Supporting Information for

Green Electrochemical Upcycling of PET Waste via Bimetallic Catalyst-Driven Ethylene Glycol Selective Oxidation to Formate

Contents of the Supporting Information

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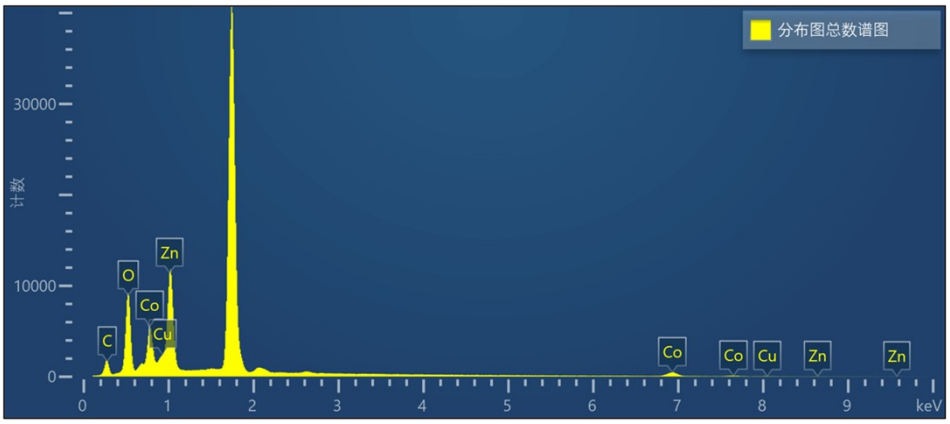

Fig. S1 The EDS analysis of $CuO/ZnCuCo_2O_4$ catalysts.

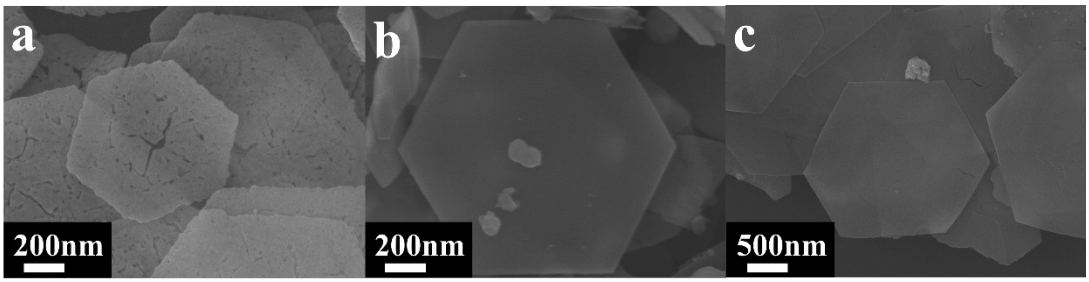

Fig. S2 SEM images of (a) Co_3O_4, (b) $ZnCo_2O_4$, (c) $CuO/CuCo_2O_4$.

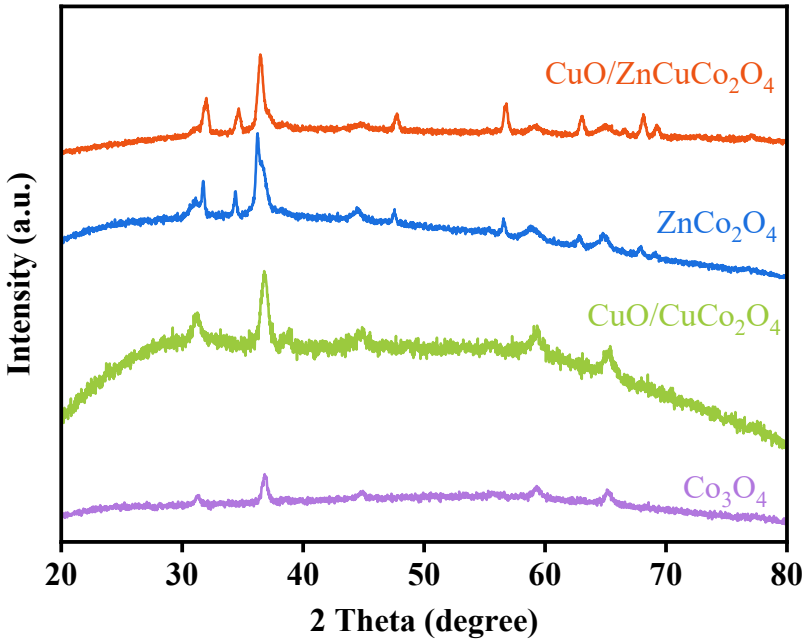

Fig. S3 The XRD patterns of Co_3O_4, $ZnCo_2O_4$, $CuCo_2O_4$ and $CuO/ZnCuCo_2O_4$ samples.

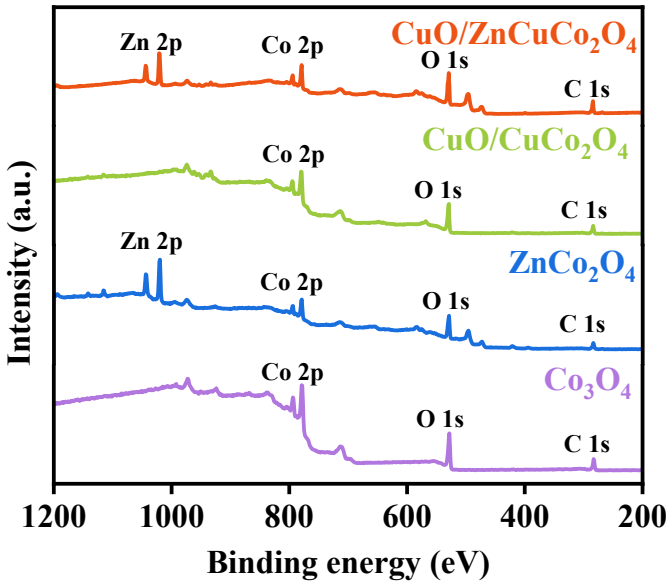

Fig. S4 Survey XPS spectrum of Co_3O_4, $ZnCo_2O_4$, $CuO/CuCo_2O_4$ and $CuO/ZnCuCo_2O_4$.

