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Supplementary material

Heteroatom-Doped Hierarchically Porous Biochar for Supercapacitor Application and Phenol Pollutant Remediation

Diyong Tang [1,*], Li Lu [1], Zhipeng Luo [1], Baokun Yang [1], Jun Ke [2], Weidong Lei [1], Hongran Zhen [1], Yuan Zhuang [3], Jie Sun [1], Ke Chen [1] and Jie Sun [1]

[1] Key Laboratory of Resources Conversion and Pollution Control of the State Ethnic Affairs Commission, College of Resources and Environmental Science, South-Central Minzu University, Wuhan 430074, China; 2021110590@mail.scuec.edu.cn (L.L.); 2020120750@mail.scuec.edu.cn (Z.L.); 2020110555@mail.scuec.edu.cn (B.Y.); 2021120875@mail.scuec.edu.cn (W.L.); 202021241174@mail.scuec.edu.cn (H.Z.); 3047207@mail.scuec.edu.cn (J.S.); kechen@mail.scuec.edu.cn (K.C.); jetsun@mail.scuec.edu.cn (J.S.)

[2] School of Chemistry and Environmental Engineering, Wuhan Institute of Technology, Wuhan 430073, China; jke@wit.edu.cn

[3] Experimental Teaching and Engineering Training Center, South-Central Minzu University, Wuhan 430074, China; 8800319@mail.scuec.edu.cn

* Correspondence: tangdy076@mail.scuec.edu.cn

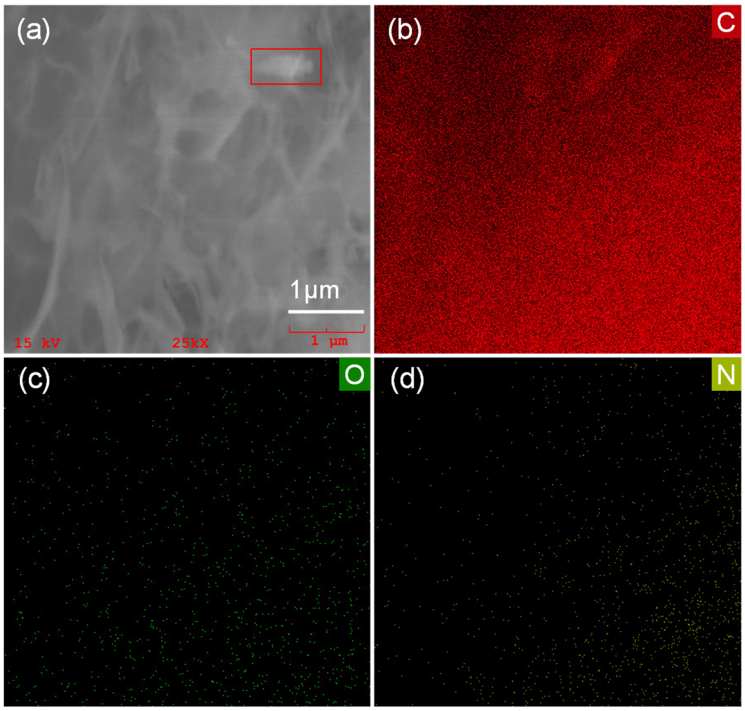

Figure S1. EDX elemental mapping images of BC-24.

