Supporting Information

$Y=1021.48X-5.81$
$R^2=0.997$

$Y=1379.59X+18.70$
$R^2=0.997$
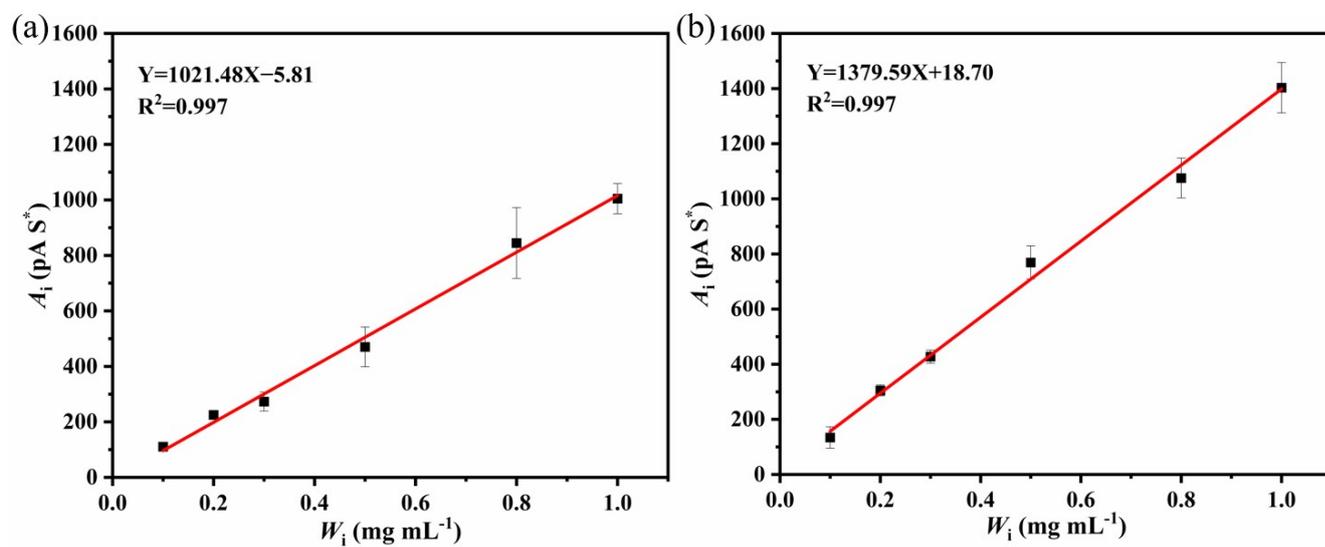
Fig. S1 Standard curves of (a) pyrazine and (b) piperazine in GC testing.

Table S1 Electrochemical parameters of the catalysts.

| Electrochemical parameters	NF	Co_3O_4/NF	Pd_2/Co_3O_4/NF	Pd_3/Co_3O_4/NF	Pd_4/Co_3O_4/NF	Pd_5/Co_3O_4/NF
Current density at -0.25 V (*vs.* RHE) from LSV (mA cm^{-2})	29.1	23.7	39.4	45.2	77.8	40.8
Net Current	8.4	0.6	9.4	7.2	37.5	1.8
Tafel slope (mV dec^{-1})	322.03	315.91	306.38	290.7	263.81	291.17
OCP difference in 1 M KOH with/without 10 mM pyrazine (V)	3.8	1.1	5.2	15.1	21.0	15.3
Charge transfer resistance (R_{ct}) at -0.25 V (*vs.* RHE) from EIS (ohm)	6.372	4.219	3.846	3.419	2.892	3.691
C_{dl} (mF cm^{-2})	0.67	7.77	23.18	62.85	99.22	56.10
ESCA（cm^2）	16.78	194.25	579.5	1571.25	2480.50	1400.25
Conversion rate after chronoamperometry at -0.25 V (*vs.* RHE) for 3 h (%)	-	28.5	68.9	92.5	99.1	88.6
Selectivity rate after chronoamperometry at -0.25 V (*vs.* RHE) for 3 h (%)		89.8	88.7	92.1	94.8	86.5

