One-pot hydrothermal synthesis of noble-metal-free NiS on $Zn_{0.5}Cd_{0.5}S$ nanosheets photocatalysts for high H_2 evolution from water under visible light.

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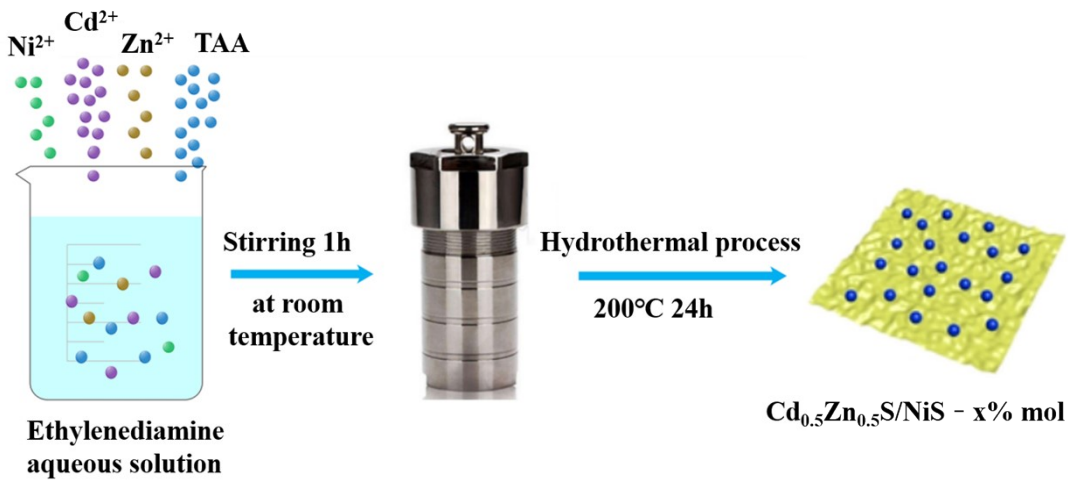

Fig. S1. Schematic illustration of the fabrication process of ZCS/NS.

