

Supporting Information

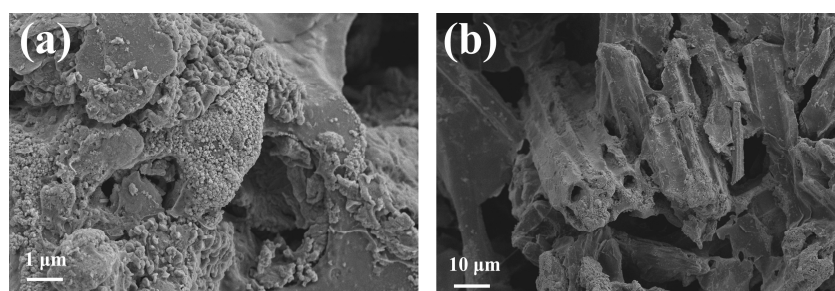


Figure S1. SEM image of Cu/C-BN material

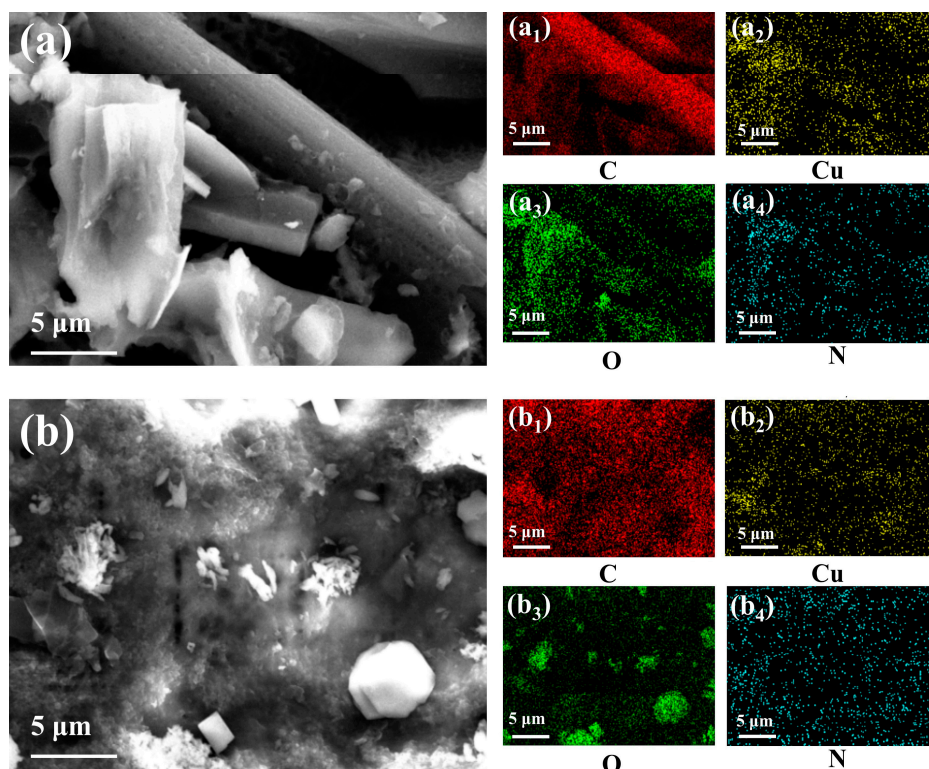


Figure S2. EDS-elements mapping of Cu/C-BN-CC(a) and Cu/C-BN-PT(b) materials.

