Supplementary material

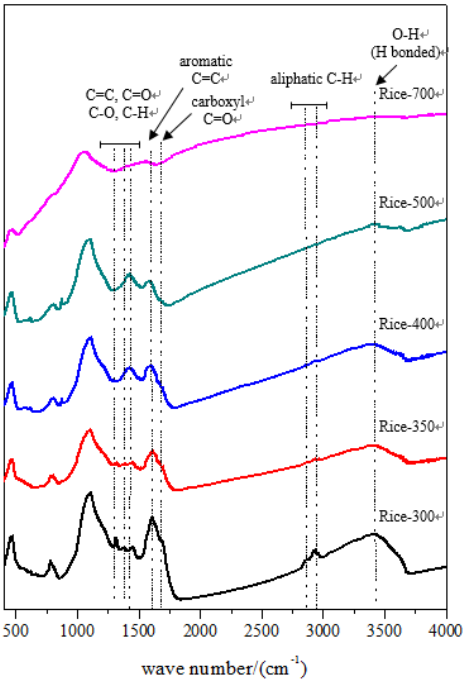


Fig. S1 FT-IR spectra of rice straw-derived BCs

Evolution of original rice BCs' spectra as the function of pyrolysis temperature is shown in Fig. S1. As can be seen, that the band around 3420 cm^{-1}, which is due to hydrogen bonded O-H stretching vibration, gradually loses its intensity as the temperature increases and diminishes completely at 700 °C, indicating the continual condensation of –OH. The peaks at 2930 cm^{-1} and 2850 cm^{-1} are the asymmetric and symmetric stretching vibration of aliphatic C-H respectively, but the intensity is significant only for Rice-300 probably due to the week heat-resistance of aliphatic structures. The peak at 1610 cm^{-1}, which is likely to represent the aromatic C=C stretching vibration, declines significantly at 700℃ owing to the loss of small aromatic units and the appearance of large graphite-like sheets. Peaks between the 1500-1200 cm^{-1} band indicate the existence of lignin related functional groups, and it almost disappear at 700 °C due to the total loss of the plant's amorphous structure[1, 2]. Similar trends can also be observed for wood and bamboo BCs.

