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Highly efficient electrocatalytic oxidation of 5-hydroxymethylfurfural on copper nanocrystalline/carbon hybrid catalysts: Structure-function relations

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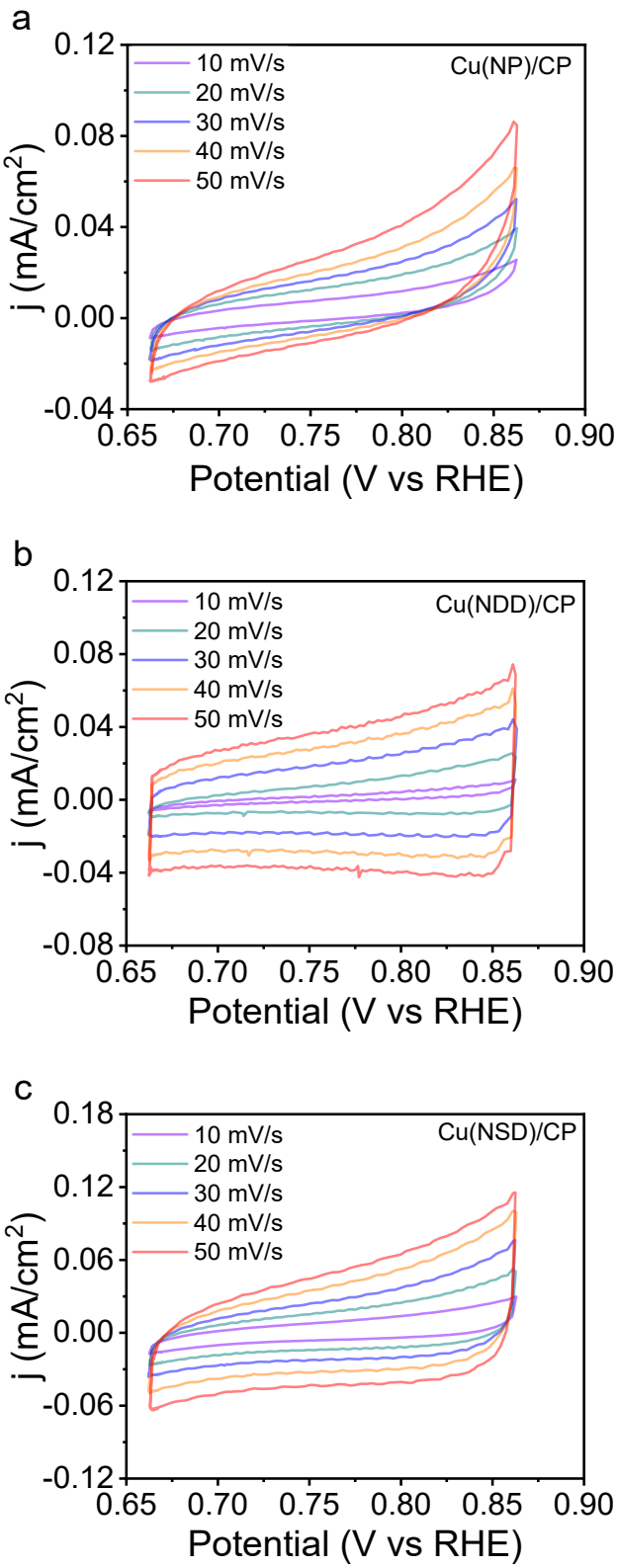

Figure S1. CV curves of Cu(NP)/CP, Cu(NDD)/CP and Cu(NSD)/CP catalysts at different scan rate from 10 mV s^{-1} to 50 mV s^{-1} in 0.1 M KOH solution with 5 mM HMF.