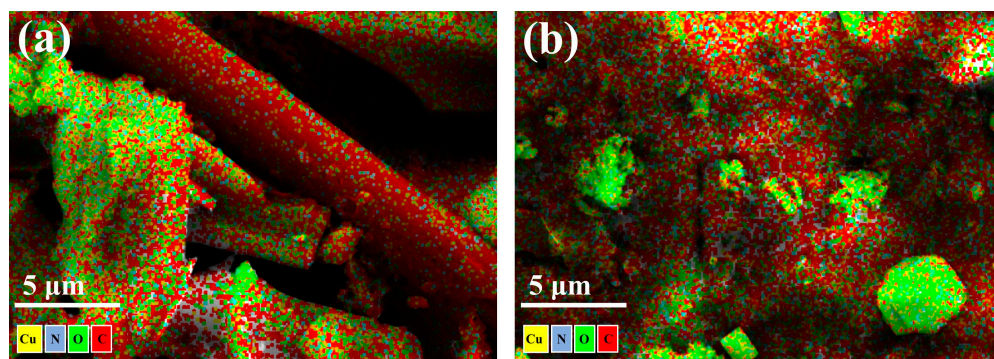


Figure S3. EDS layering images of Cu/C-BN-CC and Cu/C-BN-PT materials. (a). Cu/C-BN-CC material. (b). Cu/C-BN-PT.



Figure S4. Total number of elemental distribution maps for Cu/C-BN, Cu/C-BN-CC, and Cu/C-BN-PT materials. (a). Cu/C-BN-CC. (b). Cu/C-BN-PT. (c). Cu/C-BN.

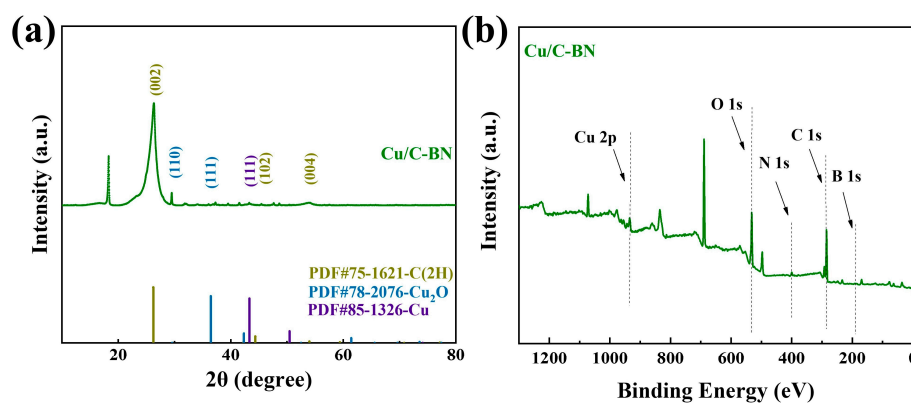


Figure S5. XRD and XPS images of Cu/C-BN materials. (a). XRD. (b). XPS.

