

Supporting Information

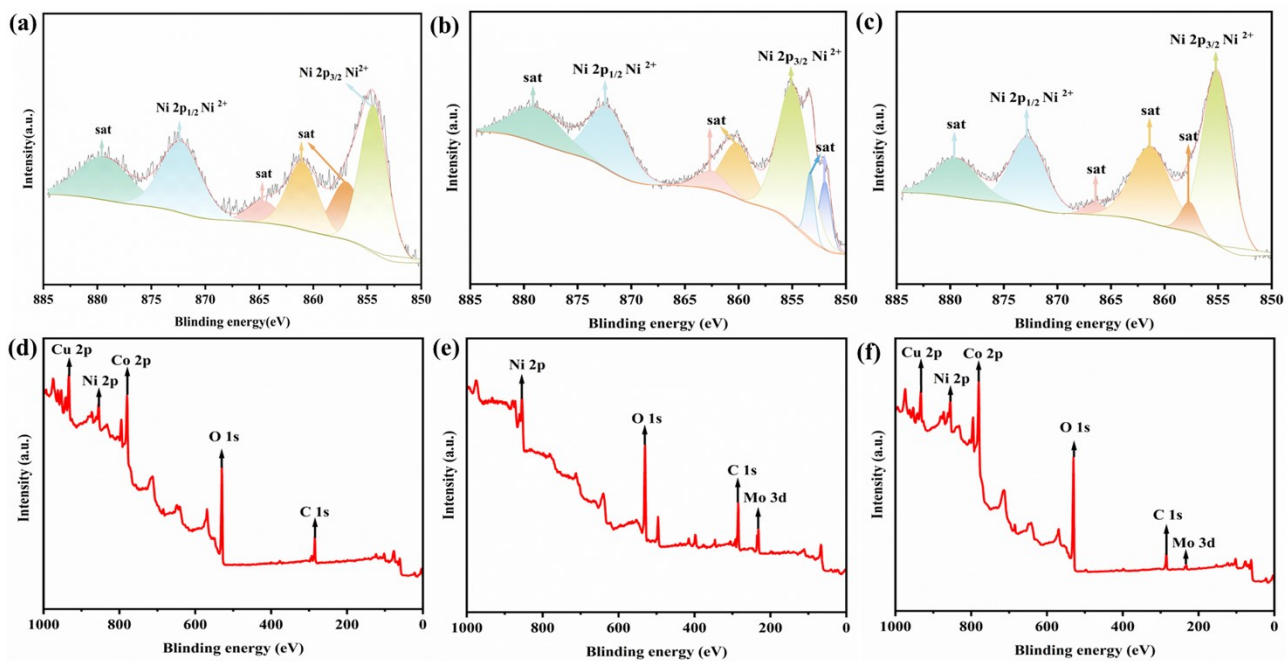


Fig. S1 Ni 2p and XPS survey spectra of (a, d) $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{NF}$, (b, e) MoO_3/NF , and (c, d) $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}$.

