Facile synthesis of ZIF-derived ZnS/$ZnIn_2S_4$ heterojunction and enhanced photocatalytic hydrogen evolution

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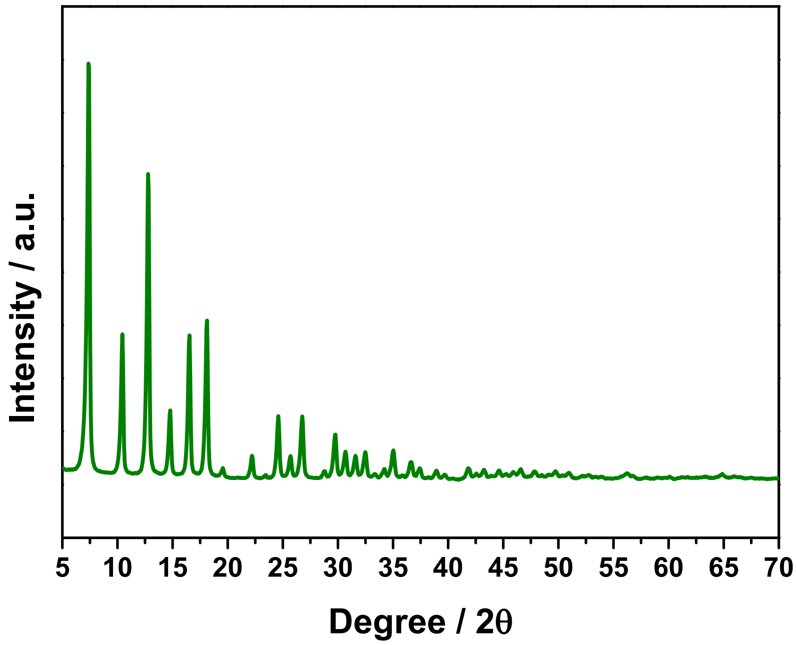


Fig. S1 XRD patterns of pure ZIF-8

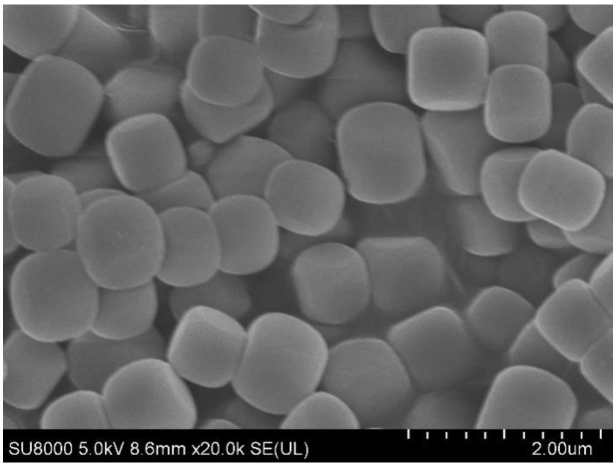
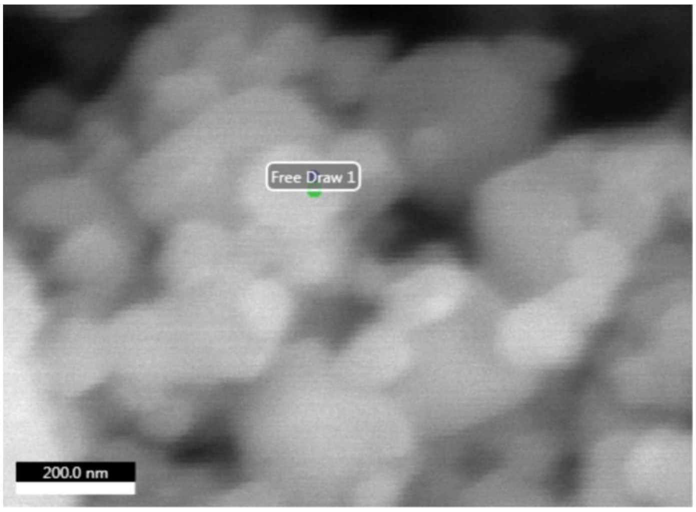
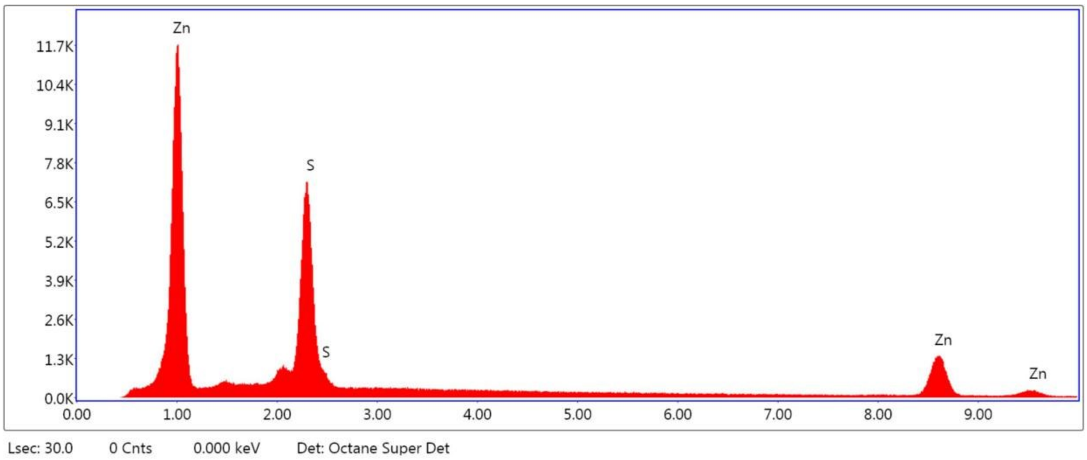