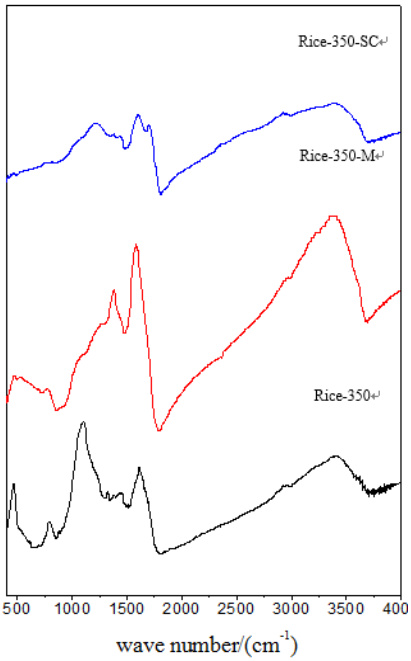


Fig. S2 FT-IR spectra of Rice-350, Rice-350-M and Rice-350-SC

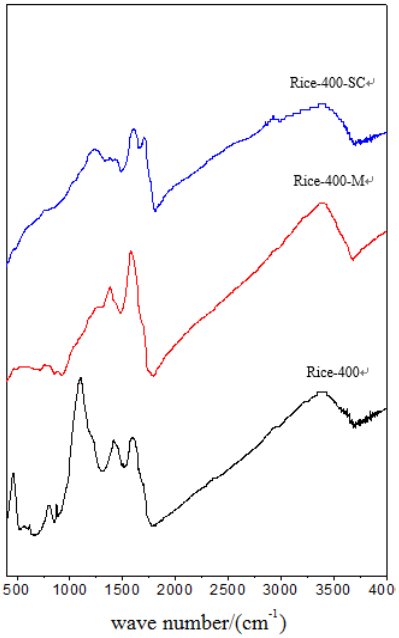


Fig. S3 FT-IR spectra of Rice-400, Rice-400-M and Rice-400-SC

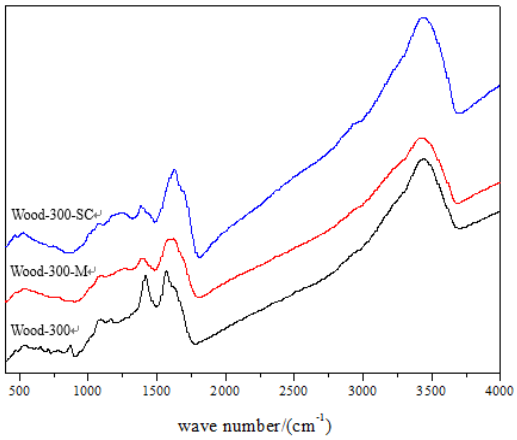


Fig. S4 FT-IR spectra of Wood-300, Wood-300-M and Wood-300-SC

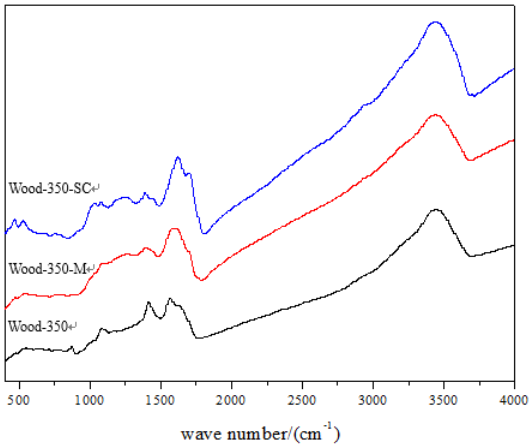


Fig. S5 FT-IR spectra of Wood-350, Wood-350-M and Wood-350-SC

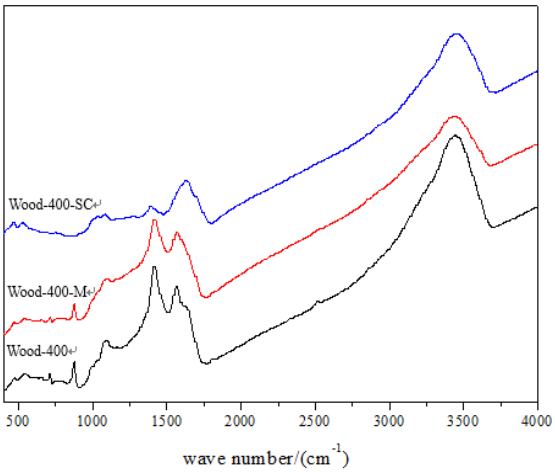


