

## **Supplementary Materials**

### **1. The detailed modification process of HNC**

20 g of BC was stirred in 2 mol/L KOH solution [1:10 (g/mL)] in a shaking bath at 80 °C and 220 rpm for 4 h, and then repeatedly washed with deionized water to neutral. Afterwards, 1 mol/L HNO<sub>3</sub> [1:10 (g/mL)] was added, stirred in a shaking bath at 80 °C and 220 rpm for 4 h, then washed repeatedly with deionized water to neutral. Finally, ammonia solution 5% (w/w) (1:10 (g/mL)) was added, stirred at 50 °C and at 220 rpm for 4h, and then washed repeatedly with deionized water until neutral.

### **2. Experimental conditions of the batch adsorption experiments under the monometal system**

**Effect of initial pH:** initial pH=1.5, 2.5, 3.5, 4.5, 5.5 and 6.5, the dosages at 2 g/L for Cu<sup>2+</sup> and Cd<sup>2+</sup>, and 1 g/L for Pb<sup>2+</sup>, reaction time 240 min, temperature 298.15 K, substrate concentration 50 mg/L

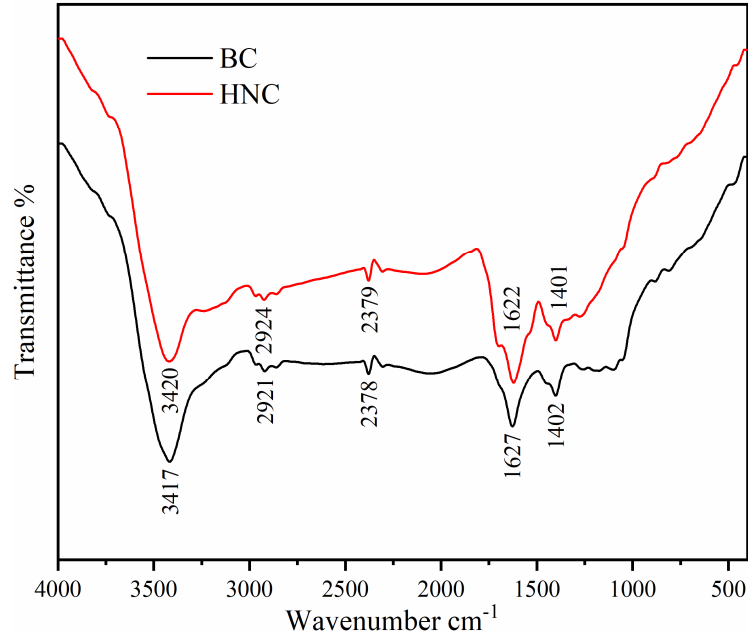
**Effect of BC and HNC dosage:** initial pH=5.5, the dosages 0.4, 1.0, 2.0, 4.0, 8.0 g/L, reaction time 240 min, temperature 298.15 K, substrate concentration 50 mg/L

**Adsorption kinetics:** initial pH=5.5, the dosages at 2 g/L for Cu<sup>2+</sup> and Cd<sup>2+</sup>, and 1 g/L for Pb<sup>2+</sup>, reaction time 0, 5, 10, 15, 20, 30, 40, 60, 90, 120, 240 and 360 min, temperature 298.15 K, substrate concentration 50 mg/L

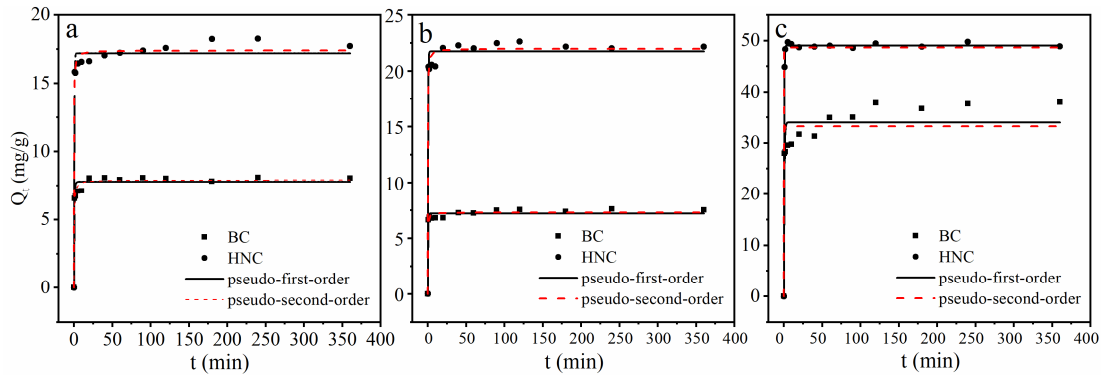
**Adsorption isotherms:** initial pH=5.5, the dosages at 2g/L for Cu<sup>2+</sup> and Cd<sup>2+</sup>, and 1g/L for Pb<sup>2+</sup>, reaction time 240 min, temperature 288.15, 298.15 and 308.15K, substrate concentration 0, 20, 50, 100, 200, 500, 800, 1000, 1200 mg/L

