Supporting Information

Ru Doped Molybdenum-based Nanowire Arrays for Efficient Hydrogen Evolution over a Broad pH Range

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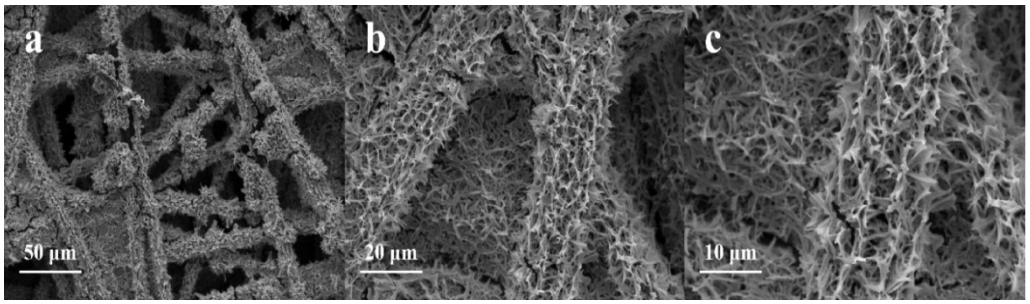

Fig. S1. SEM images of Mo-based NWAs/CFP.

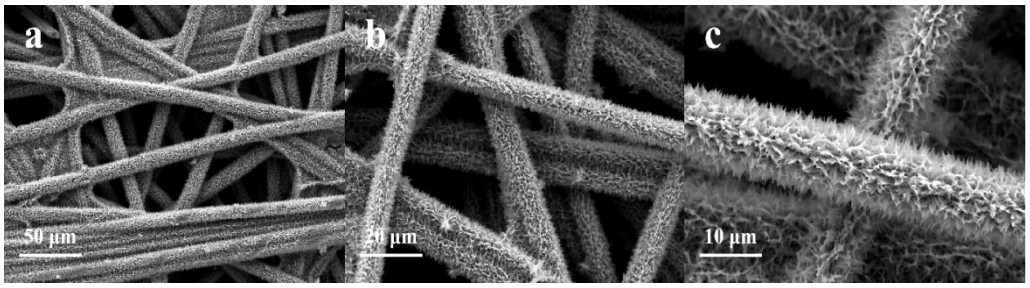

Fig. S2. SEM images of Ru-Mo-based NWAs/CFP.

Table S1. Electrochemical parameters of electrocatalysts for HER in 0.5 M H_2SO_4 electrolyte

Catalyst	η_{10} (mV)	Tafel slop (mV dec^{-1})	C_{dl} (mF cm^{-2})
Ru-MoP NWAs/CFP	39.0	39.0	66.5
Ru-MoS_2 NWAs/CFP	69.3	57.0	46.5
Ru-MoO_2 NWAs/CFP	93.1	75.0	21.9
Ru-$MoSe_2$ NWAs/CFP	120.5	83.0	16.1
Ru-MoN NWAs/CFP	154.6	82.0	14.9
Pt/C/CFP	24.2	25.0	—

Table S2. Comparison of HER activity of the Ru-NiFeP/NF catalyst with other reported electrocatalysts in 0.5 M H_2SO_4

Electrocatalysts	Overpotential (mV) at 10 mA cm^{-2}	Tafel slope (mV dec^{-1})	Reference
Ru-MoP NWAs/CFP	39.0	39.0	This work
S-MoP NPL	86.0	34.0	ACS Catal. 2019, 9, 651-659.
MoP@NC	96.0	49.2	Appl. Catal. B Environ., 263, 2020, 118358.
MoP/Mo_2C@C	89.0	45.0	ACS Appl. Mater. Interfaces 2017, 9, 19, 16270–16279.
MoP@NPSC	71.0	75.0	ACS Appl. Mater. Interfaces 2020, 12, 44, 49596–49606.
MoP-Ru_2P/NPC	82.0	39.33	Appl. Catal. B Environ., 303, 2022, 120879.
Ru-$MoSe_2$	143.0	73.0	J. Phys. Chem. C 2019, 123, 1987−1994.
2D-MoO_2/Ru/ NC	68.0	38.0	J. Phys. Chem. C 2020, 124, 10804−10814.
RuP-475	46.0	39.0	ACS Sustainable Chem. Eng. 2018, 6, 6388−6394.
Ru-modified FeP	62.0	45.0	J. Mater. Chem. A, 2020, 8, 22607.

