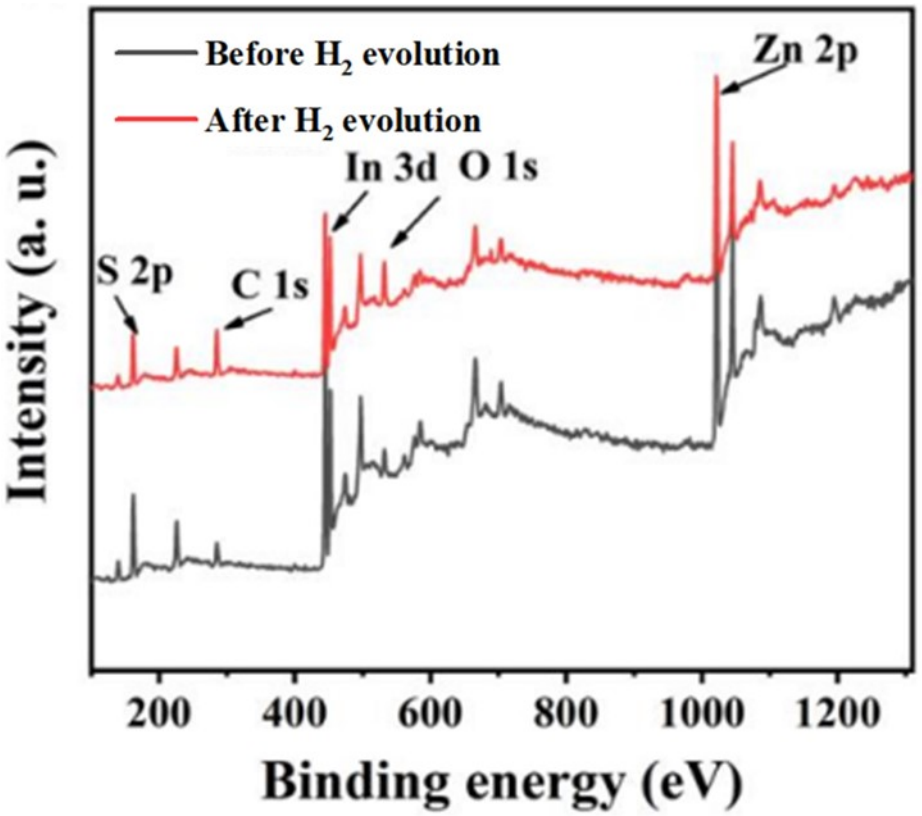

Fig. S1 XPS images of $ZnIn_2S_4$@ZnS-0.3 before and after the hydrogen production cycle test

Notes and references

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