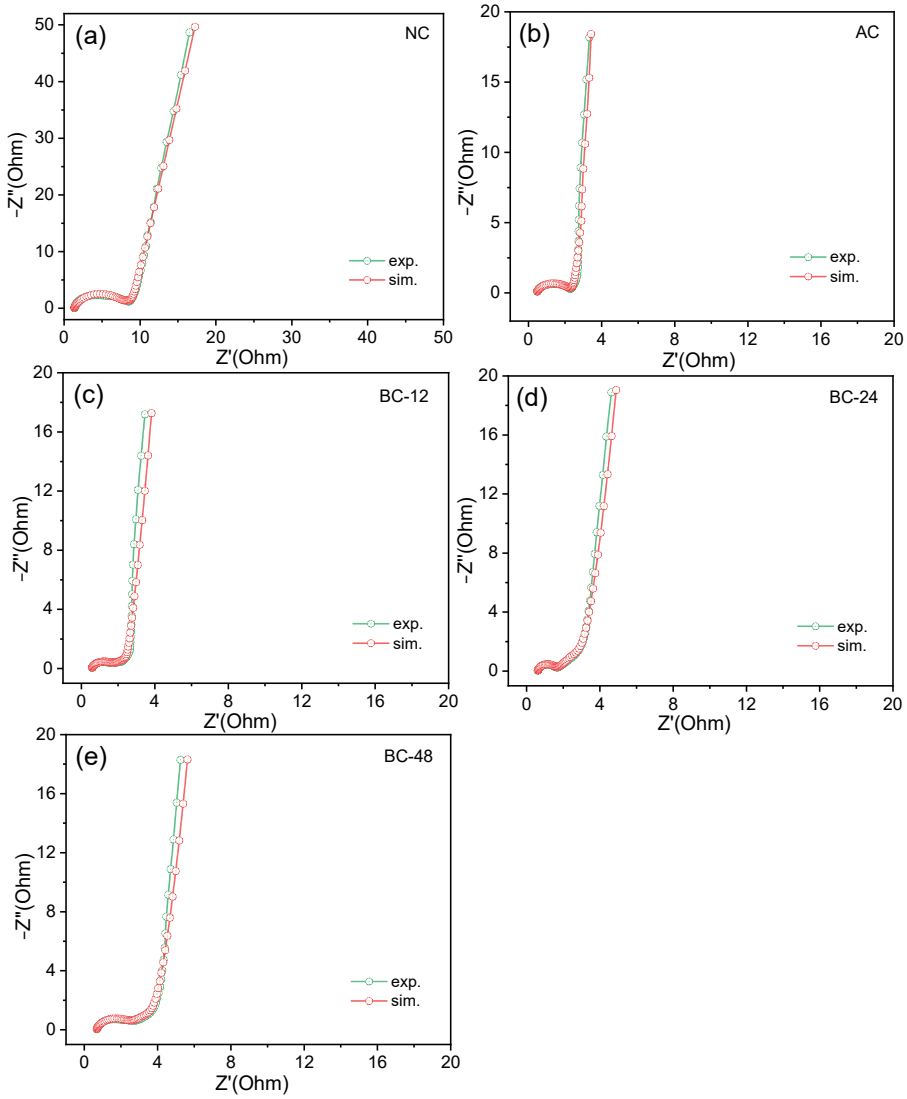

Figure S2. Experimental and simulated Nyquist plots for the indicated electrodes.

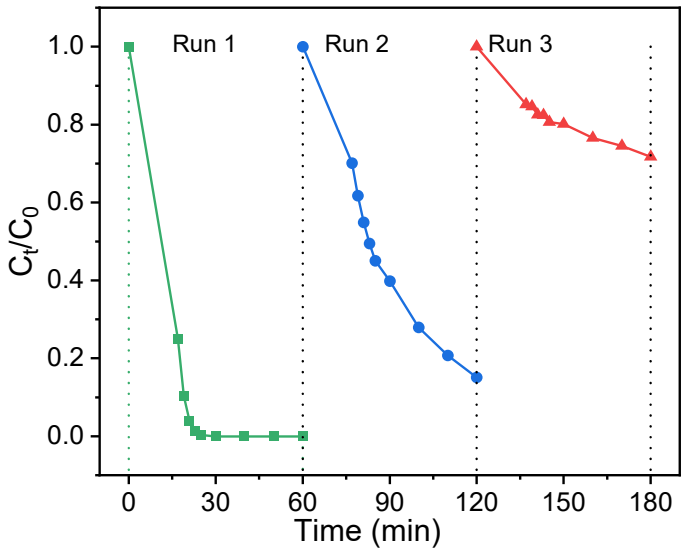

Figure S3. Cycling experiments for phenol degradation by the BC-24/PDS system ([phenol] = 0.2 mM, catalyst dosage = 0.1 g/L, [PDS] = 0.5 mM).