Table S3. Electrochemical paramters of electrocatalysts for HER in 1.0 M PBS electrolyte

Catalyst	η_{10} (mV)	Tafel slop (mV dec^{-1})	C_{dl} (mF cm^{-2})
Ru-MoP NWAs/CFP	67.1	69.0	42.8
Ru-MoS_2 NWAs/CFP	86.1	96.0	22.3
Ru-MoO_2 NWAs/CFP	118.0	83.0	19.9
Ru-$MoSe_2$ NWAs/CFP	155.6	122.0	13.1
Ru-MoN NWAs/CFP	208.6	107.0	11.4
Pt/C/CFP	57.6	46.0	—

Table S4. Comparison of HER activity of the Ru-NiFeP/NF catalyst with other reported electrocatalysts in 1.0 M PBS

Electrocatalysts	Overpotential (mV) at 10 mA cm^{-2}	Tafel slope ($mV\ dec^{-1}$)	Reference
Ru-MoP NWAs/CFP	67.1	69.0	This work
MoP@NC	191.0	95.0	Appl. Catal. B Environ., 263, 2020, 118358.
MoP/Mo_2C@C	136.0	93.0	ACS Appl. Mater. Interfaces 2017, 9, 19, 16270–16279.
MoP-Ru_2P/NPC	126.0	70.89	Appl. Catal. B Environ., 303, 2022, 120879.
Ru@WNO-C	358.0	139.7	Nano Energy., 80, 2021,105531.
Ru/Ni_2P@NPC	124.0	84.0	ACS Sustainable Chem. Eng. 2019, 7, 17714−17722.
Mo − Ni_2P NWs/NF	84.0	82.0	Nanoscale, 2017, 9, 16674.
Ru@2H-MoS_2	137.0	81.1	Appl. Catal. B Environ., 298, 2021,120490.
NiS_2/MoS_2 HNW	284.0	83.0	ACS Catal. 2017, 7, 9, 6179–6187.
Mo_2C/MoP@NPC	228.0	125.0	Journal of Colloid and Science., 513, 2018, 151-160.

Table S5. Electrochemical paramters of electrocatalysts for HER in 1.0 M KOH electrolyte

Catalyst	η_{10} (mV)	Tafel slop (mV dec^{-1})	C_{dl} (mF cm^{-2})
Ru-MoP NWAs/CFP	49.9	47.0	36.2
Ru-MoS_2 NWAs/CFP	67.9	56.0	27.3
Ru-MoO_2 NWAs/CFP	91.5	73.0	24.7
Ru-$MoSe_2$ NWAs/CFP	125.0	80.0	18.5
Ru-MoN NWAs/CFP	178.6	86.0	14.9
Pt/C/CFP	36.0	31.0	—

Table S6. Comparison of HER activity of the Ru-NiFeP/NF catalyst with other reported electrocatalysts in 1.0 M KOH

Electrocatalysts	Overpotential (mV) at 10 mA cm^{-2}	Tafel slope ($mV\ dec^{-1}$)	Reference
Ru-MoP NWAs/CFP	49.9	47.0	This work
MoP@NC	149	61.7	Appl. Catal. B Environ., 263, 2020, 118358.
MoP/Mo_2C@C	75.0	58.0	ACS Appl. Mater. Interfaces 2017, 9, 19, 16270–16279.
MoP-Ru_2P/NPC	47.0	36.93	Appl. Catal. B Environ., 303, 2022, 120879.
Ru/Ni-MoS_2	32.0	41.0	APPl. Catal. B Environ., 298, 2021, 120557.
Ru SAs-Ni_2P	57.0	75.0	Nano Energy., 80, 2021, 105467.
Ru/Ni_2P@NPC	132.0	124.0	ACS Sustainable Chem. Eng. 2019, 7, 17714−17722.
MoP/Ni_2P/NF	75.0	100.2	J. Mater. Chem. A, 2017, 5, 15940.
Mo − Ni_2P NWs/NF	78.0	100.0	Nanoscale, 2017, 9, 16674
Ni-Mo-P/NF	63.0	87.3	Electrochimica. Acta., 335, 2020, 135643.

