Hierarchical porous carbon materials derived from waste paper towel with ultrafast and ultrahigh performance for adsorption of tetracycline

Atian Xie[a], Jiangdong Dai[a], Xiang Chen[a], Jinsong He[a], Zhongshuai Chang[a], Yongsheng Yan[a,b]*, Chunxiang Li[a]*

[a] School of Chemistry and Chemical Engineering, Jiangsu University, Zhenjiang 212013, China

[b] Key Laboratory of Preparation and Applications of Environmental Friendly Materials (Ministry of Education), Jilin Normal University, Siping 136000, China

Corresponding Author: Yongsheng Yan

E-mail: cjy18252586640@163.com

Tel: +86 0511-88790683; Fax: +86 0511-88791800

The pH_{PZC} of PTHPC was measured by pH drift method. (in Supporting Information).

pH drift method:[1, 2]

The pH_{PZC} of PTHPC was measured by pH drift method. pH_{PZC} (point of zero charge) is pH when the charge in the adsorbent surface is zero. In detailed, a number of aqueous solutions (50 mL) were prepared with 0.01M NaCl and added into a series of Erlenmeyer. Then, the pH values were adjusted to an initial pH value of 2, 3, 4, 5, 6, 7, 8, 9, 10 using 0.1 M NaOH and 0.1 M HCl solution. Initial pH of solutions were measured and then noted as $pH_{initial}$. After $pH_{initial}$ have reached a constant value, PTHPC (0.2 g) was added into each Erlenmeyer and then shaken for 24 h. Then, pH of solution was measured and noted as pH_{final}. pH_{PZC} of PTHPC is the point when $pH_{initial} = pH_{final}$.

Quantification of the surface functional groups was determined by Boehm titration [3]. (Supporting Information)

The procedure of Boehm titration as follow:

1) The PTHPC of 0.2 g was added to the base solutions (0.1 M, 20 mL each) as stated below in conical flask.

a) $NaHCO_3$ ($pK_a = 6.37$) (neutralizes the carboxylic groups on the adsorbent).

b) Na_2CO_3 ($pK_a = 10.25$) (neutralizes carboxylic and lactonic groups on the adsorbent).

c) NaOH ($pK_a = 15.74$) (neutralizes carboxylic, lactonic and phenolic groups on the adsorbent).

2) The slurry with PTHPC was stirred for 48 h at 25 ^{o}C.

3) The PTHPC was filtered-off and the content of acidic functional groups on PTHPC was estimated after titrating the obtained solution against 0.1 M HCl aqueous solution. Methyl orange was used as an indicator for all titrations.

References:

(1) Prahas, D.; Kartika, Y.; Indraswati, N.; Ismadji, S. Activated carbon from jackfruit peel waste by H_3PO_4 chemical activation: Pore structure and surface chemistry characterization. *Chem. Eng. J.* 2008, 140, 32-42.

(2) Liu, Q.; Zhong, L. B.; Zhao, Q. B.; Frear, C.; Zheng, Y. M. Synthesis of Fe_3O_4/polyacrylonitrile composite electrospun nanofiber mat for effective adsorption of tetracycline. *ACS Appl. Mater. Interfaces* 2015, 7, 14573-14583.

(3) Boehm H.P. Chemical identification of surface groups, *Adv. Catal.* 1966, 16, 179-274.

