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In-situ Generated α-$Co(OH)_2/Co_3Mo$ derived from Co-Mo-N for enhanced electrochemical hydrogen evolution reaction

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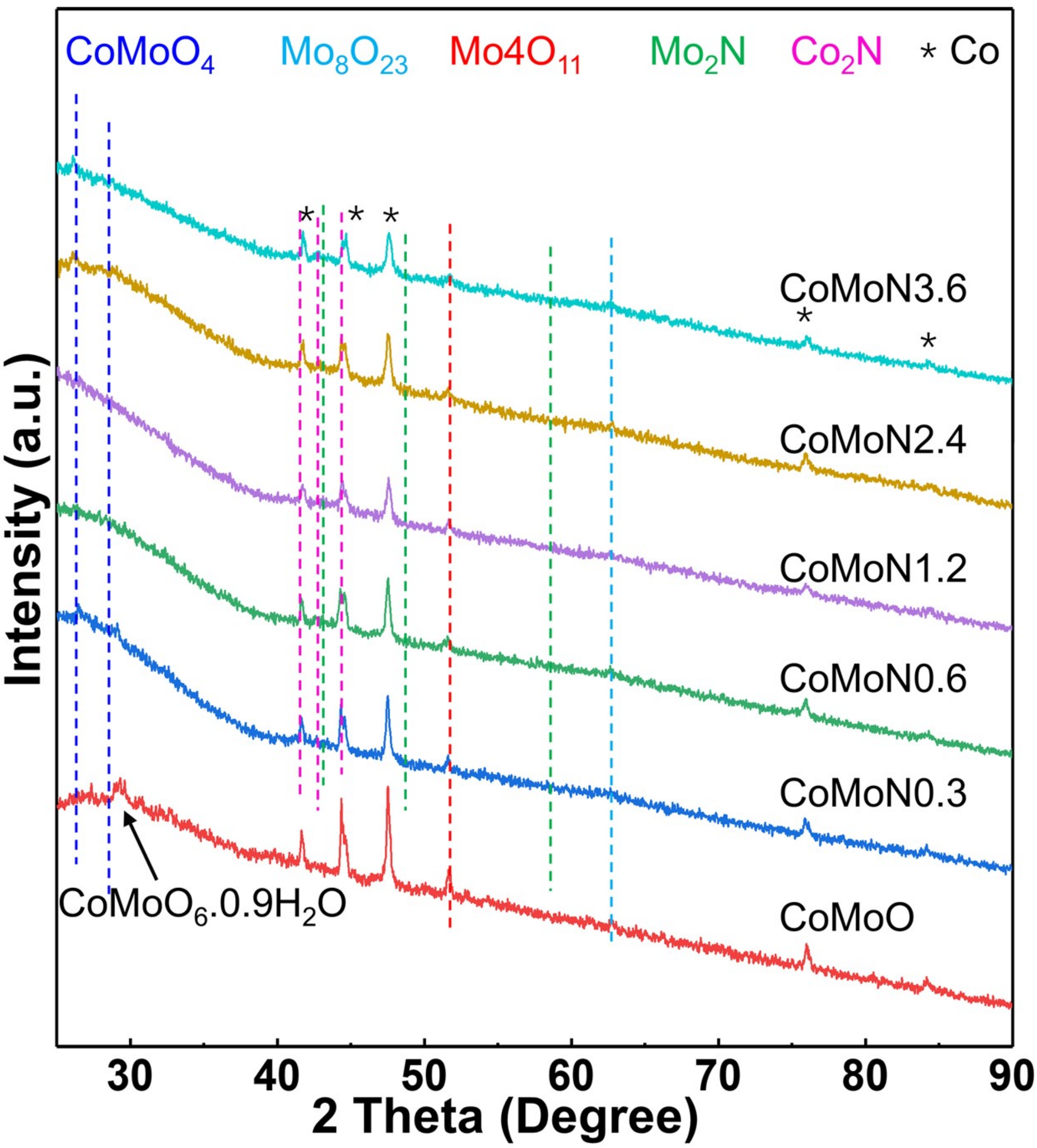

Figure S1. XRD of the CoMoO precursor and samples treated under different N content.