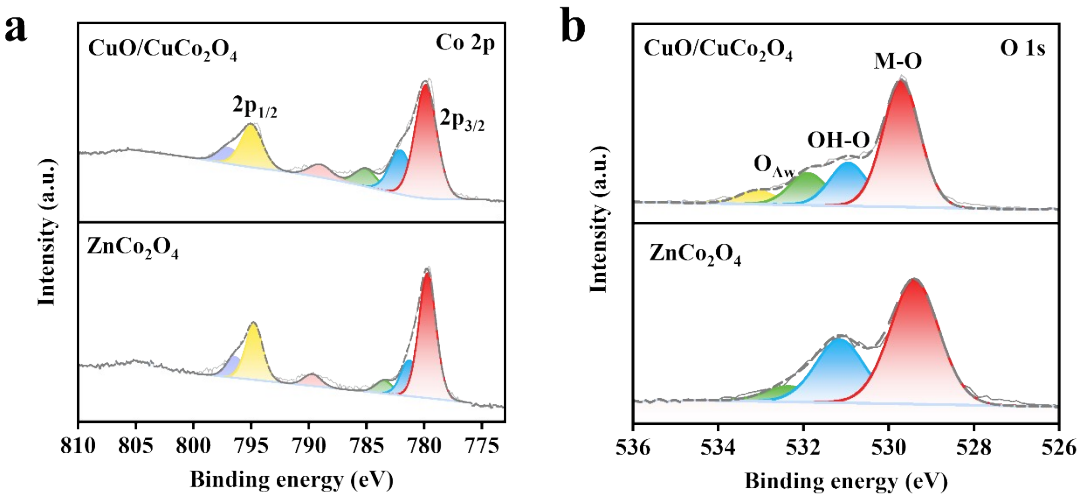

Fig. S5 High-resolution (a) Co 2p spectra, (b) O 1s XPS spectra of $ZnCo_2O_4$ and $CuO/CuCo_2O_4$.

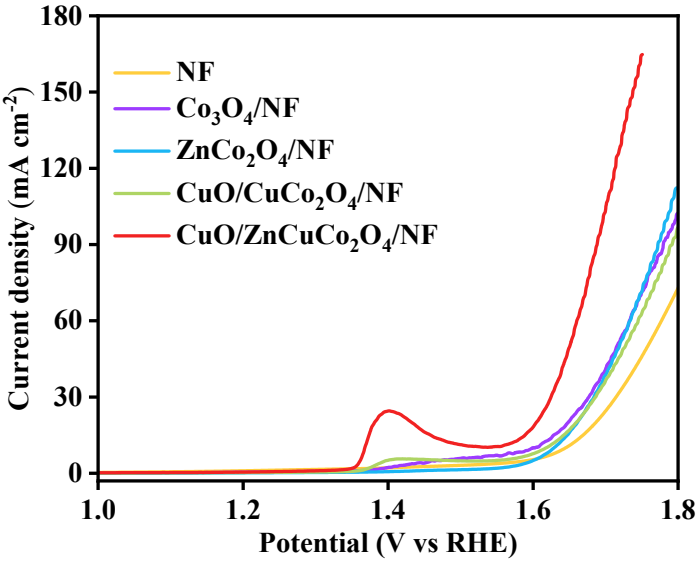

Fig. S6 LSV plots of $CuO/ZnCuCo_2O_4/NF$ and comparison samples in 1 M KOH for OER.

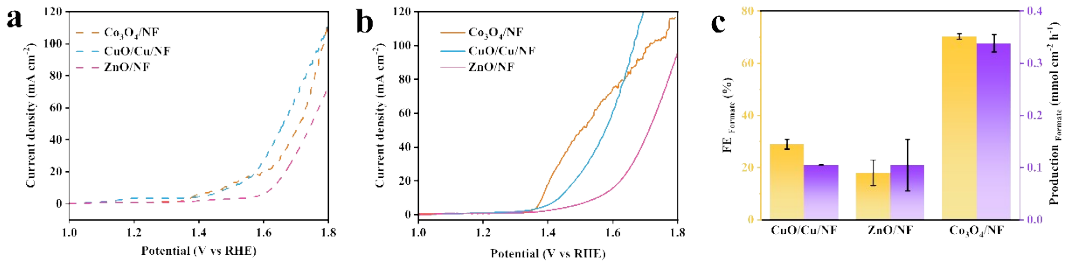

Fig. S7 (a) LSV plots with Co_3O_4 and single-metal catalysts added without EG, (b) with EG. (c) FE and production of converting EG to formate under the condition of 1.6 V vs RHE for Co_3O_4 and its comparative catalyst.

