Electronic Supplementary Material (ESI) for Dalton Transactions.

Supporting Information

Ni-directed biphase N-doped Mo_2C as efficient hydrogen evolution catalysts in both acidic and alkaline conditions

*Cheng-Feng Du, Yaxin Wang, Xiangyuan Zhao, Jinjin Wang, Xiaomei Wang, Weigang Wang, and Hong Yu**

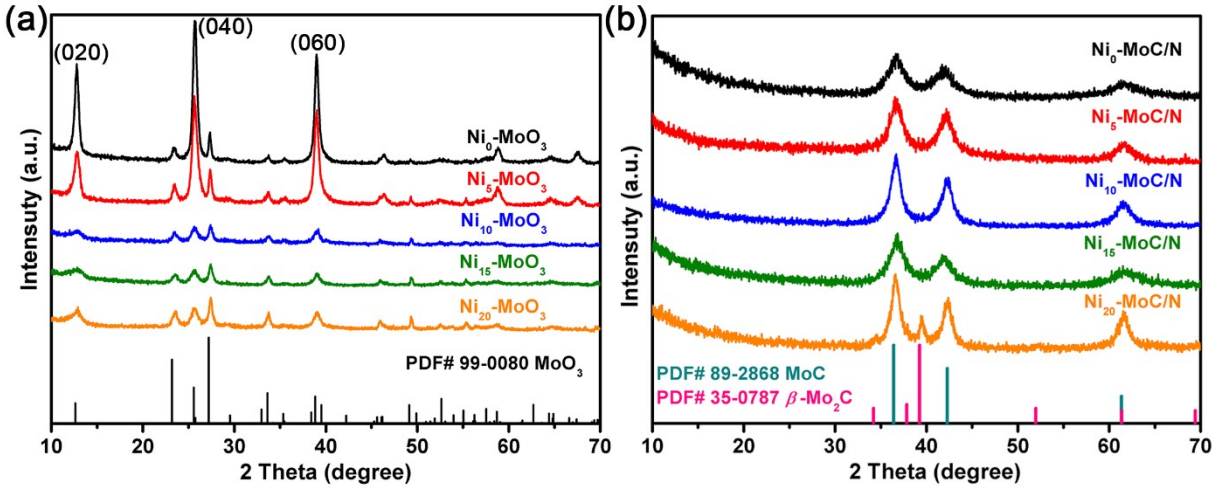

Figure S1. XRD patterns of (a) Ni_x-MoO_3 nanobelts, and (b) Ni_x-MoC/N intermedia.

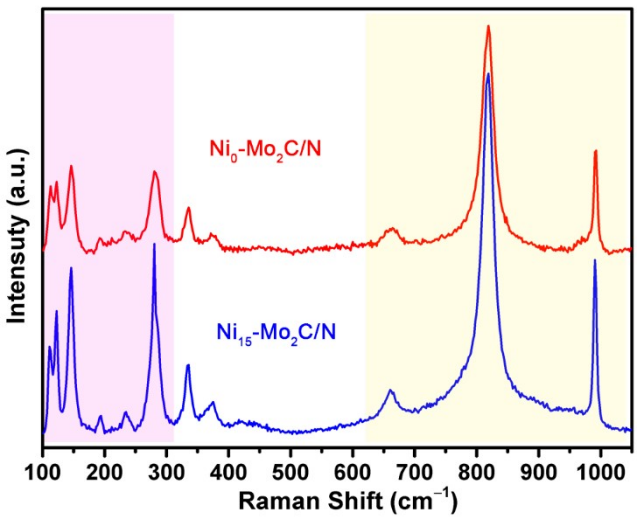

Figure S2. Raman spectrum of Ni_0-Mo_2C/N and Ni_{15}-Mo_2C/N.

