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Cu, Zn-coordinated ZIF-derived bimetal N-doped carbon framework for aerobic alcohol oxidation

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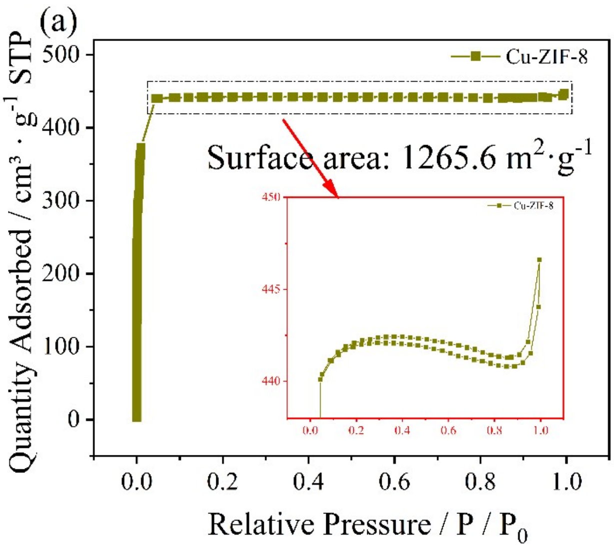

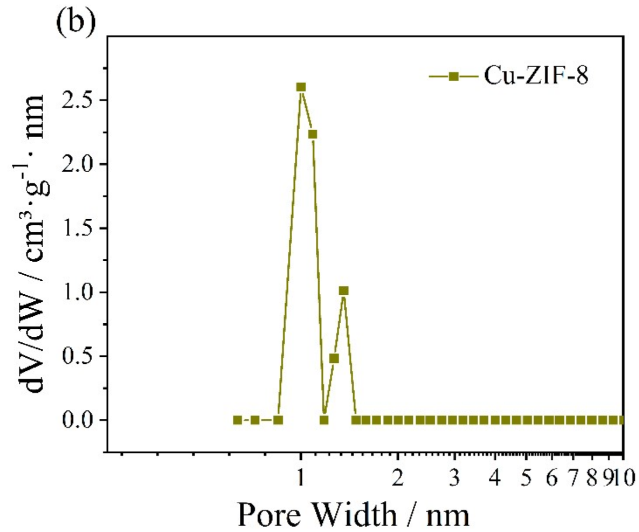

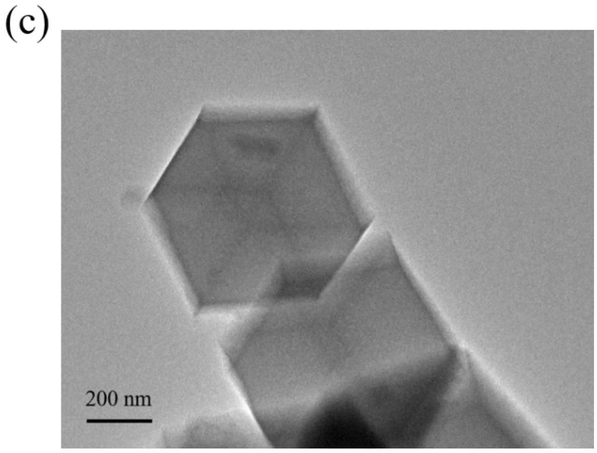

Fig. S1 (a) N_2 sorption isotherms, (b) the pore size distribution and (c) SEM image of the Cu-ZIF