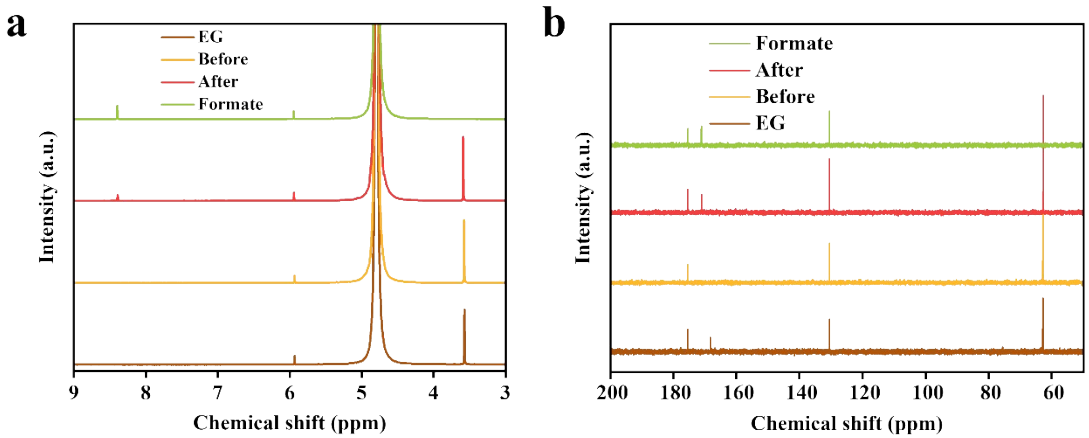

Fig. S8 Products before and after electro-reforming on CuO/$ZnCuCo_2O_4$/NF electrode (a) ^{1}H NMR spectra, (b) ^{13}C NMR spectra.

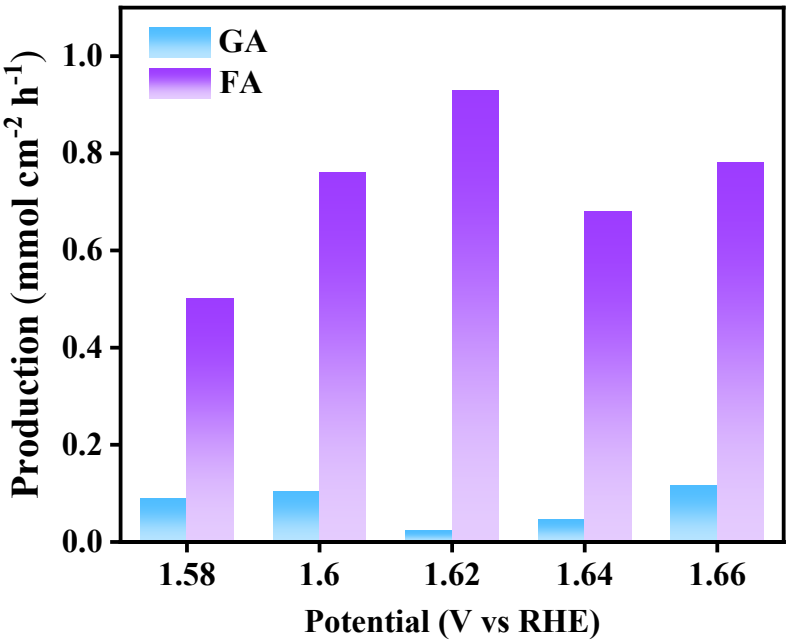

Fig. S9 The production of $CuO/ZnCuCo_2O_4/NF$ under different potentials.

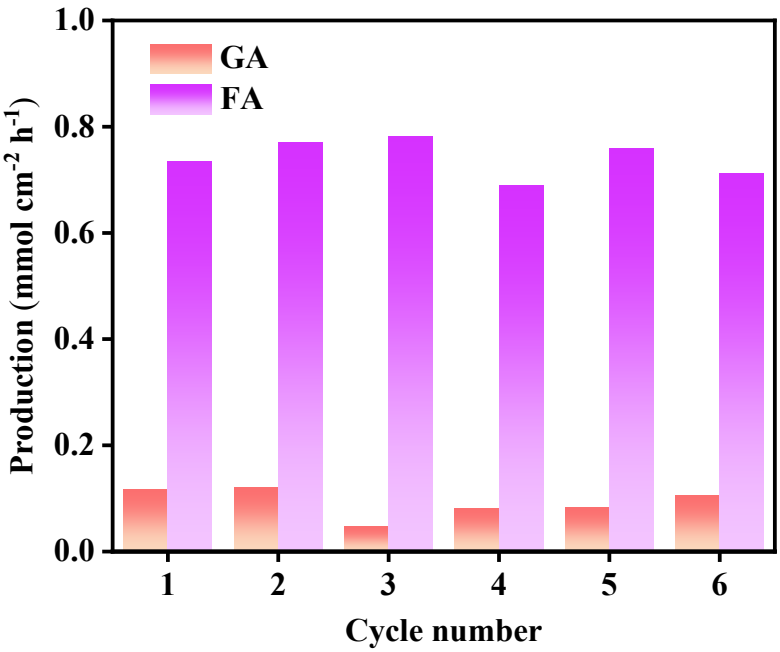

Fig. S10 The yields of CuO/$ZnCuCo_2O_4$/NF with consecutive six cycles at 1.62 V vs RHE.