Fig. S2 SEM images patterns of pure ZIF-8





Element	Weight %	Atomic %	Net Int.	Error %	Kratio	Z	R	A	F
S K	27.11	43.13	3241.47	4.60	0.2238	1.1379	0.9398	0.7199	1.0076
ZnK	72.89	56.87	845.90	4.48	0.7168	0.9379	1.0109	0.9987	1.0500

Fig. S3 EDX of ZIF-derived ZnS

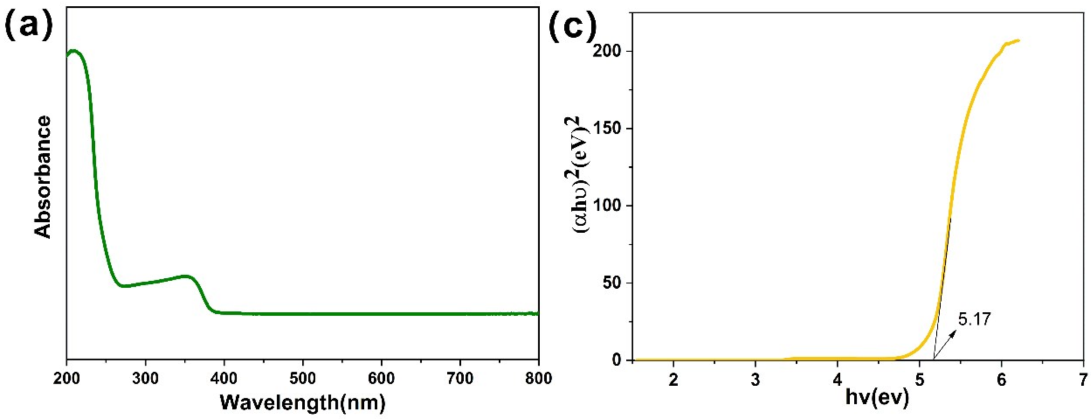


Fig. S4 UV−vis diffuse reflectance spectroscopy (a) and re-plotting curves based on Kubelka-Munk function versus the energy of light (b) of single ZIF-8.

Table S1 Comparison of photocatalytic H_2 production rate reported in the literature with that of ZIF-derived $ZnS/ZnIn_2S_4$ in our work

Photocatalysts	Hydrogen generation rate (μmol h^{-1} g^{-1})	Light source (Xe lamp)	Ref.
ZIF-derived $ZnS/ZnIn_2S_4$	453.4	300 W (AM 1.5 filter)	This work
$ZnIn_2S_4/RGO/BiVO_4$	4.1	350 W (λ ≥ 420 nm cut off filters)	[1]
$PtS\text{-}ZnIn_2S_4/WO_3\text{-}MnO_2$	19.38	300W (420/800 nm cut off filters)	[2]
$Ag_2S/ZnIn_2S_4/ZnS$	70	300 W	[3]
$ZnIn_2S_4$/ NiS	76.6	300 W (λ ≥ 420 nm cut off filter)	[4]
$ZnIn_2S_4\text{-}Au\text{-}TiO_2$	186.3	300 W	[5]
$WS_2/ZnIn_2S_4$	199.1	300 W (λ ≥ 420 nm cut off filter)	[6]
$NiS/ZnIn_2S_4$	250	300 W (λ ≥ 420 nm cut off filter)	[7]
rGO/TiO_2 nanotubes/ $ZnIn_2S_4$	462.3	300 W (λ ≥ 420 nm cut off filter)	[8]
Ag_2O quantum dot/$ZnIn_2S_4$	466.8	300 W	[9]

References

[1] R. Zhu, F. Tian, G. Cao, F. Ouyang, *Int. J. Hydrogen Energ.,* 2017, 42, 17350-17361.

[2] Y. Ding, D. Wei, R. He, R. Yuan, T. Xie, Z. Li, *Appl. Catal. B,* 2019, 258, 117948.

[3] R. Wang, L. Zhao, L. Li, Q. Song, J. Huang, *J. Phys. Chem. Solids*, 2020, 136, 109148.

[4] W. Pudkon, S. Kaowphong, S. Pattisson, P.J. Miedziak, H. Bahruji, T.E. Davies, D.J. Morgan, G.J. Hutchings, *Catal. Sci. Technol.,* 2019, 9, 5698-5711.

[5] G. Yang, H. Ding, D. Chen, J. Feng, Q. Hao, Y. Zhu, Appl. Catal. B, 2018, 234, 260-267.

[6] J. Zhou, D. Chen, L. Bai, L. Qin, X. Sun, Y. Huang, *Int. J. Hydrogen Energ.,* 2018, 43, 18261-18269.

[7] A. Yan, X. Shi, F. Huang, M. Fujitsuka, T. Majima, *Appl. Catal. B*, 2019, 250, 163-170.

[8] H. An, M. Li, W. Wang, Z. Lv, C. Deng, J. Huang, Z. Yin, *Ceram. Int.,* 2019, 45, 14976-14982.

[9] Y. Xiao, Z. Peng, W. Zhang, Y. Jiang, L. Ni, *Appl. Surf. Sci.,* 2019, 494, 519-531.