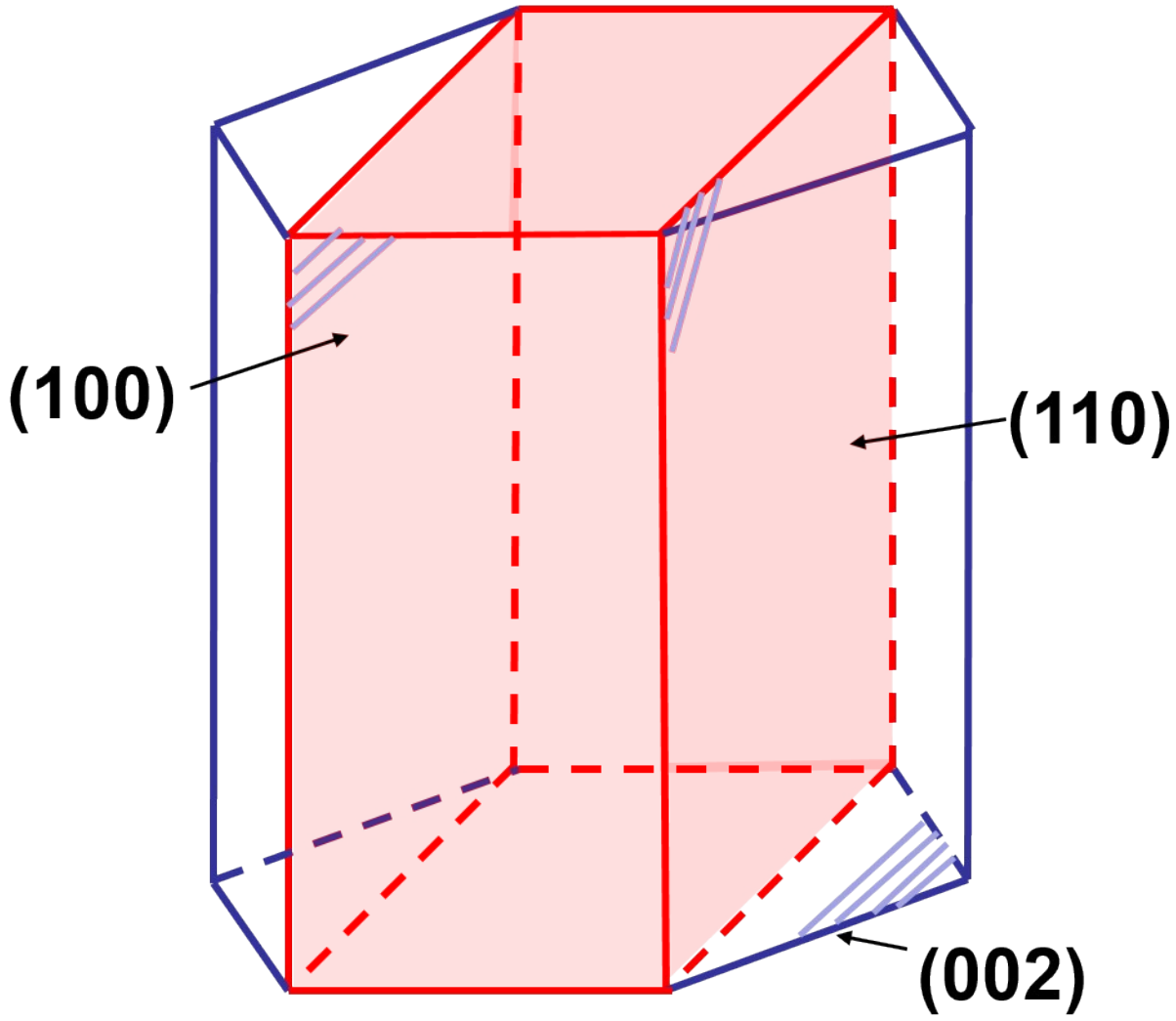

Fig. S2. Schematic diagram of formation of nanosheets in hexagonal crystal system.

Table S1. The relative intensity of different crystal faces in Zn0.5Cd0.5S sample and its PDF card

Crystal faces	**(100)**	**(002)**	**(101)**
Relative intensity of PDF card	78.5	51.4	100
Relative intensity of $Zn_{0.5}Cd_{0.5}S$	73	144	85

Table S2. The relative intensity ratios of (101)/(100), (101)/(002) and (101)/(101) in Zn0.5Cd0.5S sample and its PDF card

Crystal plane	**(100)**	**(002)**	**(101)**
Relative intensity ratios of PDF card	0.785	0.514	1
Relative intensity of ratios $Zn_{0.5}Cd_{0.5}S$	0.86	1.694	1