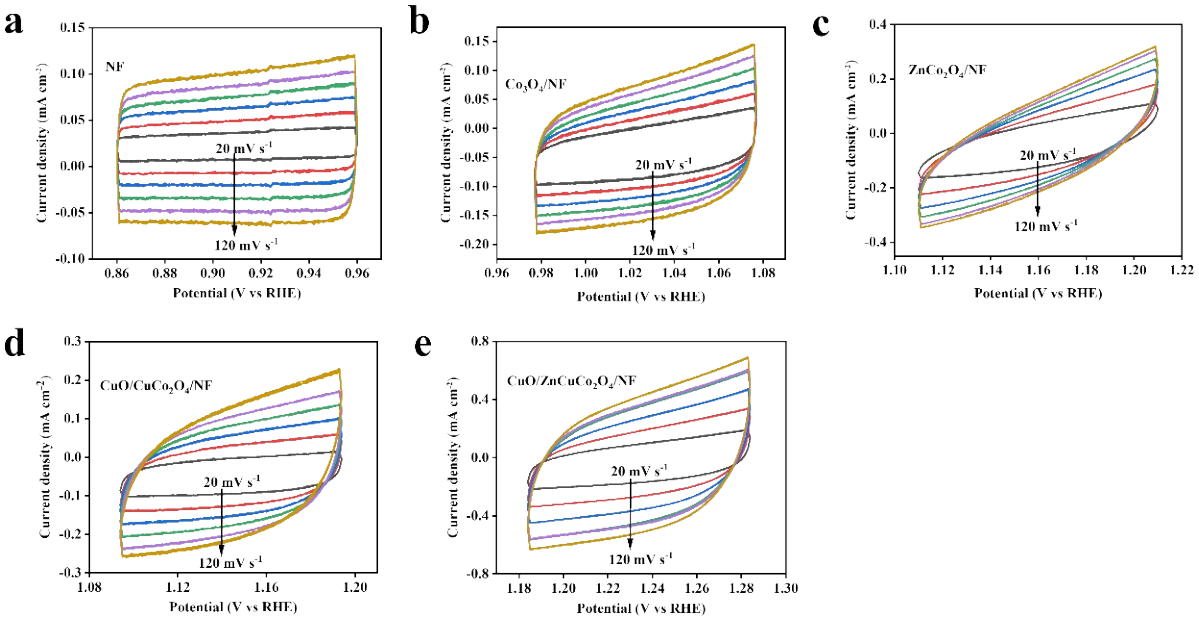

Fig. S11 The CV curves of bare NF (a), Co_3O_4/NF (b), $ZnCo_2O_4$/NF (c), CuO/$CuCo_2O_4$/NF (d) and CuO/$ZnCuCo_2O_4$/NF (e) samples.

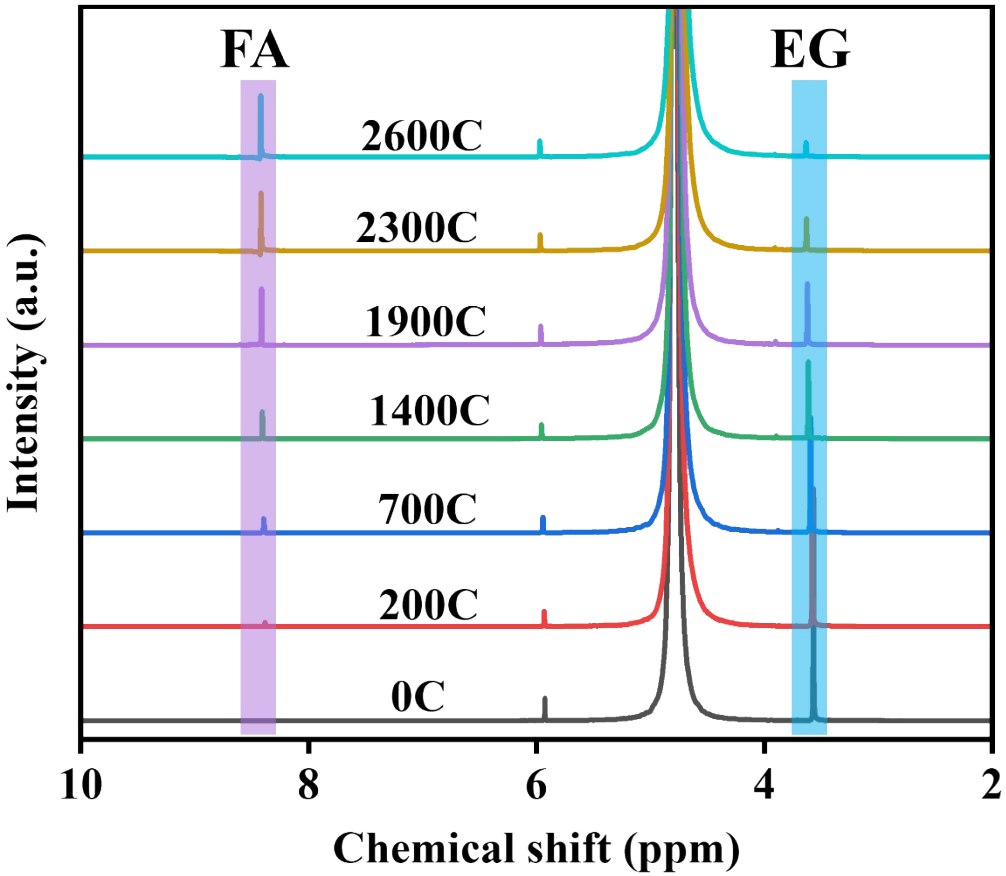

Fig. S12 ^{1}H NMR measurements of EG oxidation on CuO/$ZnCuCo_2O_4$/NF electrode.

