Electronic Supplementary Material (ESI) for Green Chemistry.

Supplementary Information

Interaction between copper and nickel species for electro-oxidation of 2,5-Bis(hydroxymethyl)furan

Peiyuan Liu,‡[a,b], Liyuan Huai,‡[a] Bin Zhu,[a,b] Yang Zhong,[a,b] Jian Zhang,[a,b,c,*] Chunlin Chen[a,b,c,*]

[a.] *Ningbo 315201, China Ningbo Institute of Materials Technology & Engineering, Chinese Academy of Sciences, 1219 Zhongguan West Road, Ningbo 315201, China.*

E-mail: jzhang@nimte.ac.cn, chenchunlin@nimte.ac.cn

[b.] *University of the Chinese Academy of Sciences, Beijing 100049, China.*

[c.] *Key Laboratory of Bio-based Polymeric Materials Technology and Application of Zhejiang Province, Ningbo 315201, China.*

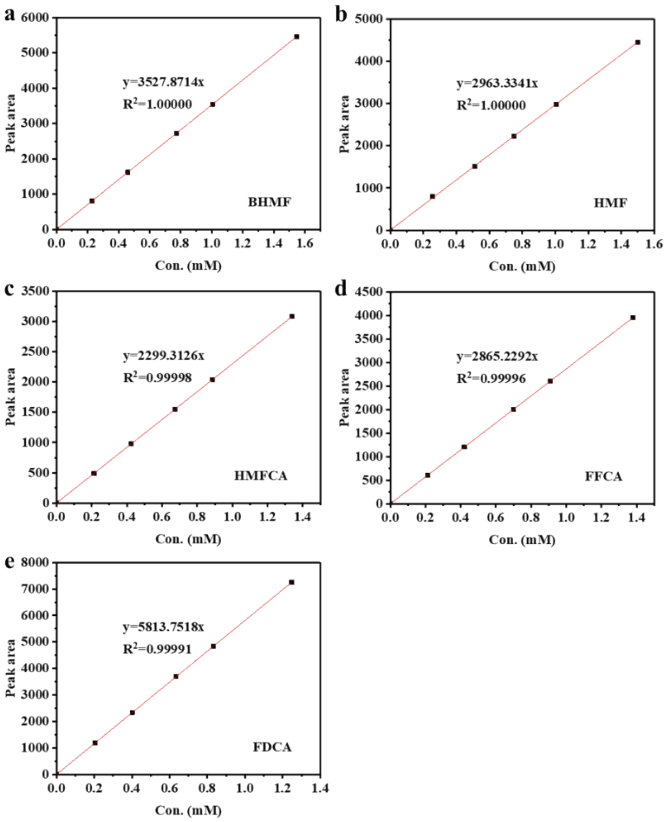

Figure S1. The standard curves of (a) BHMF, (b) HMF, (c) HMFCA, (d) FFCA, (e) FDCA.

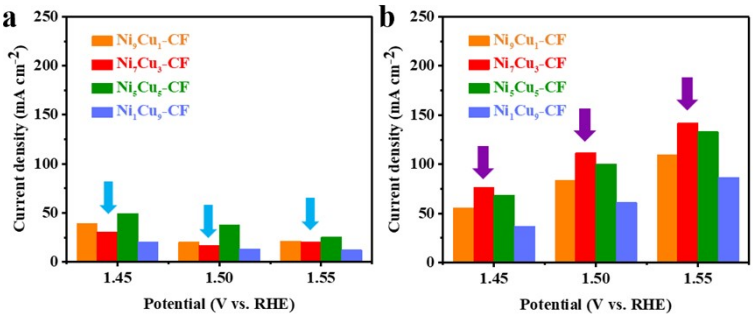

Figure S2. The corresponding current density of $Ni_xCu_{(10-x)}$ at 1.45 V, 1.50 V and 1.55 V in (a) 1 M KOH or (b) 1 M KOH with 10 mM BHMF.