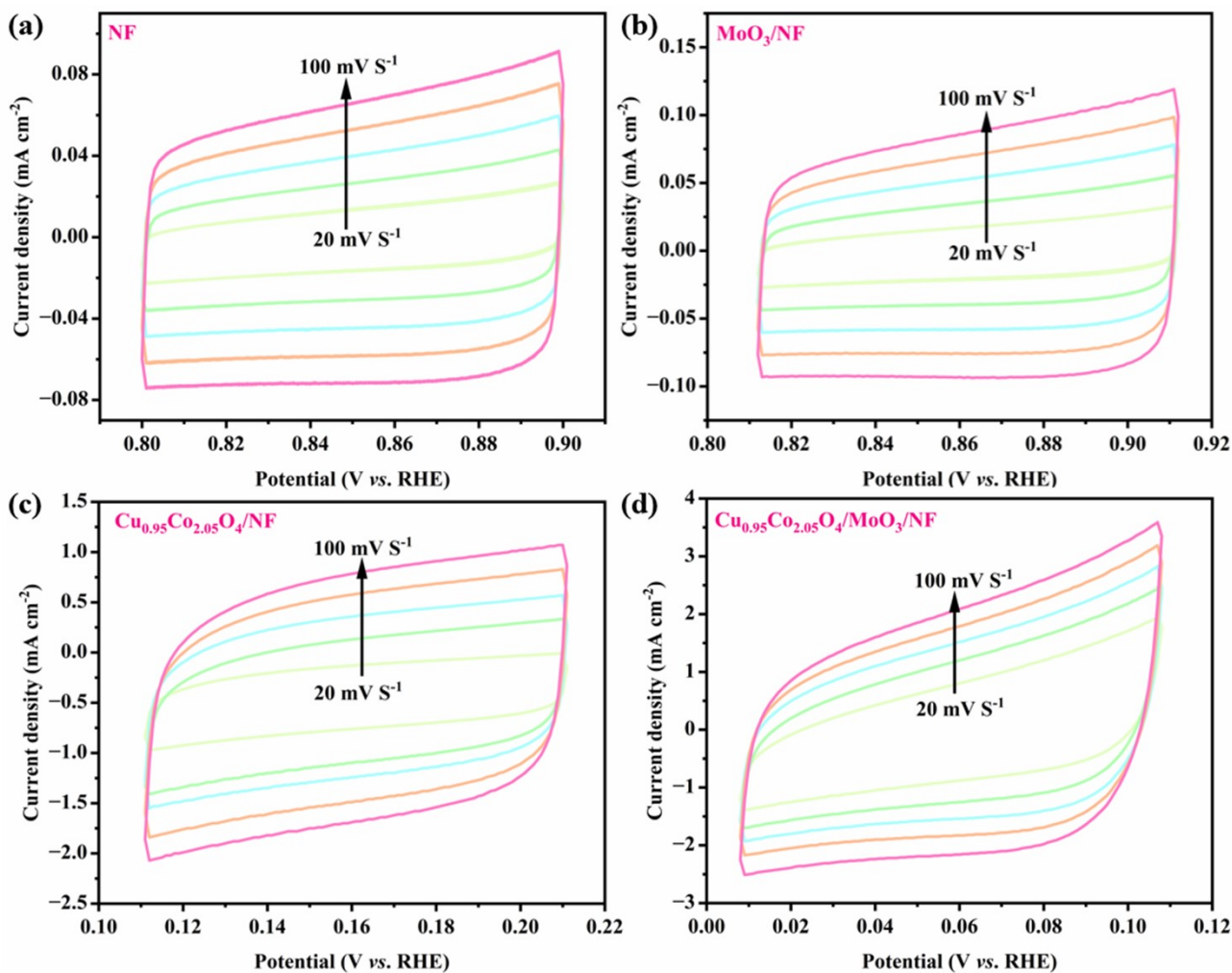


Fig. S2 CV curves at 20, 40, 60, 80, and 100 mV s^{-1} in (–) the catalyst (pyrazine/piperazine) | 1 M KOH + H_2O + 0.01 M pyrazine || 1 M KOH + H_2O | Pt(OH⁻/O₂) (+) with (a) NF, (b) MoO₃/NF, (c) Cu_{0.95}Co_{2.05}O₄/NF and (d) Cu_{0.95}Co_{2.05}O₄/MoO₃/NF as the catalysts and a working electrode and an SCE as the reference electrode.

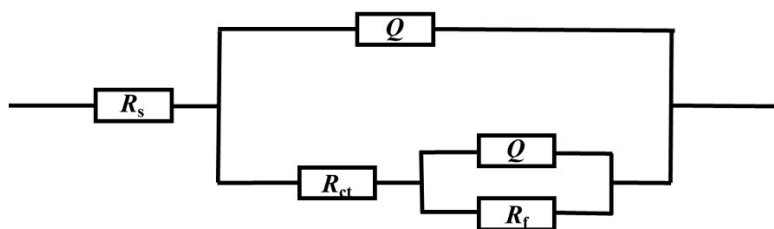


Fig. S3 Equivalent circuit model.