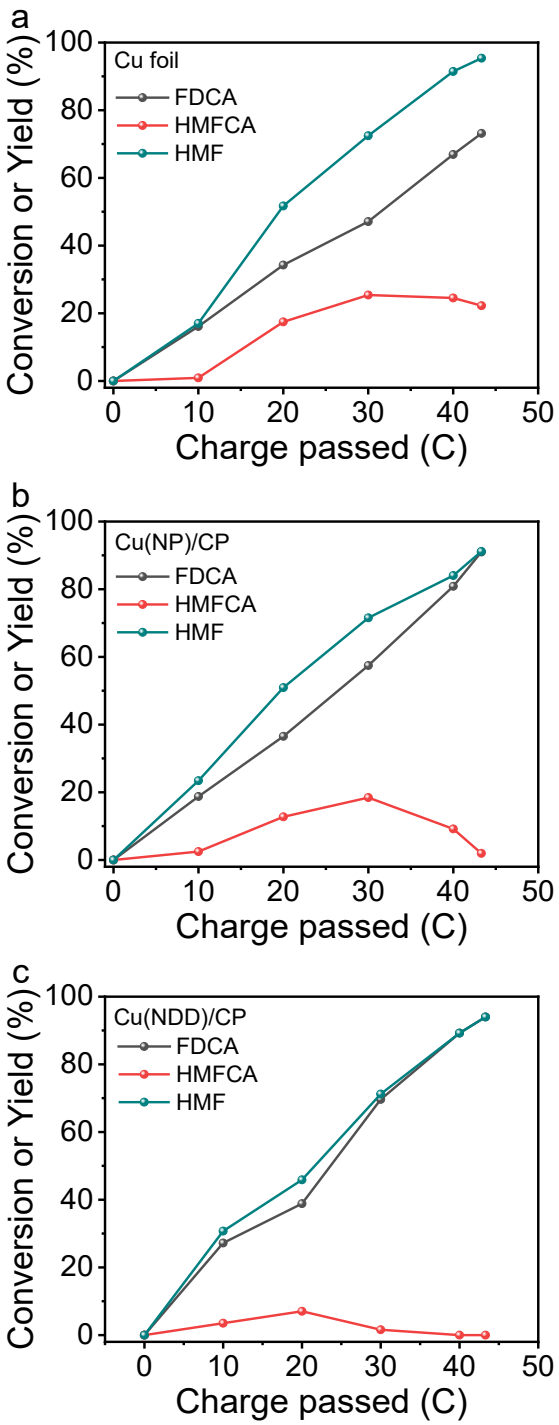

Figure S2. Conversion of HMF and selectivity of its oxidation products as function of charges passed through the electrode for Cu foil, Cu(NP)/CP and Cu(NDD)/CP catalysts at potential of 1.46 V_{RHE}.

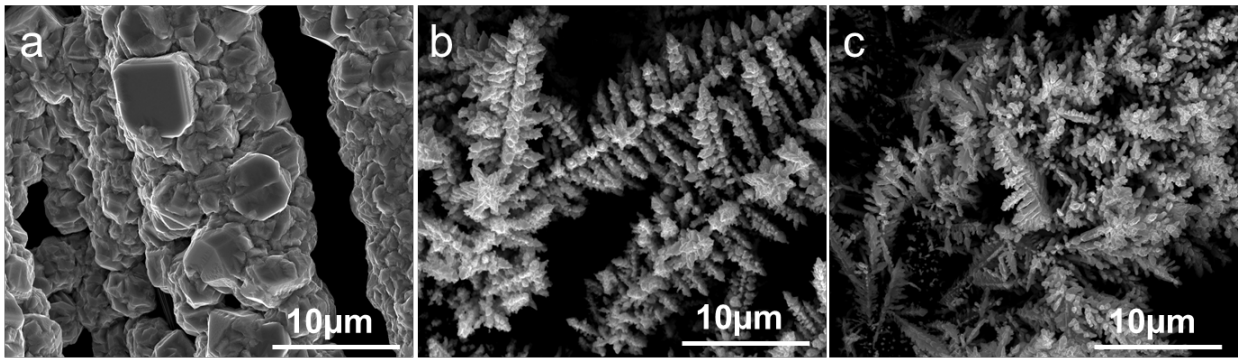

Figure S3. SEM images of (a) Cu(NP)/CP-used, (b) Cu(NDD)/CP-used and (c) Cu(NSD)/CP-used samples.