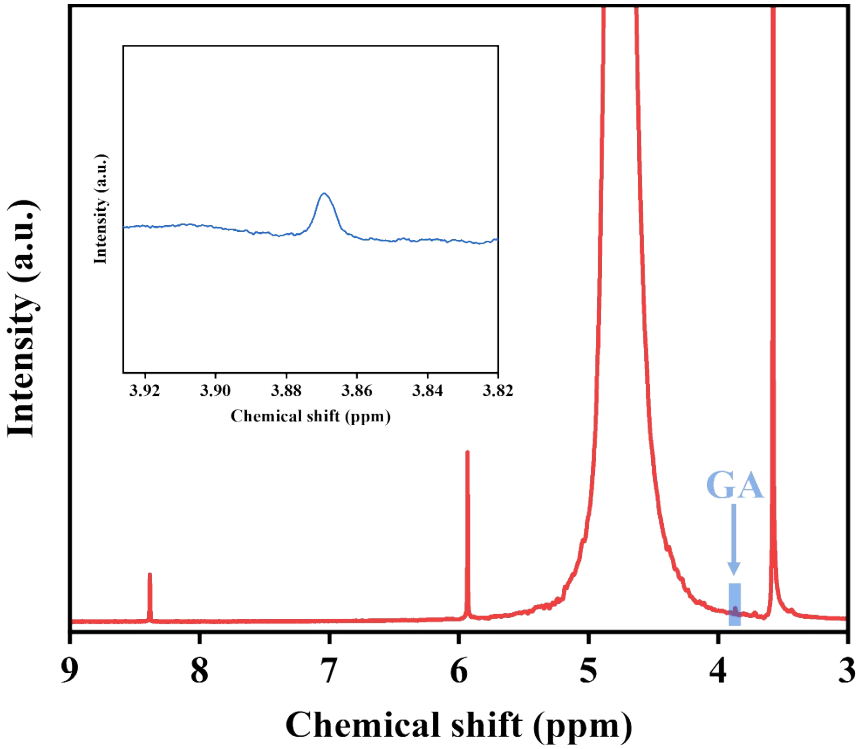

Fig. S13 ^{1}H NMR of $CuO/ZnCuCo_2O_4$/NF at an input charge of 200C.

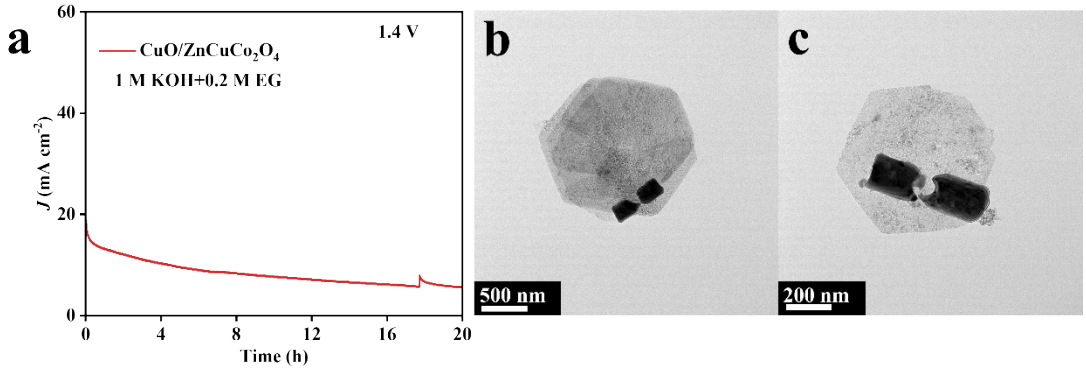

Fig. S14 (a) Chronoamperometric measurement of $CuO/ZnCuCo_2O_4$/NF for EGOR. (b) (c)TEM images of $CuO/ZnCuCo_2O_4$ catalyst at different magnifications after 20 hours.

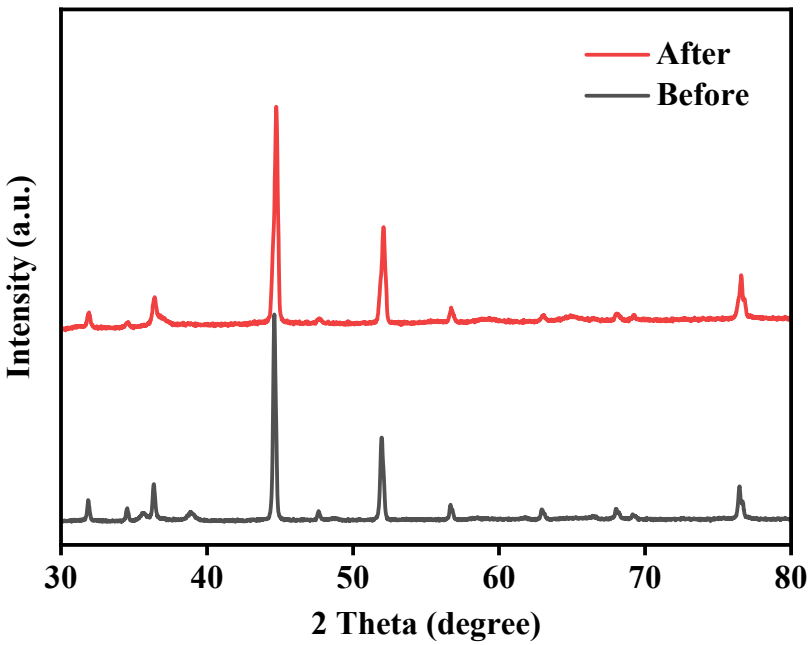

Fig. S15 XRD patterns of $CuO/ZnCuCo_2O_4$/NF electrode before and after reaction.

