

Electronic Supplementary Information: Highly Active Nickel-based catalyst for Hydrogen evolution in Anion Exchange Membrane Electrolysis

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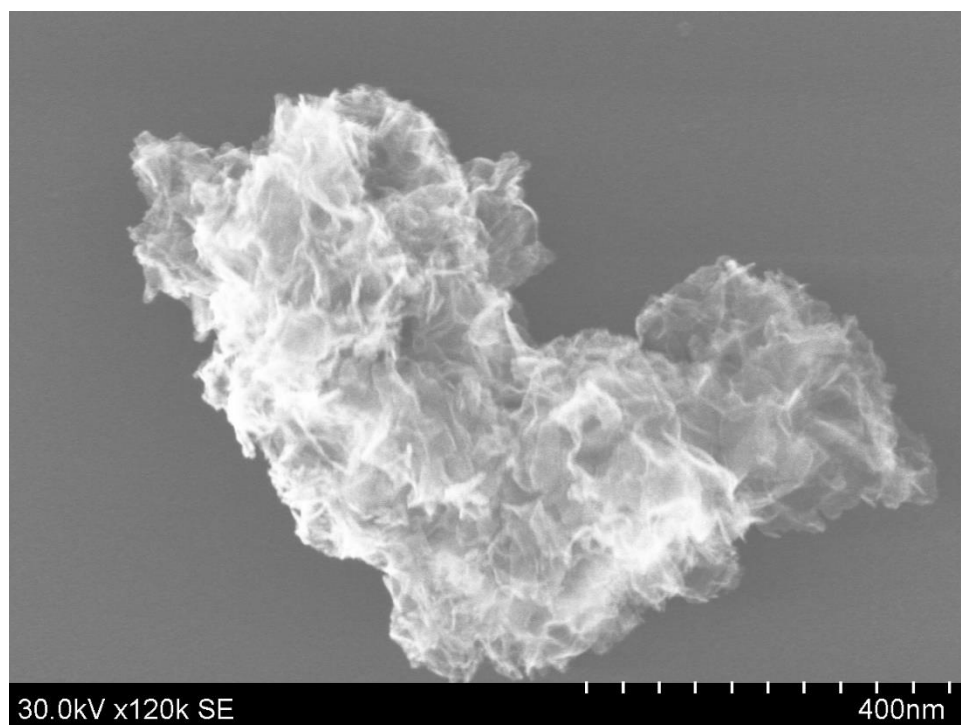
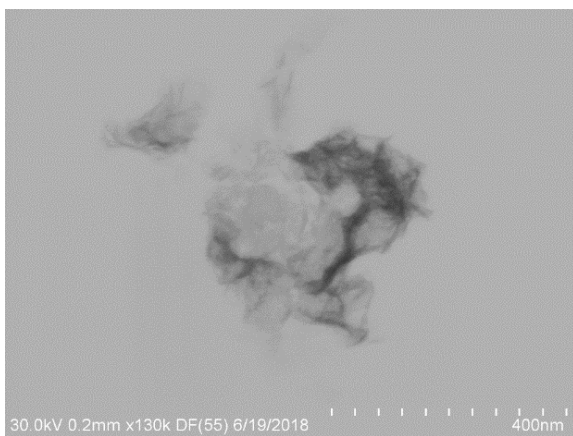


Fig S1: a) SEM image of NiMo nanosheets

a)



B)

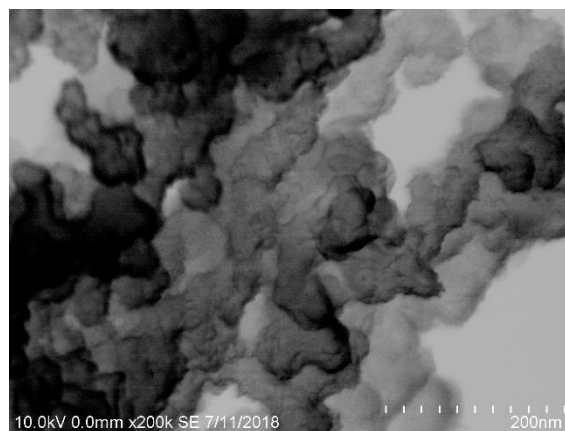


Fig S2 a) Inverted dark field STEM NiMo nanosheets b) NiMo supported in Vulcan x72 prepared by chemical reduction.