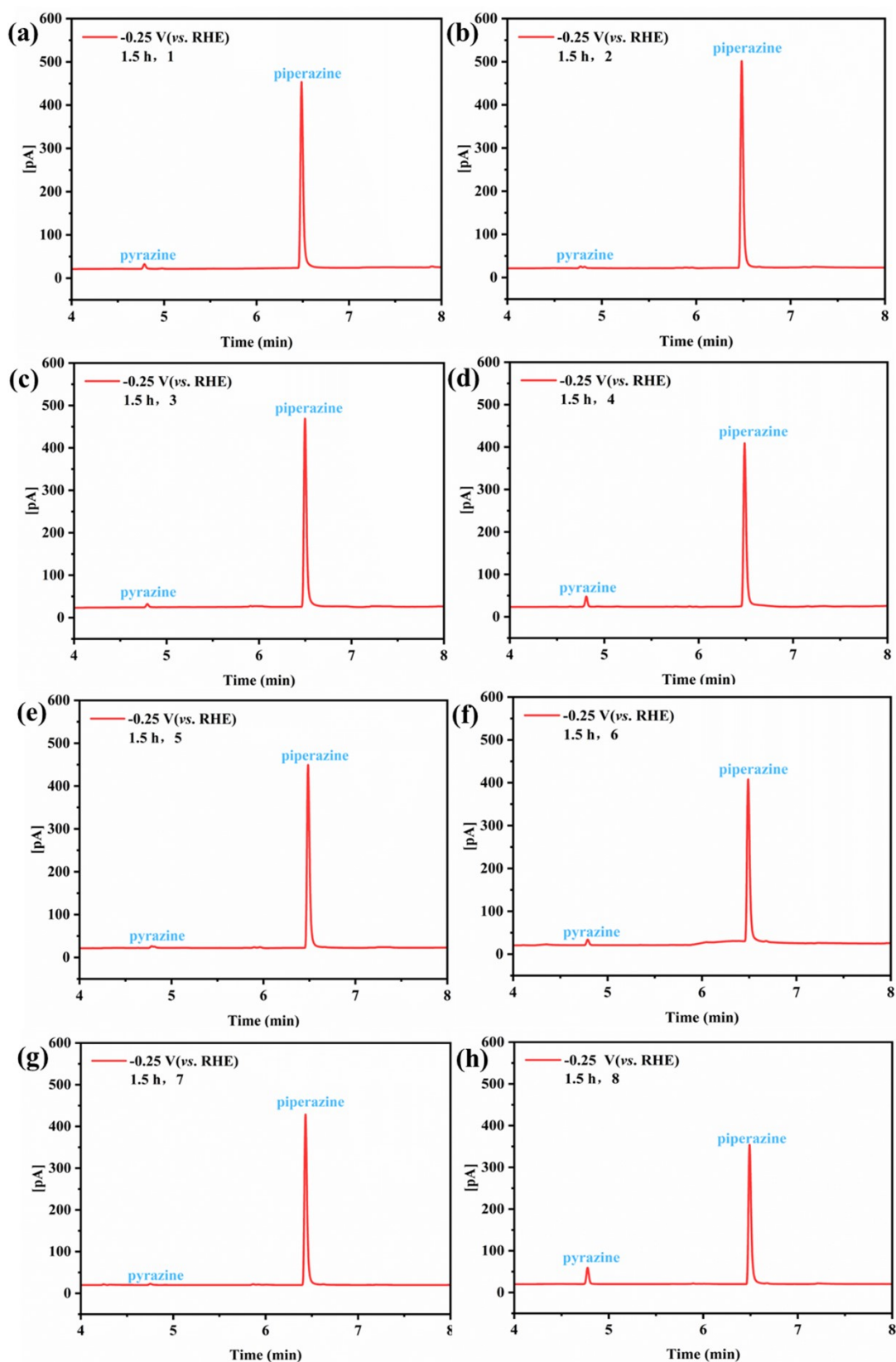


Fig. S4 GC analysis of the electrolyte after the (a) 1st, (b) 2nd, (c) 3rd, (d) 4th, (e) 5th, (f) 6th, (g) 7th, and (h) 8th chronoamperometry cycles at -0.25 V (vs. RHE) for 1.5 h. The tests were conducted in $(-)$ $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}$ (pyrazine/piperazine) | 1 M KOH + 10 mM pyrazine || 1 M KOH + H_2O | Pt(OH/O₂) (+) with $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}$ as the working electrode and a HgO/Hg electrode as the reference electrode.