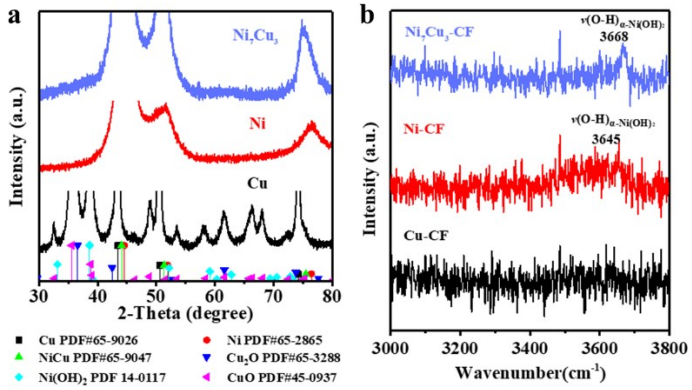

Figure S3. (a) The magnified XRD patterns of Cu, Ni and Ni_7Cu_3 for more detail. (b) The Raman spectra of Cu-CF, Ni-CF and Ni_7Cu_3-CF at the high wavenumber side.

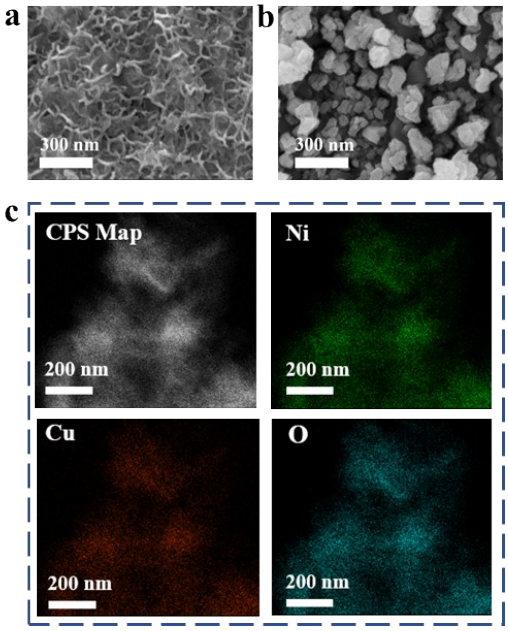

Figure S4. (a, b) The SEM images of Ni-CF and Cu-CF. (c) The elemental mapping of Ni_7Cu_3-CF.

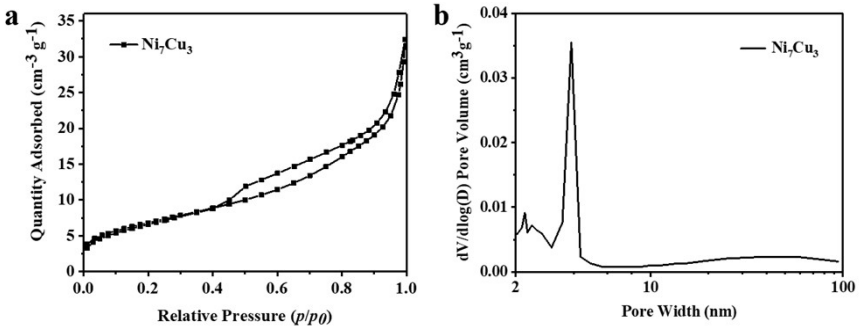

Figure S5. (a) The N_2 adsorption-desorption curve and (b) pore size distribution of Ni_7Cu_3.

Table S1. The elemental ratio in Ni_7Cu_3-CF.