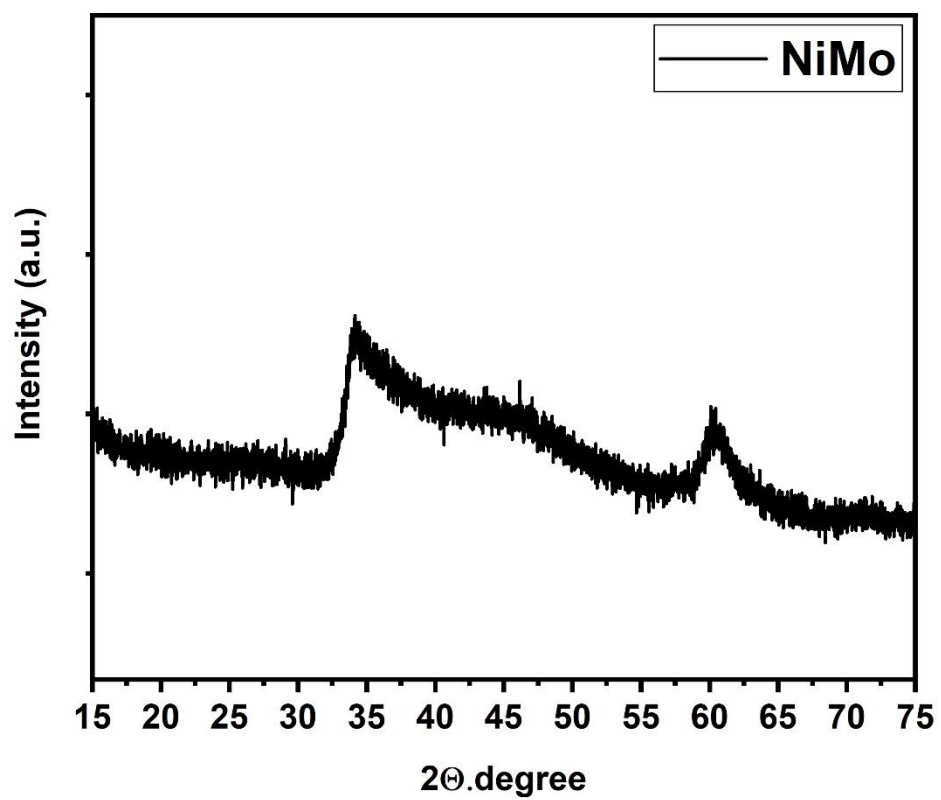


Fig S3: X-ray diffraction pattern of NiMo nanosheets

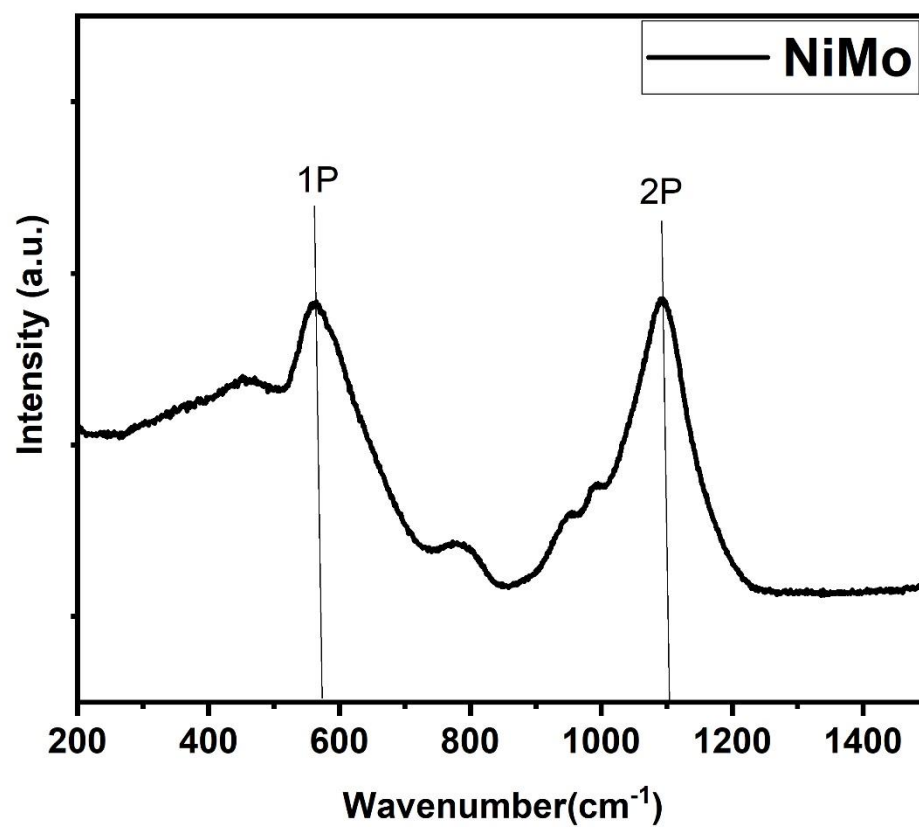


Fig S4: Raman spectrum of NiMo nanosheets

