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Electronic Supplementary Information

Constructing Urchin-Like Ni_3S_2@Ni_3B on Ni Plate as a Highly Efficient Bifunctional Electrocatalyst for Water Splitting Reaction

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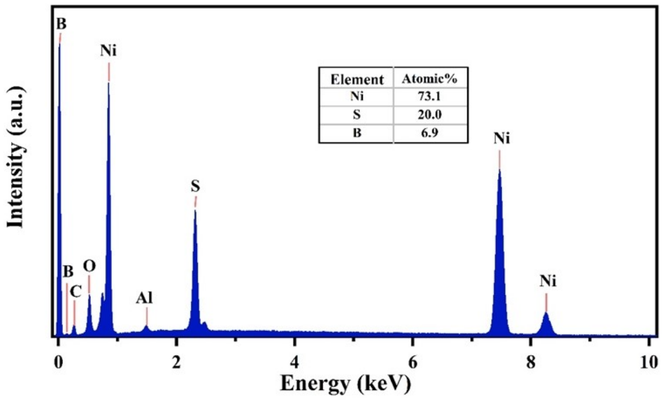

Fig. S1. the EDS spectrum and corresponding element contents of Ni_3S_2@Ni_3B

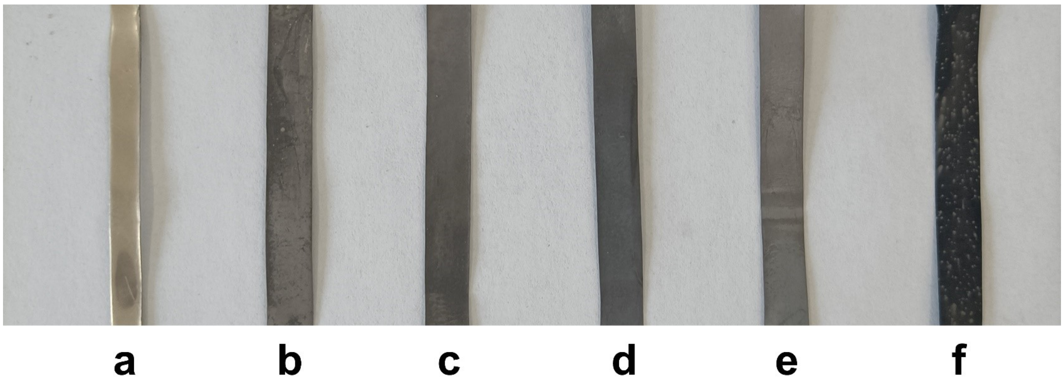

Fig. S2. Photograph of (a) Ni plates, (b) Ni_3B/NP, (c) Ni_3B/NP-1, (d) Ni_3B/NP-2, (e) Ni_3B/NP-3 and (f) Ni_3S_2@Ni_3B/NP.

Table S1. Comparison of the pH of solutions containing different components.

Solution composition	pH
$CO(NH_2)_2$	9.25
NH_4F	6.56
$CO(NH_2)_2 + NH_4F$	8.68
$CO(NH_2)_2 + NH_4F + Na_2S·9H_2O$	8.75

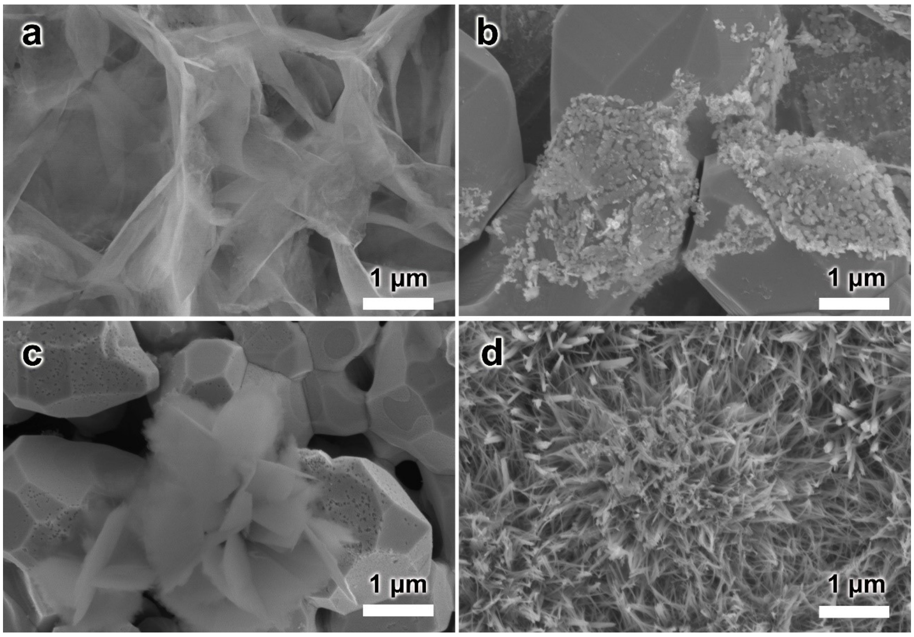

Fig. S3. SEM images of (a) Ni_3B/NP-1, (b) Ni_3B/NP-2, (c) Ni_3B/NP-3 and (d) Ni_3S_2@Ni_3B/NP.