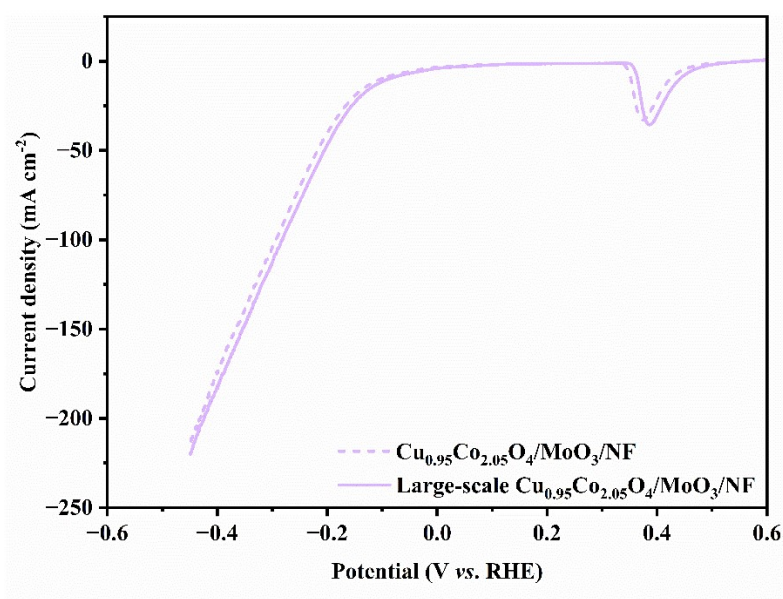
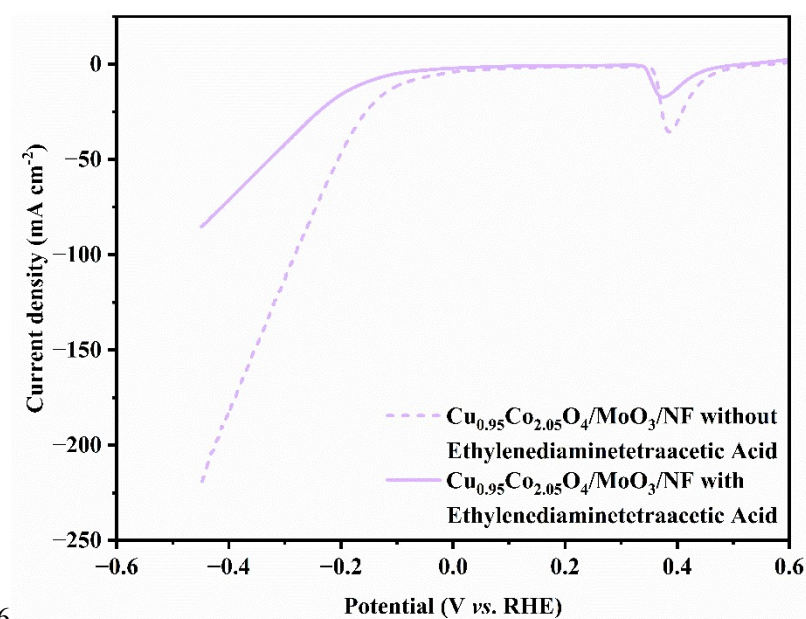


Fig. S5 Electrochemical measurements of $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}$ in (-) $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}/\text{NF}$ (pyrazine/piperazine) | 1 M KOH + 10 mM pyrazine || 1 M KOH + H_2O | Pt (+) (OH^-/O_2). LSV curves comparing the large-scale electrode and the conventional-sized electrode in the potential range of -0.45 to 0.6 V (vs. RHE).



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Fig. S6 Electrochemical measurements of $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}$ in (-) $\text{Cu}_{0.95}\text{Co}_{2.05}\text{O}_4/\text{MoO}_3/\text{NF}$ (pyrazine/piperazine) | 1 M KOH + 10 mM pyrazine with/without 10 mM ethylenediaminetetraacetic acid || 1 M KOH + H_2O | Pt (+) (OH^-/O_2). LSV curves with and without ethylenediaminetetraacetic acid in the potential range of -0.45 to 0.6 V (vs. RHE).