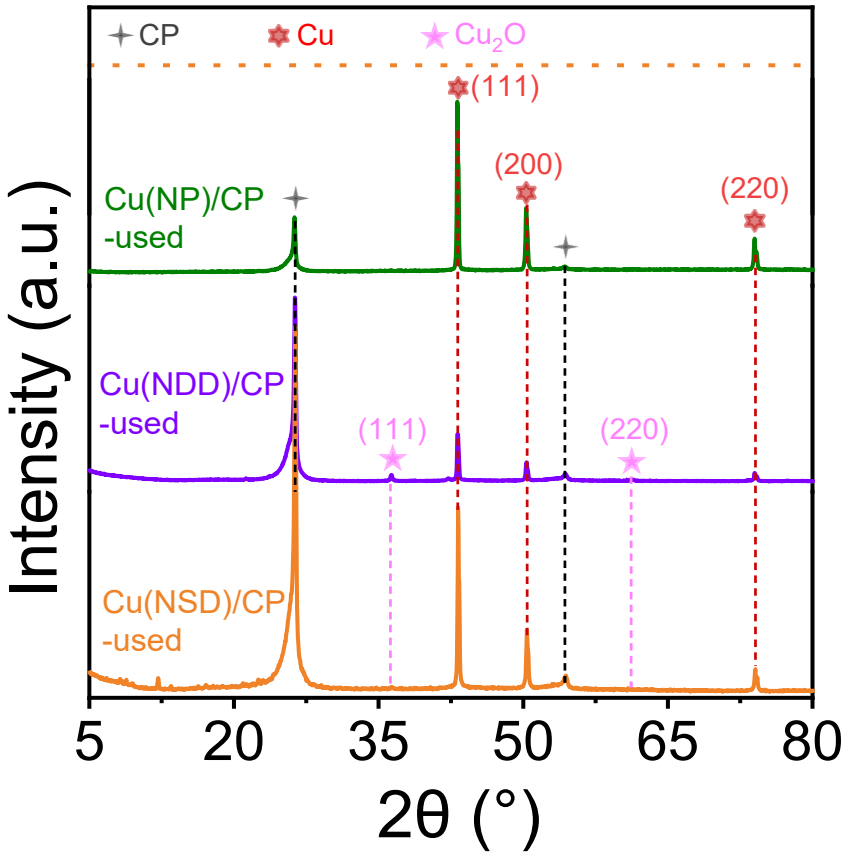

Figure S4. XRD pattern of Cu(NP)/CP-used, Cu(NDD)/CP-used and Cu(NSD)/CP-used catalysts.