Pd/C/NF preparation：

A viscous binder was prepared by mixing 270 μL of isopropanol, 810 μL of deionized water, and 120 μL of Nafion solution. Then, 8 mg of commercial 10 wt% Pd/C powder was added into the above mixture. The mixture was sonicated for 20 min to uniformly disperse the Pd/C, thereby obtaining a Pd/C-containing ink. Subsequently, 300 μL of the ink was drop-cast evenly onto a nickel foam (NF, 2 cm × 3 cm × 3 mm) surface using a micropipette. The sample was dried in a vacuum oven at 60 °C for 3 h to obtain the Pd/C/NF electrode.
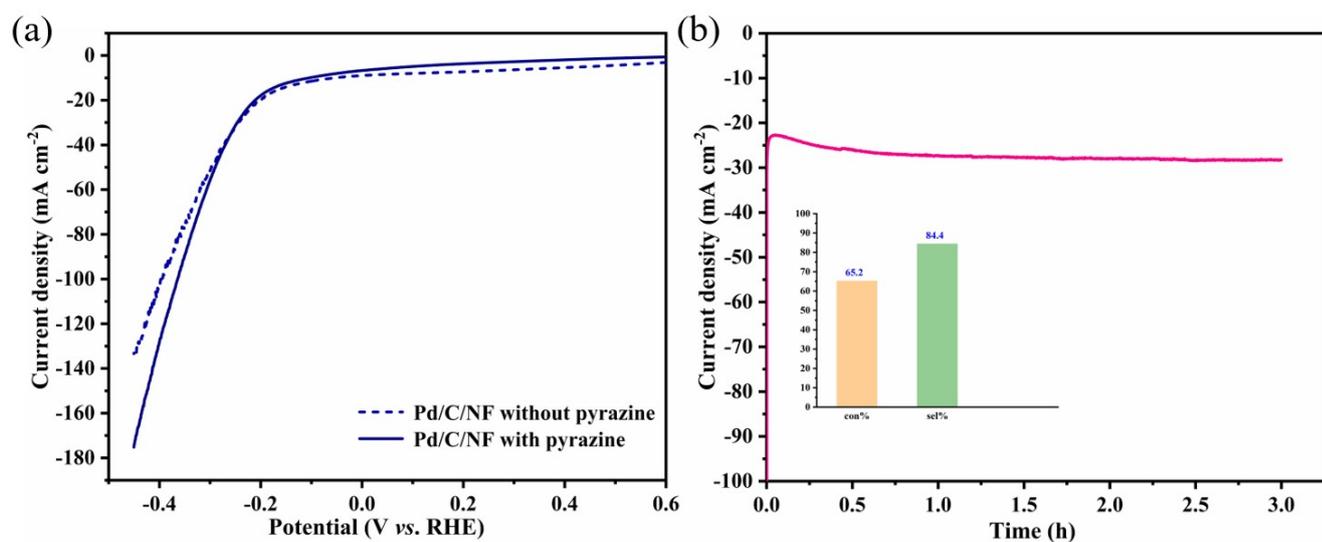
