

Supporting information

Dual-functional Ni and Co oxides doped carbon nanocomposite: an effective catalyst for electrochemical water splitting and CO₂ utilization

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Table S1. Thermal gravimetric analysis (TGA) data of NCC and MOF showing weight loss as function of time and temperature.

Time (min)	Temperature (°C)	Weight (mg)	Weight (%)
TGA Data of NCC			
0.04	27.15	5.855	99.979
25.95	281.05	5.718	97.634
31.93	340.77	5.654	96.542
56.98	590.82	5.561	94.948
70.42	724.91	5.393	92.081
Residue of NCC after 1000 °C: 5.351 mg (91.373 %)			
TGA Data of Ni/Co-BDC MOF			
0.76	19.46	0.967	99.461
39.40	406.92	0.858	88.223
Residue of Ni/Co-BDC MOF after 1000 °C: 0.272 mg (27.924 %)			

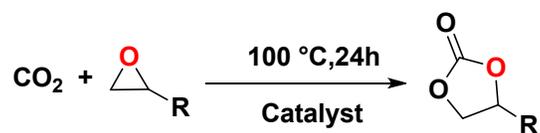
Table S2. Peak position, FWHM and crystal size calculation of NCC sample by Scherrer equation, $D = k\lambda / \cos\theta\beta$.

θ =Peak position	β =FWHM	Crystalline size (nm)	D=Average crystalline size (nm)
18.8997	0.6923	11.6334	10.9843
31.1405	0.6285	13.1210	
36.8377	1.0083	8.3044	
43.2416	0.7782	10.9816	
44.5213	0.9898	8.6723	
59.1491	0.6922	13.1954	
62.8425	0.8917	10.4396	
64.9652	0.8170	11.5270	

Table S3. The crystallinity data of NCC

Crystallinity % = Area under the crystalline peak / Area under the all peaks * 100

Area under the crystalline peak	Sum of crystalline peak	Area under all peaks	Crystallinity (%)
215.8748	5266.2817	5794	90.8920
483.1754			
1659.167			
1082.521			
494.5744			
337.2967			
477.3283			
516.3432			



Scheme S1. Synthesis of Cyclic carbonate from carbon dioxide and epoxides under given catalytic conditions.

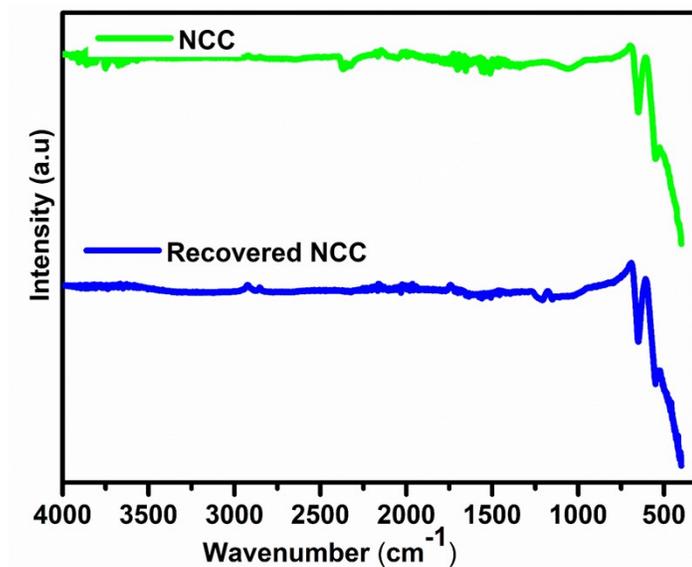


Fig. S1 The FTIR analysis of as synthesized NCC and recovered NCC.