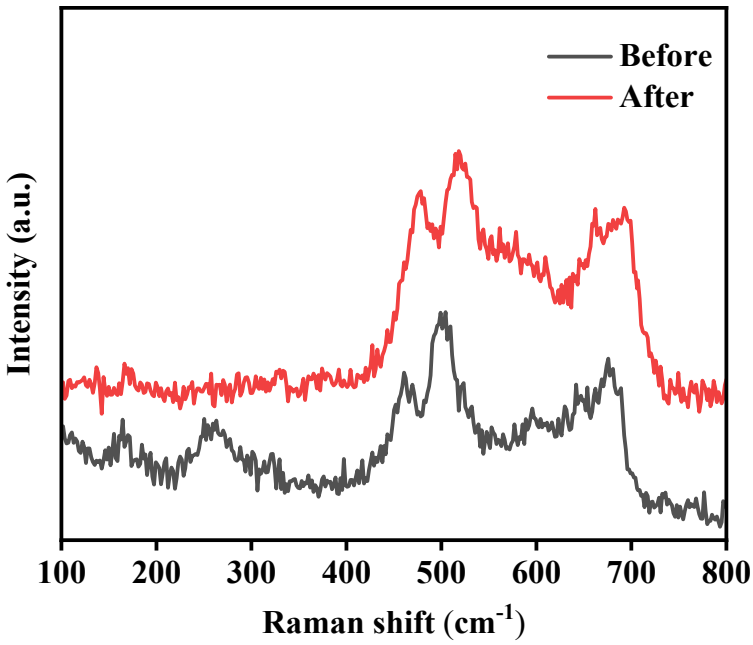

Fig. S16 Raman patterns of $CuO/ZnCuCo_2O_4$/NF electrode before and after electrocatalysis.

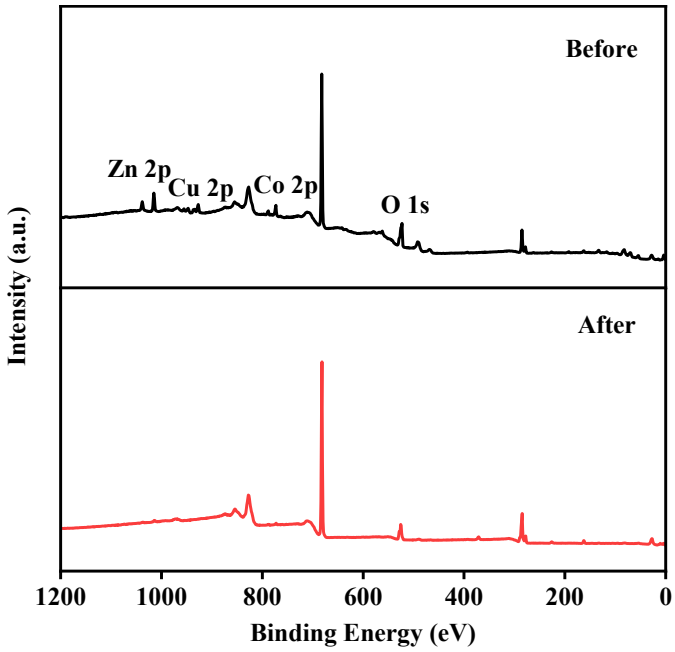

Fig. S17 Survey XPS spectra of CuO/$ZnCuCo_2O_4$/NF electrode before and after electrolysis.

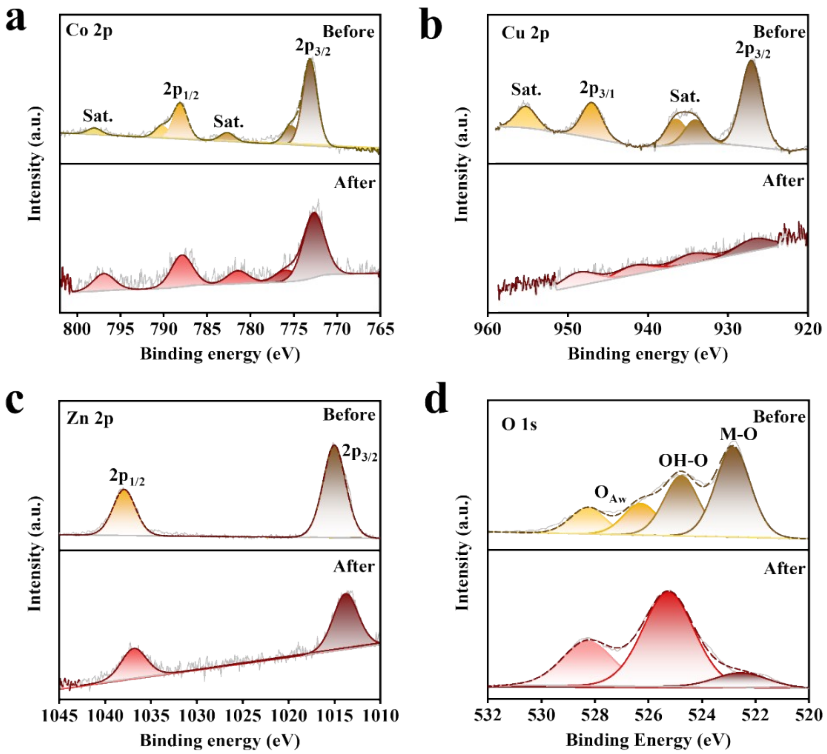

Fig. S18 XPS spectra of $CuO/ZnCuCo_2O_4$/NF electrode before and after electrolysis.