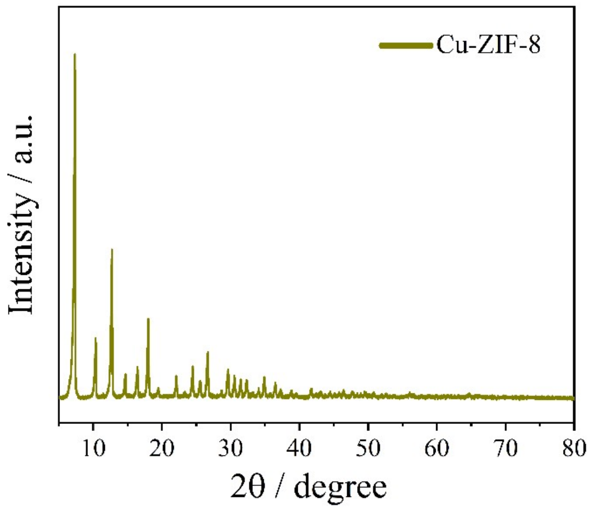

Fig. S2 XRD pattern of the Cu-ZIF

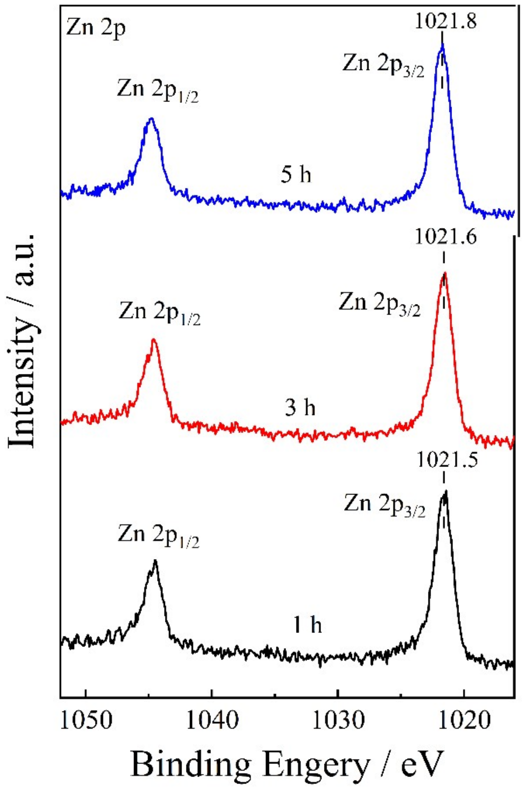

Fig. S3 XPS spectra of Zn 2p at different reaction times

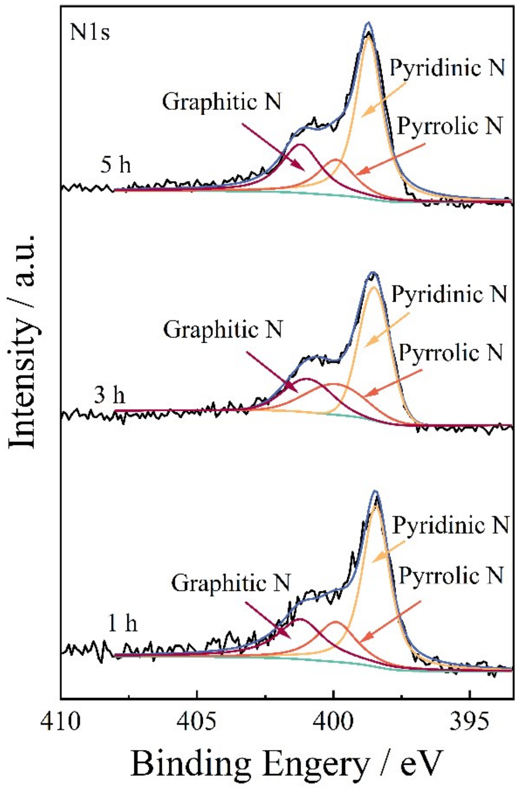

Fig. S4 XPS spectra of N1s at different reaction times

Table S1 Surface atomic ratio of the N1s at different reaction times over the Zn-N-C-800 catalyst

Sample	N%		
	Pyridinic N	Pyrrolic N	Graphitic N
1 h	58.1	20.2	21.7
3 h	54.5	24.2	21.3
5 h	54.2	20.8	25.0

Table S2 Catalytic performance at respective temperatures and solvent for selected representative benzyl alcohol oxidation systems

Catalyst	Solvent	Temperature / ℃	Time / h	Con. / %	Sel. / %	Refs.
Ag@Au/ZIF-8	THF	130	1	75	53	[1]
Pd/MagSBA	---	85	9	85	83	[2]
MnO_2@MF	Hexane	70	4	40	100	[3]
PtBi/CNT	Water	75	3	55	90	[4]
Co_3O_4/MnO_2	Toluene	100	6	81	90	[5]
Au-Pd/TiO_2	---	90	6	95	74	[6]
CuNi/C	THF	100	4	64	54	[7]
Mn_6Ni_4	Toluene	100	1	89	99	[8]
Cu-Zn-N-C-800	Toluene	50	3	95	84	This work

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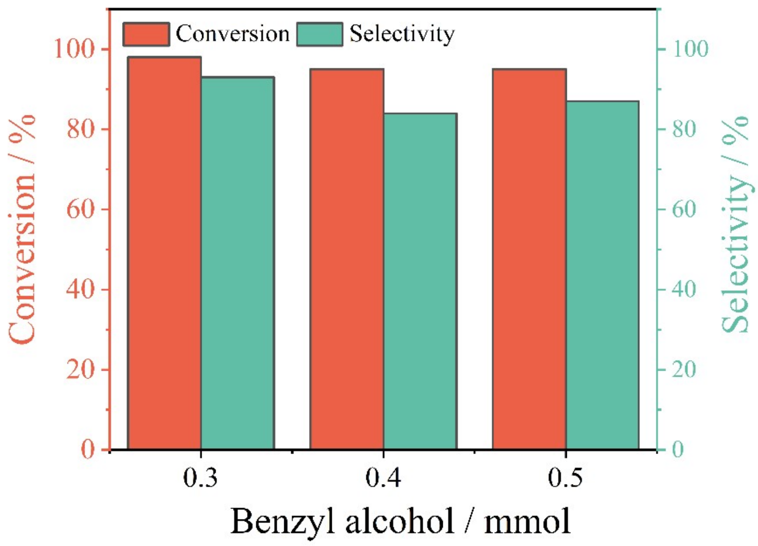

Fig. S5 Effect of benzyl alcohol concentration on catalytic performance.