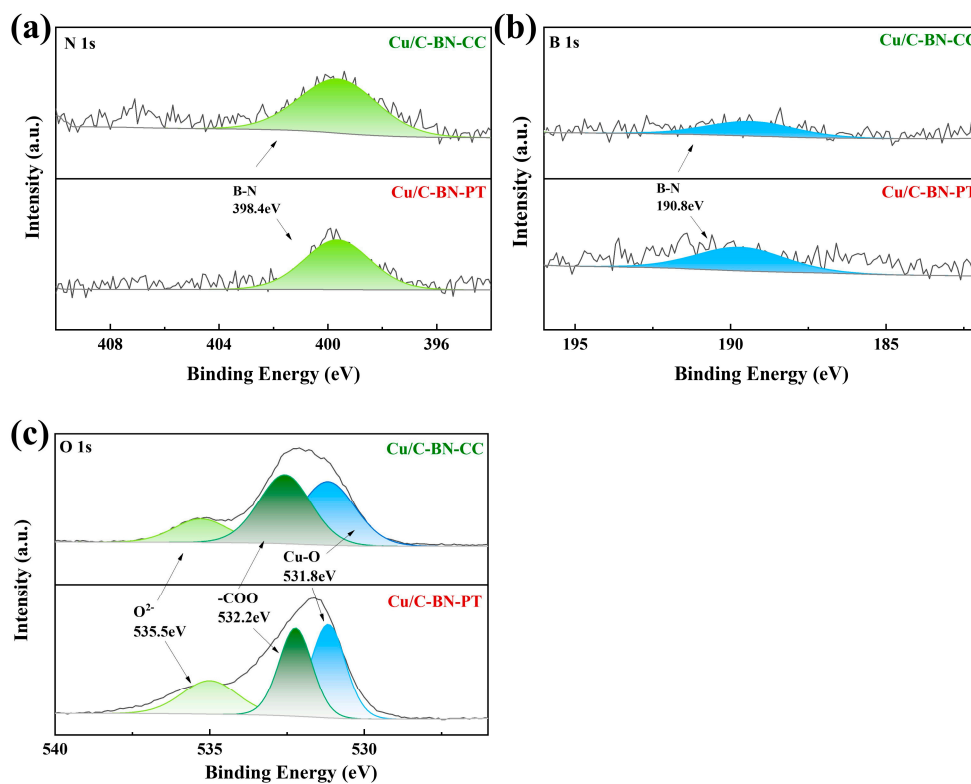


Figure S6. Cu/C-BN-CC and Cu/C-BN-PT materials N 1s(a), B 1s(b), O 1s(c) XPS fine spectrum.

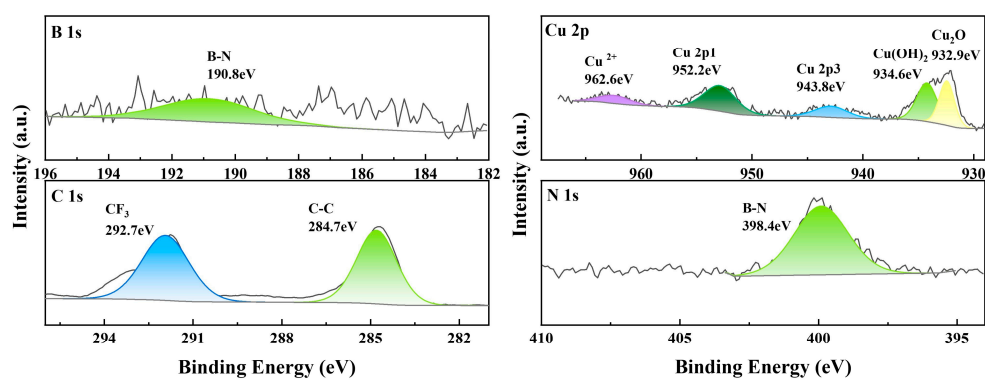


Figure S7. Cu/C-BN material B 1s, C 1s, Cu 2p, N 1s XPS fine spectrum.

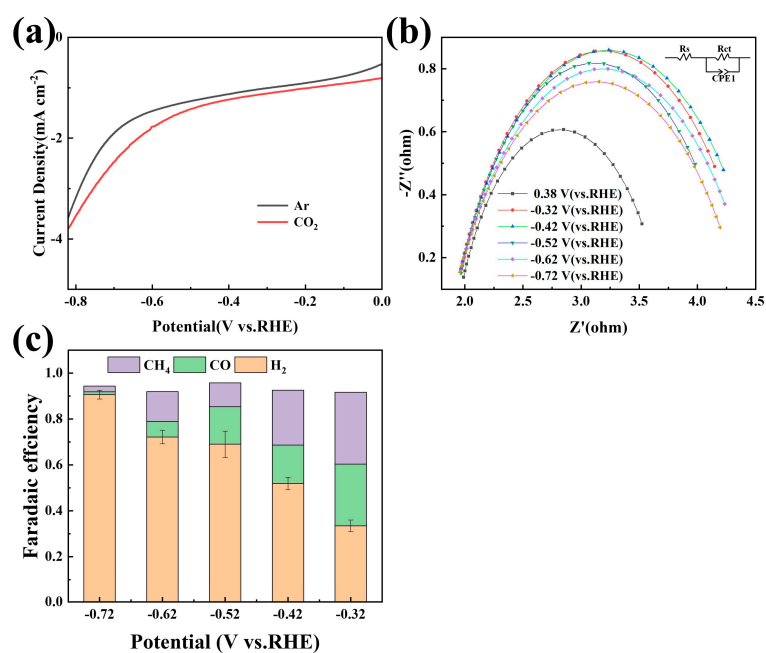


Figure S8. (a) LSV diagram of Cu/C-BN material in 0.2 M Na₂SO₄ solution. (b). Impedance diagram of Cu/C-BN in 1 M KHCO₃ solution. (c). Product diagram of Cu/C-BN in 1 M KHCO₃ solution.