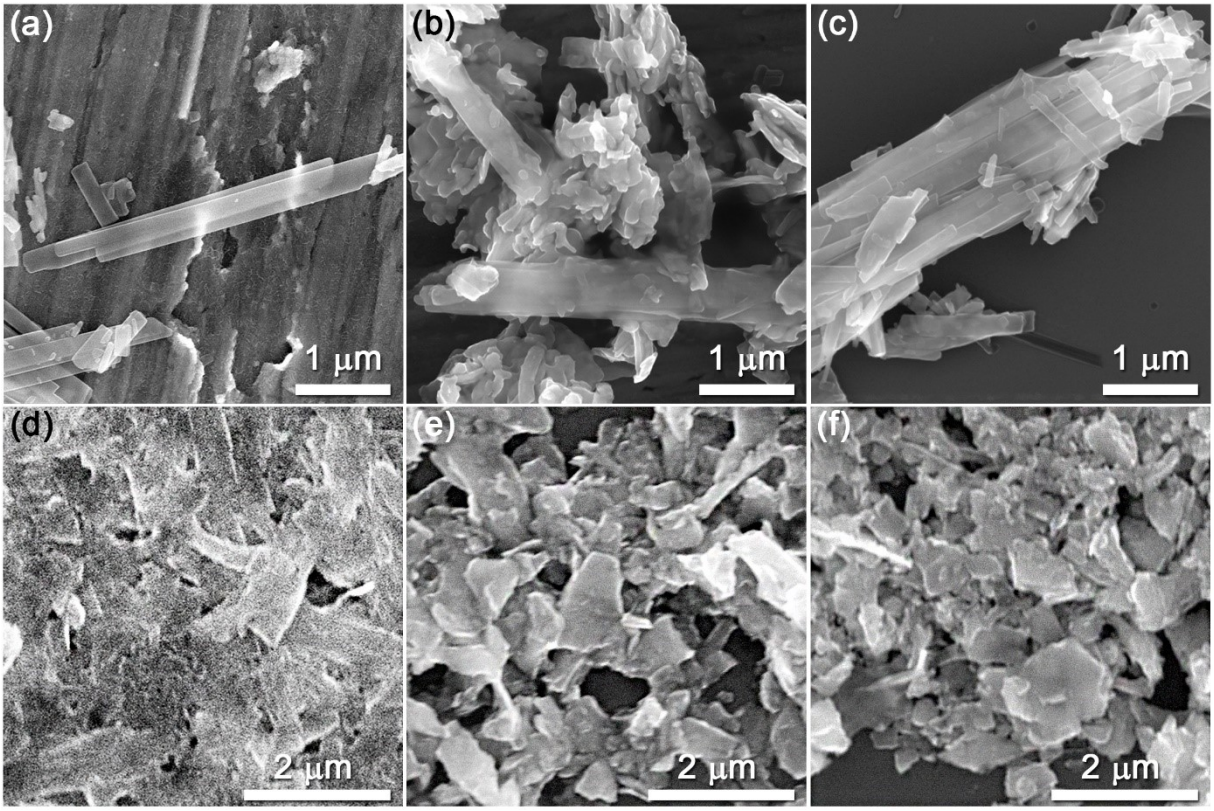

Figure S3. SEM imagines of (a) Ni_0-MoO_3, (b) Ni_0-MoC/N, (c) Ni_0-Mo_2C/N, (d) Ni_{15}-MoO_3; (e) Ni_{15}-MoC/N, and (f) Ni_{15}-Mo_2C/N.

