

Electronic Supplementary Information: Highly Active Nickel-Based Catalyst for Hydrogen Evolution in Anion Exchange Membrane Electrolysis

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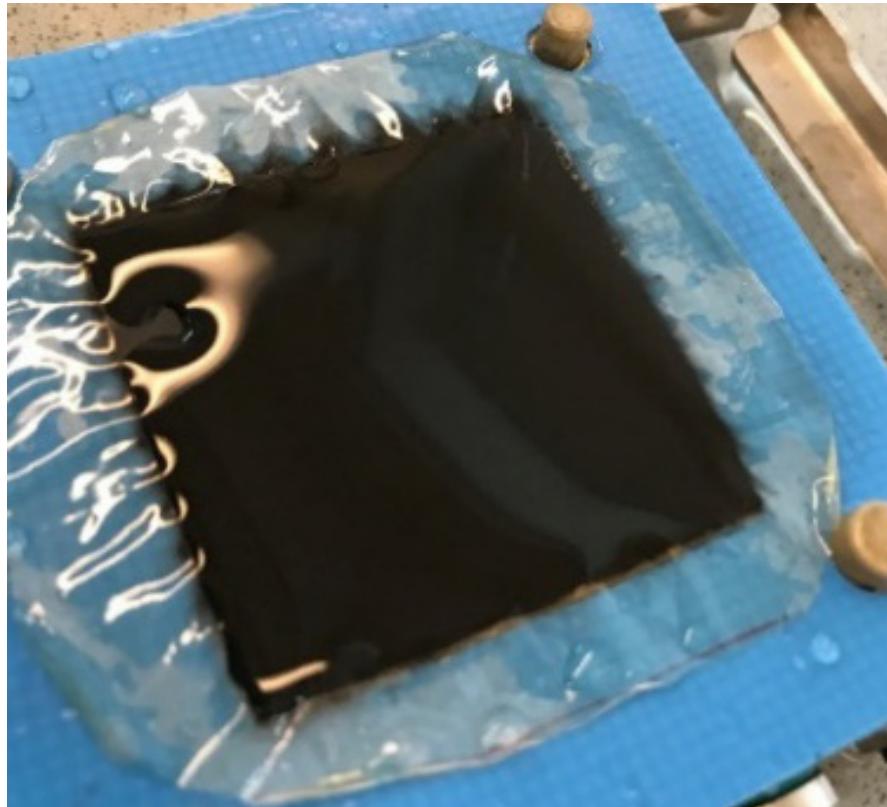


Figure S1. Photograph of an individual MEA.