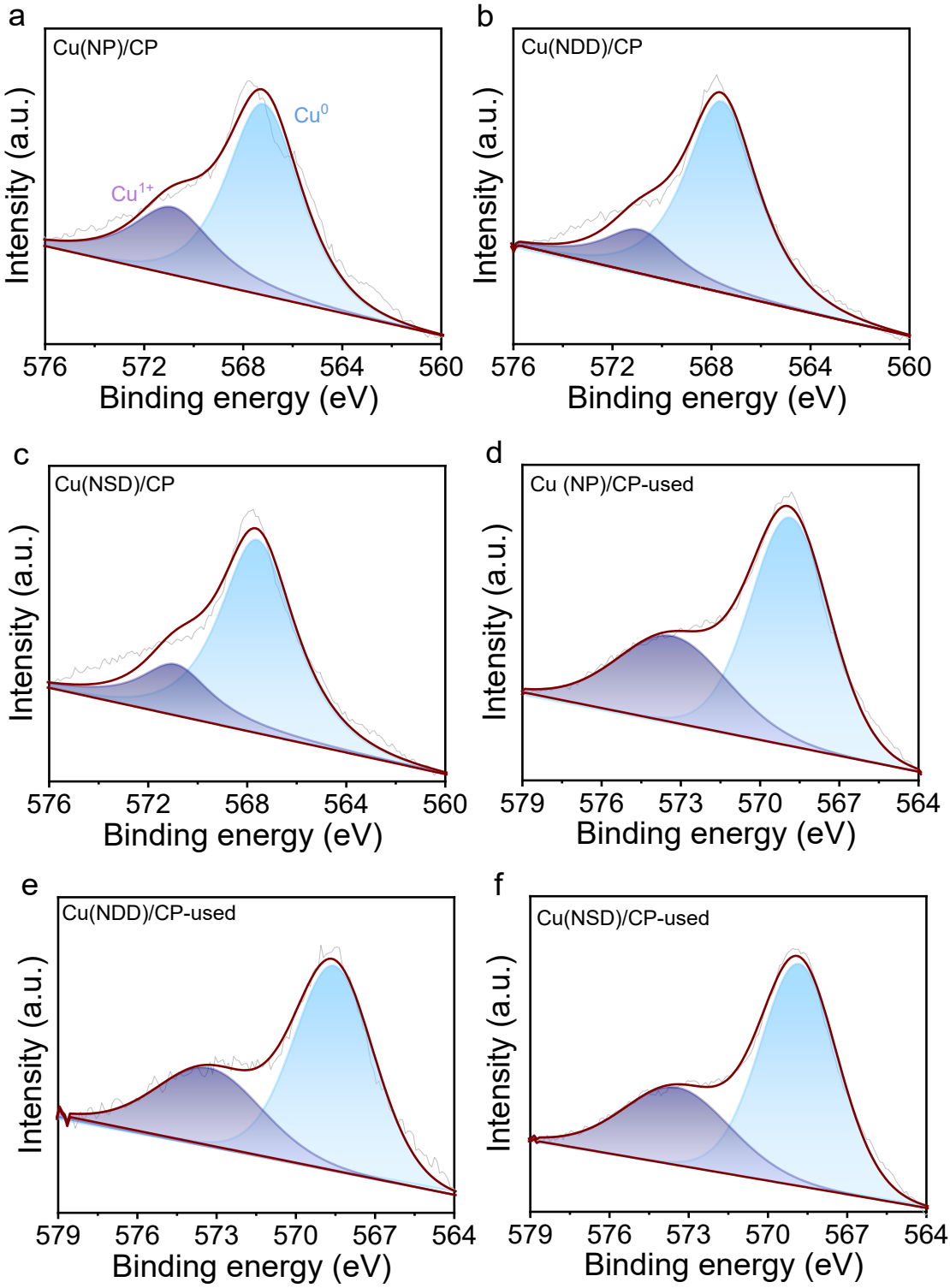

Figure S5. XPS Auger electron spectroscopy of (a) Cu(NP)/CP, (b) Cu(NDD)/CP, (c) Cu(NSD)/CP, (d) Cu(NP)/CP-used, (e) Cu(NDD)/CP-used and (f) Cu(NSD)/CP-used catalysts.

Table S1. Comparisons of catalytic performance of Cu(NSD)/CP and other reported Cu-base electrocatalysts.

Catalyst	HMF concentration	Potential	Electrolyte	Electrode area	Reaction time	HMF conversion	FDCA yield	FDCA Selectivity	
Cu(NSD)/CP	5 mM	1.46 V_{RHE}	0.1M KOH	3cm^2	43.3 C	96.0%	96.0%	100.0%	This work
CuNi/C	5 mM	1.45 V_{RHE}	1 M KOH	1 cm^2	5 h	62.9%	28.3%	45.0%	ref.1
$CuNiO_2$/C	5 mM	1.45 V_{RHE}	1 M KOH	1 cm^2	5 h	81.3%	43.6%	53.6%	ref.1
$Cu(OH)_2$/C	5 mM	1.45 V_{RHE}	1 M KOH	1 cm^2	90 C	75.8%	71.2%	93.9%	ref.1
$CuNi(OH)_2$/C	5 mM	1.45 V_{RHE}	1 M KOH	1 cm^2	90 C	100.0%	93.3%	93.3%	ref.1
$Cu(OH)_2$ NWs/CuF	10 mM	1.69 V_{RHE}	0.1 M KOH	3 cm^2	206 min	96.4%	80.3%	83.3%	ref.2
CuO NWs/CuF	10 mM	1.64 V_{RHE}	0.1 M KOH	3 cm^2	89 min	99.4%	90.9%	91.4%	ref.2
Nanocrystalline Cu Foam	5 mM	1.62 V_{RHE}	0.1 M KOH	4 cm^2	41 C	99.9%	96.0%	96.1%	ref.3

Table S2. Contents of Cu^0, Cu^{1+}, Cu^{2+} on the surface of Cu(NP)/CP, Cu(NDD)/CP and Cu(NSD)/CP samples before and after electrooxidation HMF reaction.

Catalyst	**peaks area**		
	Cu^{2+}	**Cu^{+}**	**Cu^{0}**
Cu(NP)/CP	0.00	30.61	69.39
Cu(NDD)/CP	0.00	19.75	80.25
Cu(NSD)/CP	0.00	23.52	76.48
Cu(NP)/CP-used	53.13	16.21	30.66
Cu(NDD)/CP-used	59.73	13.37	26.89
Cu(NSD)/CP-used	63.46	11.90	24.63

references

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