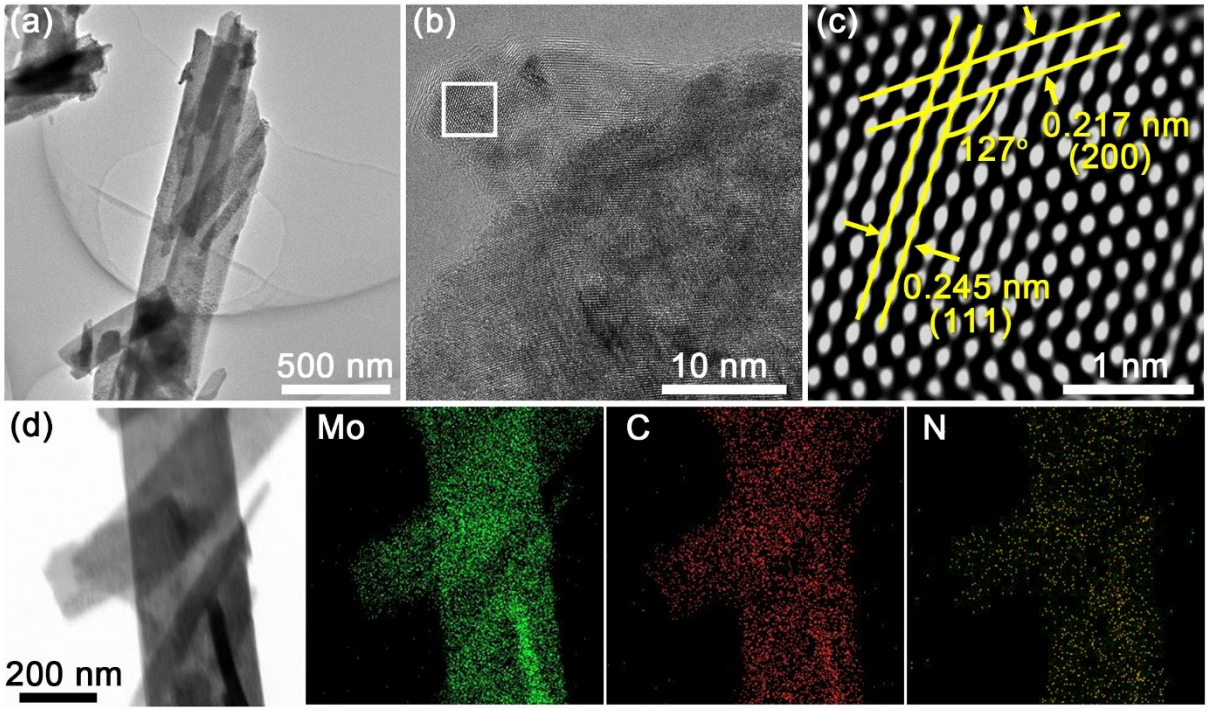

Figure S4. (a) TEM and (b) HRTEM image of Ni_0-Mo_2C/N. (c) The inverse FFT image of the region which labeled in (b). (d) Elemental mappings (Mo, C and N elements) of the Ni_0-Mo_2C/N.

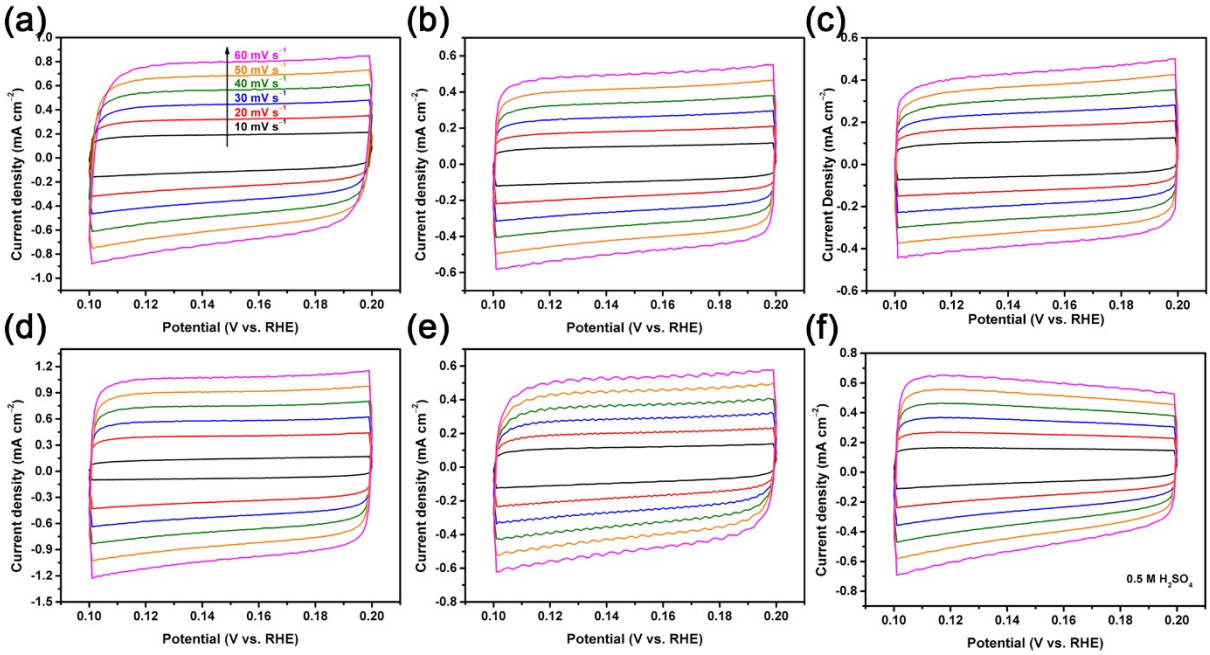

Figure S5. CV curves of the electrocatalysts: (a) Ni_0-Mo_2C/N; (b) Ni_5-Mo_2C/N; (c) Ni_{10}-Mo_2C/N; (d) Ni_{15}-Mo_2C/N; (e) Ni_{20}-Mo_2C/N, and (f) 20% Pt/C, which were measured at various scan rates of 10, 20, 30, 40, 50, and 60 mV s^{-1} in 0.5 M H_2SO_4.