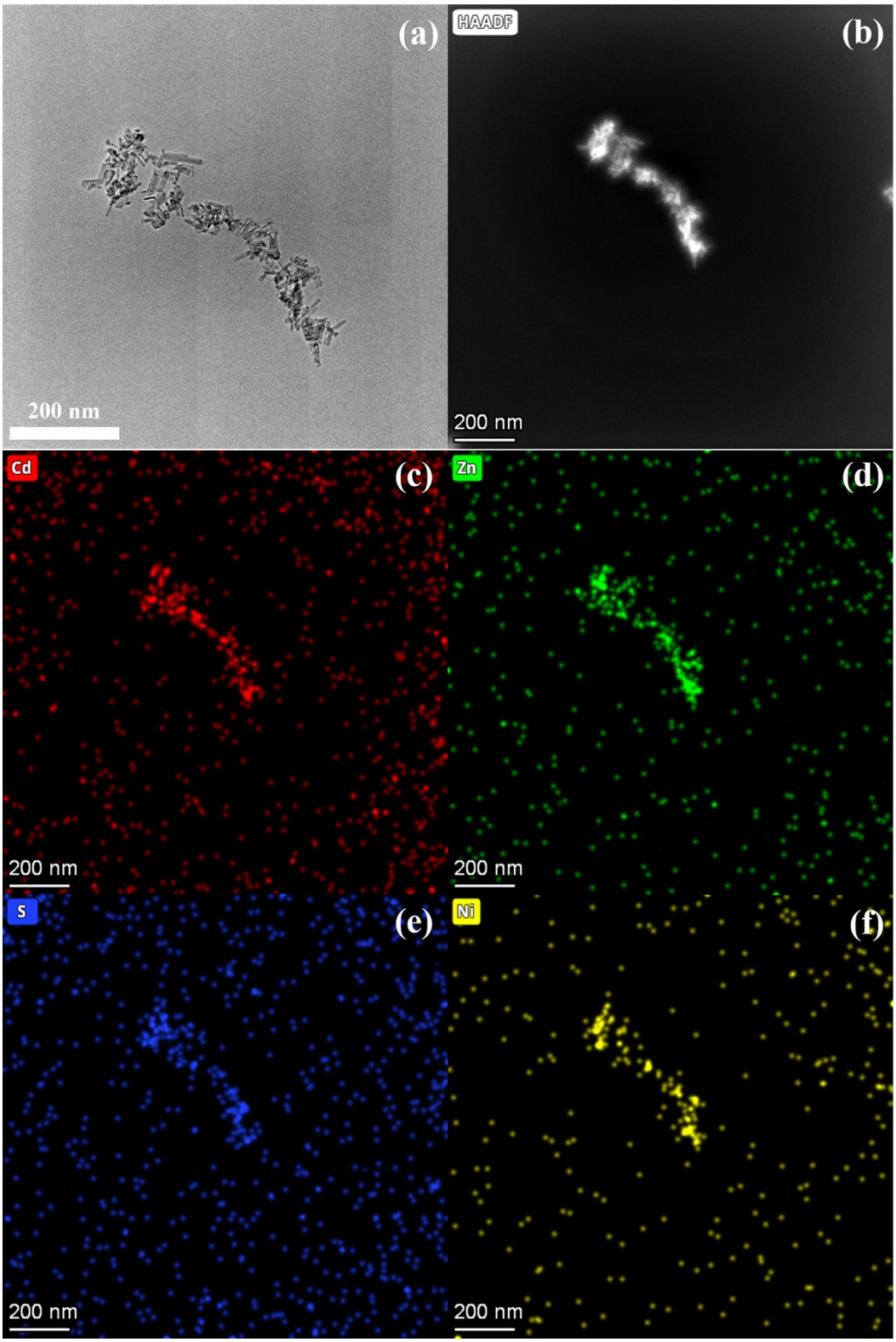

Fig. S3. (a) TEM image of ZCS-NS-5 composites. (b-f) High-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) image and the elemental mappings of ZCS-NS-5

composites.

Table S3. The measured ICP concentration and the calculated mass and molar ratio of metal ions contained in ZCS/NS-5.

Metal ion	**C1(mg/L)**	**C2(mg/L)**	**m(mg)**	**n(Mmol)**	**Practical Ni/(Cd+Mn) molar ratio**
Zn	52.75	51.76	2.77	0.042	**4.86%**
Cd	88.72	89.36	4.72	0.0424	
Ni	4.631	4.417	0.24	0.0041	

Table S4 Performance comparison of typical sulfide based photocatalysts.

Photocatalyst	Light source	Sacrificial reagent	Catalyst dosage (mg)	morphology	H_2 evolution (mmol g^{-1} h^{-1})	Ref.
MS/$Cd_{0.4}Zn_{0.4}S$(M = Mo, Cu, Pd)	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	50	nanoparticles	1.2	S1
1wt%Pt/ $Cd_{0.4}Zn_{0.4}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	50	nanoparticles	1.21	S1
$Cd_{0.2}Zn_{0.8}S$@UiO-66-NH_2	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	50	nanoparticles	5.85	S2
$Cu_2S/Zn_{0.5}Cd_{0.5}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	100	nanoparticles	4.92	S3
$CuS/Cd_{0.3}Zn_{0.7}S$	high-pressure mercury lamp(λ≥420 nm)	Na_2S-Na_2SO_3	50	nanoparticles	3.52	S4
p-Cu_2S/n-$Zn_xCd_{1-x}S$	solar simulator	Na_2S-Na_2SO_3	50	nanoparticles	0.87	S5