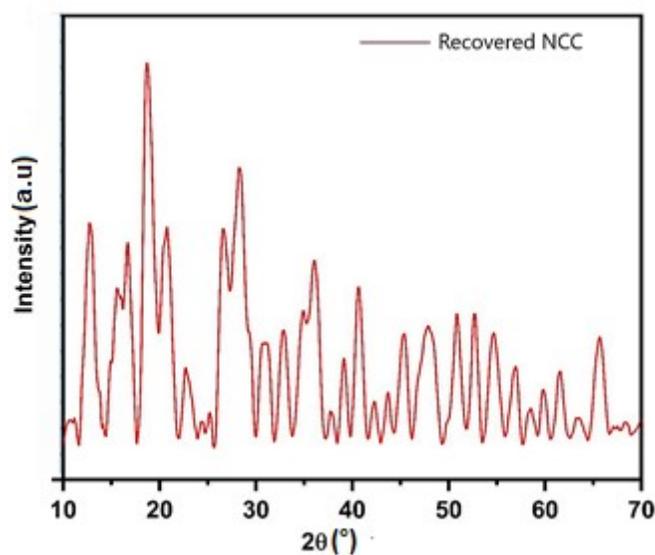
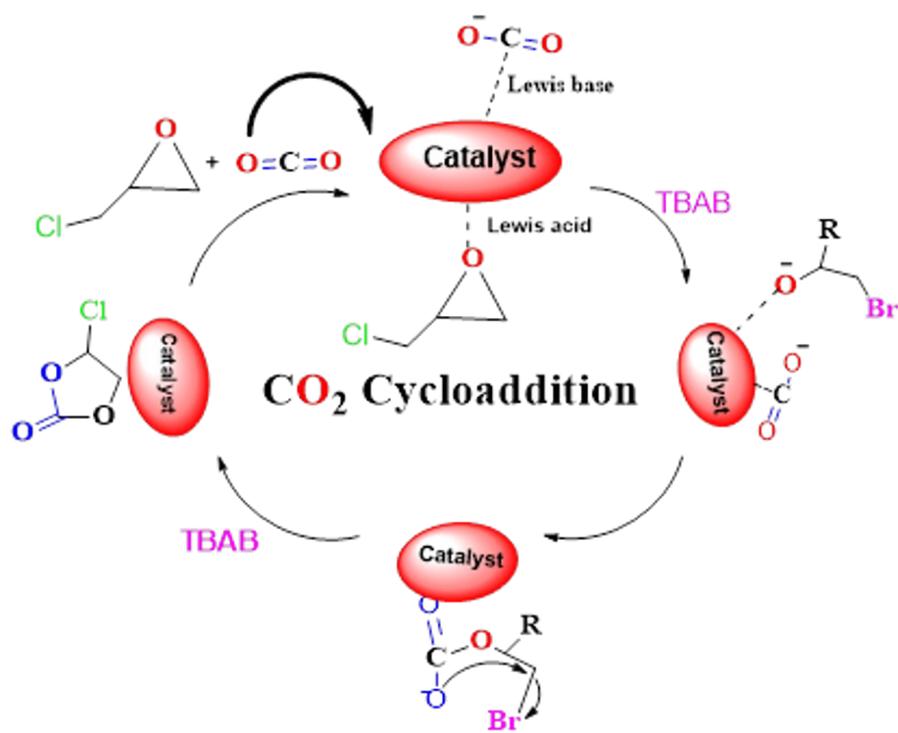


Fig. S2 Powder XRD analysis of the recovered NCC catalyst after CO₂ fixation reaction.



Scheme S2. Catalytic mechanism of cycloaddition of CO₂ in the presence of ECH as substrate and TBAB as co-catalyst.

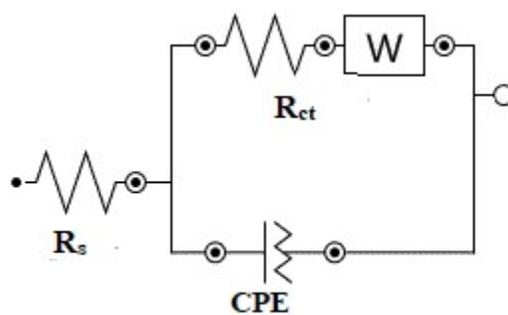


Fig. S3 EIS circuit of three electrode system containing solution resistance (R_s), Charge transfer Resistance (R_{ct}) and CPE.

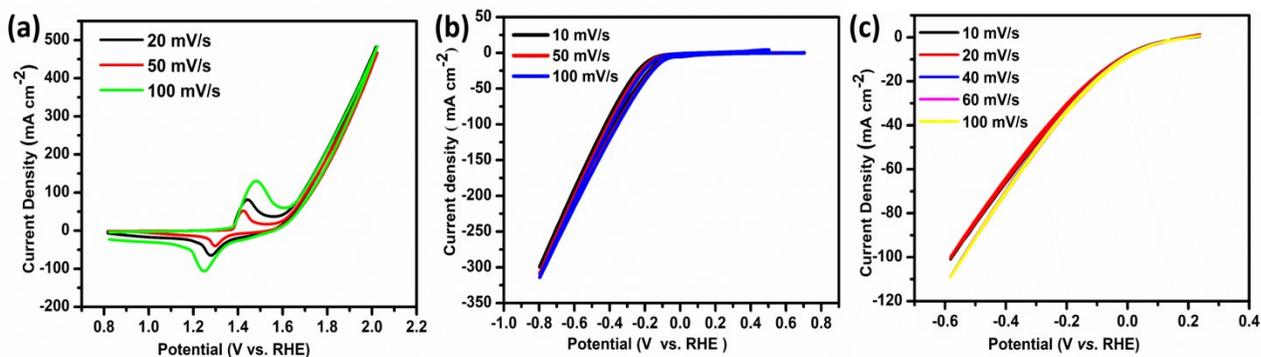


Fig. S4 Cyclic voltammetry (CV) analysis of NCC at different scan rate in both Faradic and non-faradic region (a) OER in 1.0 M KOH (b) HER in 1.0 M KOH, and (c) HER in 0.1M H₂SO₄