Fig. S6 FT-IR spectra of Wood-400, Wood-400-M and Wood-400-SC

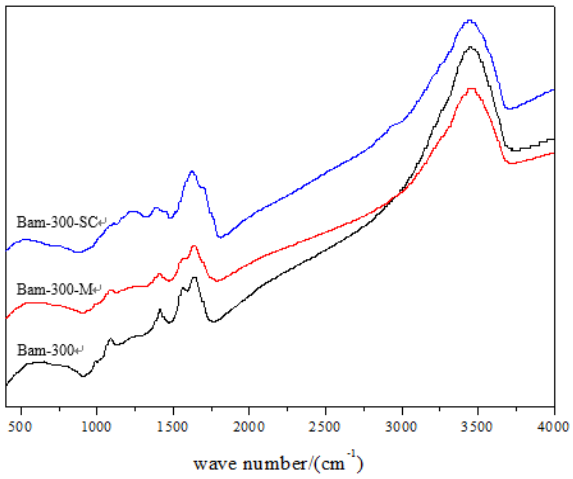


Fig. S7 FT-IR spectra of Bam-300, Bam-300-M and Bam-300-SC

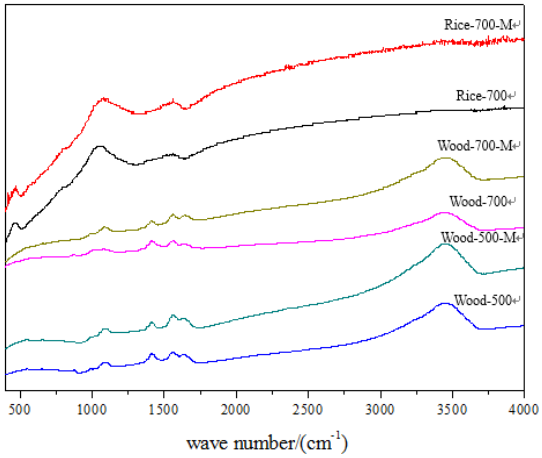


Fig. S8 FT-IR spectra of Rice-700, Rice-700-M, Wood-500/700 and Wood-500/700-M

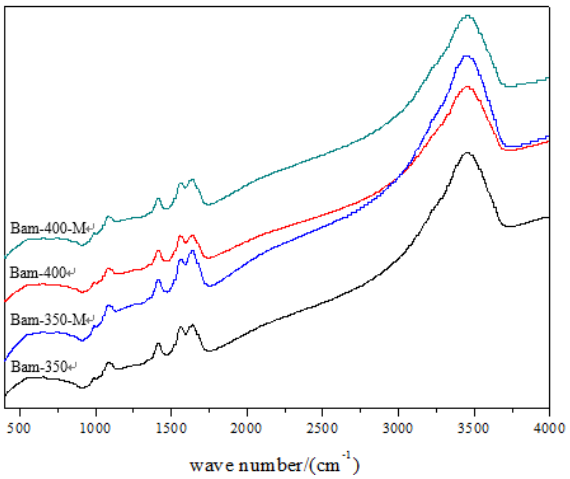


Fig. S9 FT-IR spectra of Bam-350/400 and Bam-350/400-M

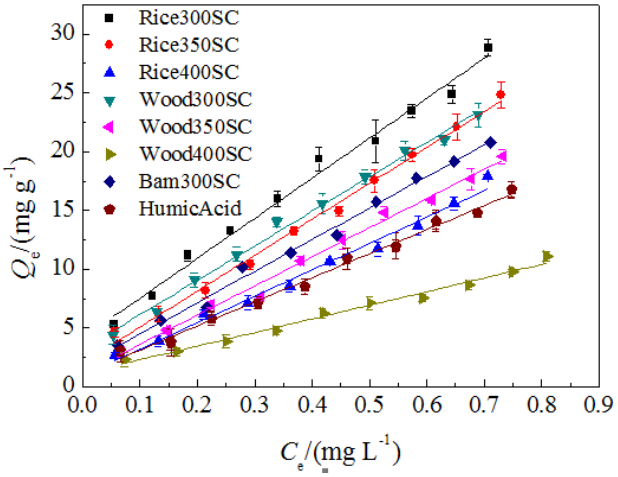
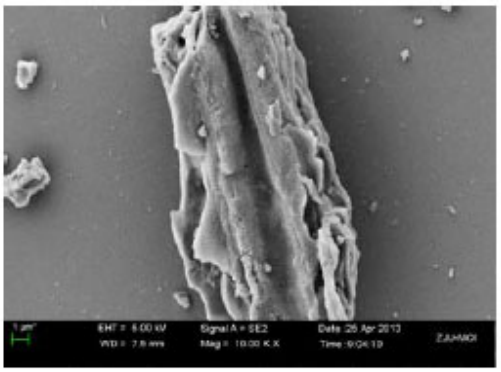
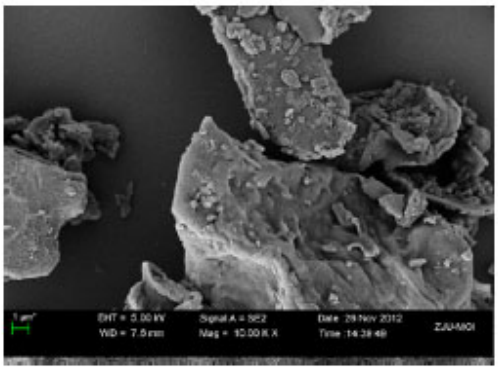