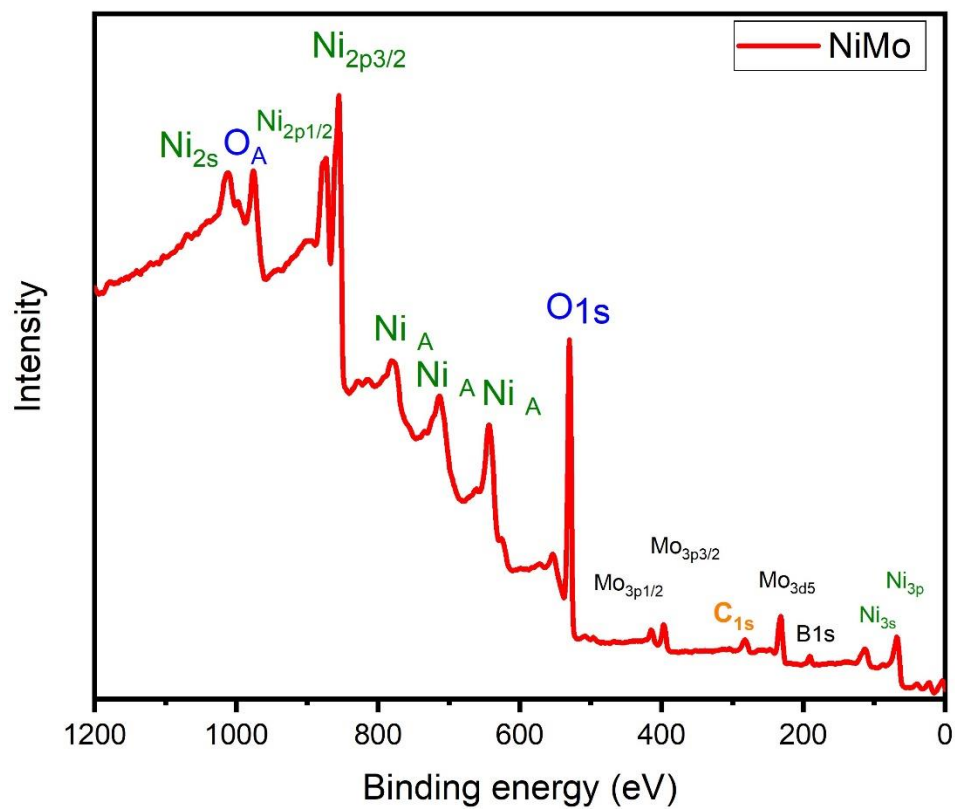


Fig S5: XPS spectrum of NiMo nanosheets

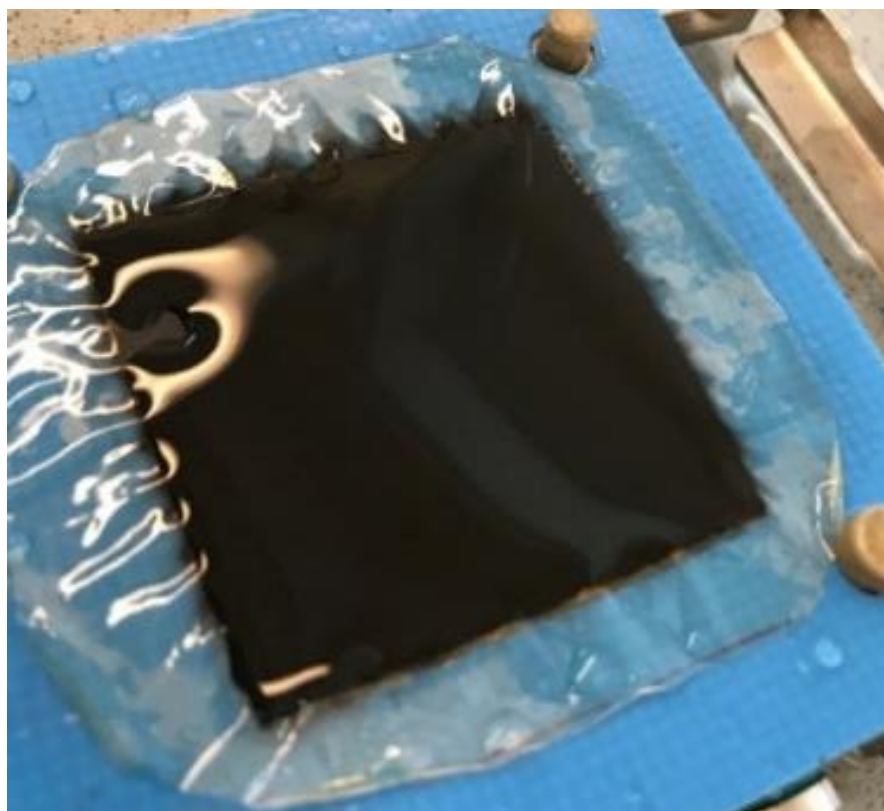


Fig S6: photograph of an individual MEA