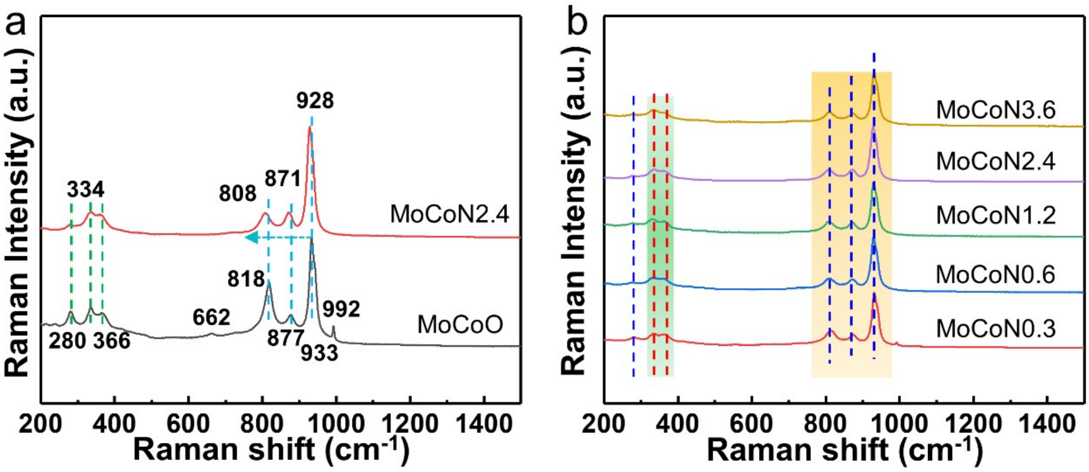

Figure S2. Raman spectra of the CoMoO precursor and CoMoN with different N content.

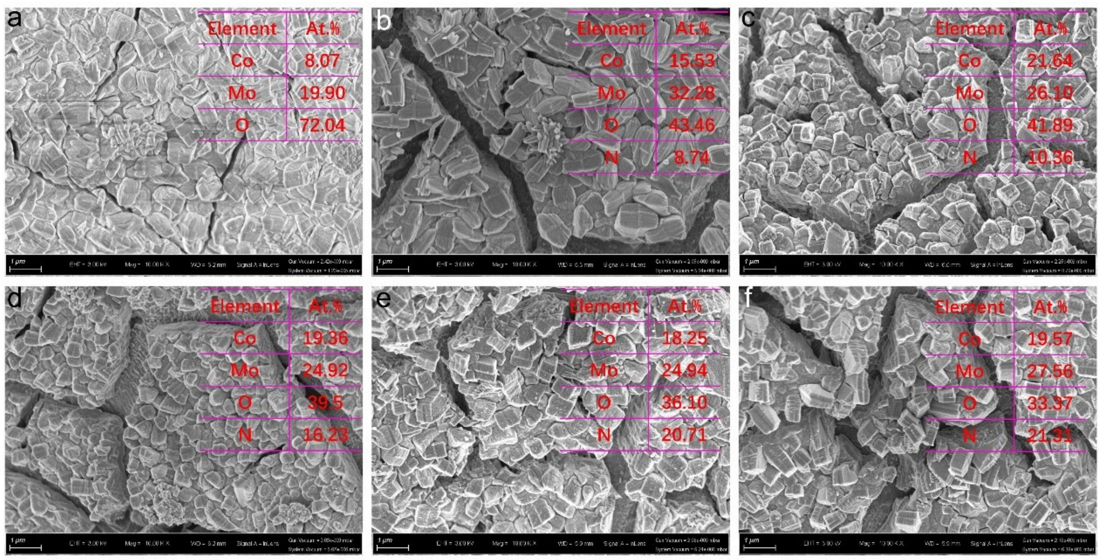

Figure S3. SEM and EDS of the catalysts. (a) CoMoO precursor, (b) CoMoN0.3, (c) CoMoN0.6, (d) CoMoN1.2, (e) CoMoN2.4, (f) CoMoN3.6.

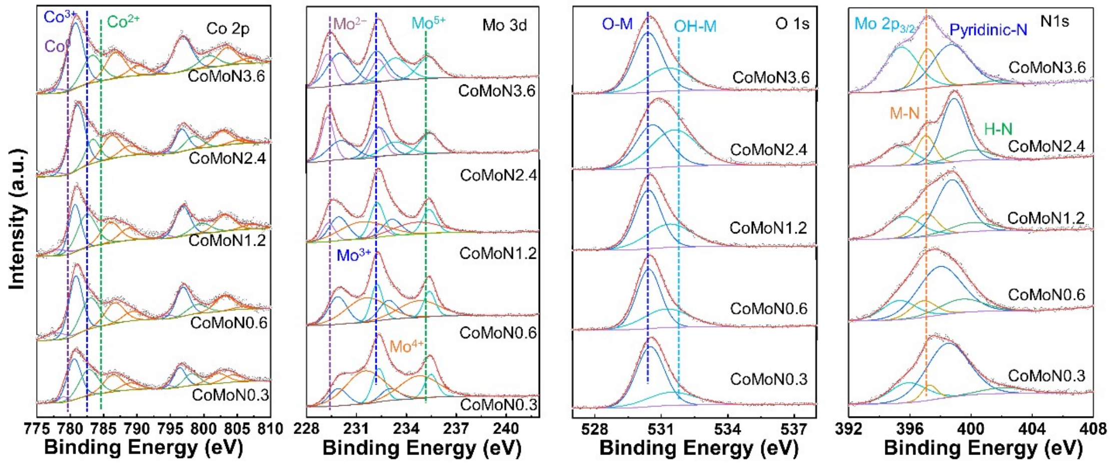

Figure S4. High-resolution XPS spectra of Co 2p, Mo 3d, O 1s, and N 1s in CoMoN with different N content.