Ni	Cu
mg/g	mg/g
363.491	266.581

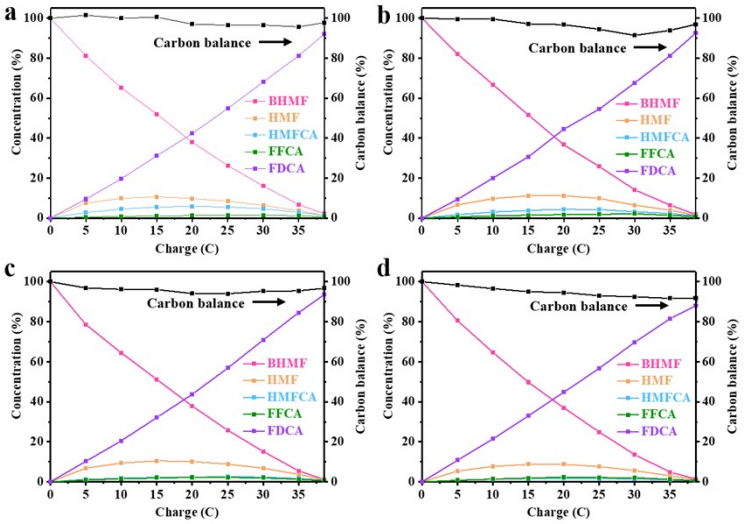

Figure S6. The HPLC analysis of solutions electrolyzed at different potentials of (a) 1.43 V, (b) 1.46 V, (c) 1.52 V and (d) 1.55 V vs. RHE. The reactions were carried out with 3-electrode systems in 1 M KOH added with 10 mM BHMF. The black curve was carbon balance.

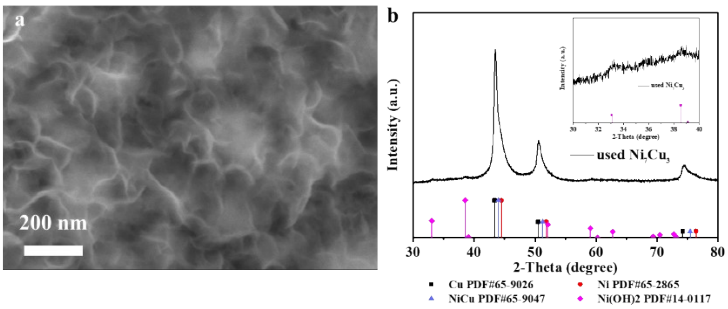

Figure S7. The characterization of the used Ni_7Cu_3-CF: (a) SEM image. (b) XRD pattern.

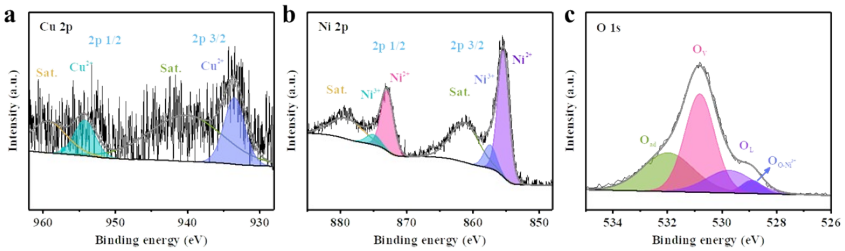

Figure S8. XPS of (a) Cu 2p, (b) Ni 2p and (c) O 1s of the used Ni_7Cu_3-CF.

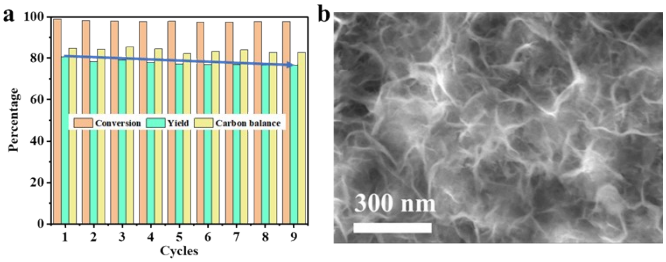

Figure S9. (a) The successive electrolysis at Ni-CF and (b) The SEM image of Ni-CF after 9th electrolysis.

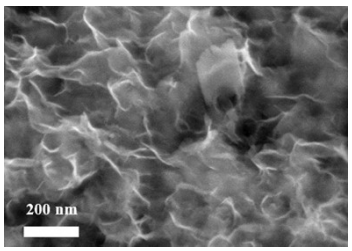

Figure S10. The SEM image of the Ni_7Cu_3-CF catalyst after 9th electrolysis.