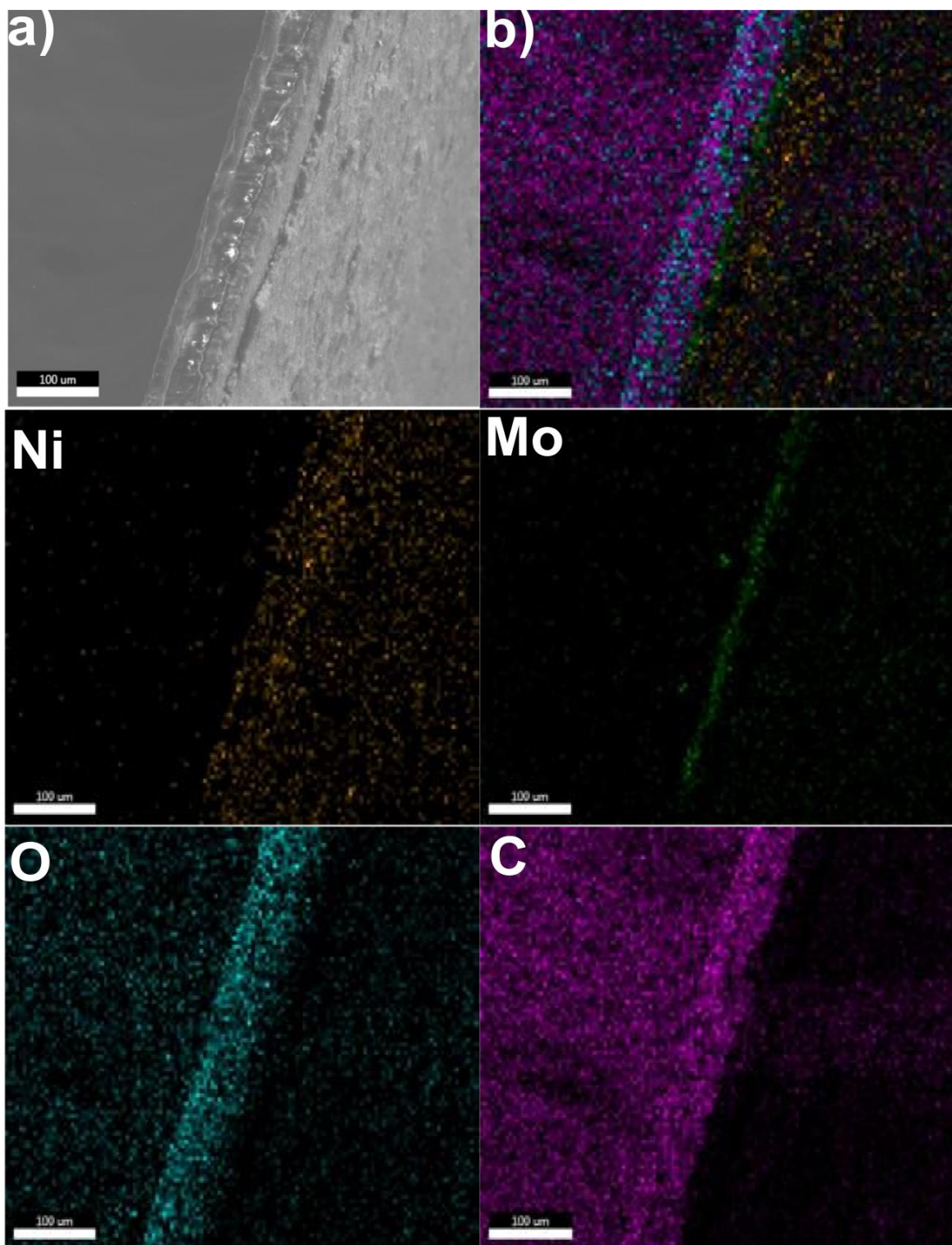


Fig S7: a) SEM image of MEA cross-section, b) EDX mapping of MEA prepared by airbrush spraying, and individual elemental mapping for Ni, Mo, O, and C respectively.