Fig. S10 FT-IR spectra of Bam-500/700 and Bam-500/700-M

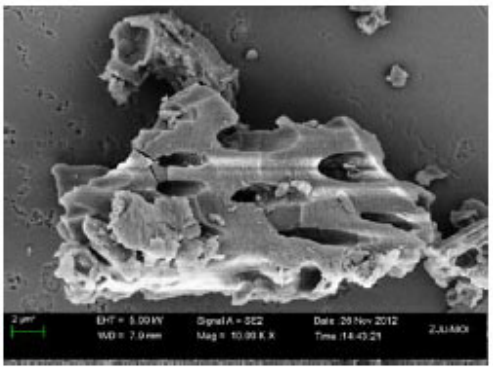
(1) Rice-300



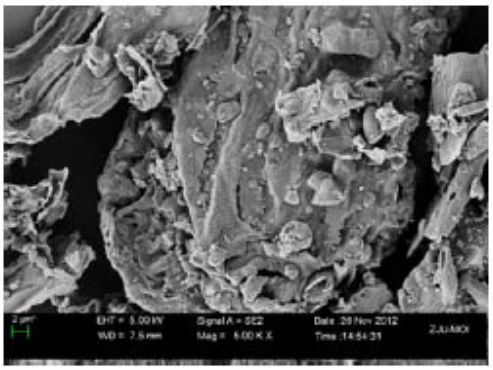
(2) Rice-300-M



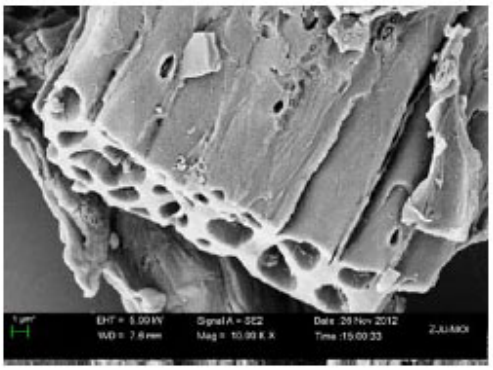
(3) Rice-350



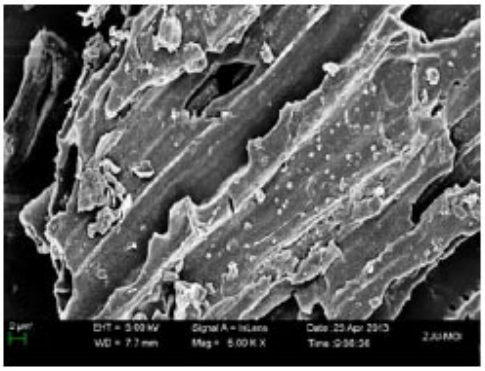
(4) Rice-350-M



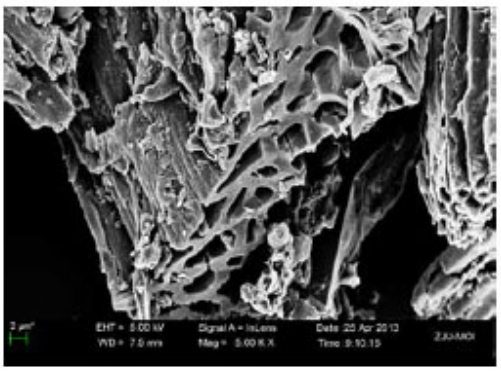
(5) Rice-400



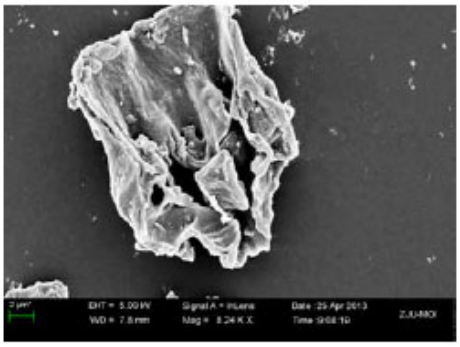
(6) Rice-400-M



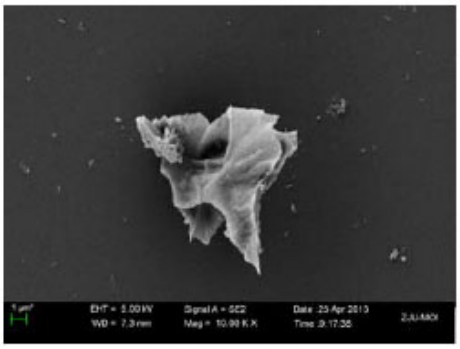
(7) Rice-500



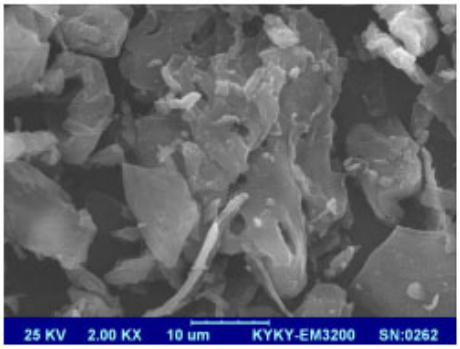
(8) Rice-500-M



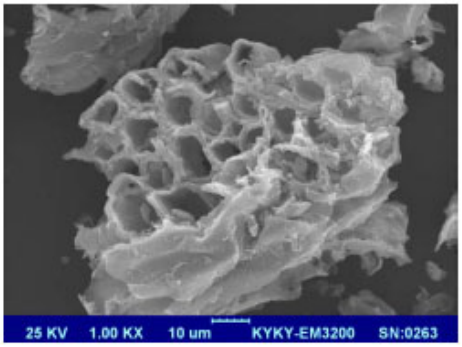
(9) Rice-700



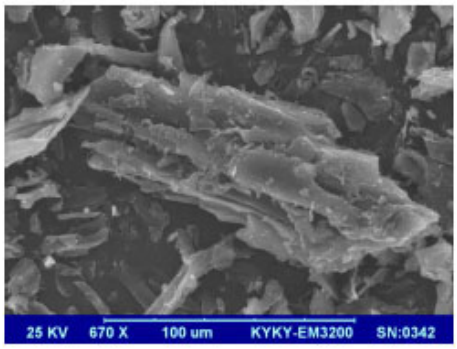
(10) Rice-700-M



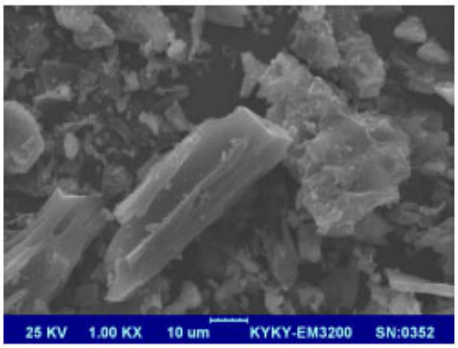
(11) Wood-300



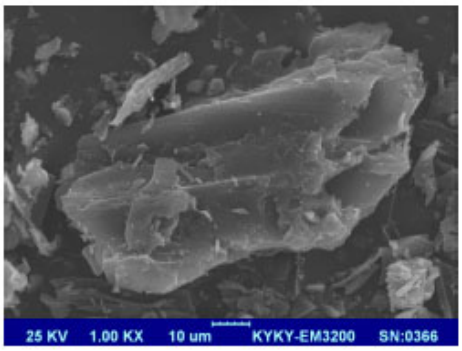
(12) Wood-300-M



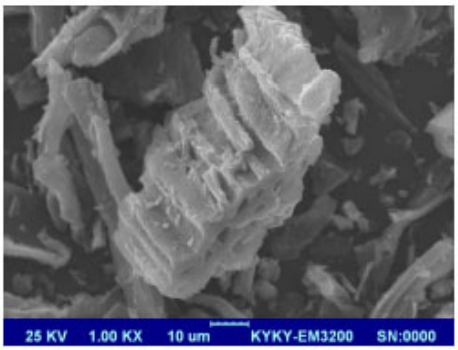
(13) Wood-350



