Supporting Information

Integrated 3D self-supported Ni decorated MoO$_2$ nanowires as highly efficient electrocatalysts for ultra-highly stable and large-current-density hydrogen evolution

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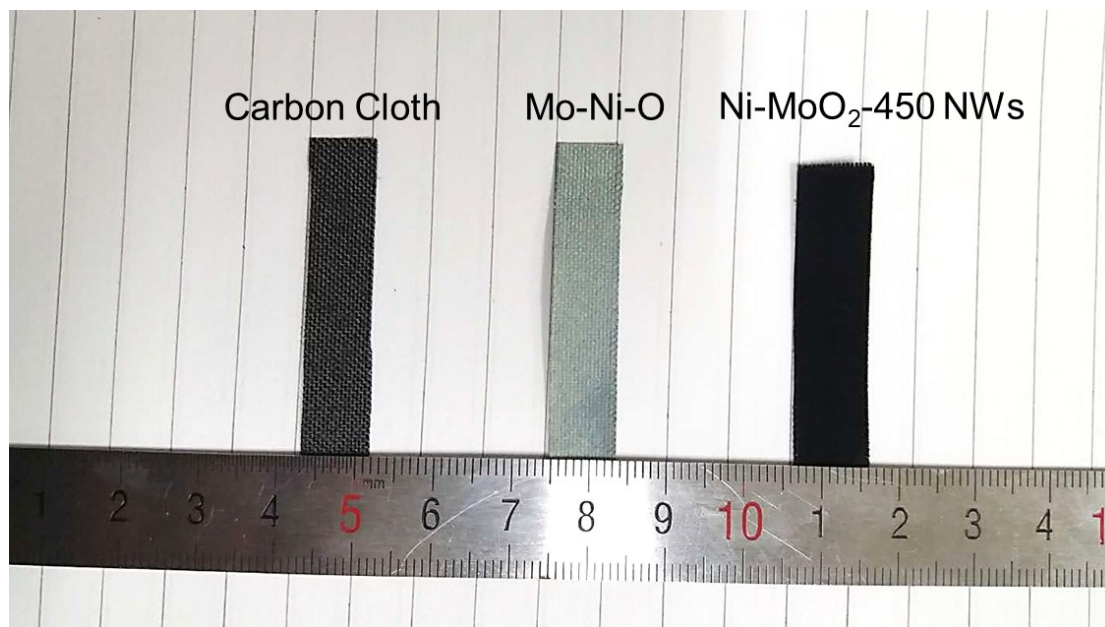
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Figure S1. Optical photograph of bare CC (left), Mo-Ni-O based precursors (middle), and Ni-MoO$_2$-450 NWs/CC (right).
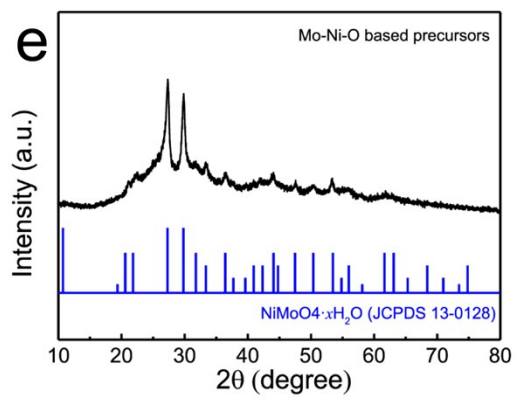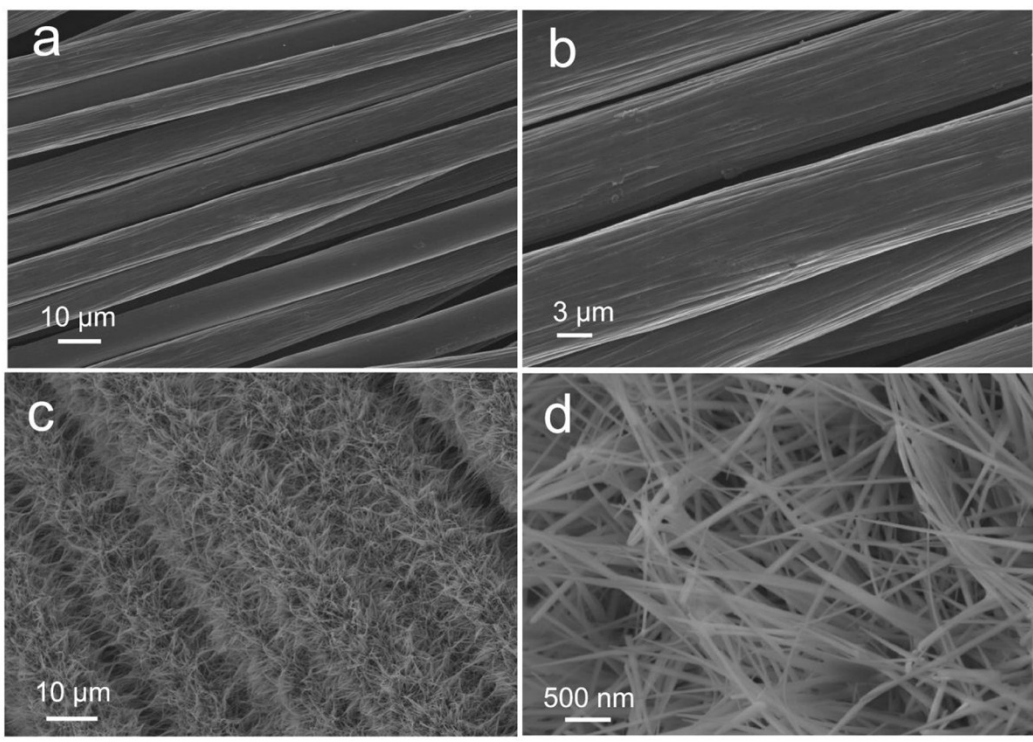
Figure S2. a) Low- and b) high-magnification SEM images of carbon cloth. c) Low-
and d) high-magnification SEM images of Mo-Ni-O based precursors. e) XRD pattern
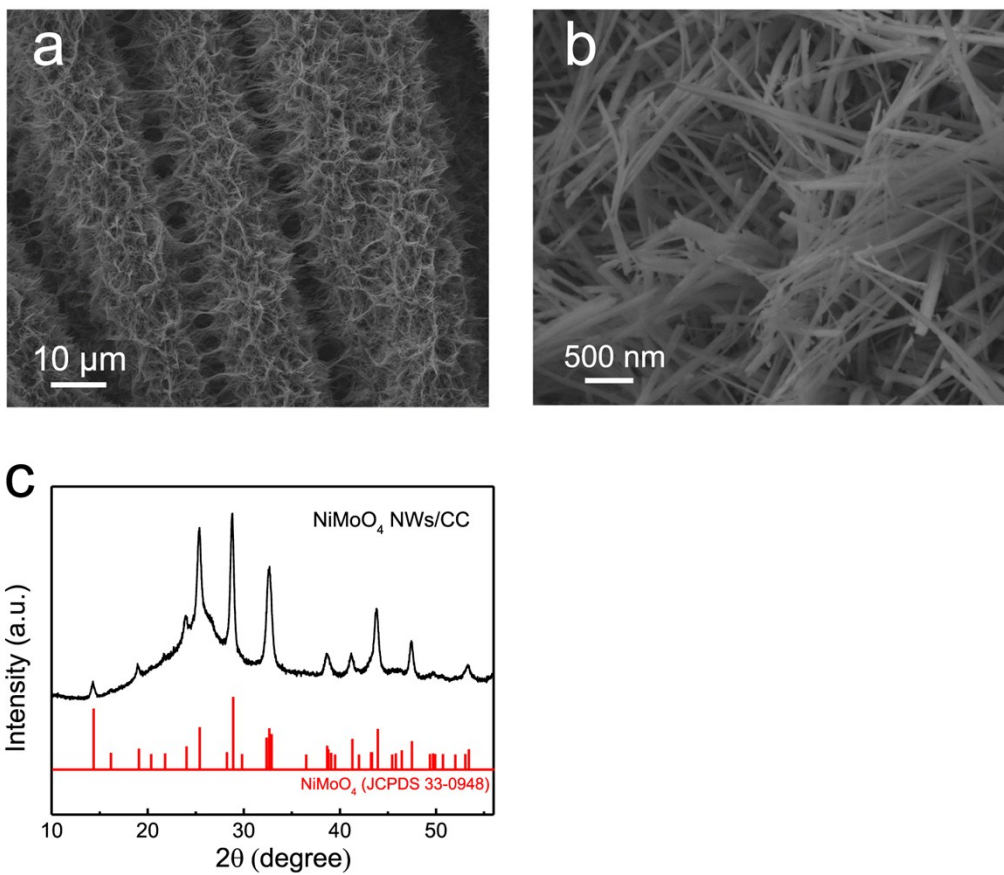of Mo-Ni-O based precursors.