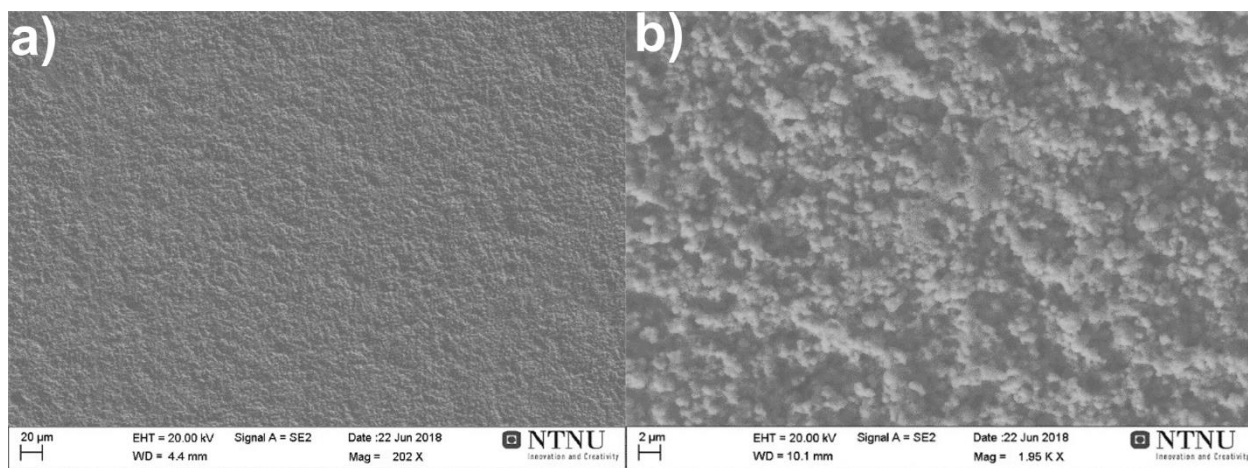


Fig S8: a) SEM image of NiMo/x72 cathode surface in MEA, b) SEM image of Ir anode surface in MEA prepared by airbrush spraying.

