Electronic Supplementary Material (ESI) for RSC Advances.

Facile Synthesis of Mesoporous Carbon Nanocomposites from Natural Biomass for Efficient Dye Adsorption and Selective Heavy Metal Removal

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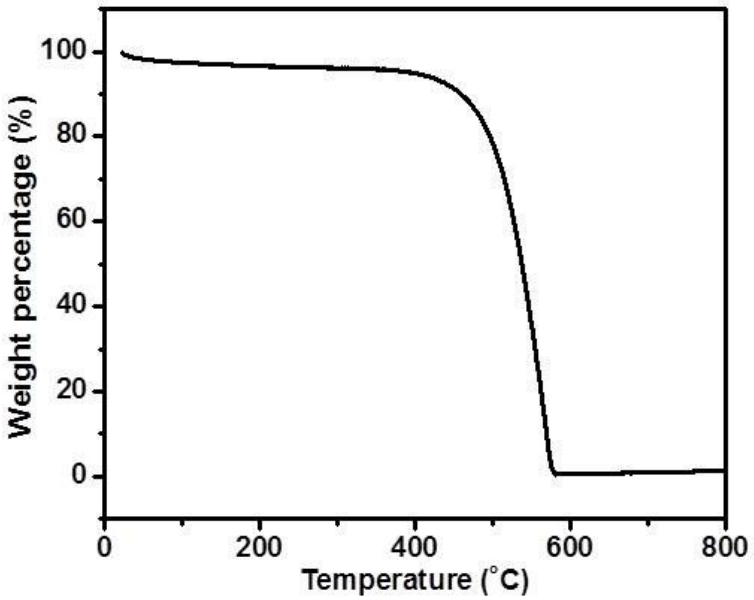

Figure S1. TGA curve of C-00M.

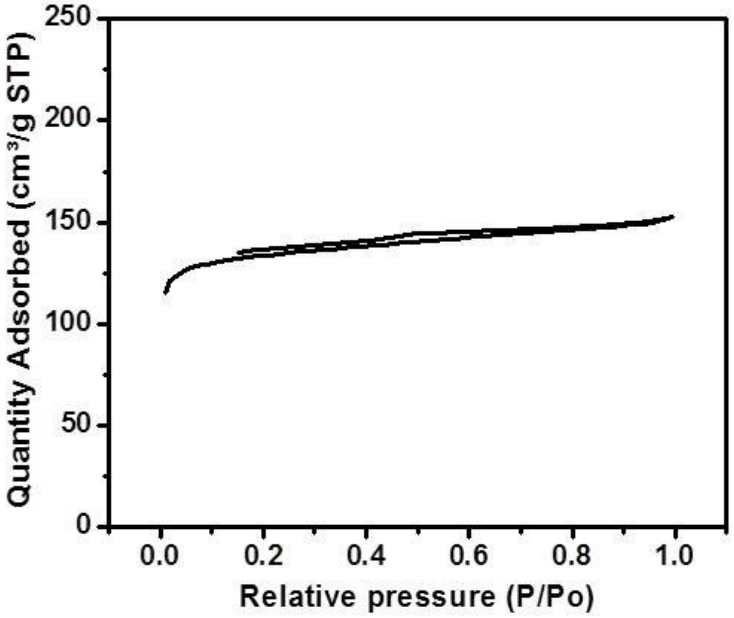

Figure S2. BET isotherm of C-00M.