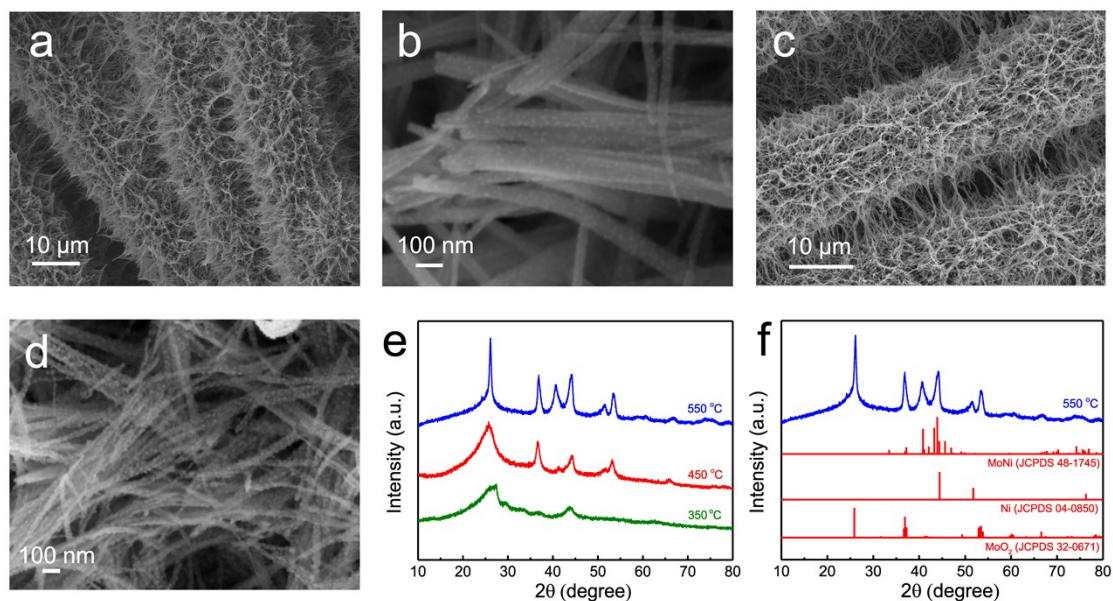**Figure S3.** a) Low- and b) high-magnification SEM images of NiMoO$_4$ NWs/CC. c) XRD pattern of NiMoO$_4$ NWs/CC.

Figure S4. a) Low- and b) high-magnification SEM images of Ni-MoO$_2$-350 NWs/CC. c) Low- and d) high-magnification SEM images of Ni-MoO$_2$-550 NWs/CC. e) XRD pattern of Ni-MoO$_2$ NWs/CC annealed at different temperature. f) XRD pattern of Ni-MoO$_2$-550 NWs/CC with the standard crystallographic spectrum of MoNi (JCPDS 48-1745), Ni (JCPDS 04-0850) and MoO$_2$ (JCPDS 32-0671).
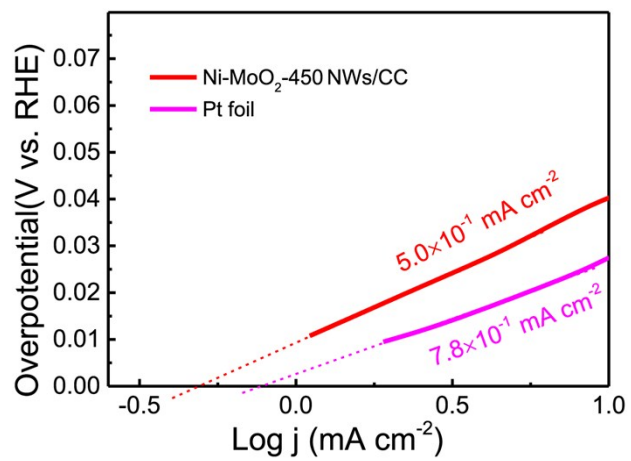
Figure S5. Exchange current densities for Ni-MoO$_2$-450 NWs/CC and Pt foil in 1 M