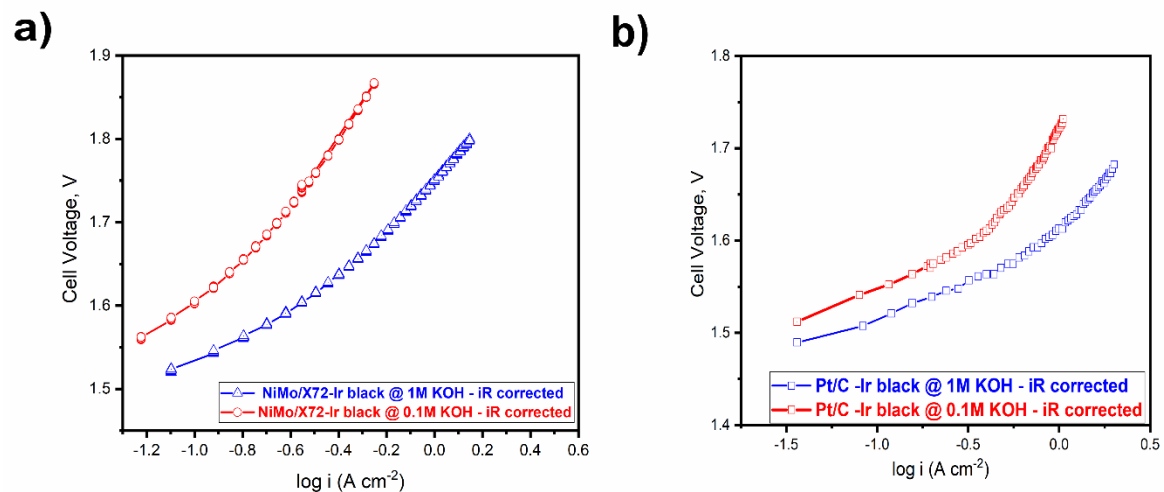


Fig S9: Tafel analysis of a) NiMo/X72 cell and b) Pt/C cell in 1 and 0.1 M KOH.

Tafel Impedance Z_t (impedance multiplied with the steady-state current density i_{st})^{1,2}