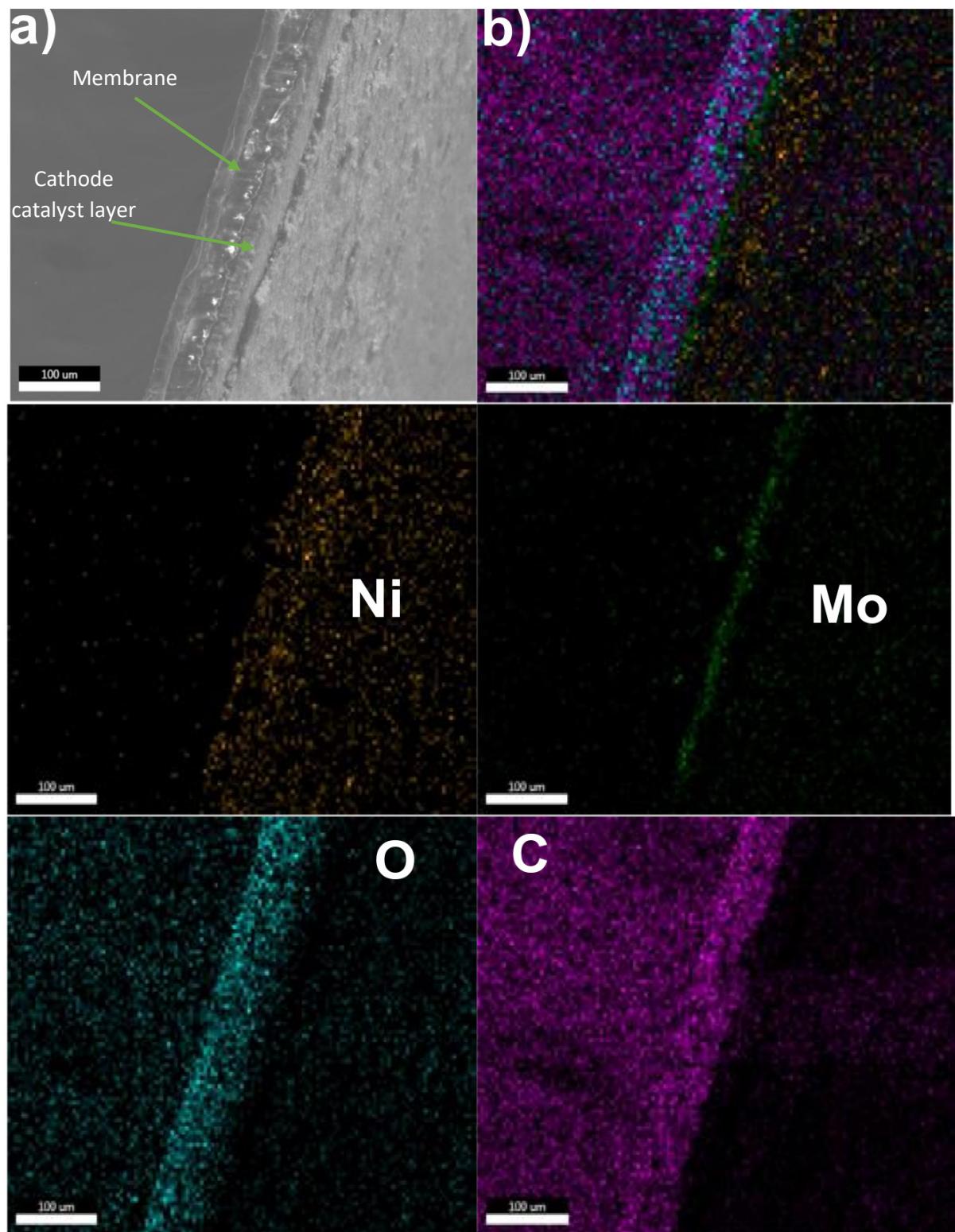


Figure S2. a) SEM image of MEA cross-section, b) EDX mapping of MEA prepared by airbrush spraying, and individual elemental mapping for Ni(yellow), Mo(green), O(Teal), and C (Fuchsia) respectively.

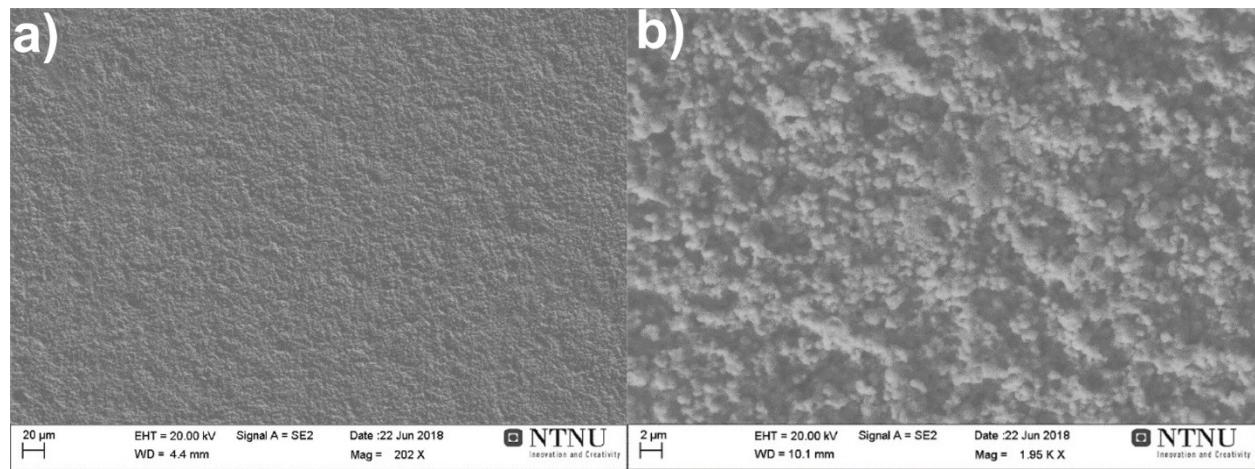


Figure S3. a) SEM image of NiMo/x72 cathode surface in MEA, b) SEM image of Ir anode surface in MEA prepared by airbrush spraying.