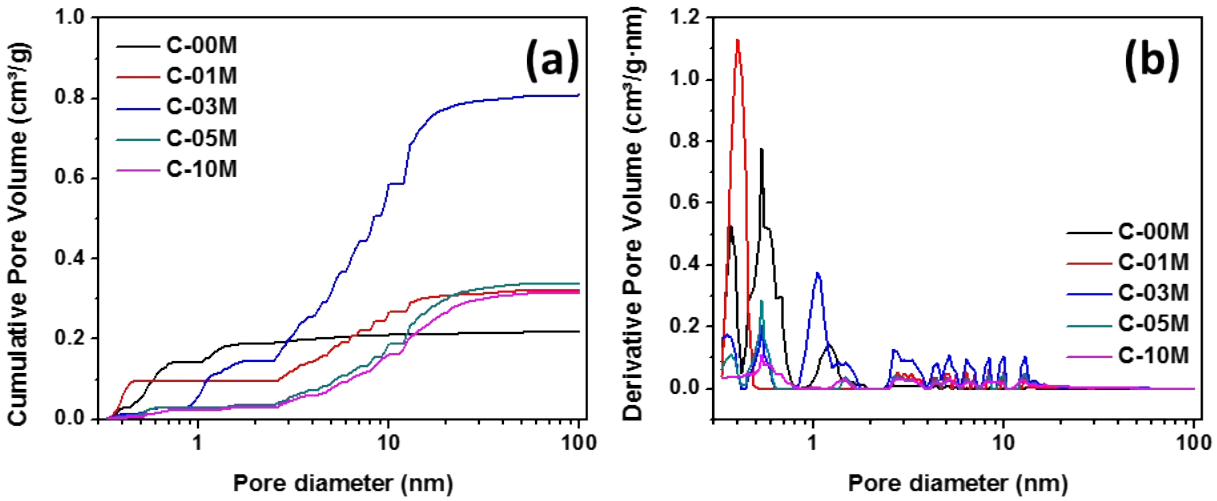

Figure S3. Change of (a) cumulative pore volume and (b) pore size distribution as a function of pore diameter of C-xxM.

The pore size distribution in the micropore region is calculated by density functional theory (DFT) method from CO_2 adsorption branch, and the one in the mesopore region is calculated by Barret Joyner and Halenda (BJH) method from N_2 adsorption branch. The combined pore size distribution is shown in Figure S3. Figure 3(a) shows the cumulative pore volume change as a function of pore diameter. Flattened curve was observed in C-00M with pore diameter larger than 2 nm. In C-xxM, a sharp increase of pore volume in $2<d<30$ nm region clearly reveals the existence of mesopores. The pore size distribution is also interpreted in derivative pore volume against pore diameter, Figure 3(b). For C-00M, peaks were only found in micropore region, while peaks were detected in both micro- and meso-pore regions for C/Fe nanocomposites.

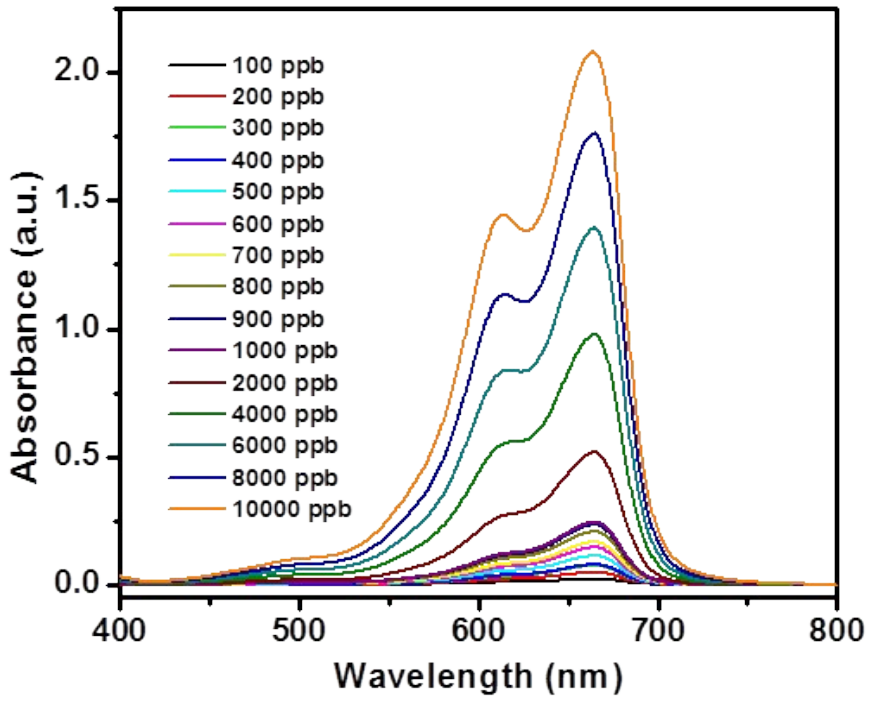

Figure S4. UV-Vis spectra with increasing MB concentration from 100 to 10000 ppb.