$$Z_t = \frac{E}{i} i_{st}$$

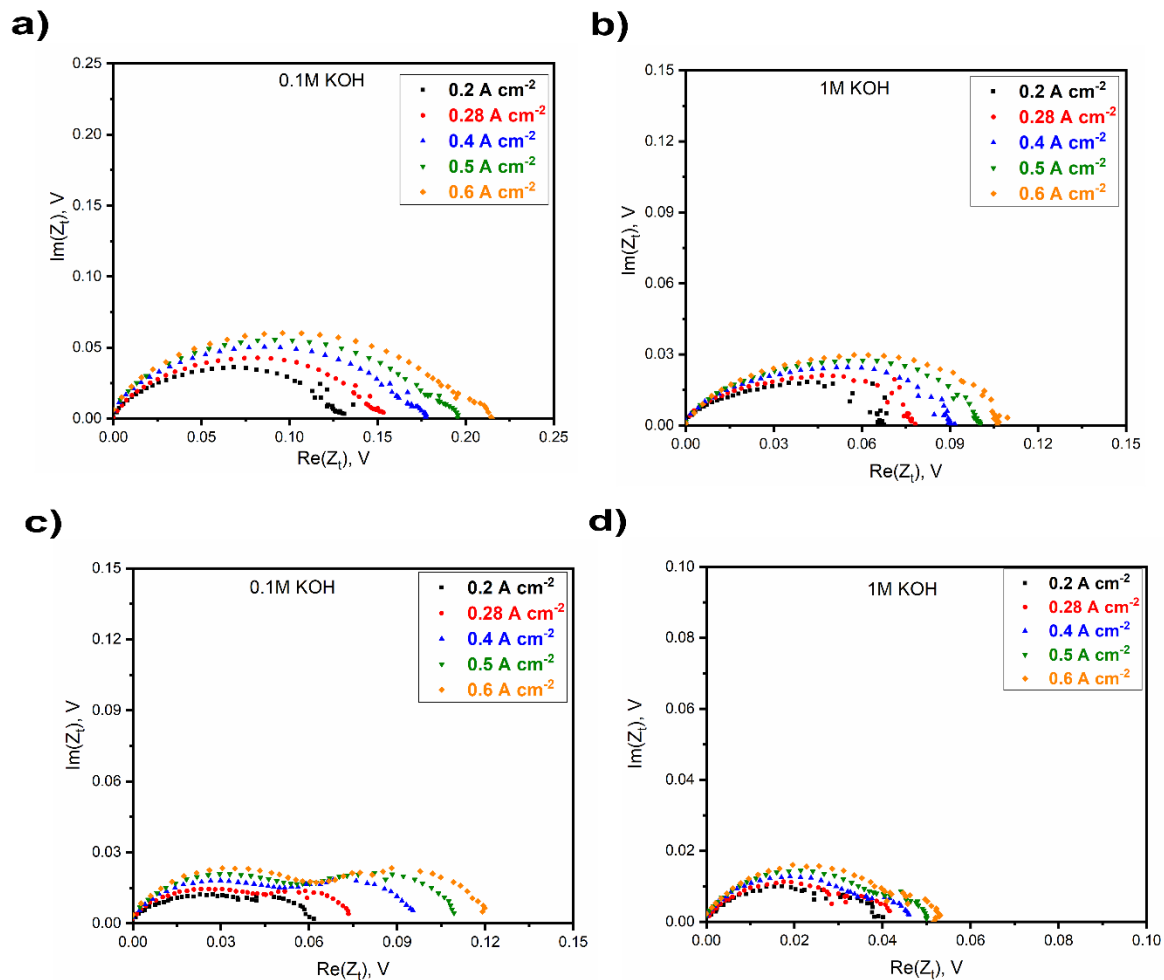


Fig S10: Tafel impedance analysis of a) and b) NiMo/X72 cell in 0.1 M and 1 M KOH respectively, c) and d) Pt/C cell in 0.1 and 1 M KOH respectively.

Table S1 Tafel impedance of NiMo/X72 cell and Pt/C cell in 0.1 and 1M KOH at different current density.

Applied current density A cm ⁻²	Tafel Impedance NiMo (V)		Tafel Impedance Pt (V)	
	1 M KOH	0.1 M KOH	1 M KOH	0.1 M KOH
0.2	0.07	0.13	0.04	0.06
0.28	0.08	0.16	0.045	0.08
0.4	0.095	0.18	0.05	0.1
0.5	0.0101	0.2	0.052	0.15
0.6	0.0108	0.22	0.053	0.121

Table S2 Review of AEM water electrolysis performance and development

Membrane electrode assembly						Electrolyte	Performance	Ref
Anode catalyst	Anode loading. mg/cm ²	Cathode catalyst	Cathode loading	Membrane	Ionomer			
Ir	3	NiMo/X 72	5	Fuma FAA 3-PE-30	Fuma FAA 3	1 M KOH	1 A/cm ² at 1.9 V, 50 °C	This work
Ir	3	Pt/C	1	Fuma FAA 3-PE-30	Fuma FAA 3	1 M KOH	1 A/cm ² , at 1.8 V, 50 °C	This work
IrO ₂	2.9	Pt black	3.2	A-201, Tokuyama	AS-4	DI water	399 mA/cm ² at 1.8V, 50 °C	³
Ni/CeO ₂ -La ₂ O ₃ /C	36	CuCoO ₃	7.4	A-201, Tokuyama	PTFE	1% K ₂ CO ₃ /KHCO ₃	470 mA/cm ² at 1.9V, 50 °C	⁴
Ni-Fe	40	Ni-Mo	40	xQAPS	xQAPS	DI water	400 mA/cm ² at 1.85V, 70 °C	⁵
Ni	0.085	Ni	0.085	A-201, Tokuyama	-	1 M KOH	150 mA/cm ² at 1.9V, 50 °C	⁶
Ni/CeO ₂ -La ₂ O ₃ /C		CuCoO ₃		LDPE-g-VBC	AS-4			⁷
Cu _{0.7} Co _{2.3} O ₄	3	Pt	1	Quaternary ammonium		1 M KOH	100 mA/cm ² at 1.8V, 25 °C	⁸
Cu _{0.7} Co _{2.3} O ₄	3	Nano Ni	2	radiation grafted membrane mm-qPVBz/Cl ⁻	QPVB/Cl ⁻	Deionized water	100 mA/cm ² at 1.9V, 55 °C	⁹
Cu _{0.7} Co _{2.3} O ₄	3	Nano Ni	2	QPDTB	Poly(DM AEMA-co-TFEMA-co-BMA)	Deionized water	100 mA/cm ² at 1.9V, 50 °C	¹⁰
Ce _{0.2} MnFe _{1.8} O ₄	3.5	Ni	3.5	FAA-3-PK-130		Deionized water	300 mA/cm ² at 1.8V	¹¹

References ESI:

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