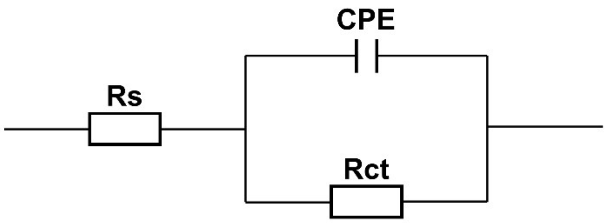

Figure S5. The equivalent circuit for the samples.

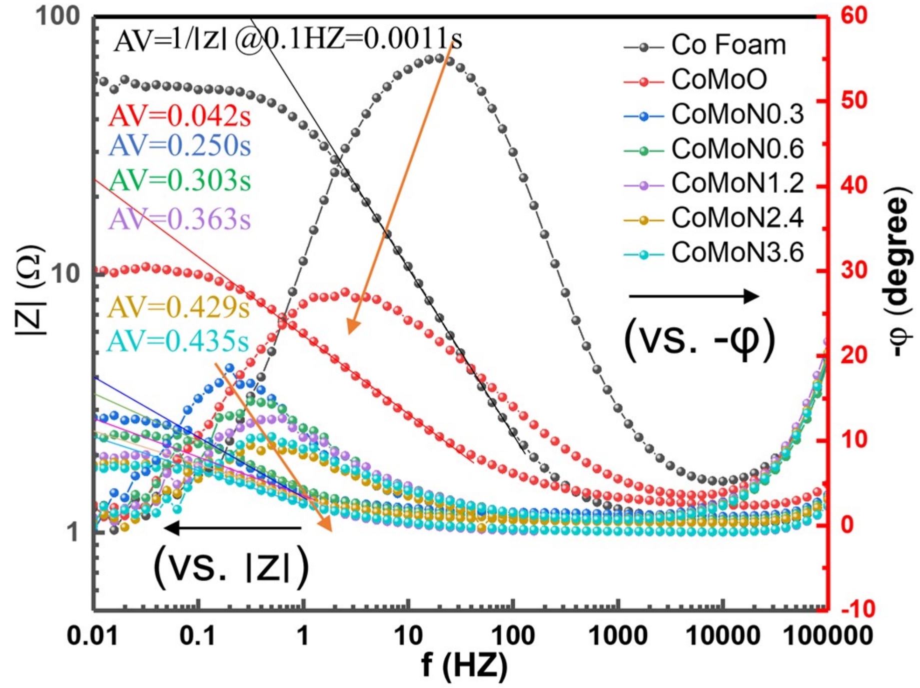

Figure S6. The Bode plots of the samples according to Figure 3c.

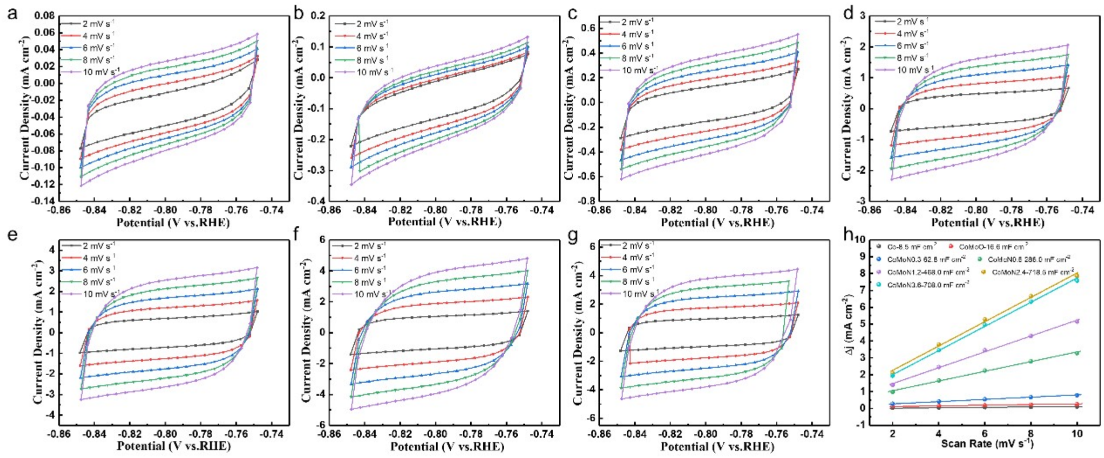

Figure S7. CV curves under different scan rates of Co foam (a), CoMoO (b), CoMoN (0.3), CoMoN (0.6), CoMoN (1.2), CoMoN (2.4), and CoMoN (3.6), and the corresponding C_{dl} calculated from the CV curves.

