Combining ZnS with WS_2 Nanosheets to Fabricate a Broad-spectrum Composite Photocatalyst for Hydrogen Evolution

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S1. Energy dispersive spectrometer (EDS) and inductively coupled plasma-atomic emission spectrometry (ICP-AES) of ZWS nanocomposites

a

0.3 wt%	Weight%	Atomic%	0.5 wt%	Weight%	Atomic%
C	28.82	54.80	C	16.40	40.21
O	12.80	18.27	O	8.34	15.35
S	18.77	13.37	S	23.84	21.89
Zn	38.40	13.41	Zn	49.31	22.21
W	1.20	0.15	W	2.11	0.34
Totals	100	100	Totals	100	100
0.7 wt%	**Weight%**	**Atomic%**	**1 wt%**	**Weight%**	**Atomic%**
C	8.79	26.28	C	10.09	28.96
O	5.53	12.40	O	6.16	13.28
S	26.71	29.90	S	26.66	28.66
Zn	56.29	30.91	Zn	54.11	28.54
W	2.68	0.52	W	2.99	0.56
Totals	100	100	Totals	100	100

b

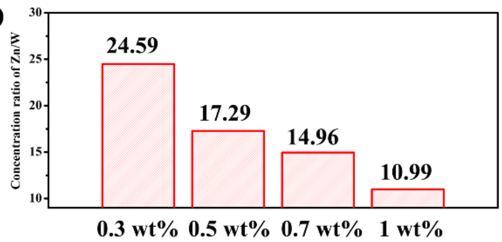

Figure S1. (a) EDS, (b) ICP-AES of ZWS nanocomposites with primary addition of WS_2 NSs is 0.3 wt%, 0.5 wt%, 0.7 wt% and 1 wt%, respectively.

The weight ratios between ZnS and WS_2 in ZWS nanocomposites were detected by EDS (Figure S1a), and ICP-AES (Figure 1b). The EDS elemental analysis shows that with the primary addition of WS_2 NSs increasing, the weight percentage of WS_2 NSs in ZWS nanocomposites increases (Zn/W=32, 23.37, 21, and 18.1, respectively). Figure 1b shows the ICP-AES of ZWS nanocomposites with different amount of WS_2 NSs. Just as shown in Figure S1a, with the primary addition of WS_2 NSs increasing, the weight percentage of WS_2 NSs in ZWS nanocomposites increases. For convenience, in this article, the primary addition of WS_2 NSs in ZWS nanocomposites (x wt% ZWS) is used as representation for the samples, instead of the real weight ratios.