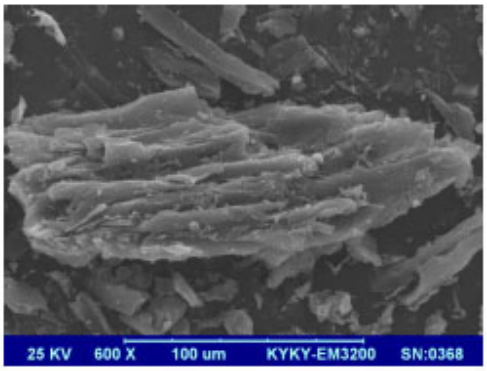
(14) Wood-350-M



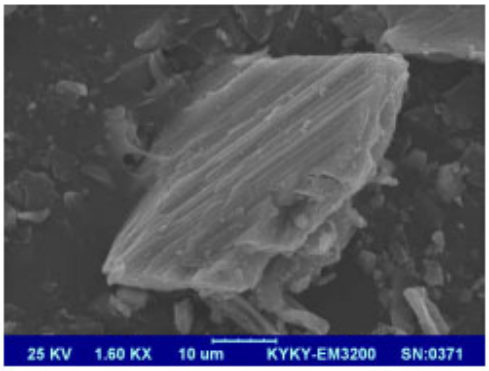
(15) Wood-500



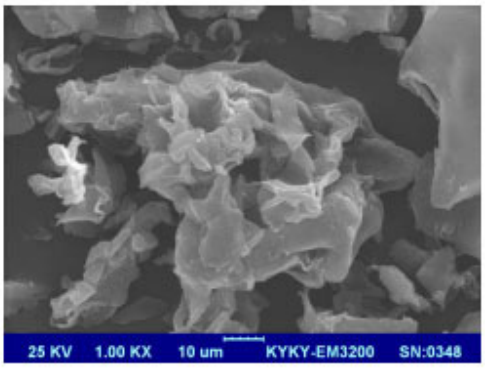
(16) Wood-500-M



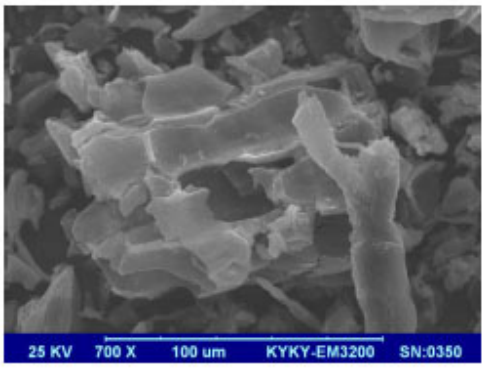
(17) Wood-700



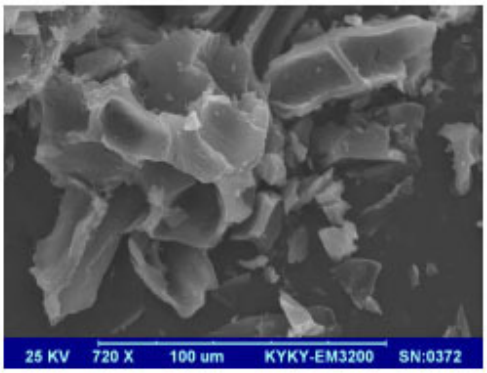
(18) Wood-700-M



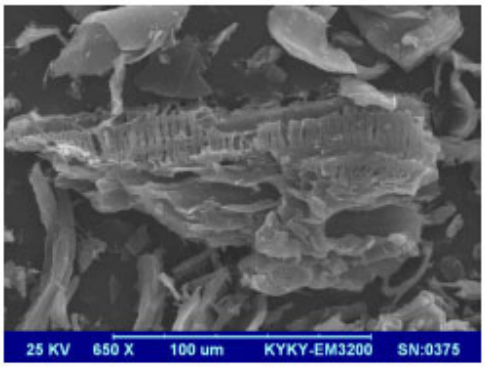
(19) Bam-300



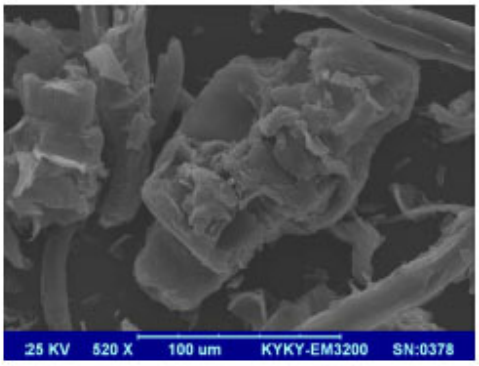
(20) Bam-300-M



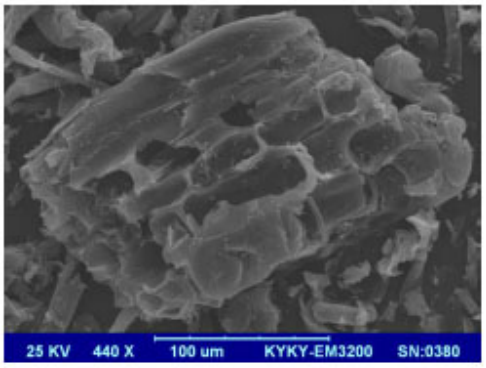
(21) Bam-350



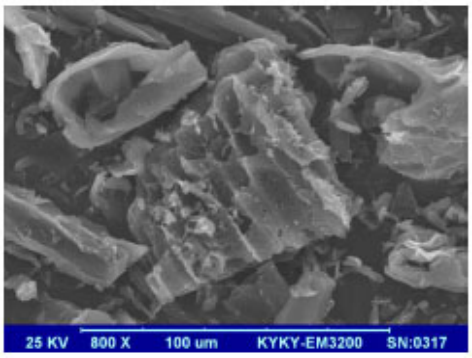
(22) Bam-350-M



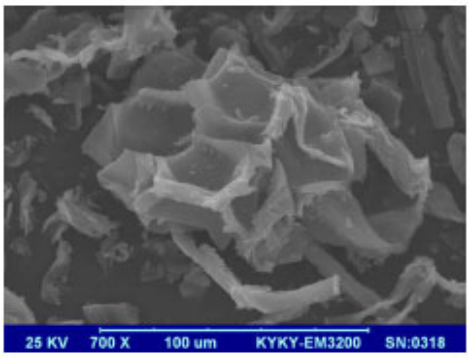
(23) Bam-500



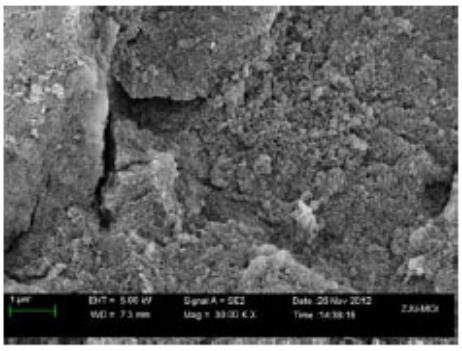
(24) Bam-500-M



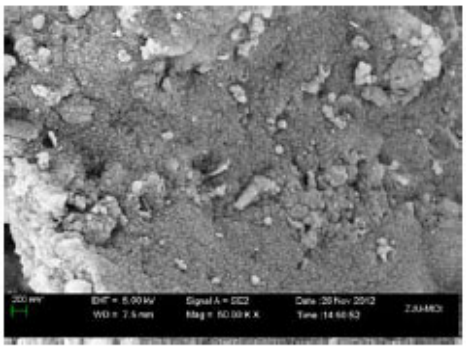
(25) Bam-700



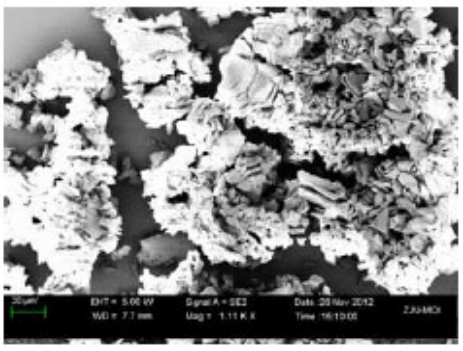
(26) Bam-700-M



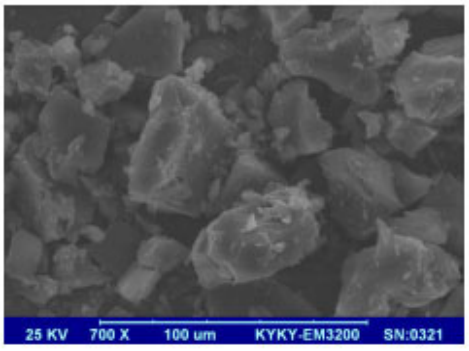