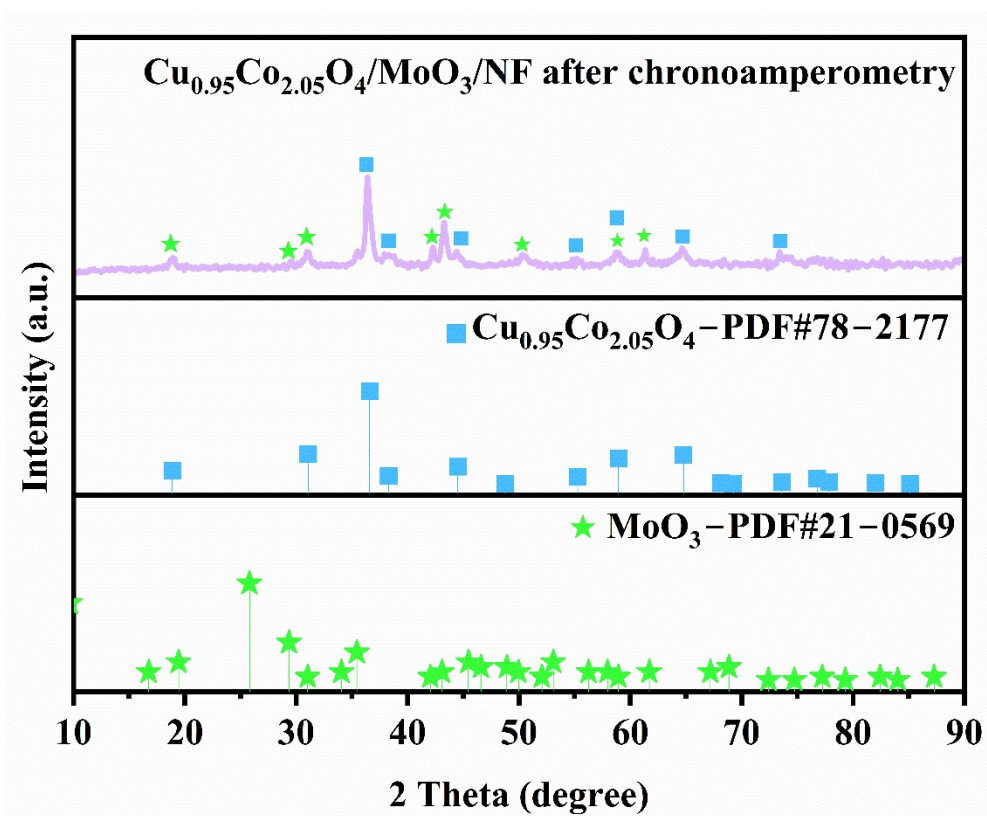


Fig. 7 XRD of Cu_{0.95}Co_{2.05}O₄/MoO₃/NF after 8 cycles of chronoamperometry at -0.25 V (vs. RHE) for 1.5 h.

Table S1 Electrochemical parameters of the samples.

Electrochemical parameters	NF	MoO ₃ /NF	Cu _{0.95} Co _{2.05} O ₄ /NF	Cu _{0.95} Co _{2.05} O ₄ /MoO ₃ /NF
Current density (mA cm ⁻²) at -0.25 V (vs. RHE) in LSV (with pyrazine)	20.91	26.06	48.81	73.73
Tafel slope (mV dec ⁻¹)	254.89	212.08	195.80	156.22
Charge transfer resistance (ohm) from EIS at -0.25 V (vs. RHE)	2.60	1.71	1.69	0.84
C _{dl} (mF cm ⁻²)	0.67	0.91	11.30	15.66
ESCA (cm ²)	19.00	75.00	253.00	694.5
Faradaic efficiency (%) after chronoamperometry at -0.25 V (vs. RHE) for 1.5 h	48.69	59.49	96.70	98.11
Selectivity (%) after chronoamperometry at -0.25 V (vs. RHE) for 1.5 h	--	--	39.96	98.00