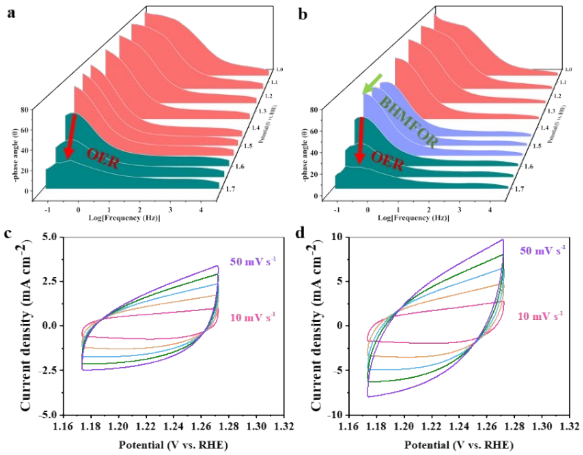

Figure S11. The Bode plots in (a) 1 M KOH, (b) 1 M KOH with 10 mM BHMF on Cu-CF. (c) The CVs of Ni_7Cu_3-CF in 1M KOH. (d) The CVs of Ni_7Cu_3-CF in 1M KOH added with 10 mM BHMF.

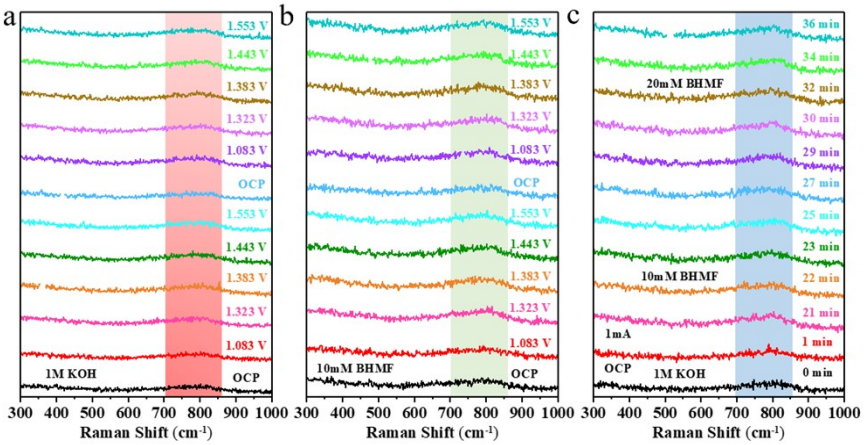

Figure S12. The In-situ Raman of Cu-CF under (a) LSV in 1 M KOH, (b) LSV in 1 M KOH added with 10 mM BHMF, (c) The chronopotentiometry test at 4 mA cm^{-2} in 1 M KOH along with adding 10 mM, 20 mM BHMF. The scan rates of LSVs were 5 mV s^{-1}.

Table S2. Comparison of the catalytic performance in the oxidation of BHMF to FDCA.

Catalysts	C_{BHMF}	Conditions	Potential / voltage	Conv. (%)	Yield (%)	Ref.
Ni_7Cu_3-CF	10 mM	RT	1.49 V vs. RHE	100	99.8	this work
CoOOH/Ni	10 mM	RT	1.6 V	100	90.2	[1]
NiCo/CF	10 mM	RT	1.4 V vs. RHE	100	95.4	[2]
Co_3O_4/CF	10 mM	RT	1.65 V	100	95.8	[3]
Pt/Pb	50 mM	RT	1 V vs. RHE	100	7	[4]
Pd/o-CNT	20 mM	RT, 100 mL/min O_2	-	100	93	[5]
Au_mPd_n/N-BN_xC	~9.8 mM	100 °C, 2.0 MPa O_2	-	100	95.8	[6]
Au_1Pd_1/pBNC-30 %HNO_3	-	100 °C, 2.0 MPa O_2	-	94.3	35.6	[7]
Ru-Acr(^{i}PR)	250 mM	160 °C	-	-	81	[8]

C_{BHMF}: the concentration of BHMF; RT: room temperature; Conv.: the conversion of BHMF

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