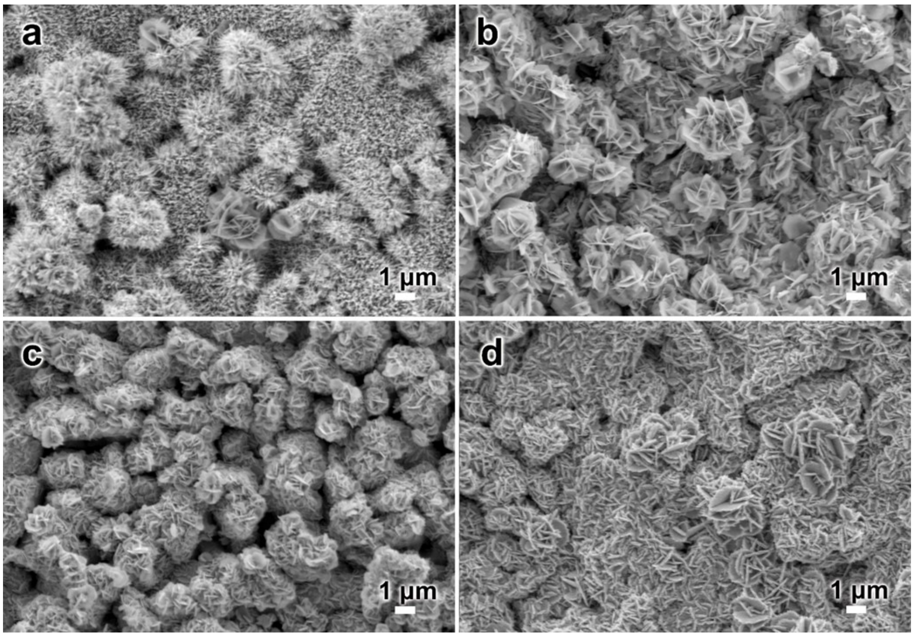

Fig. S4. SEM images of different sulfur ion concentrations (a) 80 mL, (b) 120 mL, (c) 160 mL and (d) 200 mL for sulfide reactions.

Table S2. The simulated series resistance (R_s) and charge transfer resistance (R_{ct}) based on the Nyquist plots (Figure 4a) in the presence of Ni_3S_2@Ni_3B/NP, Ni_3S_2/NP and Ni_3B/NP.

Sample	R_s (Ω cm^2)	R_{ct} (Ω cm^2)
Ni_3S_2@Ni_3B/NP	0.44	4.83
Ni_3B/NP	0.28	12.41
Ni_3S_2/NP	0.59	9.95

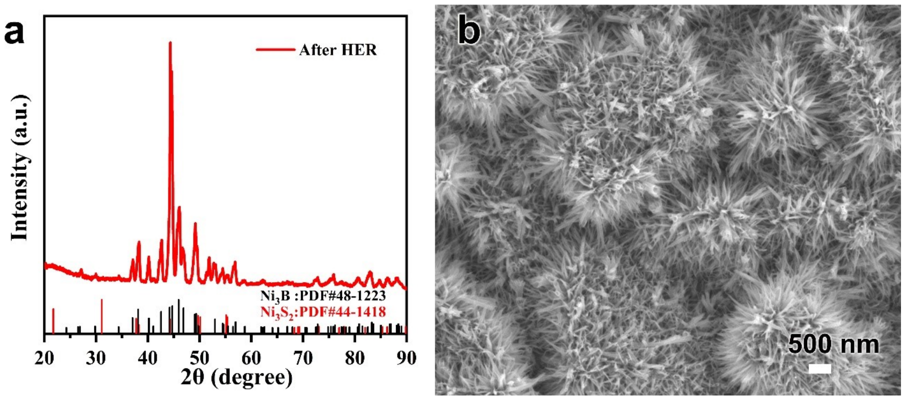

Fig. S5. (a) XRD pattern and (b) SEM image of Ni_3S_2@Ni_3B/NP after HER.