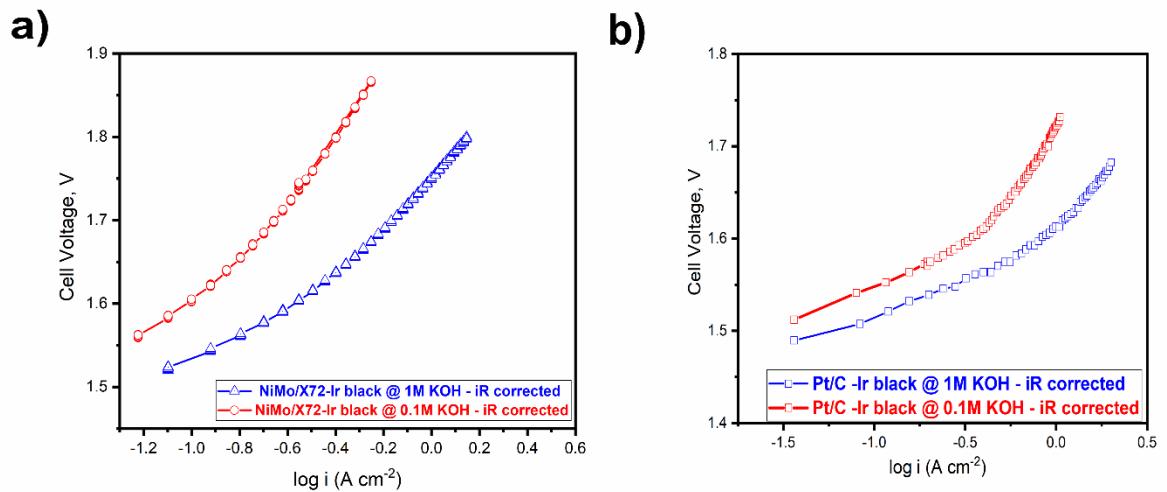
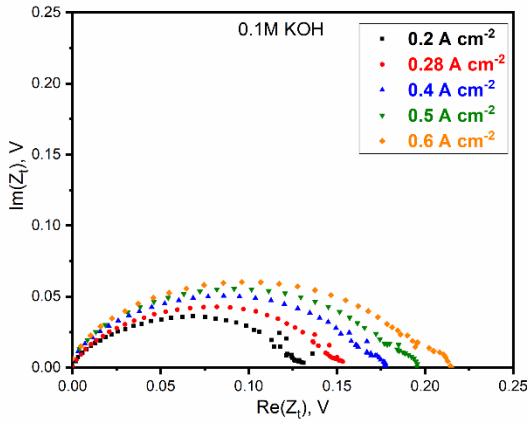


Figure S4. Tafel analysis from polarization curves of a) NiMo/X72 cell and b) Pt/C cell in 1 and 0.1 M KOH.

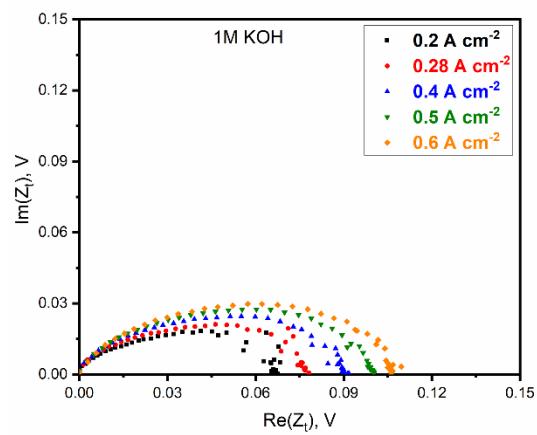
Tafel Impedance Z_t (impedance multiplied with the steady-state current density i_{st})^{1,2}

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

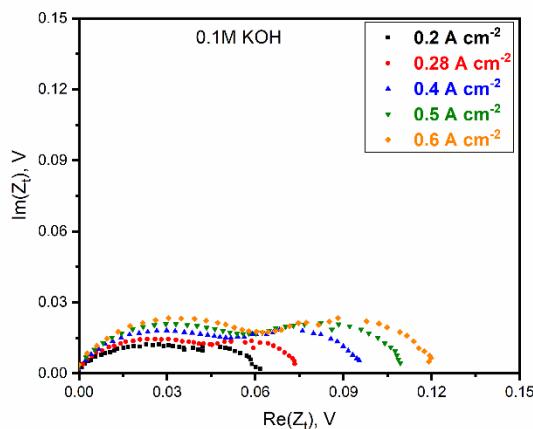
a)



b)



c)



d)

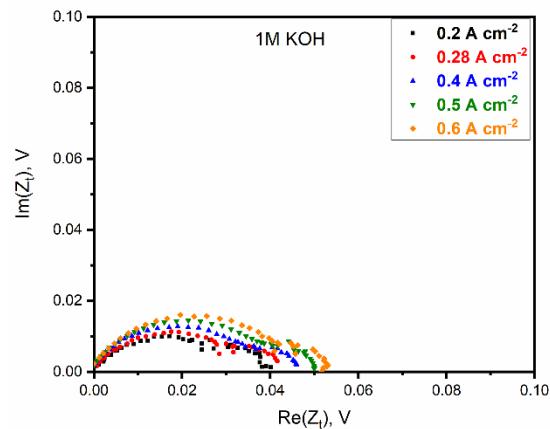


Figure S5. Tafel impedance analysis of a) and b) NiMo/X72 cell in 0.1 M and 1 M KOH respectively, c) and d) Pt/C cell in 0.1 and 1 M KOH respectively.

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	0.101	0.2	0.052	0.15
0.6	0.108	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/X72	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

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