Supporting Information

Enhanced Peroxydisulfate Activation by Co-doping of Nitrogen, Chlorine, and Iron: Preparation, Synergistic Effects, and Application

Zhipeng Li[1,2]; Hao Zhang[3,*]; Wanjiang Guo[1]; Tan Meng [2]; Hongru Cui[1]; ChaoMa[3,*]

1. Shengli Oilfield Company, Sinopec, Dongying, 257000, China;

2. School of Environmental Science and Engineering, Tianjin University, Tianjin, 300072, China

3. School of Mechanical and Power Engineering, Tianjin Renai College, Tianjin, 301636, China;

Corresponding author: *Hao Zhang; Email: 15130248376@163.com

*Chao Ma; mail: machao0412@163.com

Number of pages: 11

2 Text, 6 Figures, 2 Tables

Text S1 Materials and Methods

Surface functional groups elimination experiments:

Ketonic (C=O): 0.2 g phenylhydrazine (PH) and 50 μL HCl were dissolved in 100 mL ethanol, and then 0.2 g biochar was added to the aqueous matrix. After stirring under N_2 protection for 48 hours, the suspension was filtered through a 0.45 μm membrane and washed with ethanol several times to ensure that the PH adsorbed on the surface of biochar was all removed. The biochar was dried in a vacuum at 80 °C for 72 h.

Carboxyl (-COOH): 0.2g of 2-bromo-1-phenylethanone (BrPE) was dissolved in 50 mL of ethanol, and then 0.2 g of biochar was added to the solution. After stirring under N2 protection for 48 hours, the precipitate was filtered through a 0.45 μm membrane and washed with ethanol several times to ensure that the BrPE adsorbed on the surface of biochar was all removed. The biochar was dried in a vacuum at 80 °C for 72 h.

Text S2 The elimination of PFRs and defects

The role of PFRs in PDS activation and SMX degradation was determined by using KI for the treatment of the biochar. The biochar was immersed in a 0.1 M KI solution for 24 h. Ultrapure water was then used several times to wash the pretreated biochar to remove the two chemicals. EDTA-2Na (10 mM) was added directly to the BCNF/PDS system to remove the influence of defects, and the difference in PDS activation was explored by comparing the activation rates of PDS.

Table S1. The physical and chemical properties of CRs.

	Surface area (m^2/g)	Element ratio				
		C	**N**	**O**	**Cl**	**Fe**
BCS	506.85	72.33%	0.58%	23.7%	0.79%	2.6%
BCNF	819.8	58.02%	8.32%	16.02%	1.61%	16.03%
BCN	698.45	/	/	/	/	/
BCF	409.53	/	/	/	/	/

Table S2. The change in components of CRs.

	Electron Resistivity	g factor	PFRs (spins/g)	Fe leaching (mg/L)
BCS	6.86 Ω	/	/	/
BCNF	2.578 Ω	2.004	3.6×10^{16}	/
BCNF treated by KI	3.89 Ω	2.004	1.1×10^{16}	/