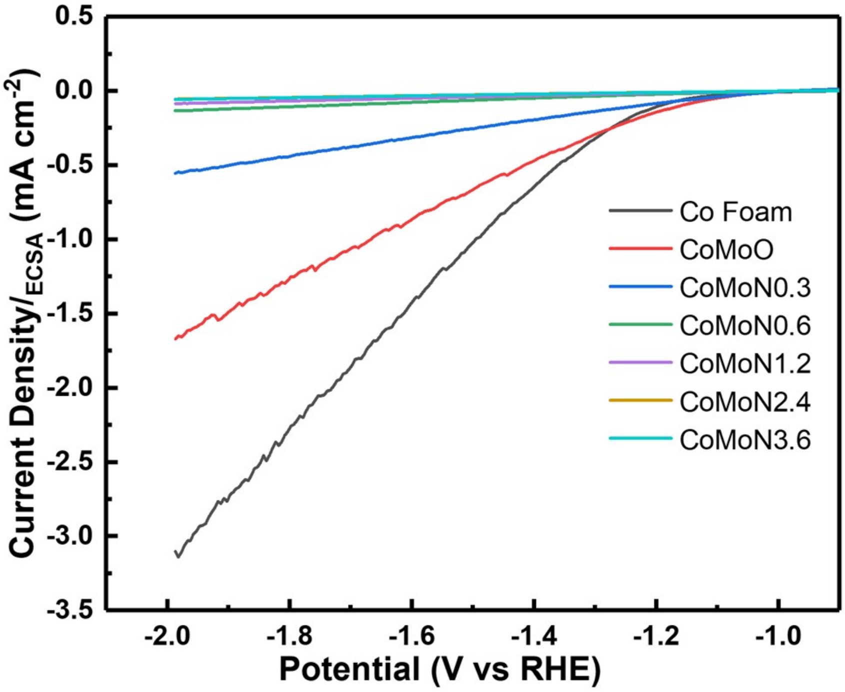

Figure S8 ECSA normalized LSV curves of the samples for HER, ECSA=C_{dl}/C_s(C_s=0.04 mf cm^{-2})[1], the Current Density/$_{ECSA}$= the current density/ECSA.

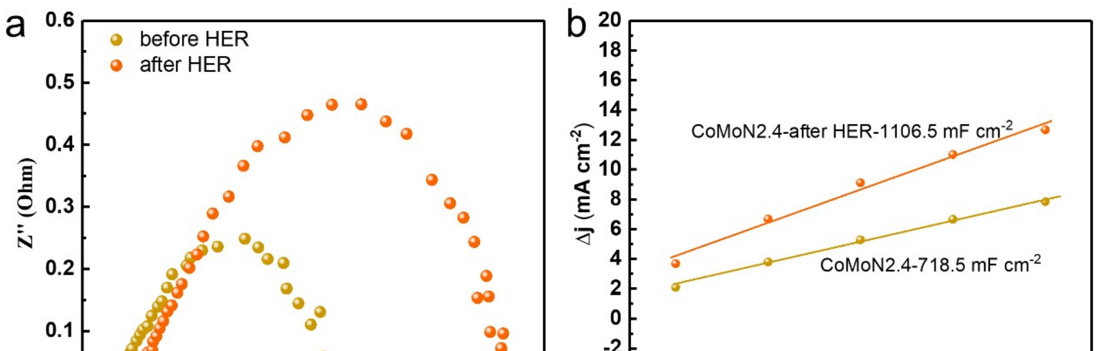

Figure S9. The electrochemical impedance spectroscopies (EIS) and electrochemical double-layer capacitance (C_{dl}) of the CoMoN2.4 before and after the HER long-term stability test.

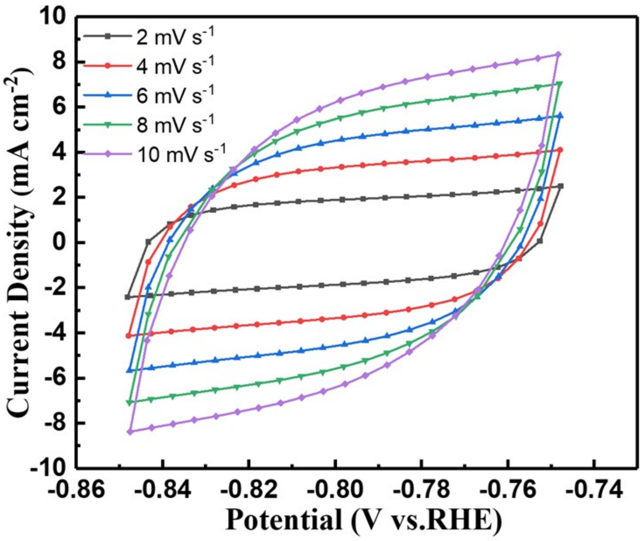

Figure S10. CV curves under different scan rates of CoMoN2.4 after HER stability test