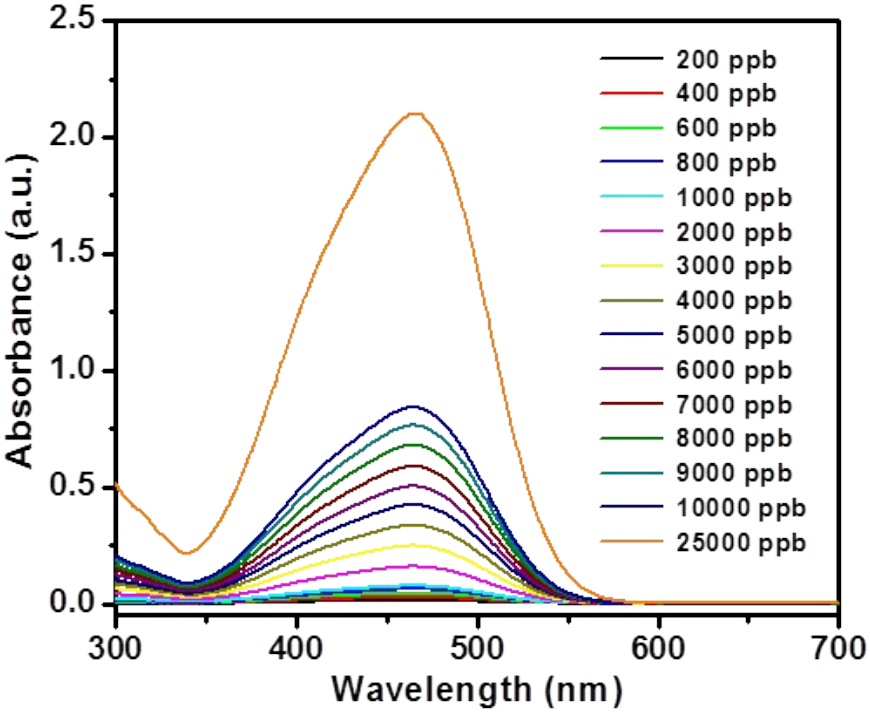

Figure S5. UV-Vis spectra with increasing MO concentration from 200 to 25000 ppb.

Non-linear fitting

The nonlinear mathematical form of the Langmuir model is expressed as:

$$q_e = \frac{k_1 q_{max} C_e}{1 + k_1 C_e}$$

Where c_e and q_e are dye concentration remained in the solution (mg/L) and the amount of dye adsorbed onto adsorbent (mg/g) at equilibrium, respectively. q_{max} is the maximum adsorption capacity (mg/g) and k_1 represents the energy constant related to the energy of adsorption. q_e can be calculated by following Equation:

$$q_e = \frac{c_o - c_e}{m/V}$$

Where c_0 and c_e are initial and equilibrium pollutant concentrations (mg/L), m is the mass of adsorbent (g) and V is volume of polluted solution (L). Adsorption capacity q_{max} can be determined by fitting the data to Langmuir adsorption model using non-linear regression method.

The nonlinear mathematical form of the pseudo-second-order kinetic model is expressed as:

$$q_t = \frac{{q_e}^2 k_2 t}{1 + q_e k_2 t}$$

Where t is the sampling time (min), q_t is the dye concentration on adsorbent at time t (mg/g), q_e is the amount of dye adsorbed on to adsorbent (mg/g) at equilibrium. k_2 is the pseudo-second-order rate constant (g/mg min).adsorption rate constant can be obtained by fitting the data to pseudo-second-order kinetic model.