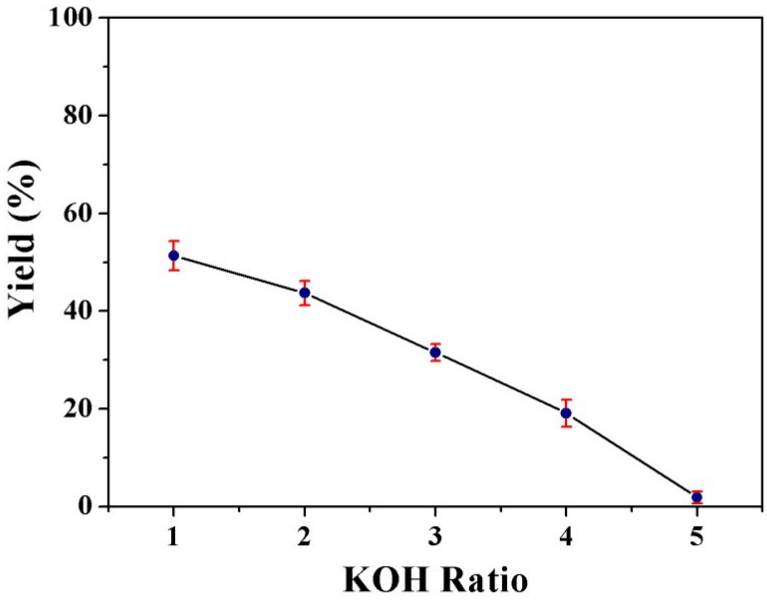

Figure S1. Effect of KOH ratio on yield of PTHPC

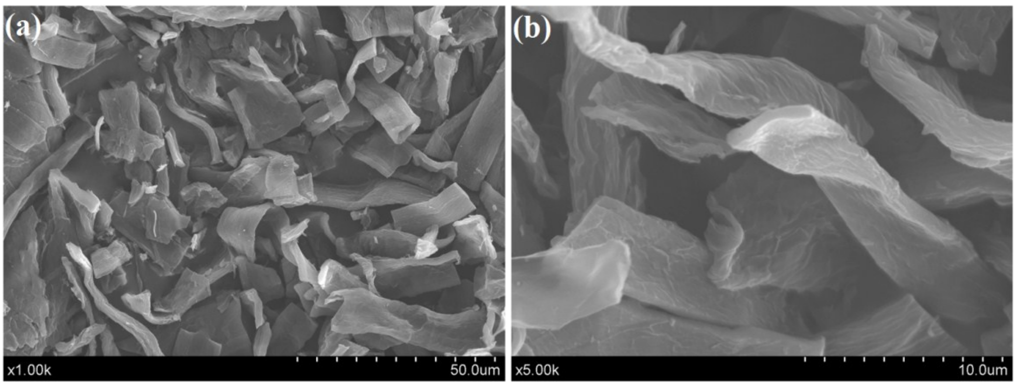

Figure S2. SEM images of PTHPC-2

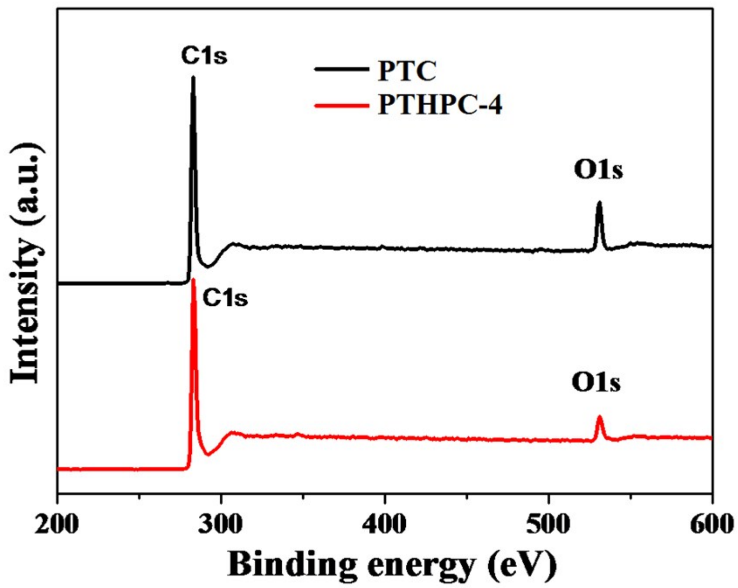

Figure S3. XPS spectra of wide survey scans for PTC and PTHPC-4

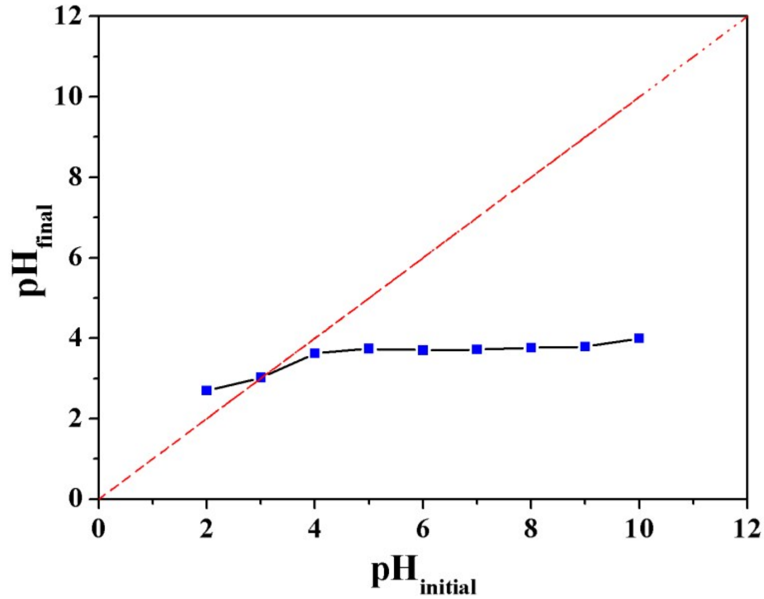

Figure S4. pH_{PZC} determination by pH drift method of PTHPC-4

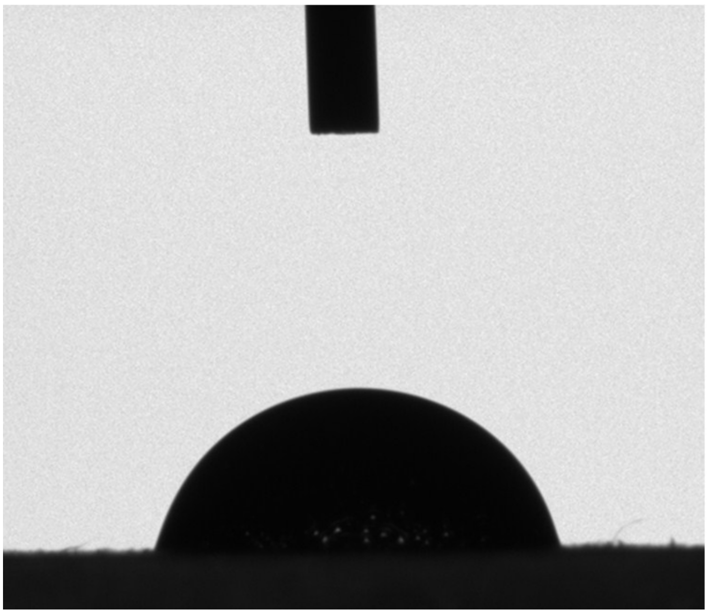

Figure S5. Static water contact angle of PTHPC-4

Table S1. The detailed percentage of carbon species

samples	D1 (1163 cm^{-1})	D4 (1332 cm^{-1})	D3 (1499 cm^{-1})	G (1590 cm^{-1})
PTC	5.60	42.72	32.25	19.43
PTHPC-4	5.96	64.44	14.65	14.95

Table S2. Elemental analysis of the WPT，PTC and PTHPC-4.

Elements	C (%)	H (%)	O (%)
PT	39.48639	6.095313	54.418297
PTC	74.90157	3.268258	21.830172
PTHPC-4	93.34456	0.516842	6.138598

Table S3. Kinetic parameters of intra-particle diffusion adsorption kinetic model

Intra-particle diffusion model							
C_0 (mg L^{-1})	T (K)	K_1 (mg g^{-1} $min^{-0.5}$)	C_1	R^2	K_2 (mg g^{-1} $min^{-0.5}$)	C_2	R^2
100	298	53.52	372.1	0.995	1.180	488.8	0.910
	308	5.652	483.9	0.973	0.397	495.9	0.858
	318	7.604	481.2	0.998	0.153	497.8	0.911
150	298	40.05	639.6	0.970	2.218	729.2	0.931
	308	15.8	702	0.992	1.875	733.5	0.922
	318	7.619	726.5	0.997	0.676	742.3	0.962
200	298	109.6	604.3	0.994	19.76	811.6	0.969
	308	16.63	891.2	0.961	6.441	920.1	0.926
	318	22.84	915.2	0.998	3.436	961	0.955