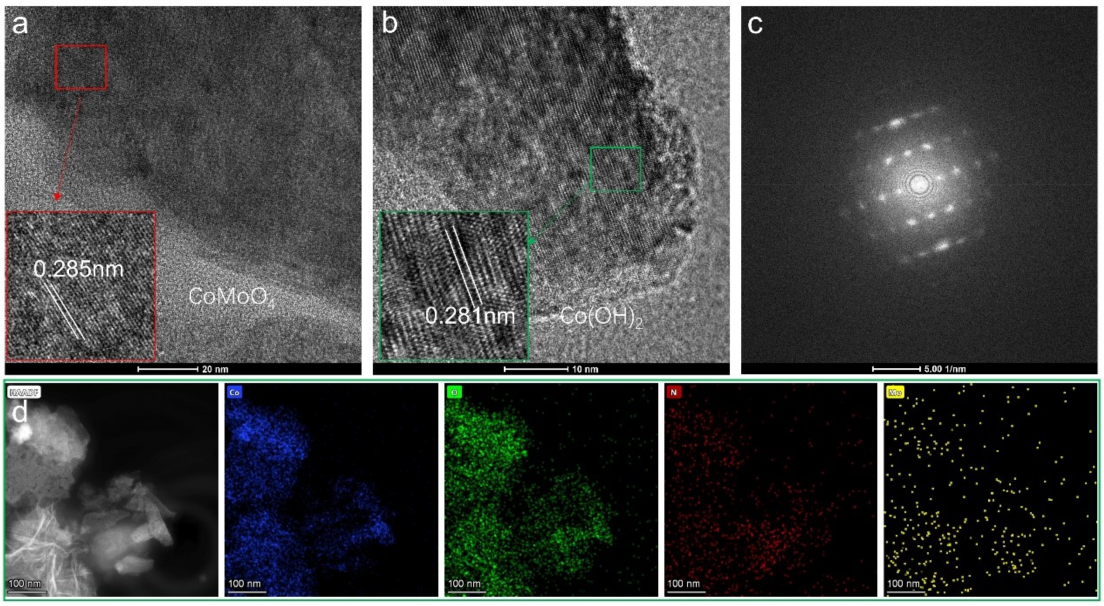

Figure S11. HRTEM images (a) and (b), corresponding SAED pattern of b (c), and EDS mappings (d) of CoMoN2.4.