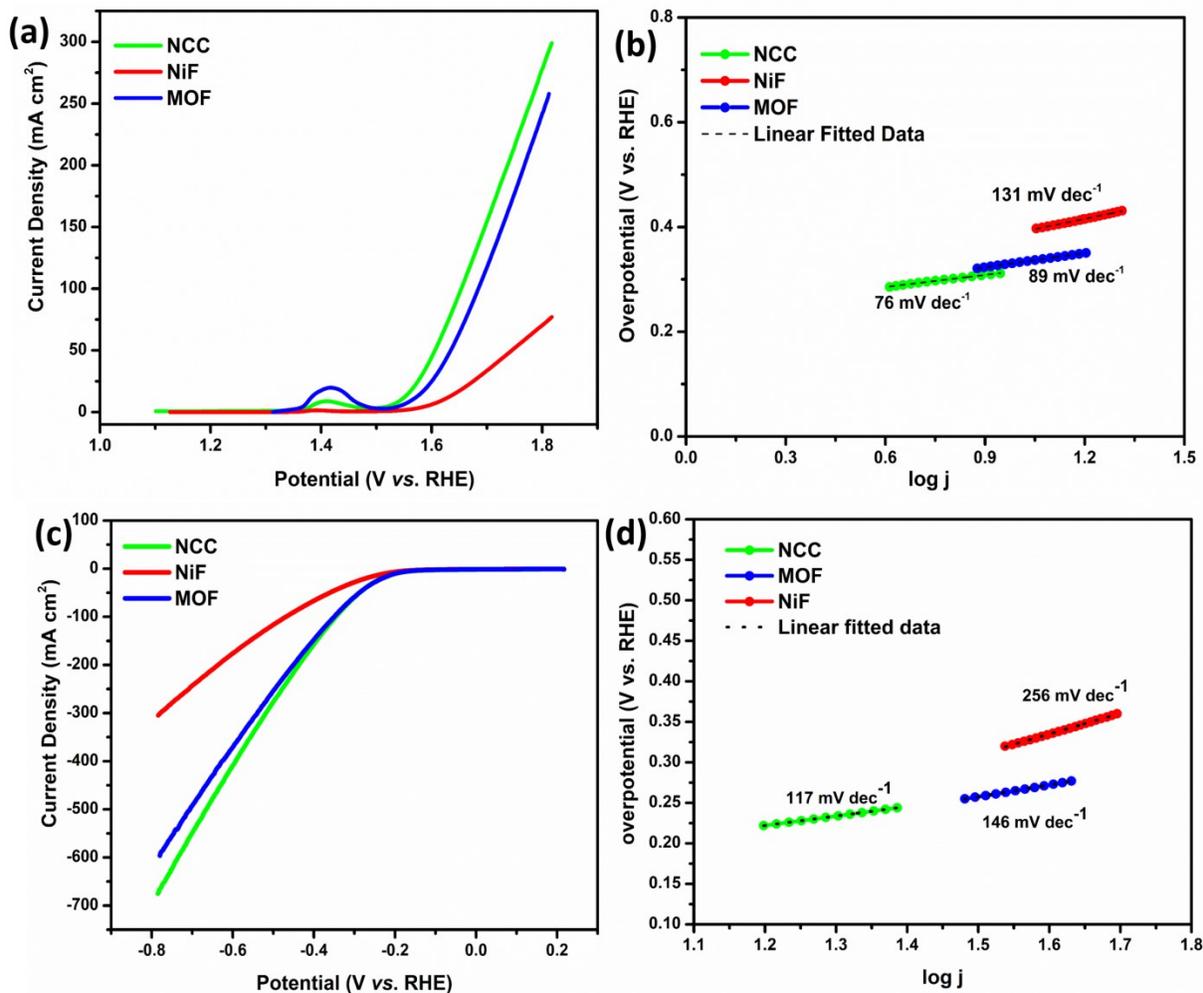


Fig. S5 OER and HER (in 1.0 M KOH) comparison between MOF (NiCoBDC), NCC and NiF: (a) LSVs at 10 mV/s & Tafel slopes analysis (a & b and c & d, respectively).