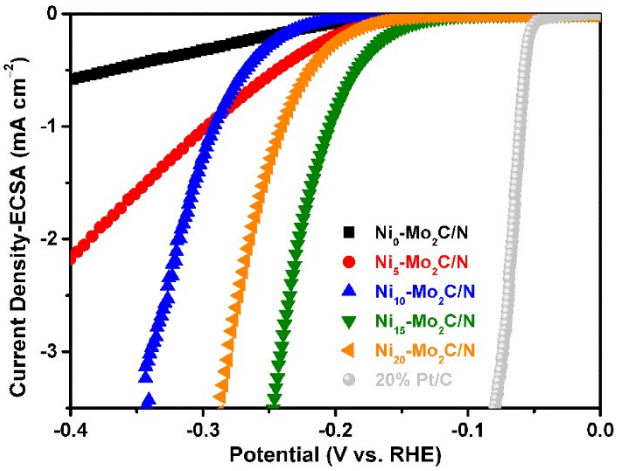

Figure S6. Normalized LSV curves by ECSA of the electrocatalysts in 0.5 M H_2SO_4.

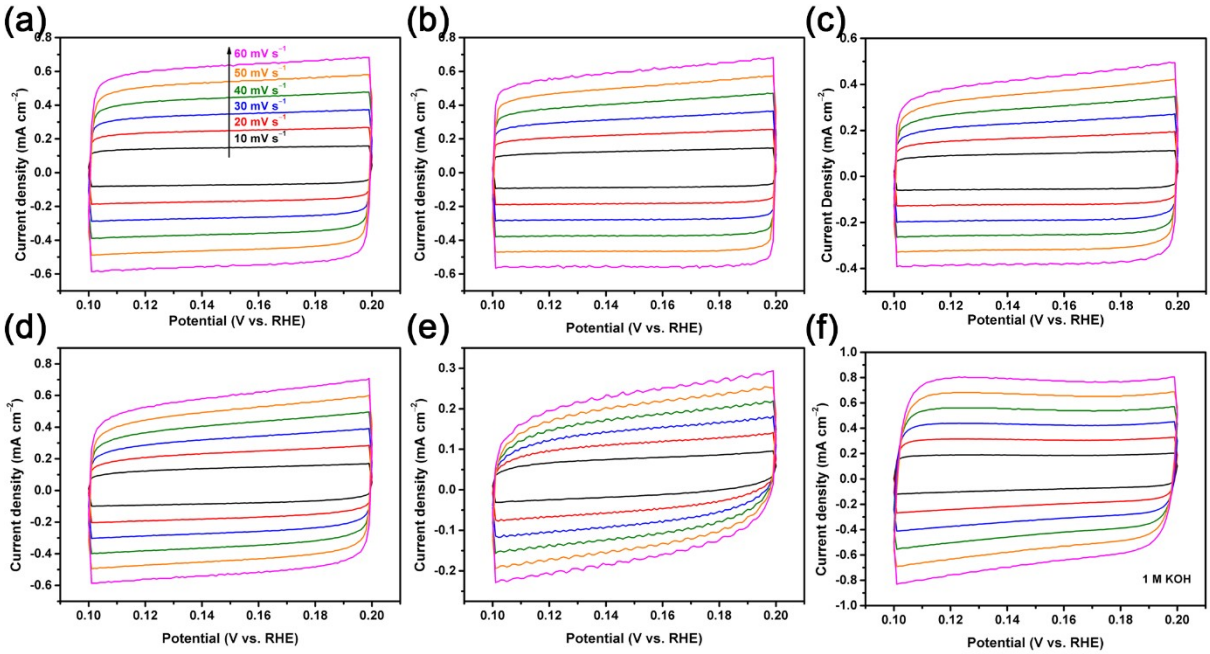

Figure S7. CV curves of the electrocatalysts: (a) Ni_0-Mo_2C/N; (b) Ni_5-Mo_2C/N; (c) Ni_{10}-Mo_2C/N; (d) Ni_{15}-Mo_2C/N; (e) Ni_{20}-Mo_2C/N, and (f) 20% Pt/C, which were measured at various scan rates of 10, 20, 30, 40, 50, and 60 mV s^{-1} in 1 M KOH.