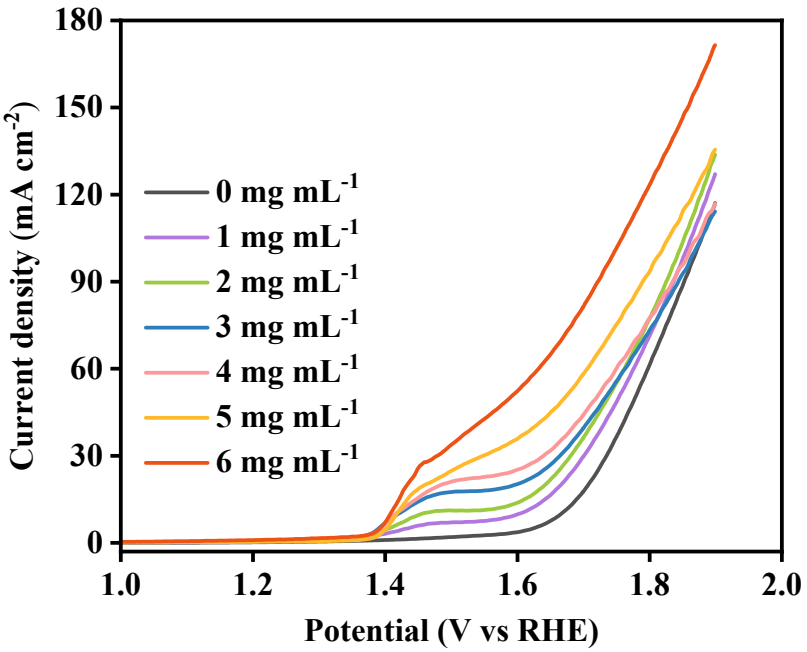

Fig. S19 LSV curves of CuO/ZnCuCo$_2$O$_4$/NF in 1 M KOH with different concentrations of PET.

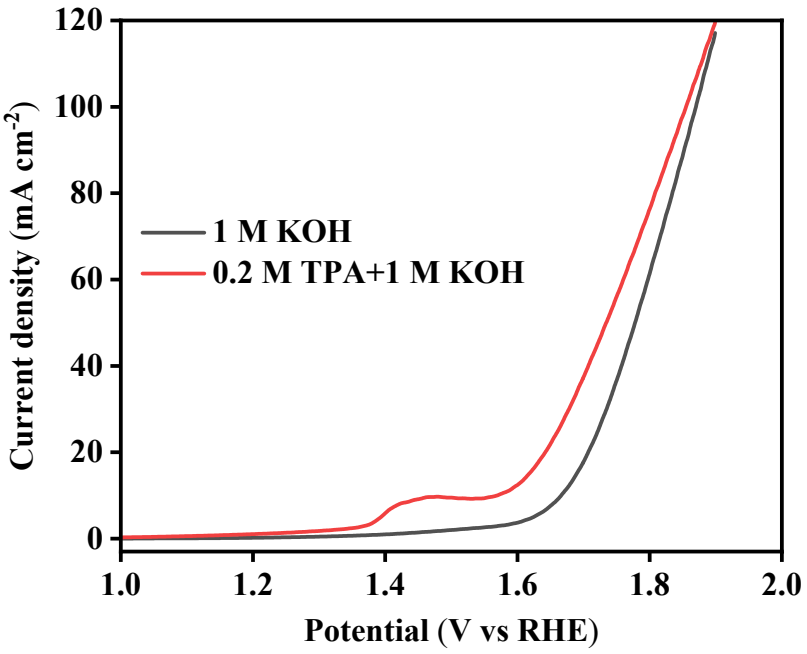

Fig. S20 LSV plots for $CuO/ZnCuCo_2O_4$/NF electrode in 1 M KOH with and without TPA addition.

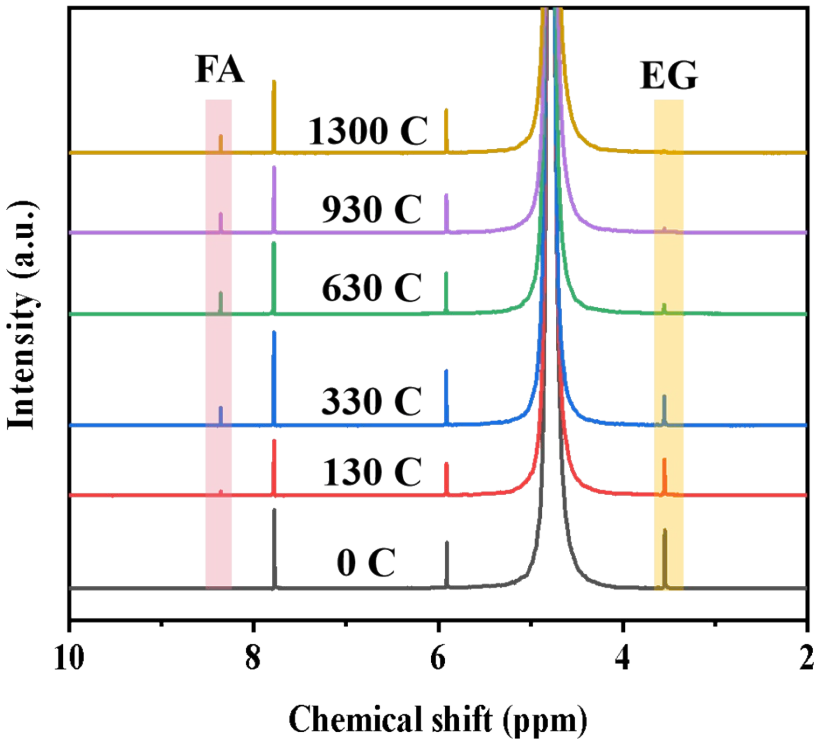

Fig. S21 ^{1}H NMR measurements of PET hydrolysate oxidation on $CuO/ZnCuCo_2O_4$/NF electrode.