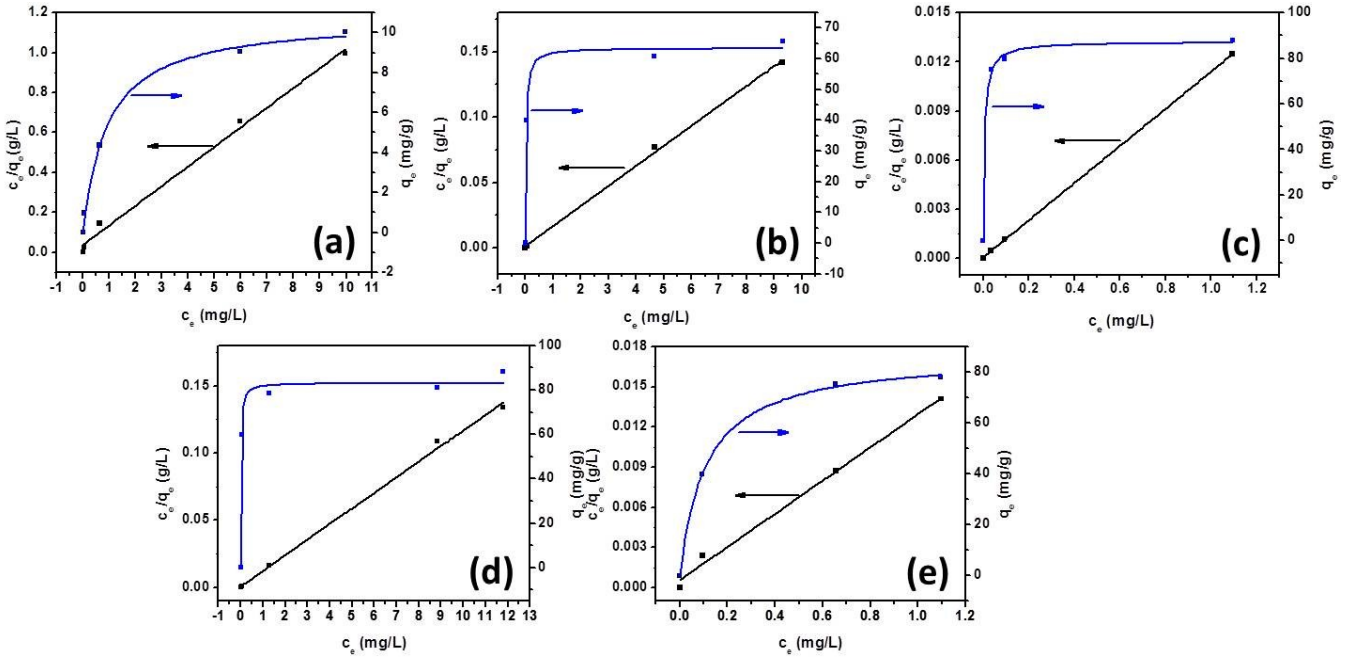

Figure S6. Non-linear regression of MB adsorption data to Langmuir isotherm model (a) C-00M, (b) C-01M, (c) C-03M, (d) C-05M and (e) C-10M.