Fig. S3. Electrochemical double-layer capacitances of the Ru-MoP NWAs/CFP catalyst measured in

(a) acidic 0.5 M H_2SO_4, (b) neutral 1 M PBS, and (c) alkaline 1 M KOH, respectively.

Fig. S4. Cyclic voltammograms of the Ru-MoP NWAs/CFP catalyst measured in (a) acidic 0.5 M H_2SO_4, (b) neutral 1 M PBS, and (c) alkaline 1 M KOH, respectively.

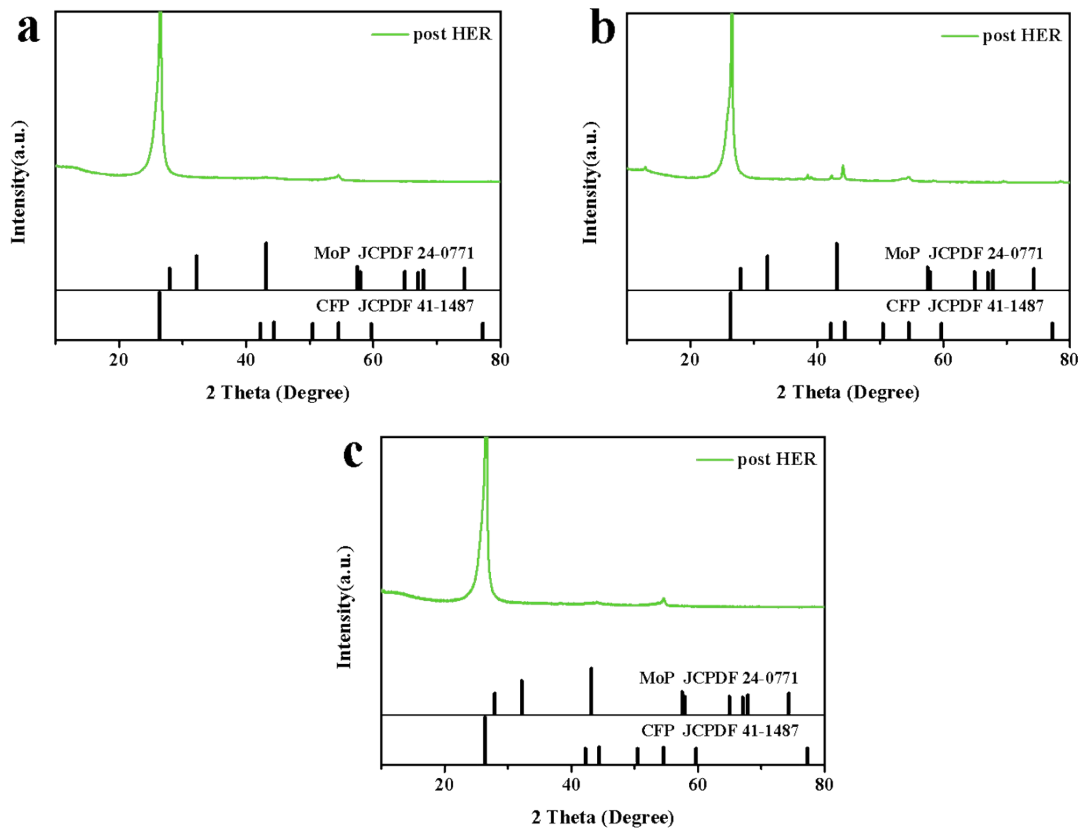

Fig. S5. XRD patterns of the Ru-MoP NWAs/CFP catalyst after HER durability tests in (a) 0.5 M H_2SO_4, (b) 1 M PBS, and (c) 1 M KOH.

Fig. S6. SEM images of Ru-MoP NWAs/CFP after HER stability measurements.