KOH, which were calculated from Tafel plots by extrapolation method.
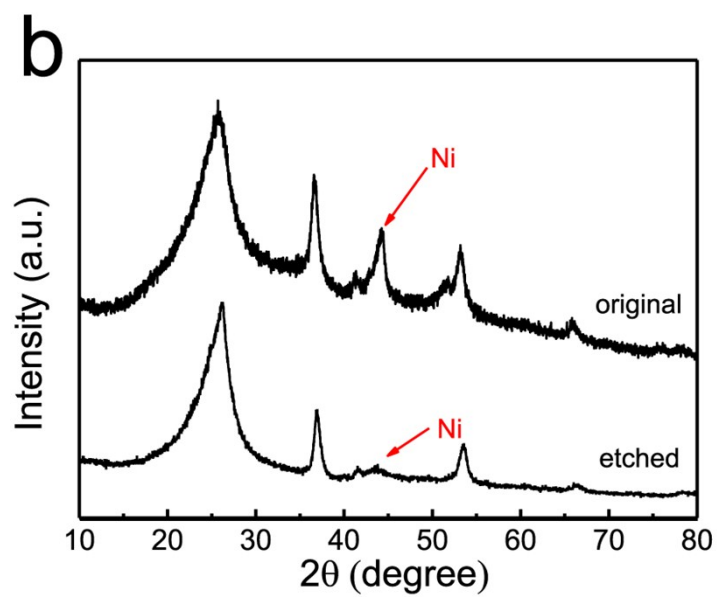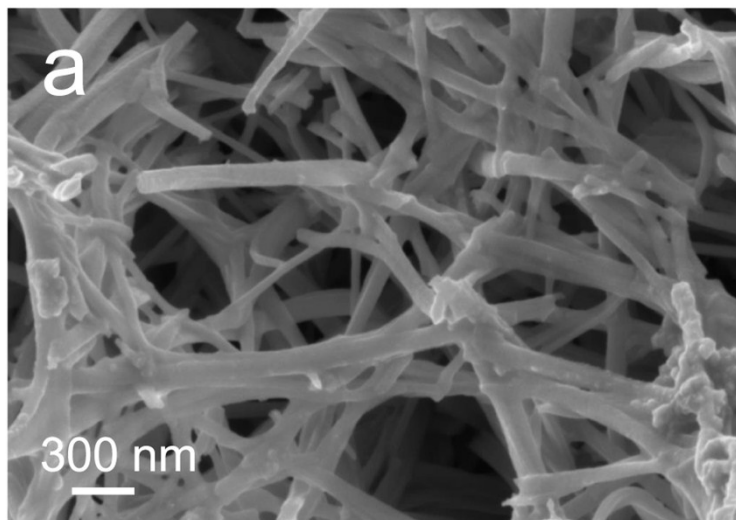
Figure S6. a) SEM image and b) XRD pattern of ETH-Ni-MoO$_2$-450 NWs/CC.
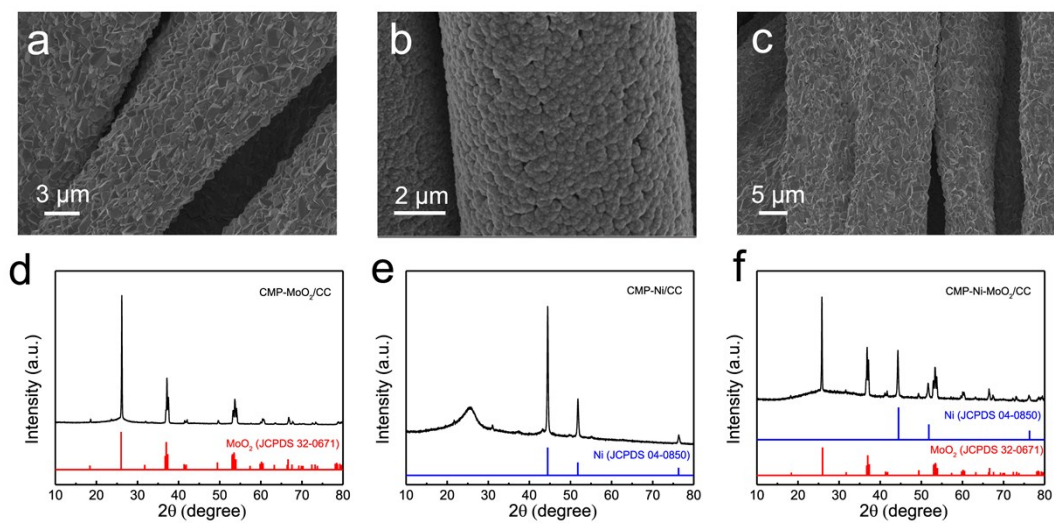
Figure S7. SEM images of a) CMP-MoO$_2$/CC, b) CMP-Ni /CC, and c) CMP-Ni-MoO$_2$/CC. XRD pattern of a) CMP-MoO$_2$/CC, b) CMP-Ni /CC, and c) CMP-Ni-MoO$_2$/CC.
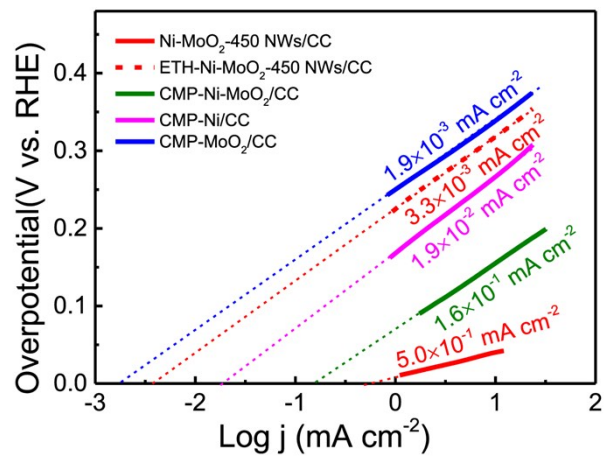