Table S3 Catalytic activity of prepared catalyst.[a]

Catalyst	Amount of catalyst / g	Con. / %	Sel. / %	TOF / h^{-1} [b]
Zn-N-C-700	0.02	5.7	76	2.01
Zn-N-C-800	0.02	8.6	62	6.54

Zn-N-C-900	0.015	2.6	99	6.01
Cu-Zn-N-C-800	0.012	5.5	99	7.08

[a] Reaction conditions: 0.4 mmol benzyl alcohol, 10 mL toluene, O_2 flow rate 30 mL/min, 70 ºC, 1h.

[b] Calculated based on the total amount of metal.

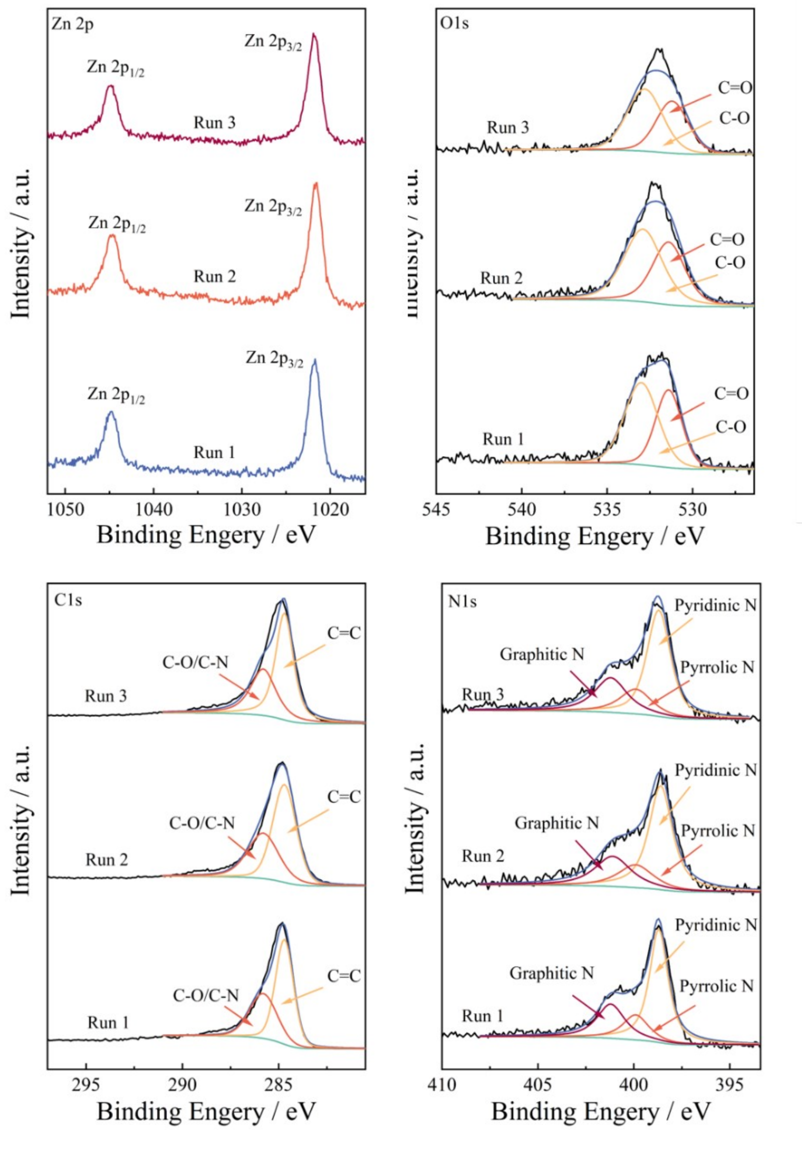

Fig. S6 XPS spectra of Zn-N-C-800 catalyst for different reaction cycles

Table S4 Surface atomic ratio of the catalyst as estimated by XPS.

Sample	C%		N%			O%	
	C=C	C-O/C-N	Pyridinic N	Pyrrolic N	Graphitic N	C=O	C-O
Run 1	60.4	39.6	54.2	20.8	25.0	42.5	57.5
Run 2	59.8	40.2	54.7	20.7	24.6	42.4	57.6
Run 3	60.8	39.2	54.0	20.8	25.2	42.9	57.1