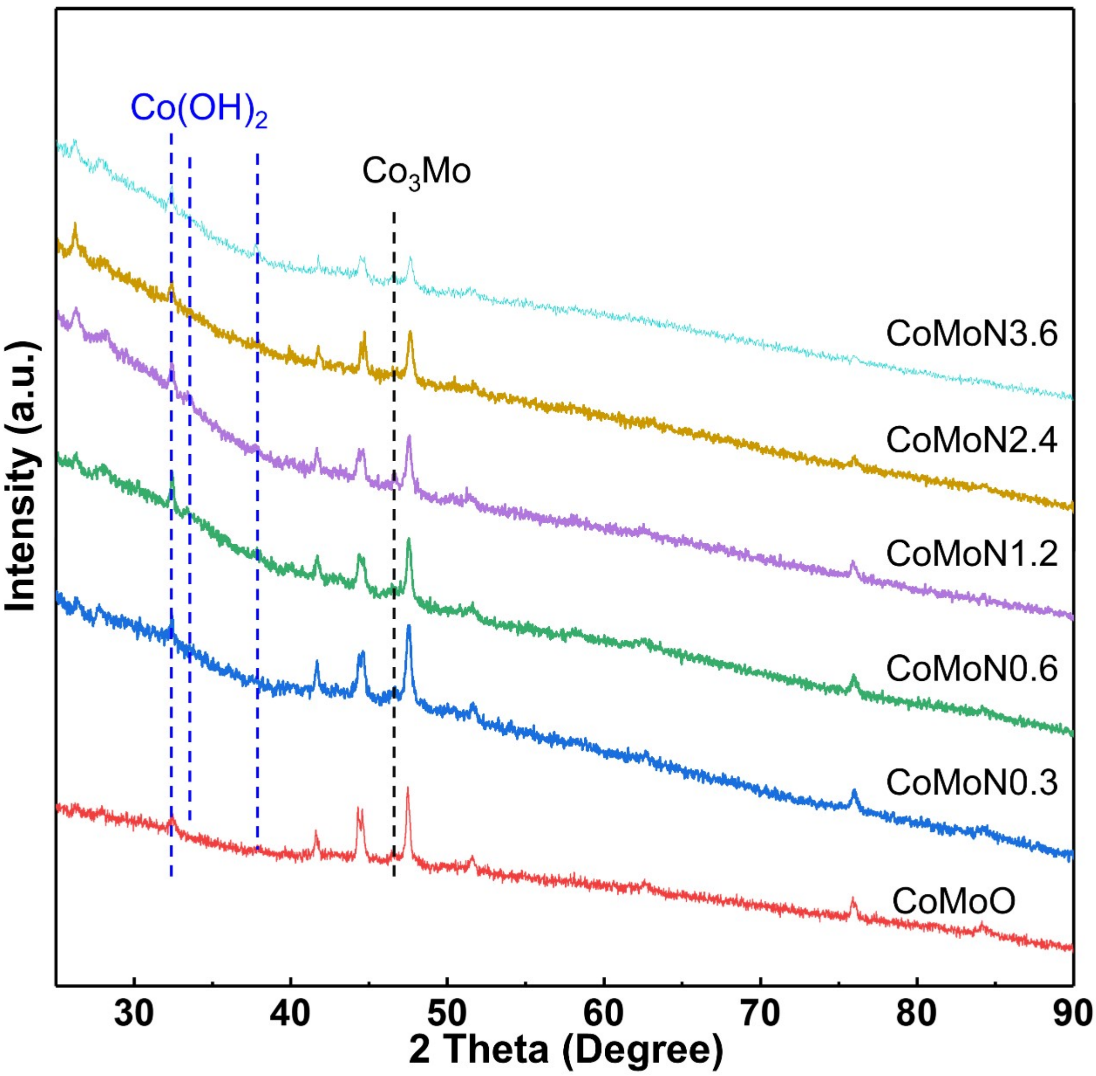

Figure S12. XRD pattern of the samples after a short-time HER test.

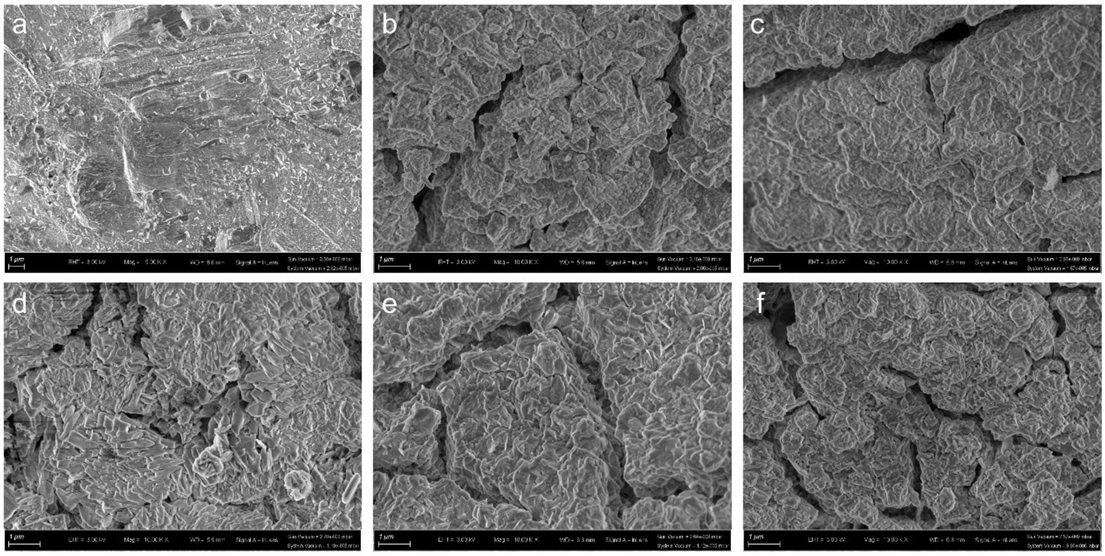

Figure S13. SEM of the catalysts after a short-time HER test. (a) CoMoO precursor, (b) CoMoN0.3, (c) CoMoN0.6, (d) CoMoN1.2, (e) CoMoN2.4, (f) CoMoN3.6.

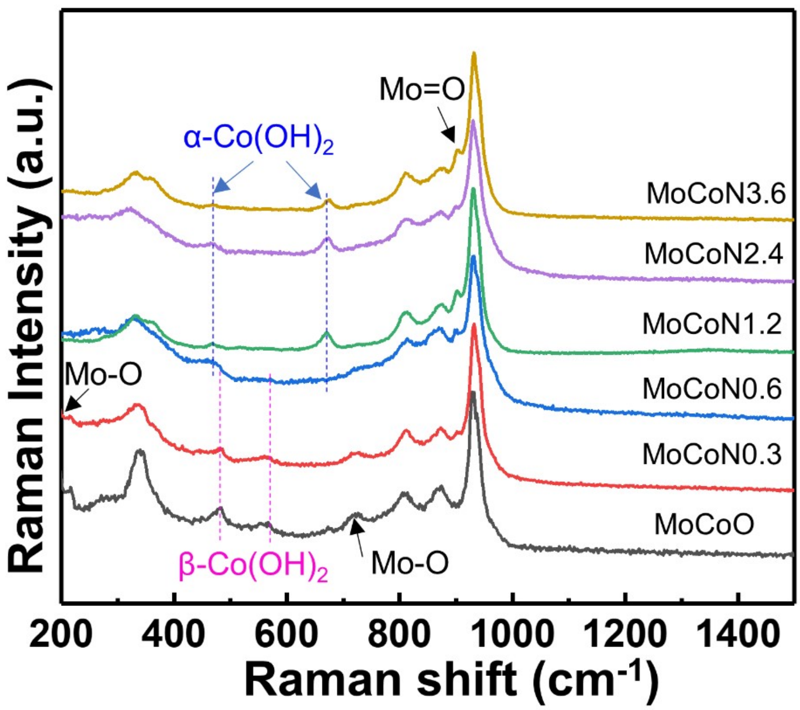

Figure S14. Raman spectra of the samples after a short-time HER test.