Figure S8. Exchange current densities for Ni-MoO$_2$-450 NWs/CC, ETH-Ni-MoO$_2$-450 NWs/CC, CMP-Ni-MoO$_2$/CC, CMP-MoO$_2$/CC, and CMP-Ni/CC in 1 M KOH, which were calculated from Tafel plots by extrapolation method.
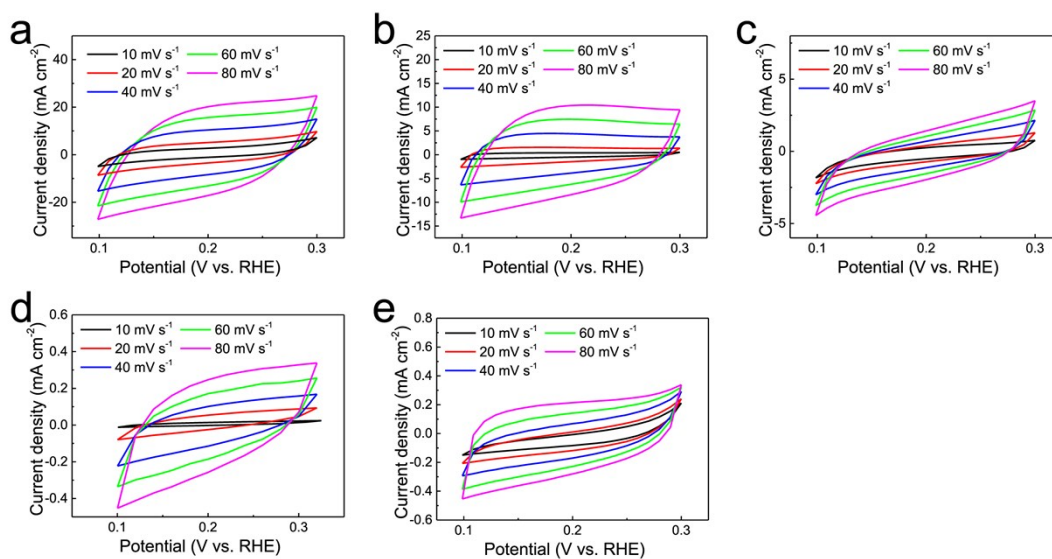
Figure S9. Electrochemically active surface area measurements. CV curves measured from 10 to 80 mV s^{-1} in 1 M KOH of CV curves measured from 10 to 80 mV s^{-1} of a) Ni-MoO$_2$-450 NWs/CC, b) ETH-Ni-MoO$_2$-450 NWs/CC, c) CMP-Ni-MoO$_2$/CC, d) CMP-MoO$_2$/CC, and e) CMP-Ni/CC.