S2. SEM image of raw WS_2

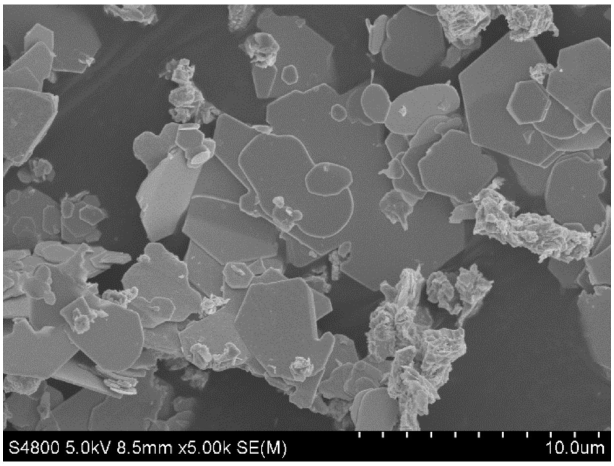

Figure S2. SEM image of raw WS_2

S3. XPS survey spectrum of ZWS nanocomposites

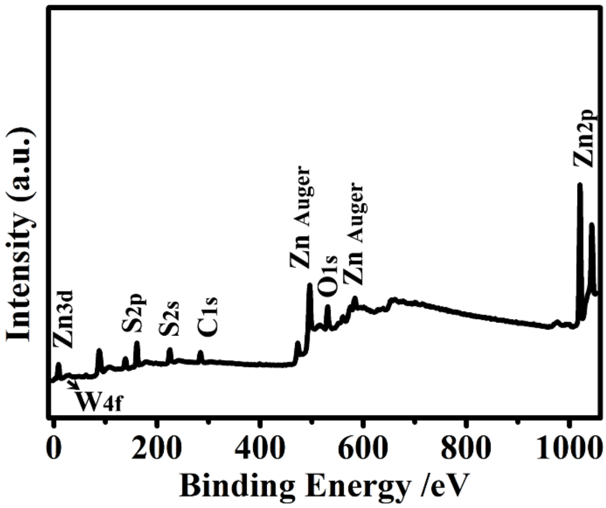

Figure S3. XPS survey spectrum of ZWS nanocomposites

S4. PHE of 0.5 wt% ZWS nanocomposites in different sacrificial agents

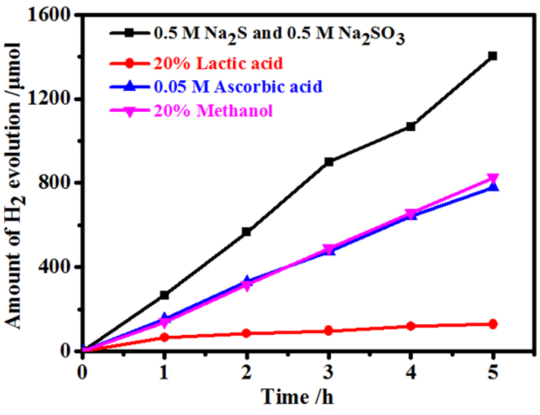

Figure S4. PHE of 0.5 wt% ZWS nanocomposites in different sacrificial agents

S5. Photocatalytic stability of ZnS nanoparticles

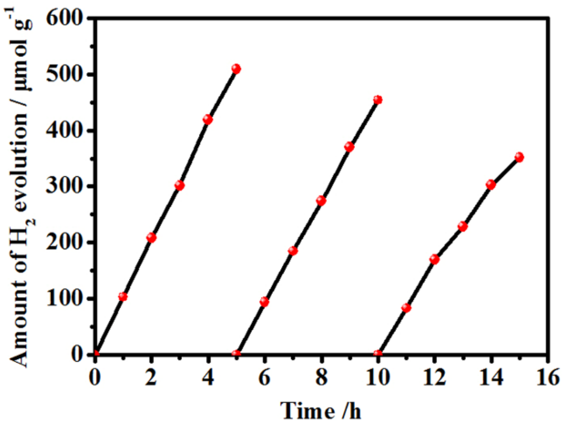

Figure S5. The photocatalytic stability of ZnS nanoparticles.

S6 Photoluminescence spectra of ZnS nanoparticles and ZWS nanocomposites

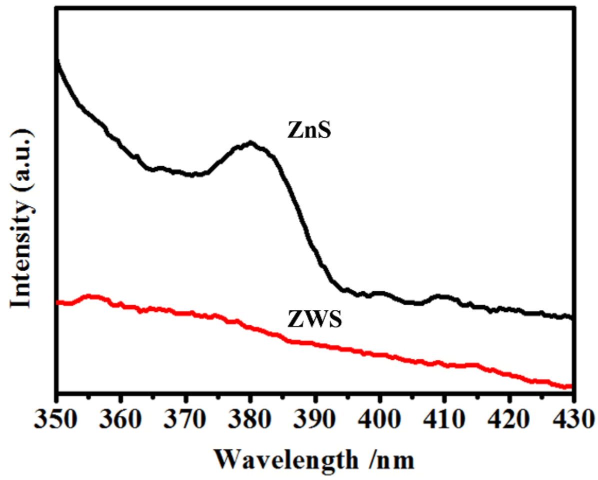

Figure S6. Photoluminescence (PL) spectra of ZnS nanoparticles and ZWS nanocomposites

S7. UV-vis diffuse reflectance spectrum (DRS) of WS_2 NSs

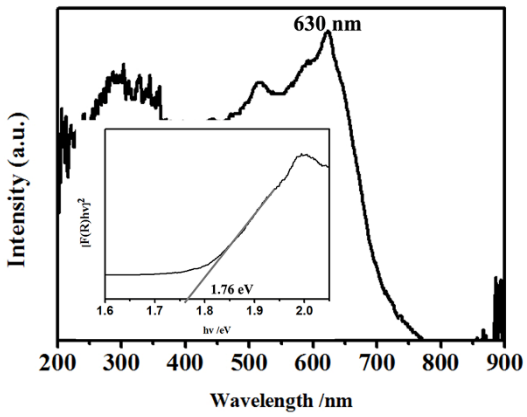

Figure S7. The UV-vis DRS of WS_2 NSs (the inset is plot of $[F(R)hv]^2$ versus hv for estimation of optical band-gap of WS_2 NSs).

S8. VB-XPS spectrum of WS_2 NSs

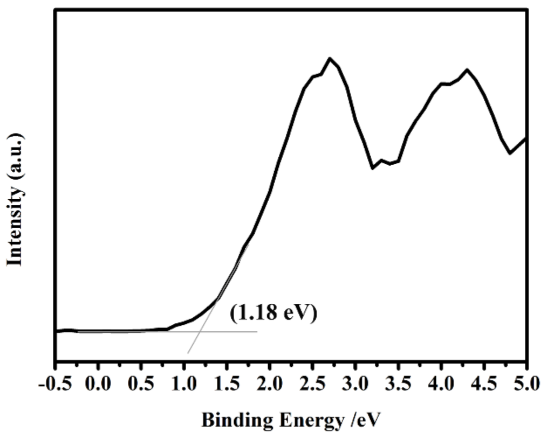

Figure S8. The VB-XPS spectrum of WS_2 NSs.