**Table S1** Isotherm parameters for the adsorption of Cu<sup>2+</sup>, Cd<sup>2+</sup> and Pb<sup>2+</sup> by BC and HNC

Temperature (K)	Adsorption isotherm	Parameter	Cu <sup>2+</sup>		Cd <sup>2+</sup>		Pb <sup>2+</sup>	
			BC	HNC	BC	HNC	BC	HNC
288.15	Langmuir	$q_{max}$ (mg/g)	9.76	23.53	16.63	36.22	60.79	136.05
		$K_L$ (L/mg)	0.017	0.104	0.045	0.071	0.032	0.023
		$R^2$	0.9911	0.9986	0.9989	0.9988	0.9965	0.9846
	Freundlich	$K_F(\text{mg/g (L/mg)}^{1/n})$	3.16	12.22	5.96	14.32	20.86	52.46
		$1/n$	0.150	0.099	0.152	0.142	0.153	0.123
		$R^2$	0.9022	0.9452	0.9447	0.9328	0.9831	0.9026
	Temkin	$A$	6.4	2344	12.0	170.2	50.8	46.3
		$B$	2367	1488	1358	798.2	451.9	209.7
		$R^2$	0.8528	0.9517	0.9573	0.9804	0.9537	0.8644
	Langmuir	$q_{max}$ (mg/g)	15.95	27.62	16.93	39.56	93.55	158.73
		$K_L$ (L/mg)	0.040	0.112	0.064	0.055	0.021	0.021
		$R^2$	0.9967	0.9984	0.9991	0.9984	0.9838	0.9731
298.15	Freundlich	$K_F(\text{mg/g (L/mg)}^{1/n})$	6.84	12.93	4.90	18.16	28.87	65.17
		$1/n$	0.120	0.118	0.191	0.113	0.161	0.112
		$R^2$	0.9183	0.9369	0.7131	0.9417	0.9373	0.9216
	Temkin	$A$	52.7	556.6	3.3	431.3	25.8	104.2
		$B$	1734.0	1164.8	1134.7	832.5	297.4	203.6
		$R^2$	0.8768	0.9594	0.7488	0.944	0.9150	0.8090
	Langmuir	$q_{max}$ (mg/g)	17.04	31.06	38.37	58.48	96.90	161.29
		$K_L$ (L/mg)	0.075	0.040	0.007	0.026	0.021	0.032
		$R^2$	0.9975	0.9875	0.9241	0.9935	0.9823	0.9895
	Freundlich	$K_F(\text{mg/g (L/mg)}^{1/n})$	9.58	13.23	4.19	20.11	30.41	59.31
		$1/n$	0.086	0.125	0.297	0.144	0.158	0.138
		$R^2$	0.6826	0.9204	0.9187	0.9570	0.9438	0.9685
308.15	Freundlich	$A$	5256.4	301.7	0.2	32.9	19.5	31.6
		$B$	2313	1067	414.0	496.0	286.9	175.7
		$R^2$	0.6066	0.9051	0.8156	0.8819	0.9223	0.9152
	Temkin	$A$	5256.4	301.7	0.2	32.9	19.5	31.6
		$B$	2313	1067	414.0	496.0	286.9	175.7



**Fig.S1** FT-IR spectra of BC and HNC



**Fig.S2** Pseudo-first-order kinetic and pseudo-second-order kinetic fitting of  $\text{Cu}^{2+}$  (a),  $\text{Cd}^{2+}$  (b) and  $\text{Pb}^{2+}$  (c) adsorption by BC and HNC, dosage of 2 g/L for  $\text{Cu}^{2+}$  and  $\text{Cd}^{2+}$ , and 1 g/L for  $\text{Pb}^{2+}$ , pH 5.5, initial concentration of  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  50 mg/L, and temperature 298.15K