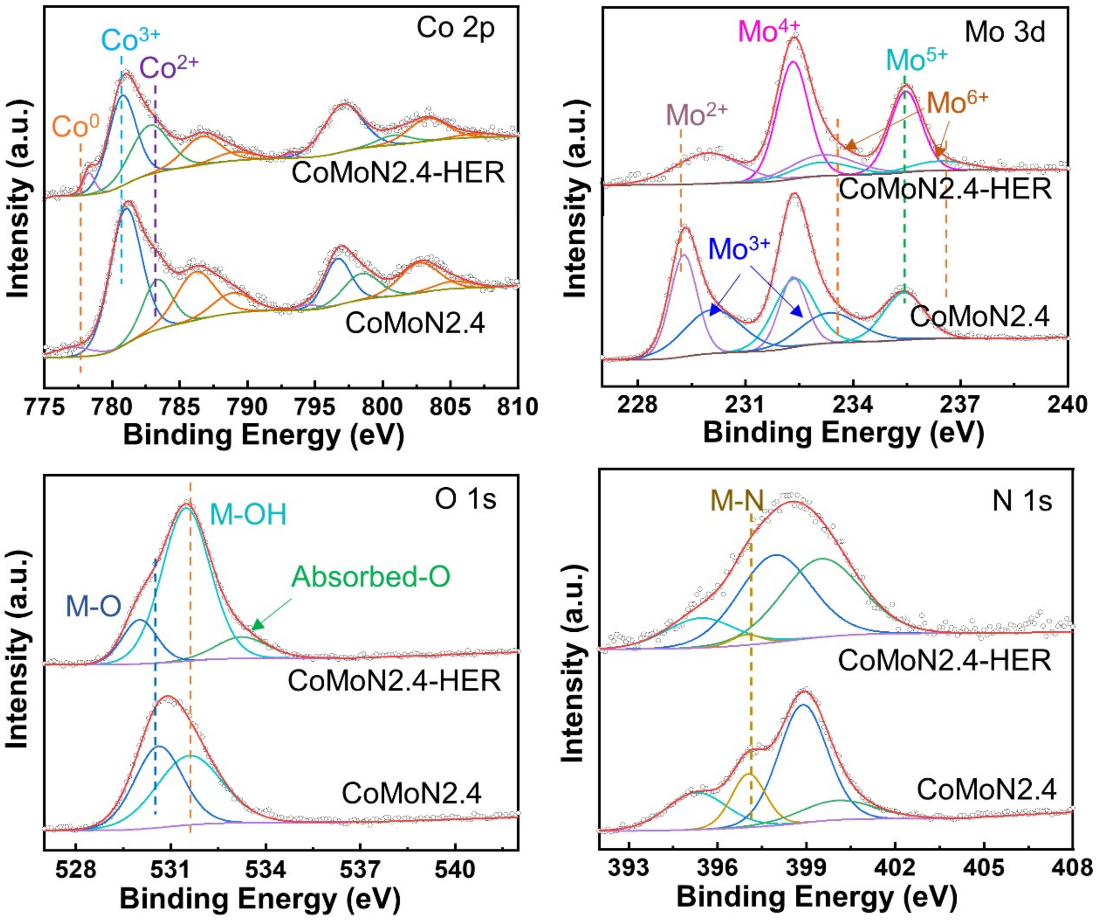

Figure S15. High-resolution XPS spectra of Co 2p, Mo 3d, O 1s, and N 1s in CoMoN2.4 before and after HER long-term stability.

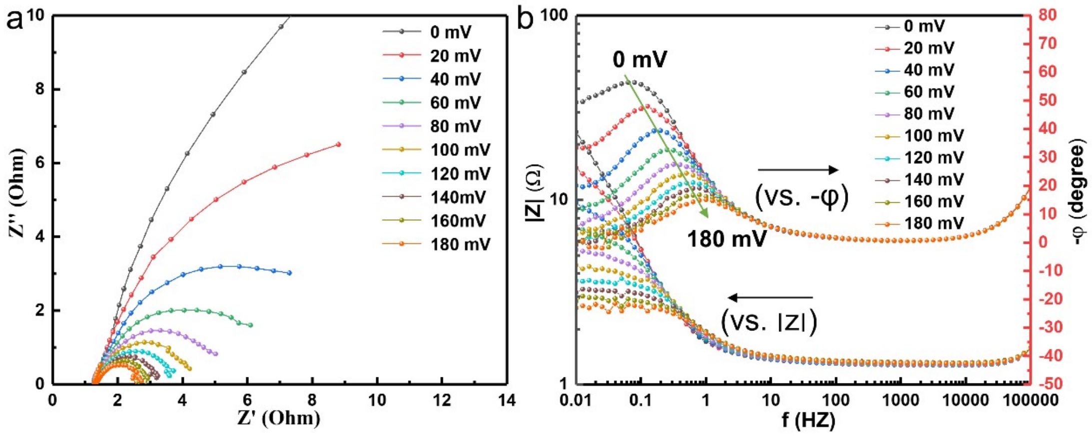

Figure S16. The Nyquist (a) and Bode frequency-resistance plots (b) of CoMoN2.4 under different overpotentials.