(27) Rice-300-SC



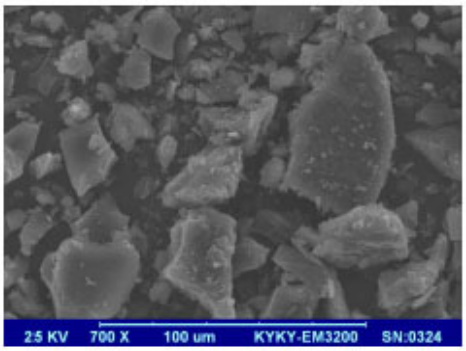
(28) Rice-350-SC



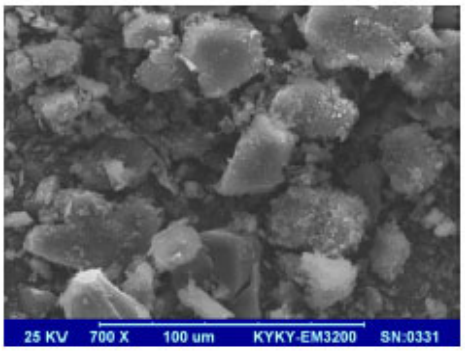
(29) Rice-400-SC



(30) Wood-300-SC



(31) Wood-350-SC



(32) Bam-300-SC

Fig. S11 SEM micrographs of the other samples

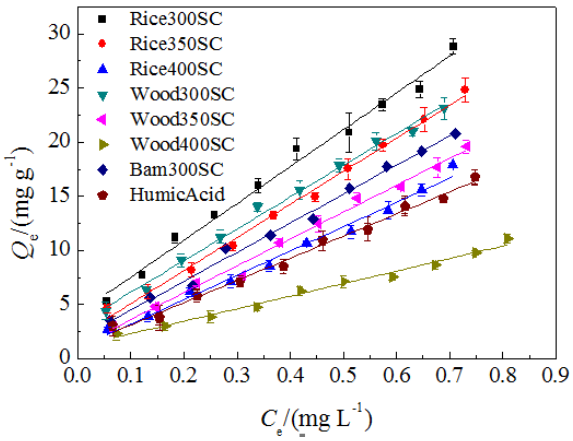


Fig. S12 Isotherms for all SCs and the commercial humic acid

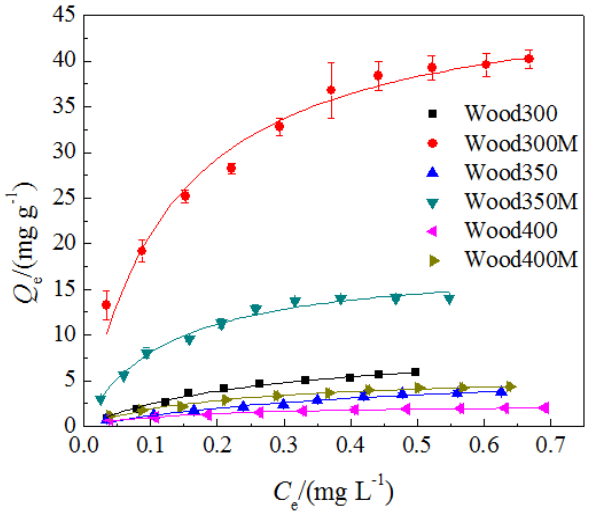


Fig. S13 Isotherms for Wood-300/350/400 and Wood-300/350/400-M

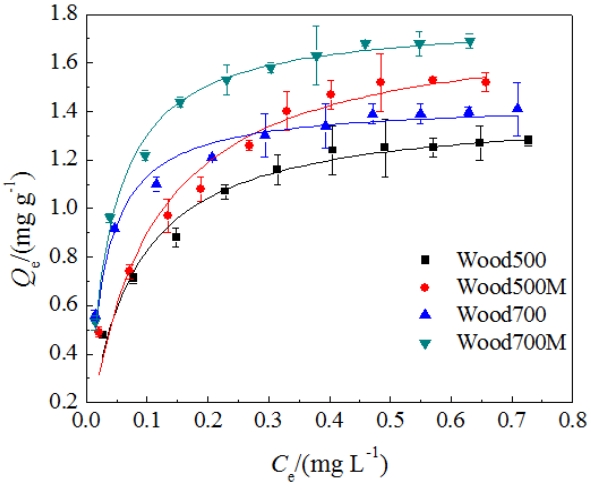


Fig. S14 Isotherms for Wood-500/700 and Wood-500/700-M

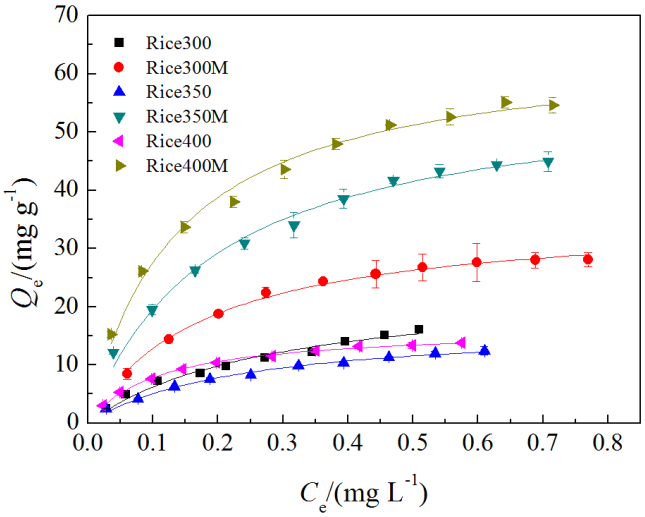


Fig. S15 Isotherms for Rice-300/350/400 and Rice-300/350/400-M

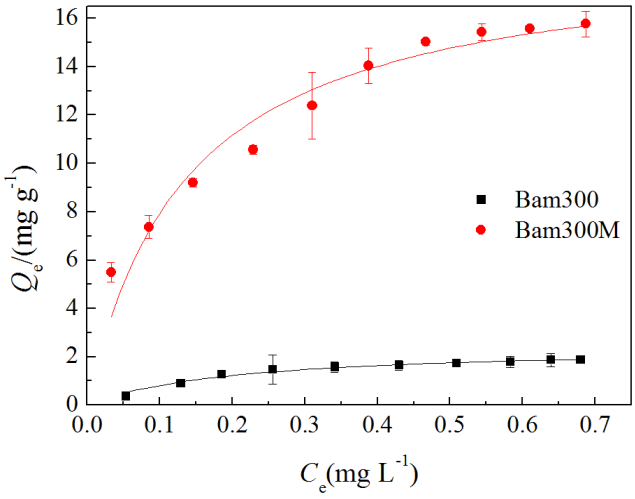


Fig. S16 Isotherms for Bam-300 and Bam-300-M

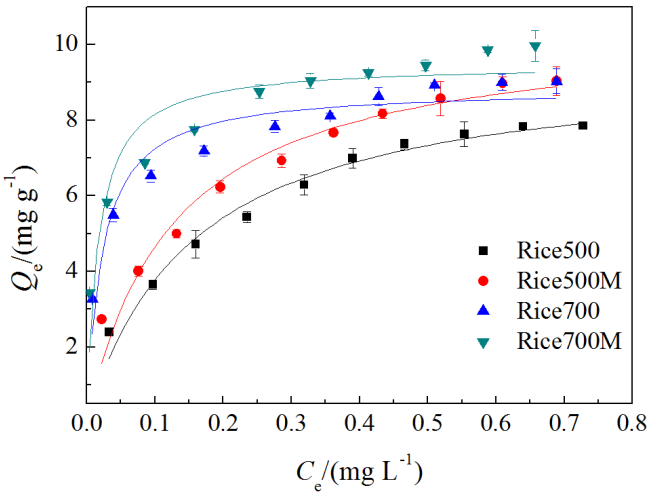