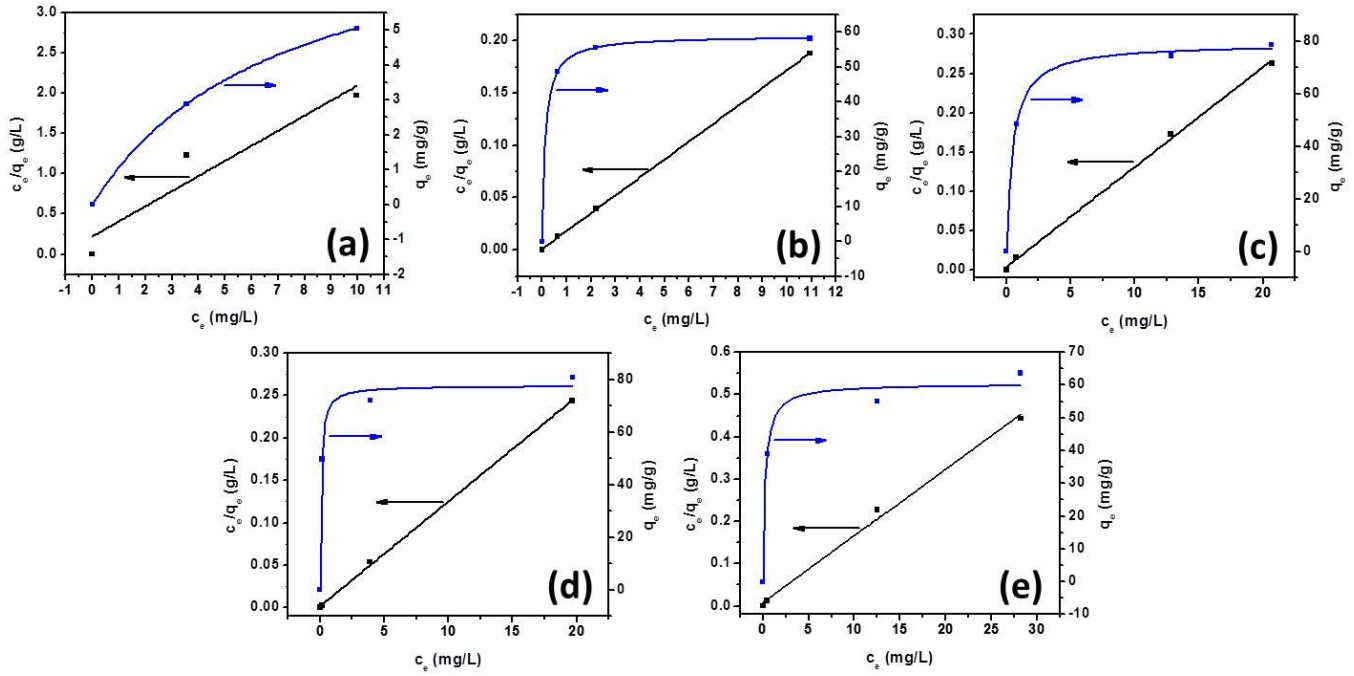

Figure S7. Non-linear regression of MO adsorption data to Langmuir isotherm model (a) C-00M, (b) C-01M, (c) C-03M, (d) C-05M and (e) C-10M.