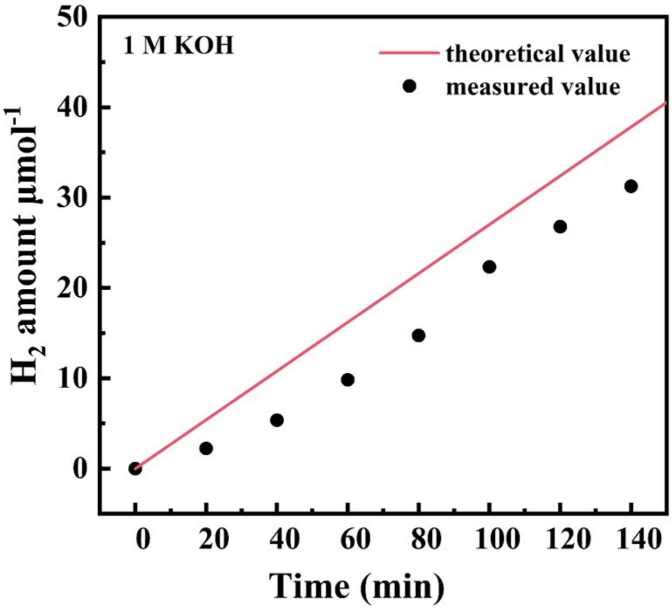

Fig. S6. Faradaic efficiency of Ni_3S_2@Ni_3B/NP for HER.

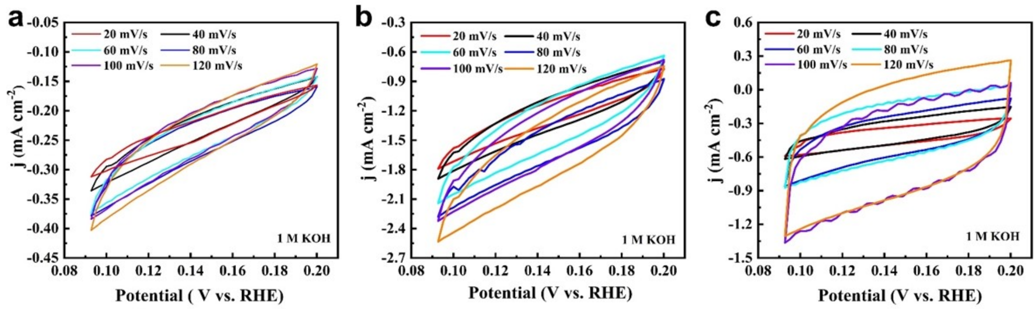

Fig. S7. Cyclic Voltammetry curves of (a) Ni_3B, (b) Ni_3S_2 and (c) Ni_3S_2@Ni_3B/NP.

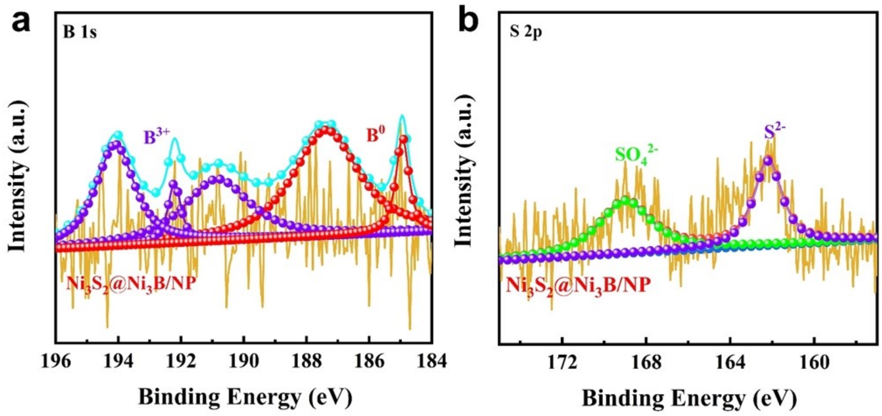

Fig. S8. High-resolution XPS spectra of (a) B 1s and (b) S 2p in Ni_3S_2@Ni_3B/NP.

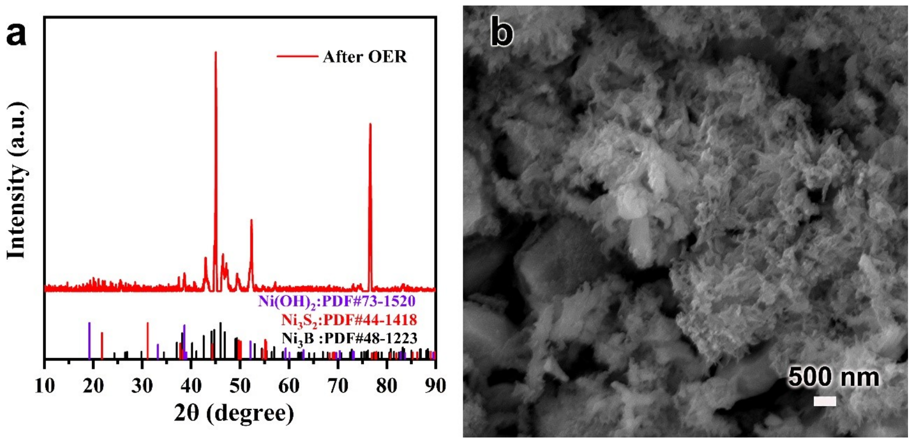

Fig. S9. (a) XRD pattern and (b) SEM images of Ni_3S_2@Ni_3B/NP after OER.