Fig. S17 Isotherms for Rice-500/700 and Rice-500/700-M

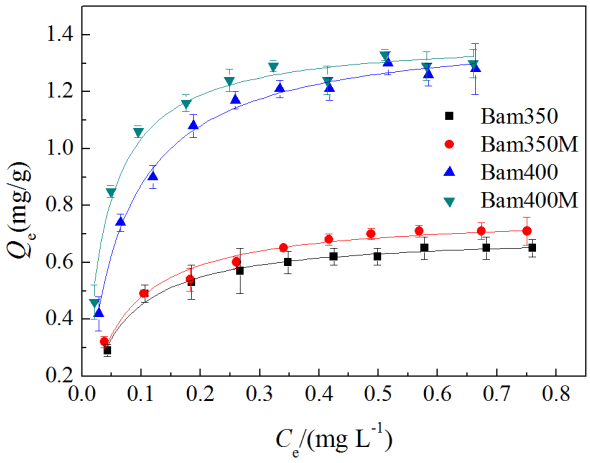


Fig. S18 Isotherms for Bam-350/400 and Bam-350/400-M

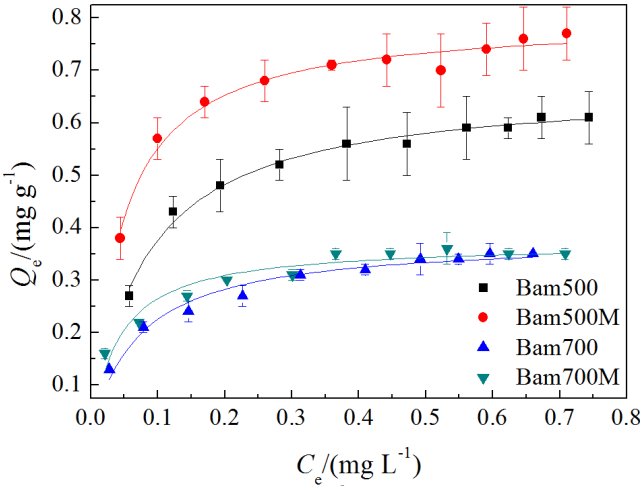


Fig. S19 Isotherms for Bam-500/700 and Bam-500/700-M

Table S1 Kinetic parameters for the three different models

Samples	Pseudo-first-order			Elovitch		
	Q_e (mg g^{-1})	K_1 (d^{-1})	R^2	a (mg g^{-1} d^{-1})	b (g mg^{-1})	R^2
Rice-300	9.0	0.351	0.983	43.8	0.466	0.983
Rice-350	6.9	0.294	0.841	18.6	0.415	0.969
Rice-500	3.3	0.373	0.948	65.2	1.102	0.948
Rice-700	2.1	0.232	0.923	435.1	1.166	0.900
Rice-300-M	7.8	0.335	0.983	183228.3	0.381	0.900
Rice-350-M	6.3	0.180	0.868	1722573.2	0.370	0.900
Rice-500-M	2.4	0.298	0.954	86.4	1.043	0.936
Rice-700-M	2.4	0.330	0.864	313.7	0.991	0.926
Rice-300-SC	23.5	0.488	0.945	436.2	0.233	0.947
Rice-350-SC	12.3	0.254	0.974	105.1	0.262	0.990

Notes: Rice-300/350/500/700 represent biochars made from rice straw pyrolyzed at 300, 350, 500 and 700 °C, respectively. Rice-300/350/500/700-M represent base modified biochars made from Rice-300/350/500/700, respectively. Rice-300/350-SC represent base soluble carbon extracted from Rice-300/350, respectively.

References

1. Chen B L, Zhou D D, Zhu L Z. Transitional adsorption and partition of nonpolar and polar aromatic contaminants by biochars of pine needles with different pyrolytic temperatures. Environmental Science & Technology, 2008, 42(14): 5137-5143
2. Keiluweit M, Nico P S, Johnson M G, Kleber M. Dynamic molecular structure of plant biomass-derived black carbon (Biochar). Environmental Science & Technology, 2010, 44(4): 1247-1253