Photocatalyst	Light source	Sacrificial reagent	Catalyst dosage (mg)	morphology	H_2 evolution (mmol g^{-1} h^{-1})	Ref.
$Cu_2(OH)_2CO_3/Zn_{0.5}Cd_{0.5}S$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	50	nanoparticles	5.51	S6
$CuS/Zn_{0.8}Cd_{0.2}S$	300 W Xe lamp(λ≥400nm)	Na_2S-Na_2SO_3	200	nanoparticles	2.79	S7
$MoS_2/Zn_{0.5}Cd_{0.5}S/g\text{-}C_3N_4$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	100	particles	4.91	S8
$CoFe_2O_4/Cd_{0.9}Zn_{0.1}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	100	nanorods	3.5	S9
$Zn_{0.5}Cd_{0.5}S$-OLC	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	30	nanosheets	10.8	S10
$Zn_{0.7}Cd_{0.3}S/NiWO_4$	5 W LED (λ≥420 nm)	Na_2S-Na_2SO_3	10	nanosheets	15.95	S11
AuPd/ $Cd_{0.5}Zn_{0.5}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	50	spheres	3.65	S12
Bi^{3+}-doped $Cd_{0.5}Zn_{0.5}S$	high-pressure mercury lamp(λ≥420 nm)	Na_2S-Na_2SO_3	100	particles	0.56	S13
$MoS_2/Cd_{0.8}Zn_{0.2}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	35	urchin-like	1.3	S14
$Zn_{0.1}Cd_{0.9}S/NiS$	300 W Xe lamp (λ > 300 nm)	glucose	10	nanorods	12.7	S15
NiS modified $Mn_xCd_{1-x}S$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	50	nanoparticles	8.39	S16
1wt%Pt/$Ni_{0.01}Mn_{0.56}Cd_{0.43}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	200	nanoparticles	0.33	S17
Cu_2S/CdS	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	200	polyhedrons	2.0	S18

Photocatalyst	Light source	Sacrificial reagent	Catalyst dosage (mg)	morphology	H_2 evolution (mmol g^{-1} h^{-1})	Ref.
$CdS/NiTiO_3/CoS$	300 W Xe lamp (λ≥420 nm)	lactic acid	50	nanoflakes	6.24	S19
NiS/TiO_2	300 W Xe lamp (λ > 300 nm)	methanol	50	nanosheets	0.31	S20
$Co(OH)_2/CdS$	500 W Xe lamp	ethanol	100	nanorods	0.061	S21
NiS/CDs/CdS	350 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	100	spheres	1.44	S22
$Cd_{0.5}Zn_{0.5}S/BiVO_4$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	certain amounts	spheres	2.35	S23
$Cd_{0.5}Zn_{0.5}S$	300 W Xe lamp (λ≥420 nm)	$AgNO_3$, benzoquinone and EDTA-2Na	50	dendritic	0.15	S24
Mo doped $Cd_{0.5}Zn_{0.5}S$	300 W Xe lamp (λ≥420 nm)	lactic acid	20	nanorods	11.32	S25
NiS_x/ $Cd_{0.5}Zn_{0.5}S$	300 W Xe lamp (λ≥430 nm)	Na_2S-Na_2SO_3	100	nanorods	4.46	S26
$SiO_2/Ni_2P/rGO/Cd_{0.5}Zn_{0.5}S$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	30	yolk-shell	11.65	S27
PtPd decorated $Zn_{0.5}Cd_{0.5}S$	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	50	nanorods	9.689	S28
$Cd_{0.5}Zn_{0.5}S@Bi_2Fe_4O_9$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	20	quantum dots	0.8	S 29
$Co_{0.85}Se/Cd_{0.5}Zn_{0.5}S$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	100	nanorods	0.76	S30

Photocatalyst	Light source	Sacrificial reagent	Catalyst dosage (mg)	morphology	H_2 evolution (mmol g^{-1} h^{-1})	Ref.
$Cd_{0.5}Zn_{0.5}S@C_3N_4$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	20	quantum dots	33.4	S31
p-CuS/n-CdS	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	20	nanoparticles	7	S32
CoO_x-loaded TiO_2/CdS	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	10	nanoparticles	0.66	S33
CuS/ZnS	300 W Xe lamp (λ≥400 nm)	Na_2S-Na_2SO_3	50	hexagonal plates	1.23	S34
Ni-doped ZnS	300 W Xe lamp (λ≥420 nm)	Na_2S-K_2SO_3	1000	particles	0.28	S35
Cu-doped $ZnIn_2S_4$	300 W Xe lamp (λ≥430 nm)	Na_2S-Na_2SO_3	200	microspheres	0.76	S36
MoS_2-graphene/$ZnIn_2S_4$	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	50	microspheres	4.17	S37
$CdIn_2S_4$	450 W Xe lamp (λ≥420 nm)	methanol	50	nanotubes	6.96	S38
$Zn_{0.5}Cd_{0.5}S$/NiS	300 W Xe lamp (λ≥420 nm)	Na_2S-Na_2SO_3	50	nanosheets	**9.98**	**This work**

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