Table S1. EIS fitting data of Cu/C-BN material in 1.0 M KHCO₃ solution

Potential	Rs	RCT	CPE-T	CPE-P
0.38	1.92	1.8	0.00054	0.75
-0.32	1.88	2.62	0.00065	0.74
-0.42	1.88	2.7	0.00076	0.72
-0.52	1.89	2.45	0.0006	0.75
-0.62	1.87	2.64	0.0011	0.69
-0.72	1.86	2.54	0.0012	0.69

Table S2. EIS fitting data of Cu/C-BN-CC material in 1.0 M KHCO₃ solution

Potential	Rs	RCT	CPE-T	CPE-P
0.48	1.87	1.17	0.0023	0.71
-0.32	1.75	3.24	0.0035	0.63
-0.42	1.75	6.83	0.0020	0.68
-0.52	1.79	4.60	0.0018	0.70
-0.62	1.80	2.97	0.0019	0.70
-0.72	1.77	2.21	0.0041	0.63

Table S3. EIS fitting data of Cu/C-BN-PT material in 1.0 M KHCO₃ solution

Potential	Rs	RCT	CPE-T	CPE-P
0.38	2.17	155.2	0.00061	0.81
-0.32	2.28	337.8	0.00056	0.86
-0.42	2.30	75.27	0.00060	0.85
-0.52	2.30	19.30	0.00066	0.84
-0.62	2.32	6.41	0.00068	0.84
-0.72	2.31	3.18	0.00068	0.84

Table S4. Product efficiency of Cu/C-BN material at different potentials in 1.0 M KHCO₃ solution

Potential	FE (H ₂)	FE (CO)	FE (CH ₄)
-0.72	90.65%	1.29%	2.40%
-0.62	72.19%	6.84%	12.93%
-0.52	69.04%	16.31%	10.46%
-0.42	51.94%	16.68%	23.94%
-0.32	33.51%	26.91%	31.26%

Table S5. Product efficiency of Cu/C-BN-CC material at different potentials in 1.0 M KHCO₃ solution

Potential	FE (H ₂)	FE (CO)	FE (CH ₄)
-0.72	89.78%	1.36%	2.13%
-0.62	74.73%	7.54%	10.51%
-0.52	70.26%	16.60%	9.75%
-0.42	50.62%	17.65%	21.50%
-0.32	24.92%	30.32%	30.45%

Table S6. Product efficiency of Cu/C-BN-PT material at different potentials in 1.0 M KHCO₃ solution

Potential	FE (H ₂)	FE (CO)	FE (CH ₄)
-0.72	89.91%	5.48%	0.07%
-0.62	75.59%	12.09%	2.11%
-0.52	68.54%	15.19%	11.75%
-0.42	41.30%	28.20%	19.31%
-0.32	12.38%	47.70%	28.45%

Table S7. EIS fitting data of Cu/C-BN material in 90% PC (10% H₂O) solution

Potential	R _s	RCT	CPE-T	CPE-P
-0.16	13.71	48.41	0.013	0.47
-0.76	13.75	144.2	0.014	0.48
-0.96	14.07	41.20	0.012	0.52
-1.16	14.20	14.45	0.011	0.54
-1.36	14.25	8.47	0.009	0.57
-1.56	14.29	5.37	0.008	0.59

Table S8. Product efficiency of Cu/C-BN material at different potentials in 90% PC (10% H₂O) solution

Potential	FE (H ₂)	FE (CO)	FE (CH ₄)
-1.56	49.05%	23.66%	13.10%
-1.36	55.12%	21.32%	10.06%
-1.16	48.54%	44.34%	11.78%
-0.96	24.80%	63.31%	15.27%
-0.76	17.24%	64.70%	12.00%