Table S1. The HER performance comparison of the nitrides in 1 M KOH.

Note: NF, CC, CFC, CP, and CF represent Ni Foam, Carbon Cloth, Carbon Fiber Cloth, Carbon Paper, and Co Foam, respectively. Y and NA represent Yes and Not Available.

Samples	Preparation Methods	Overpotential under a certain current density	Stability under a certain current density	IR correction	References
Ni_3N_{1-x}/NF	N_2 plasma	55 mV, 10 mA cm^{-2}	50h, 50 mA cm^{-2}	NA	[2]
Ni_3N/NF	Electrodeposition+ Nitridation in NH_3	12 mV, 10 mA cm^{-2}	50h, 10 mA cm^{-2}	Y	[3]
P,Ce-$FeNi_3N$/NF	Hydrothermal	153 mV, 100 mA cm^{-2}	50h, 50 mA cm^{-2}	Y	[4]
Ni_2Mo_3N/NF	Annealed	21.3 mV, 10 mA cm^{-2} 89 mV, 50 mA cm^{-2} 123.8 mV, 100 mA cm^{-2}	24h, 10 mA cm^{-2}	Y	[5]
Ni_3N/NF	Oxided+Nitridation in NH_3	171.9 mV, 50 mA cm^{-2} 207.3 mV, 100 mA cm^{-2}	20h, 24 mA cm^{-2}	Y	[6]

Cr-Co_4N/CC	Hydrothermal+ Nitridation in urea	21 mV, 10 mA cm^{-2} 99 mV, 100 mA cm^{-2}	150h, 10 mA cm^{-2}	NA	7
CoN/CC	Hydrothermal+ Nitridation in urea	150mV, 10 mA cm^{-2} 330 mV, 100 mA cm^{-2}	---	NA	7
NiMoN/NF	Hydrothermal+ Nitridation in NH_3	56mV, 100 mA cm^{-2} 127 mV, 500 mA cm^{-2}	48h, 100/500 mA cm^{-2}	Y	8
VNiN/CP	Hydrothermal+ Nitridation in NH3	95 mV, 10 mA cm^{-2}	12h, 10 mA cm^{-2}	NA	9
Co-Ni_3N/NFF	Hydrothermal+ Nitridation in NH_3	194 mV, 10 mA cm^{-2}	24h, 10-50 mA cm^{-2}	NA	10
Cu_1Ni_2-N/CFC	Solvothermal+ Nitridation in NH_3	71.4 mV, 10 mA cm^{-2}	60h, 10 mA cm^{-2}	NA	11
W_2N_3-powder	Nitridation in NH_3	379 mV, 10 mA cm^{-2}	---	NA	12
cRu-Ni_3N/NF	Hydrothermal+ Nitridation in NH_3	32 mV, 10 mA cm^{-2} 99 mV, 100mA cm^{-2}	100h, 50 mA cm^{-2}	Y	13

Ni_3N/NF	Hydrothermal+ Nitridation in NH_3	92 mV, 10 mA cm^{-2} 125 mV, 100mA cm^{-2}	---	Y	[13]
Co-Mo_5N_6/NFF	Hydrothermal+ Nitridation in NH_3	19 mV, 10 mA cm^{-2} 280 mV, 1000 mA cm^{-2}	10h, 10/50/1000 mA cm^{-2}	Y	[14]
NiMoN/CC	Electrodeposition+N_2 plasma	109 mV, 10 mA cm^{-2}	12h, 10/30/50 mA cm-2	NA	[15]
Ni-Ni_3N/CC	Hydrothermal+N_2 plasma	150 mV, 10 mA cm^{-2}	15h, 100 mA cm^{-2}	Y	[16]
$CoMoN_{0.3}$/CF	Hydrothermal+ Nitridation in urea	74mV, 10 mA cm^{-2} 231mV, 100 mA cm^{-2} 678mV, 500 mA cm^{-2}	---	NA	This work
$CoMoN_{0.6}$/CF	Hydrothermal+ Nitridation in urea	51mV, 10 mA cm^{-2} 194mV, 100 mA cm^{-2} 616mV, 500 mA cm^{-2}	---	NA	This work
$CoMoN_{1.2}$/CF	Hydrothermal+	42mV, 10 mA cm^{-2}	---	NA	This work

	Nitridation in urea	180mV, 100 mA cm^{-2} 595mV, 500 mA cm^{-2}			
$CoMoN_{2.4}$/CF	Hydrothermal+ Nitridation in urea	37mV, 10 mA cm^{-2} 164mV, 100 mA cm^{-2} 578mV, 500 mA cm^{-2}	110h, 10-600 mA cm^{-2}	NA	This work
$CoMoN_{3.6}$/CF	Hydrothermal+ Nitridation in urea	35mV, 10 mA cm^{-2} 164mV, 100 mA cm^{-2} 585mV, 500 mA cm^{-2}	---	NA	This work

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