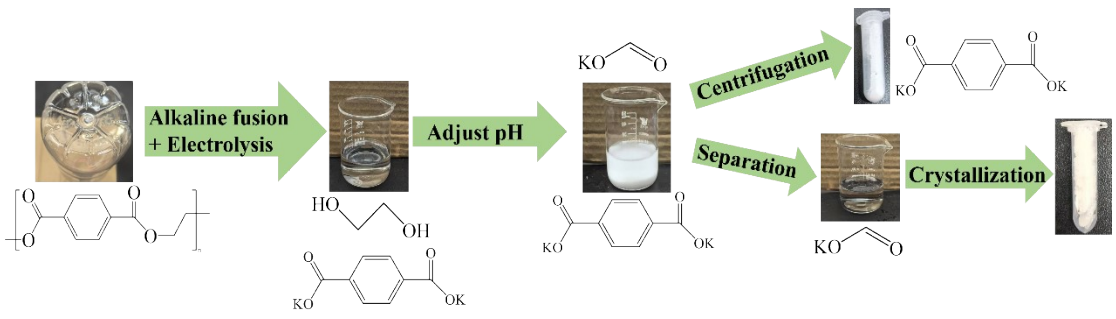

Fig. S22 Schematic illustration of the process of PET electro-reforming and product separation.

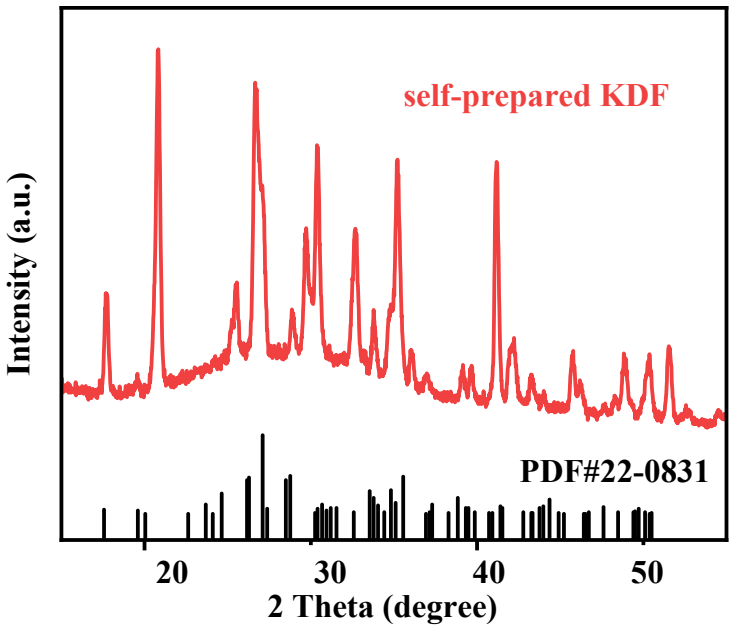

Fig. S23 The XRD pattern of KDF prepared from PET electrolyte.

Table S1. Comparison of state-of-the-art catalysts for ethylene glycol and PET hydrolysate.

Catalysts	Electrolyte	Stability	Overpotential	Current density (mA cm^{-2})	FE (%)	Formate yield (mmol cm^{-2} h^{-1})	Ref.
CuO/ZnCu Co_2O_4/NF	1 M KOH + 0.2 M EG	20 H (1.4 vs RHE)	271 mV@100 mA cm^{-2}	100 (1.42 vs RHE)	**95.5**	0.78	**This work**
NiFe-LDH/NF	0.5 M EG + 1 M KOH	24 H (1.4 vs RHE)	122 mV@100 mA cm^{-2}	100 (1.47 vs RHE)	94.3	-	[1]
$Ni_{0.9}Mn_{0.1}$ LDH	1 M KOH + 1 M EG	12 H	180 mV@10 mA cm^{-2}	100 (1.37 vs RHE)	85.8	-	[2]
CoFe-LDH/NF-10	1 M KOH + 0.1 M EG	-	240 mV@10 mA cm^{-2}	10 (~1.44 vs RHE)	49.7	-	[3]

$NiCu_{60s}$/NF	1 M KOH + 0.3 M EG	24 H (1.42 V vs RHE)	307 mV@100 mA cm^{-2}	50 (~1.42 vs RHE)	95.8	0.70	[4]
R-NiCo/NF	1.0 M KOH + 0.1 M EG	10 H (1.45 V vs RHE)	264 mV@50 mA cm^{-2}	50 (1.43 vs RHE)	98.2	0.63	[5]
Cu(F)@CuO@ $Ni(OH)_2$	1.0 M KOH + 0.1 M EG	24 H (1.4 V vs RHE)	200 mV@50 mA cm^{-2}	50 (1.36 vs RHE)	-	-	[6]
$NiCo_2O_4$	1.0 M KOH + 0.3 M EG	18 H (1.5 V vs RHE)	244 mV@150 mA cm^{-2}	100 (1.40 V vs RHE)	90.4	-	[7]

References:

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