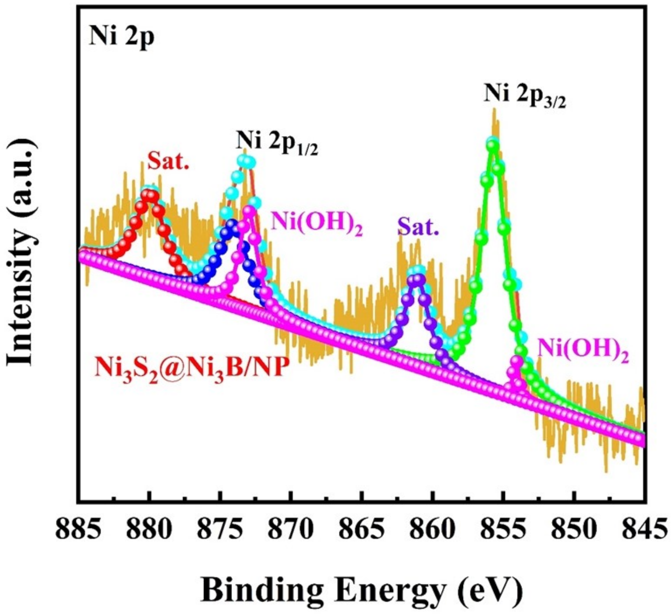

Fig. S10. High-resolution XPS spectra of Ni_3S_2@Ni_3B/NP after OER.

Table S3. Comparison of the electrocatalytic performance of Ni_3S_2@Ni_3B/NP with some representative elelctrocatalysts reported recently for HER and OER.

Catalyst	Electrolyte solution	HER/ OER	Current density (j)	Overpotential (η)	Stability test	Reference
Ni_3S_2@Ni_3B/NP	**1 M KOH**	**HER**	**10 mA cm^{-2}** **100 mA cm^{-2}** **1000 mA cm^{-2}**	**182 mV** **304 mV** **517 mV**	**100 h**	**This work**
		OER	**10 mA cm^{-2}** **100 mA cm^{-2}** **1000 mA cm^{-2}**	**288 mV** **383 mV** **632 mV**	**100 h**	
Ni_3B/NP	1 M KOH	OER	10 mA cm^{-2}	300 mV	1500 h	J. Mater. Chem. A, 2019, 7, 5288.
Ni-Fe-OH@Ni_3S_2/NF	1 M KOH	OER	100 mA cm^{-2}	300 mV	50 h	Adv. Mater., 2017, 29, 1606200.
Ni_3S_2/NF	1 M KOH	HER	10 mA cm^{-2}	223 mV	200 h	J. Am. Chem. Soc. 2015, 137, 14023.
		OER		260 mV		
boronized NiFe	1 M KOH	OER	10 mA cm^{-2}	309 mV	3000 h	Energy Environ. Sci., 2019, 12, 684.
$Zr_{0.8}Ni0_{.2}B_2$	1 M KOH	OER	10 mA cm^{-2}	350 mV	12 h	Electrochim. Acta, 2021, 389, 138789.
$Zr_{0.8}Co_{0.2}B_2$		HER		420 mV	12 h	
Co-B@Co-Bi	1 M KOH	OER	10 mA cm^{-2}	291 mV	25 h	ACS Sustainable Chem. Eng., 2019, 7, 5620.
Ni_1Co_3@BC	1 M KOH	OER	10 mA cm^{-2}	309 mV	20 h	Appl. Surf. Sci., 2020, 532, 147381.
$Cu(OH)_2$ NRs@$Ni(OH)_2$ NSs	1 M KOH	HER	10 mA cm^{-2}	200 mV	20 h	ChemistrySelect, 2021, 6, 4129.
Ni_3S_2/NF	1 M KOH	HER	10 mA cm^{-2}	189 mV	50 h	J. Mater. Chem. A, 2019 7, 18003.
		OER	10 mA cm^{-2}	296 mV	5000 s	
Ni_3S_2@$Co(OH)_2$	1 M KOH	OER	10 mA cm^{-2}	290 mV	40 h	Int. J. Hydrogen Energ., 2019, 44, 22955.