Figure S10. XRD patterns of Ni-MoO$_2$-450 NWs/CC before and after the multi-current-step measurement.
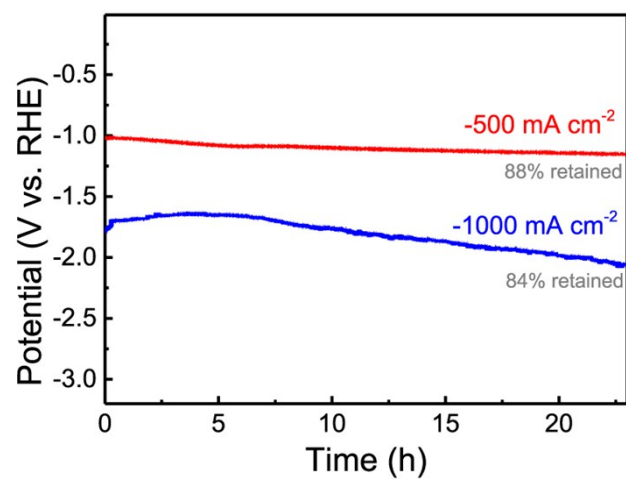
Figure S11. Chronoamperometry measurement at a static current density of -500 and

-1,000 mA cm^{-2} in 1 M KOH for more than 20 hours without *iR* correction.

Table S1. Summary of Ni-MoO$_2$ NWs/CC annealed at different temperature.

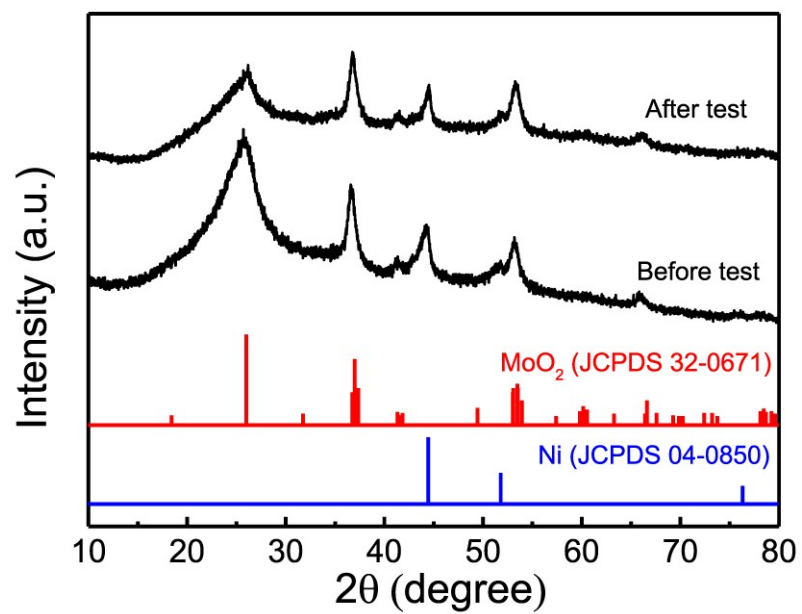| Materials	Annealing temperature (℃)	Crystallinity	Chemical composition	η_{10} (mV)	Tafel slope (mV dec^{-1})
Ni-MoO$_2$-350 NWs/CC	350	Low	Ni/MoO$_2$	56	42
Ni-MoO$_2$-450 NWs/CC	450	Middle	Ni/MoO$_2$	40	30
Ni-MoO$_2$-550 NWs/CC	550	High	MoNi/Ni/MoO$_2$	55	38

Table S2. The HER activities of the Ni-MoO$_2$-450 NWs/CC and reported catalysts in

1 M KOH.

Materials	Onset overpotential (mV)	Overpotential at 10 mA cm^{-2} (mV)	Tafel slope (mV dec^{-1})	Reference
Ni-MoO$_2$-450 NWs/CC	0	40	30	**This work**
MoNi$_4$ on MoO$_2$	0	15	30	1
MoS$_2$/Ni$_3$S$_2$	50	110	83	2
Ni(OH)$_2$/MoS$_2$	20	80	60	3
MoC-Mo$_2$C	33	120	42	4
Ni-MoC	-	123	83	5
MoP	50	130	48	6
Ni$_2$P/Ni	41	~75	50	7
N,P-doped Mo$_2$C@carbon nanospheres	0	50	71	8
NiMoN	50	109	95	9
Ni-WN	0	47	71	10
Co/Co$_3$O$_4$	30	~90	44	11

References

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