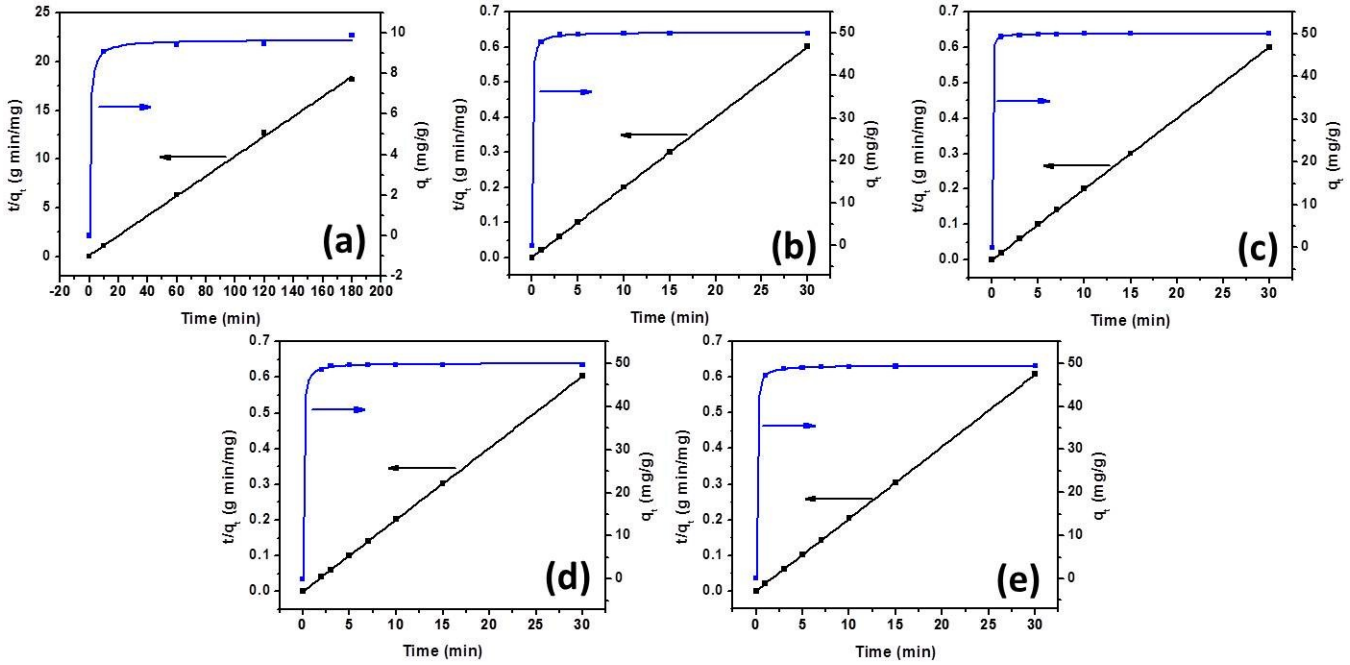

Figure S8. Non-linear regression of MB adsorption data to pseudo-second-order kinetic model (a) C-00M, (b) C-01M, (c) C-03M, (d) C-05M and (e) C-10M.

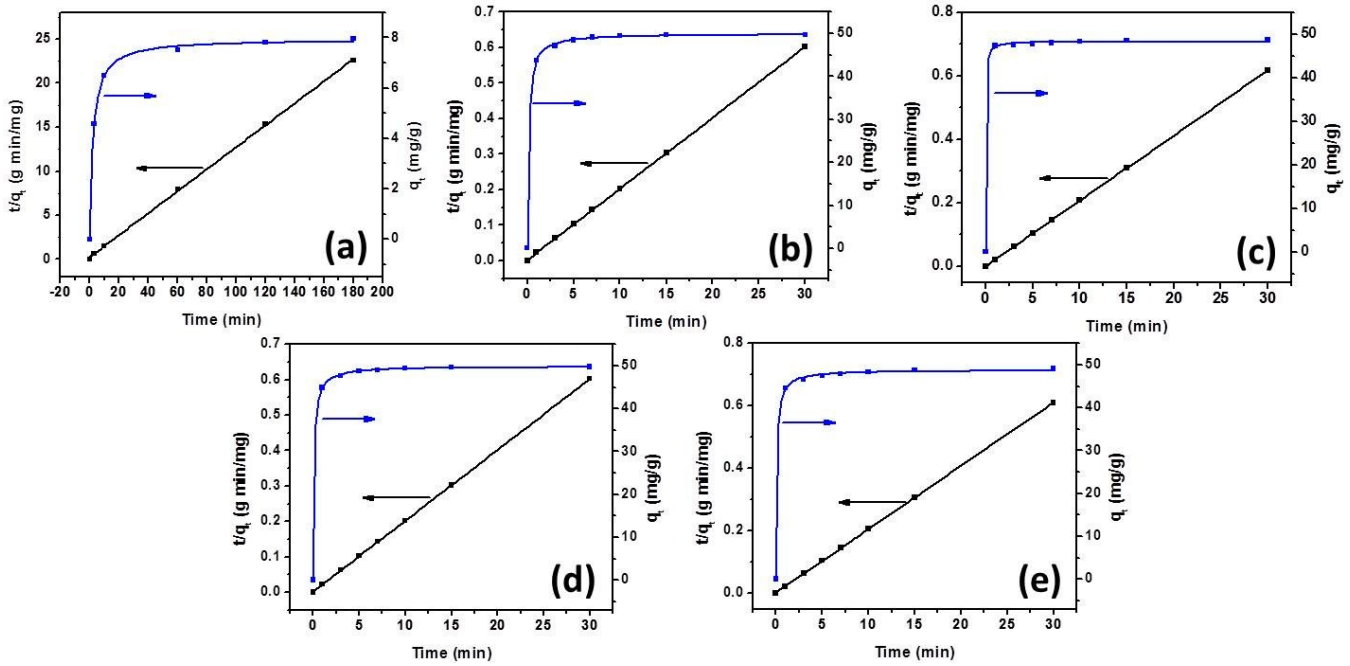

Figure S9. Non-linear regression of MO adsorption data to pseudo-second-order kinetic model (a) C-00M, (b) C-01M, (c) C-03M, (d) C-05M and (e) C-10M.