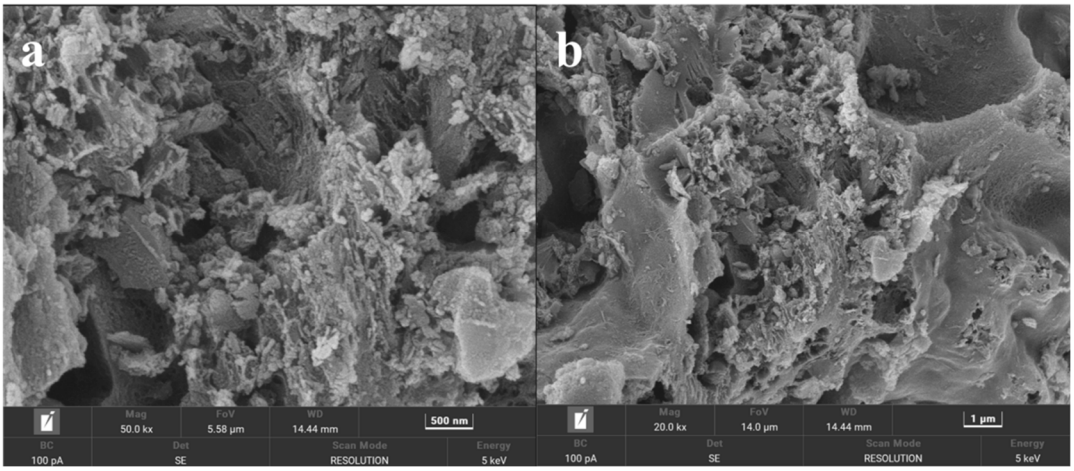


Figure S1. The SEM results of BCNF.

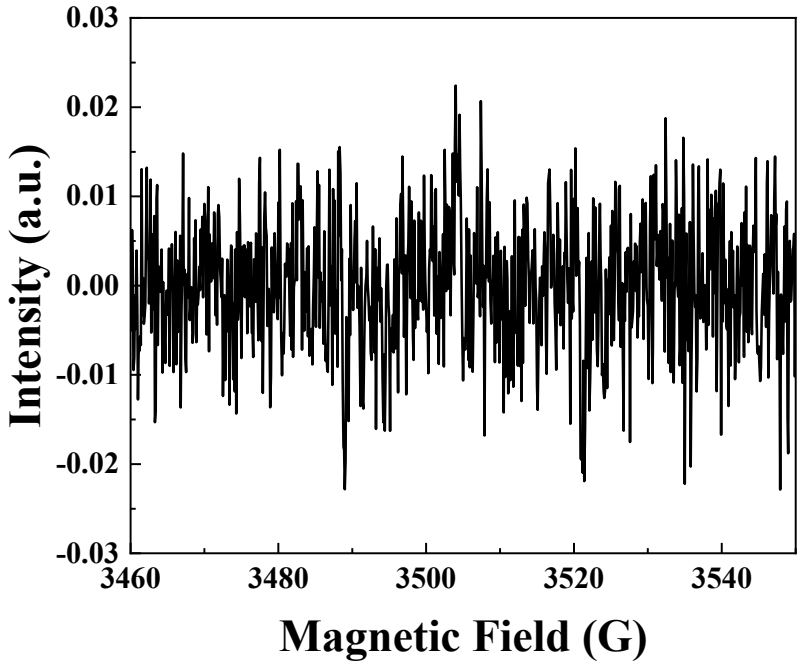


Figure S2. The EPR results of the BCNF/PDS system with BQ.

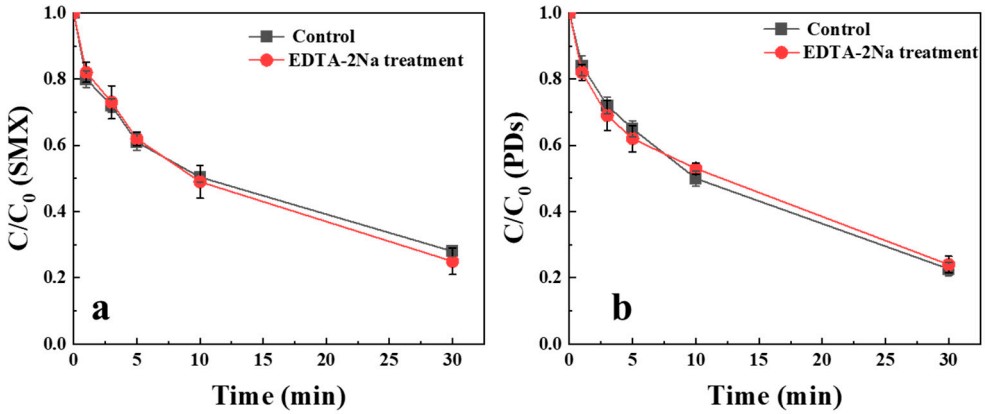


Figure S3. The SMX degradation and PDS activation of BCNF after being treated with EDTA-2Na.