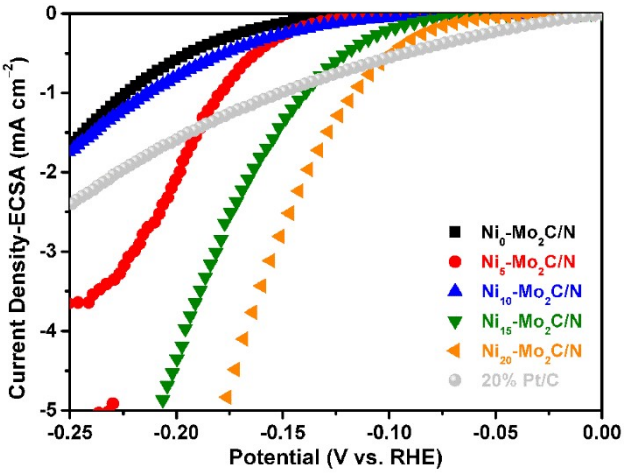

Figure S8. Normalized LSV curves by ECSA of the electrocatalysts in1 M KOH.

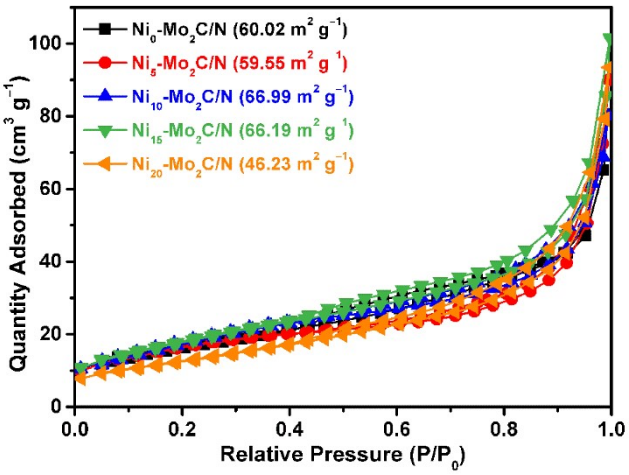

Figure S9. N_2 adsorption-desorption isotherms of the series Ni_x-Mo_2C/N electrocatalysts.

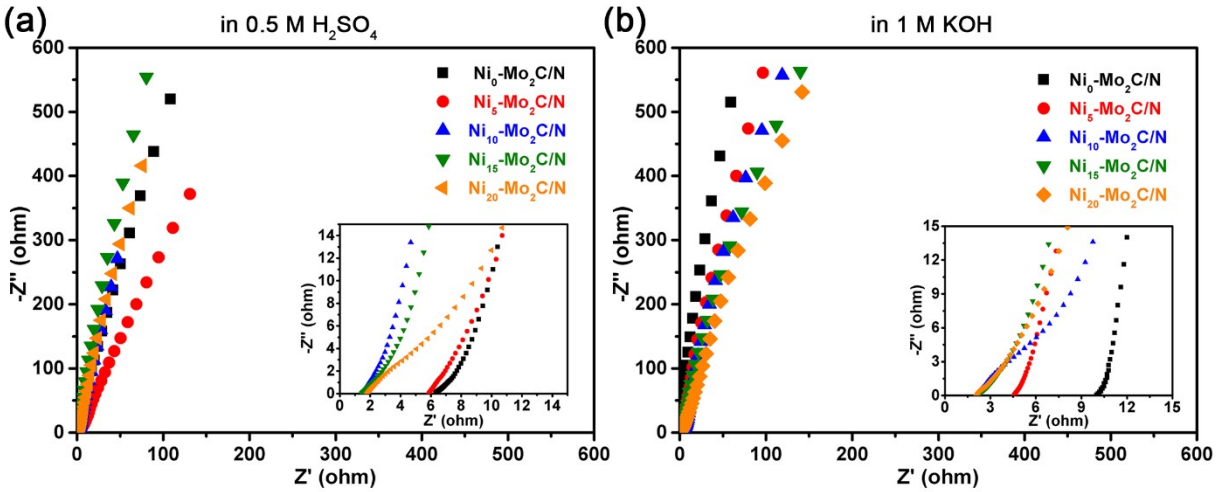

Figure S10. Nyquist plots of Ni_x-Mo_2C/N in (a) 0.5 M H_2SO_4; (b) 1 M KOH.