Table S1. The resistance parameters deduced from the equivalent circuits of EIS measurements.

Electrodes	R_s (Ω)	R_{ct} (Ω)	R_w (Ω)
NC	1.31	5.93	0.44
AC	0.44	1.67	0.44
BC-12	0.56	1.10	0.46
BC-24	0.61	0.82	0.46
BC-48	0.66	1.61	0.42

Table S2. Comparison of the capacitive performance of BC-24 in a three-electrode system with other biochar materials in the reported literature.

Samples	Electrolyte	Current Density (A/g)	Gravimetric Specific Capacitance (F/g)	Ref.
BBC-4	1 M H_2SO_4	0.3	259	[1]
PC-900	1 M H_2SO_4	0.5	169.4	[2]
C_K/H_3PO_4	1 M H_2SO_4	0.5	186.3	[3]
ACRP-650	1 M H_2SO_4	0.5	289	[4]
HM-24	1 M H_2SO_4	0.5	314	[5]
AA-RSC	1 M H_2SO_4	0.5	332	[6]
BC-24	1 M H_2SO_4	0.5	342	This work
S-AC	1 M KOH	10	85	[7]
AC_{TS}-1.0	6 M KOH	10	150	[8]
GHPB-0.2	6 M KOH	10	160	[9]
GHPB-0.2	1 M H_2SO_4	10	118	[9]
ACRP-650	1 M H_2SO_4	10	187	[4]
AA-RSC	1 M H_2SO_4	10	190	[6]
BC-24	1 M H_2SO_4	10	198	This work

Table S3. Comparison of the catalytic phenol degradation performance of BC-24 through persulfate activation with reported literature.

Catalysts	Experimental Conditions	Reaction Time (min)	Degradation Efficiency	k (min^{-1})	Stability	Ref.
AC950	[catalyst] = 0.2 g/L, [PS] = 5 mM, [phenol] = 0.5 mM	60	99.5%	0.087	Removal 10% after 3 cycles	[10]
Ca/BS-800-KOH	[catalyst] = 0.066 g/L, [PS] = 1 g/L, [phenol] = 20 mg/L	90	100%	0.040	Removal 48% after 3 cycles	[11]
GK-BC-850	[catalyst] = 0.5 g/L, [PS] = 1 mM, [phenol] =10 mg/L	60	90%	0.155	Removal 50% after 5 cycles	[12]
BM-α-FeOOH/PBC700	[catalyst] = 0.2 g/L, [PS] = 8.4 mM, [phenol] =50 mg/L	180	89.6%	0.100	Removal 82.9% after 4 cycles	[13]
BC	[catalyst] = 0.5 g/L, [PS] = 0.8 mM, [phenol] =25 mg/L	240	86.0%	0.381	Removal 90% after 3 cycles	[14]
RGO	[catalyst] = 0.5 g/L, [PS] = 0.8 mM, [phenol] =25 mg/L	240	86.0%	0.317	Removal 90% after 3 cycles	[14]
NCd-4-800	[catalyst] = 0.5 g/L, [PS] = 0.5 mM, [phenol] =10 mg/L	30	85%	—[a]	Removal 62% after 3 cycles	[15]
N-BC900	[catalyst] = 0.2 g/L, [PS] = 2 mM, [phenol] =20 mg/L	20	100%	0.206	Removal 45% after 5 cycles	[16]
Cu-GBC10C	[catalyst] = 0.3 g/L, [PS] = 2 mM, [phenol] =0.1 mM	30	90%	—[a]	Removal 30.6% after 4 cycles	[17]
BC-24	[catalyst] = 0.1 g/L, [PS] = 0.5 mM, [phenol] =0.2 mM	25	100%	0.683	Removal 30% after 3 cycles	This work

[a] Not given.

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