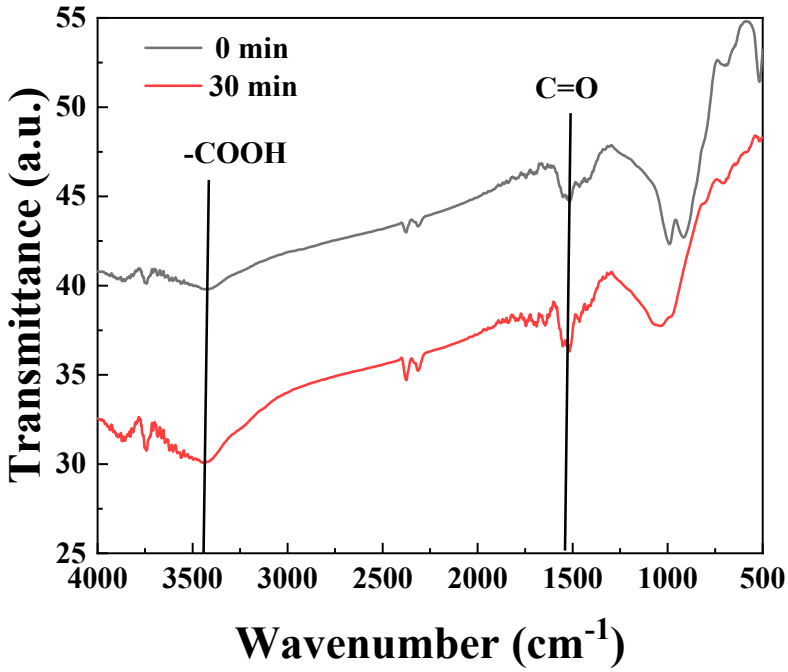


Figure S4. The FTIR results of BCNF.

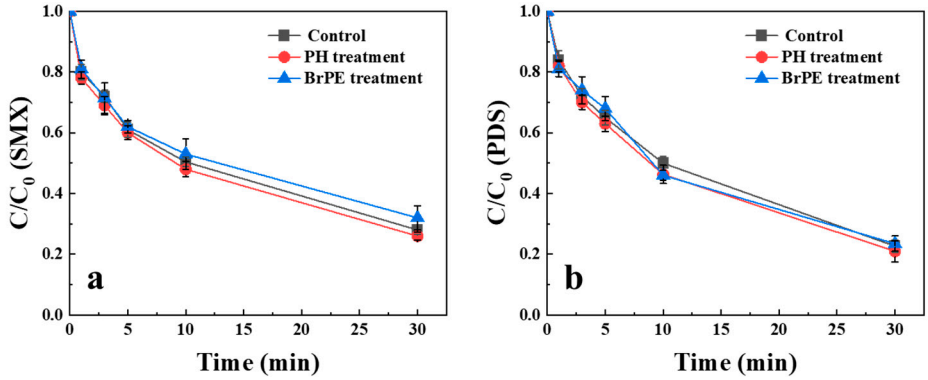


Figure S5. The effects of surface groups elimination on SMX degradation (a) and PDS activation (b). [BCNF] = 1 g/L, [PDS] = 1 mM, [SMX] = 10 μM, pH = 7.

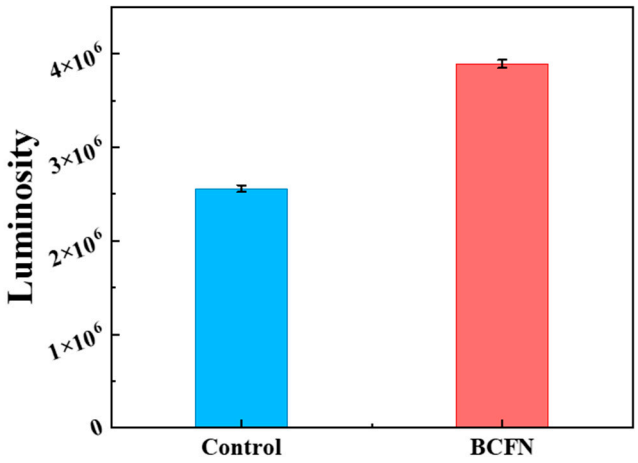


Figure S6. The bacterial luminescence results in BCNF solution.