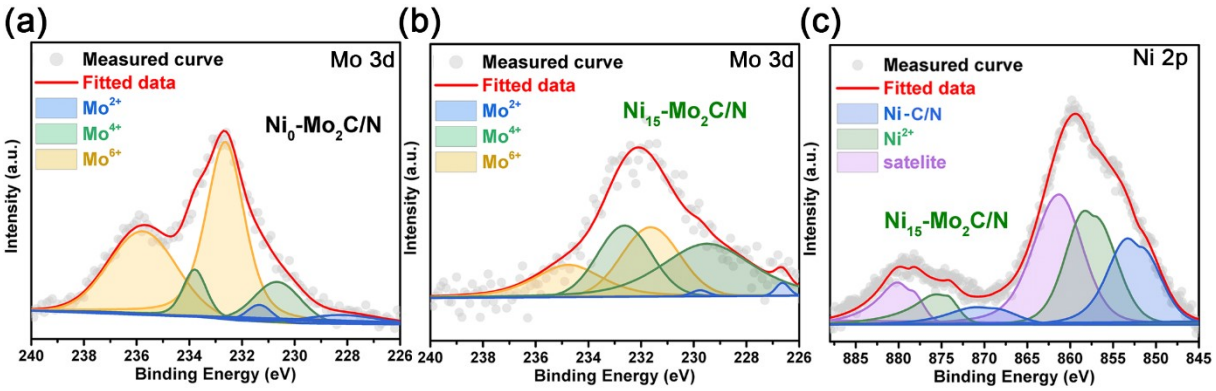

Figure S11. The high-resolution XPS spectra after stability test in 1M KOH: (a) Mo 3d spectrum of Ni_0-Mo_2C/N, (b) Mo 3d and (c) Ni 2p spectra of Ni_{15}-Mo_2C/N.

Table S1 Comparison of element contents in Mo_2C/N, 15% Ni-Mo_2C/N from EDS results.

Samples	Atomic Fraction (%)			
	C	N	Mo	Ni
Mo_2C/N	56.89	6.67	36.44	-
15% Ni-Mo_2C/N	60.53	2.90	35.86	0.71

Table S2 The comparison of HER performance for different catalysts in literatures.

Samples	Overpotential (mV)		Tafel Slopes (mV/dec)		References
	0.5M H_2SO_4	1M KOH	0.5M H_2SO_4	1M KOH	
Ni_{15}-Mo_2C/N	155	110	56.9	46.5	This work
Mo_2C,Mo_2N/N,P-rGO	195	115	60	57	[2]
Mo_2C@C	170	119	58	51	[3]
$Mo_{0.84}Ni_{0.16}$-Mo_2C/NCNFs	229	183	76	71	[4]
Mo_2C@BNC	184	145	68.3	57.4	[5]
Mo_2C	235	152	70.5	40.2	[6]
Mo_2C/NCF	144	100	55	65	[7]
Mo/Mo_2C/N-CNFs	175	162	64.6	47.9	[8]
Fe-Mo_2C@NCF	65	129	110	76	[9]
$Ni_{0.5}$@MoC_x/NC	100	150	53.2	76.1	[10]
PMTC-7HA	172	219	56.2	63.3	[11]
Ni–N–MoC_x	163	124	69.32	106.74	[12]
m-Mo_2C/G	135	128	58	56	[13]
$Ni_{0.5}$@MoC_x/NC	100	150	53.2	74.6	[14]
Ni@Mo_2C-HC800	192	123	98	83	[15]
$Mo_{0.84}Ni_{0.16}$-Mo_2C/NCNFs	-	183	-	71	[16]
Ni-GF/Mo_2C	158	189	159	64	[17]
30 wt.% Ni-MO_2C-R,	-	120	-	49	[18]

Table S3 The internal resistance tested before and after CV in acidic and alkaline conditions.

Samples	0.5 M H_2SO_4 (Ω)		1 M KOH (Ω)	
	Before	After	Before	After
Ni_0-Mo_2C/N	6.31	12.60	10.00	6.42
Ni_5-Mo_2C/N	5.87	5.88	4.56	3.71
Ni_{10}-Mo_2C/N	1.49	1.52	2.14	2.11
Ni_{15}-Mo_2C/N	1.45	1.46	2.19	2.19
Ni_{20}-Mo_2C/N	1.81	1.79	2.09	2.03

Reference

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