Fig. S2 (a) LSV tests of Pd/C/NF with and without the addition of pyrazine, (b) chronoamperometry profile of Pd/C/NF at −0.25 V (*vs*. RHE) for 3 h. Embedding was data on conversion and selectivity.
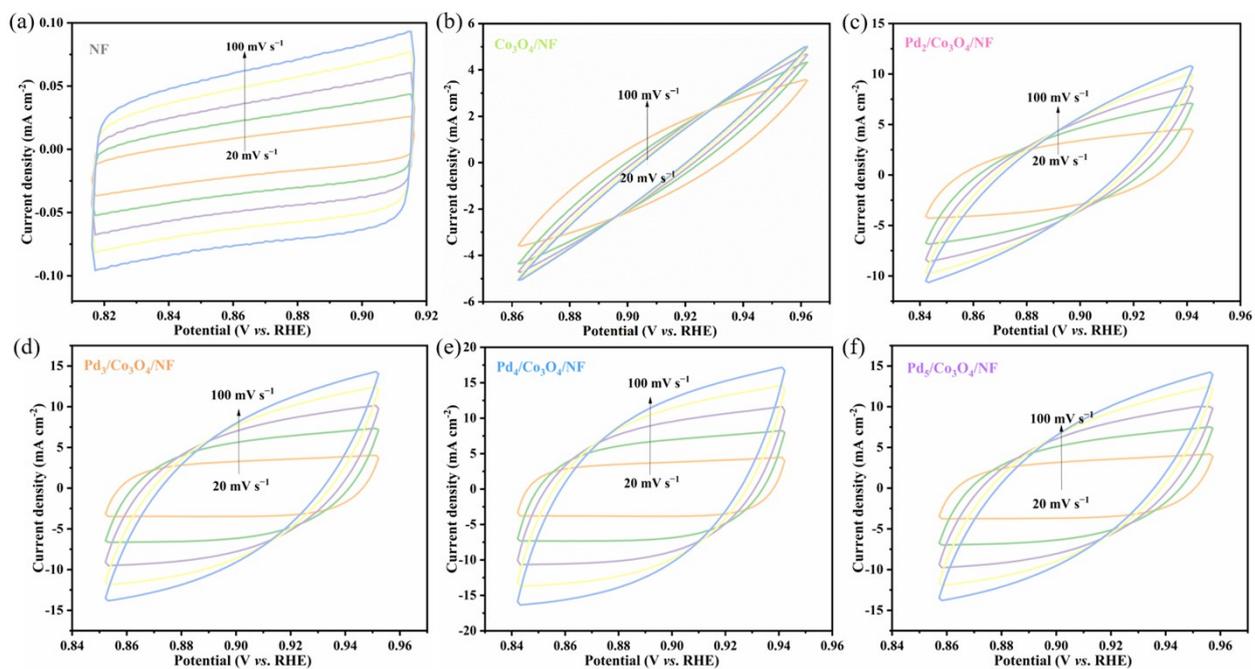
Fig. S3 CV curves at 20, 40, 60, 80, and 100 mV s⁻¹ of (a) NF, (b) Co₃O4/NF, (c) Pd₂/Co₃O₄/NF, (d) Pd₃/Co₃O₄/NF (e) Pd₄/Co₃O₄/NF and (f) Pd₅/Co₃O₄/NF in 1 M KOH with pyrazine.
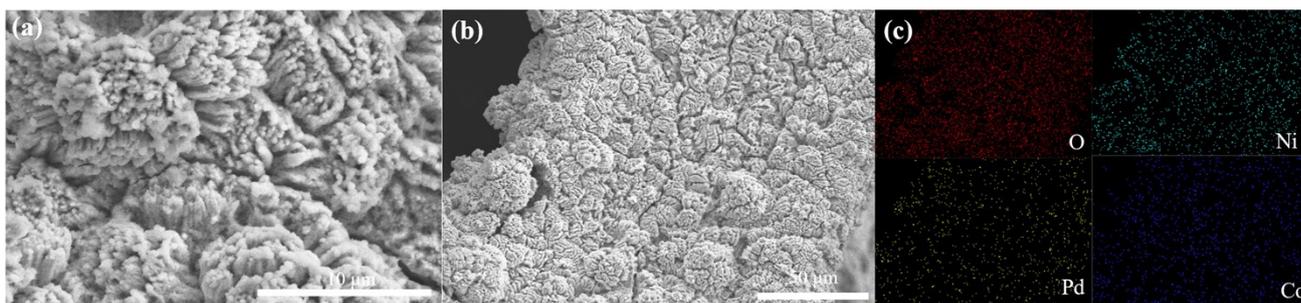
Fig. S4 (a, b) SEM images and (c) corresponding EDS mapping of Pd$_4$/Co$_3$O$_4$/NF after chronoamperometry of 8 cycles.