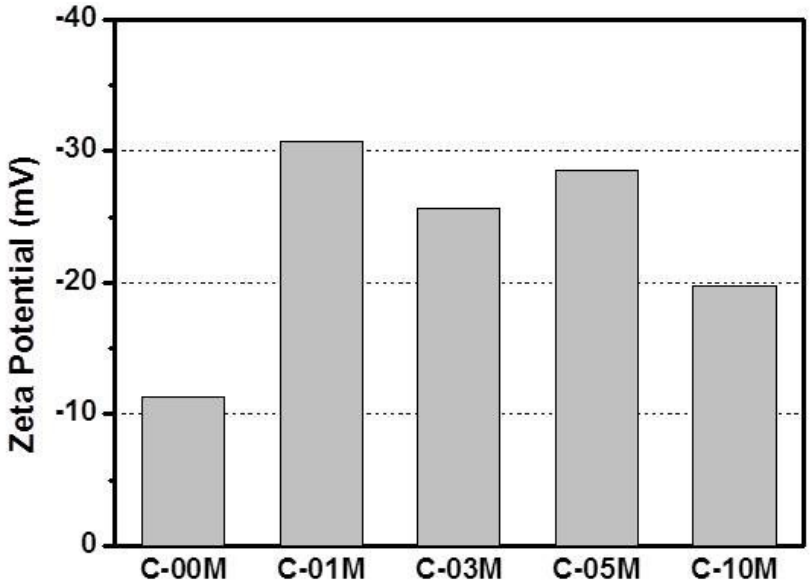

Figure S10. Zeta potential of pure carbon and carbon nanocomposites.

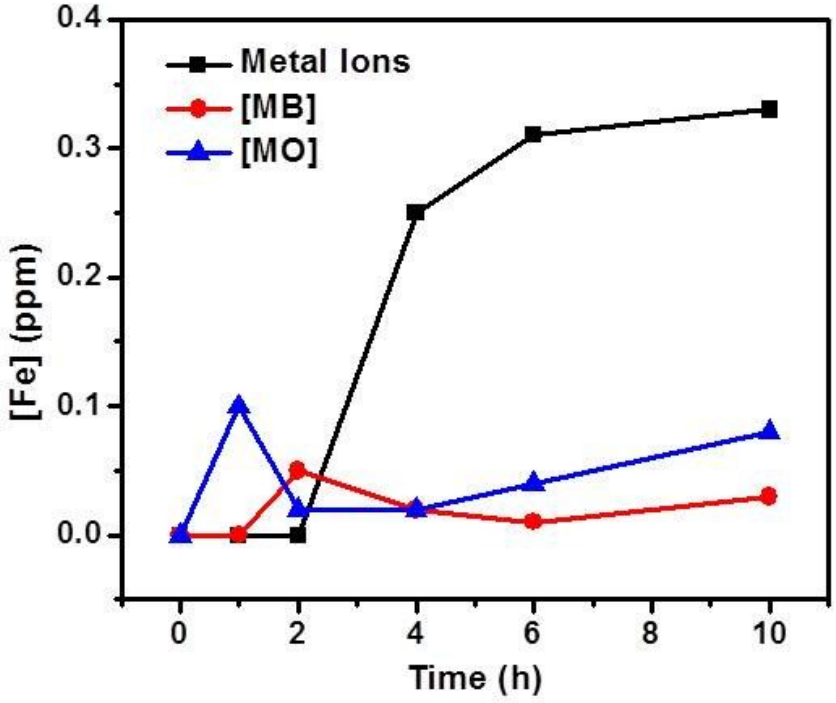

Figure S11. [Fe] leached into aqueous solution during adsorption.

Table S1. Comparison of surface property and MB adsorption capacity.

Sample	Adsorption Capacity (mg/g)	Surface Area (m^2/g)	Adsorption Capacity (mg/m^2)	Reference
C-03M	87.3	251.7	0.35	This work
AC-cotton stalk	193.5	794.8	0.24	J. Hazard. Mater., 2009, 166, 1514-1521
AC-rattan sawdust	294	1896	0.16	Dyes Pigments, 2007, 75, 143–149
AC-Waste apricot	102	1060	0.10	J. Hazard. Mater., 2006, B135 232–241

Table S2. Freundlich isotherm parameters for heavy metal ions adsorption with C-03M.

Metal ions	Parameters	
	K_f	n
Zn(II)	1.00	0.91
Ni(II)	0.92	0.88
Cu(II)	9.08	1.69
Cr(VI)	12.5	1.31
Pb(II)	10.5	1.56