Supporting Information

Figures

Synthesis, characterization and adsorption capacity of magnetic carbon composites activated by CO_2: implication to the catalytic mechanisms of iron salts

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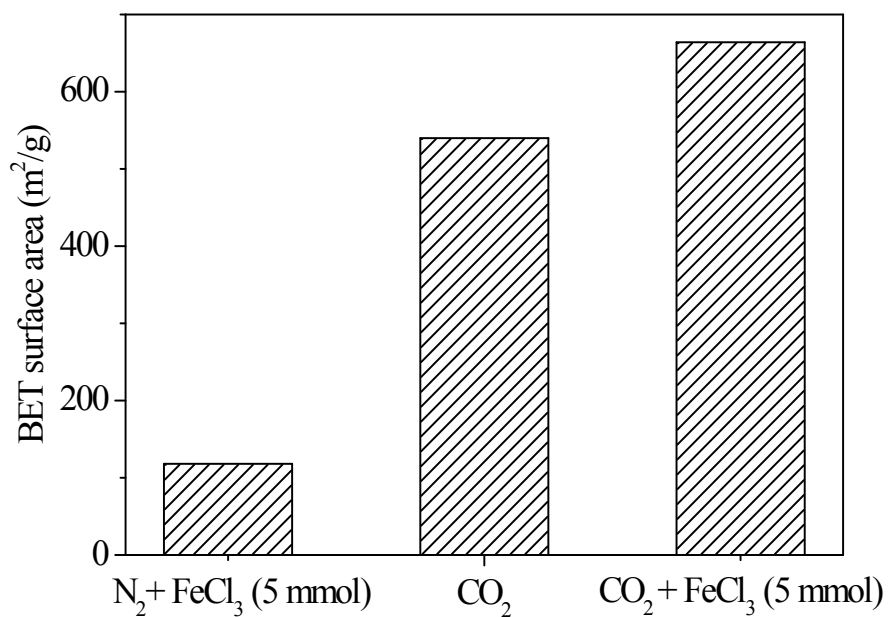
Fig. S1 Effect of FeCl$_3$ and CO$_2$ gas on the porosity of as-prepared MCs (750°C of activation temperature and 2 h of hold time).
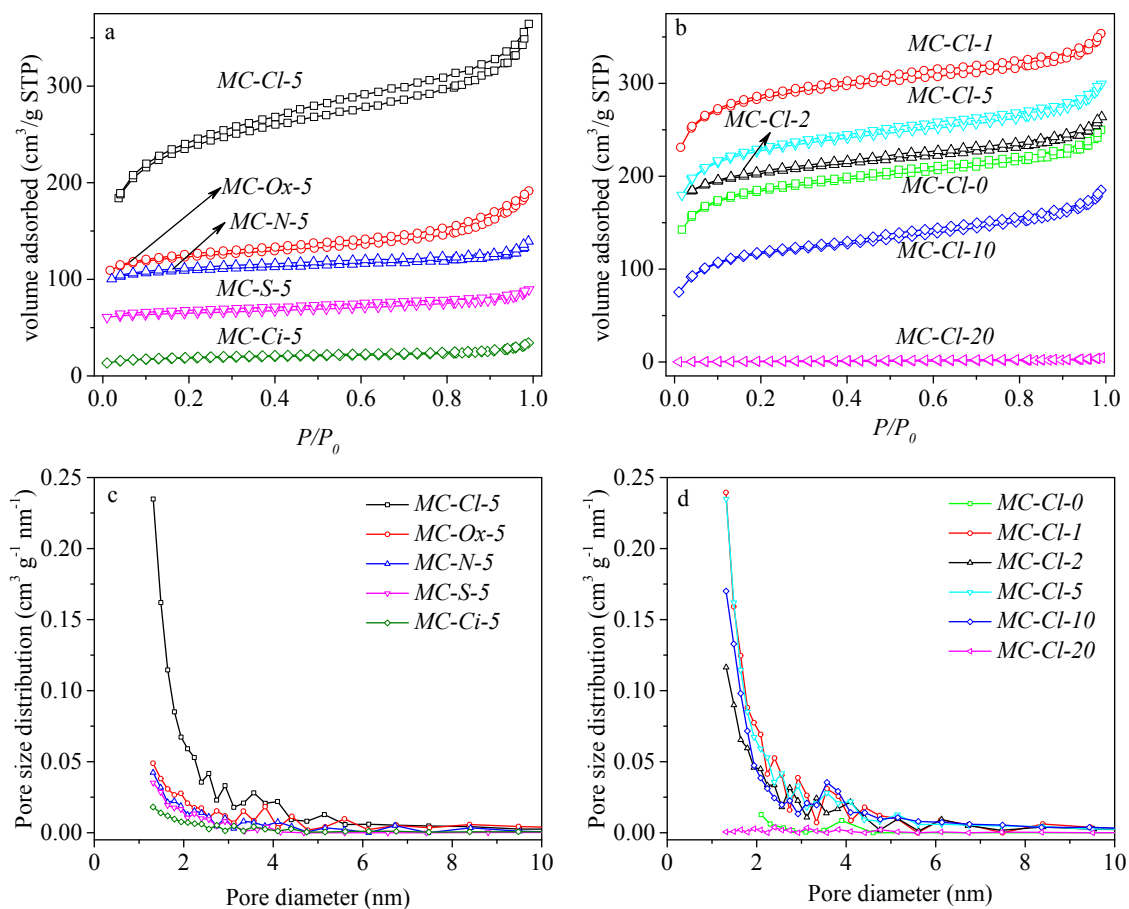
Fig. S2 (a) N_2 adsorption-desorption isotherms for different iron salt type derived MCs, (b) N_2 adsorption-desorption isotherms for different $FeCl_3$ loading content derived MCs, (c) pore size distributions for different iron salt type derived MCs, (d) pore size distributions for different iron $FeCl_3$ loading content derived MCs (750°C of activation temperature and 2 h of hold time).
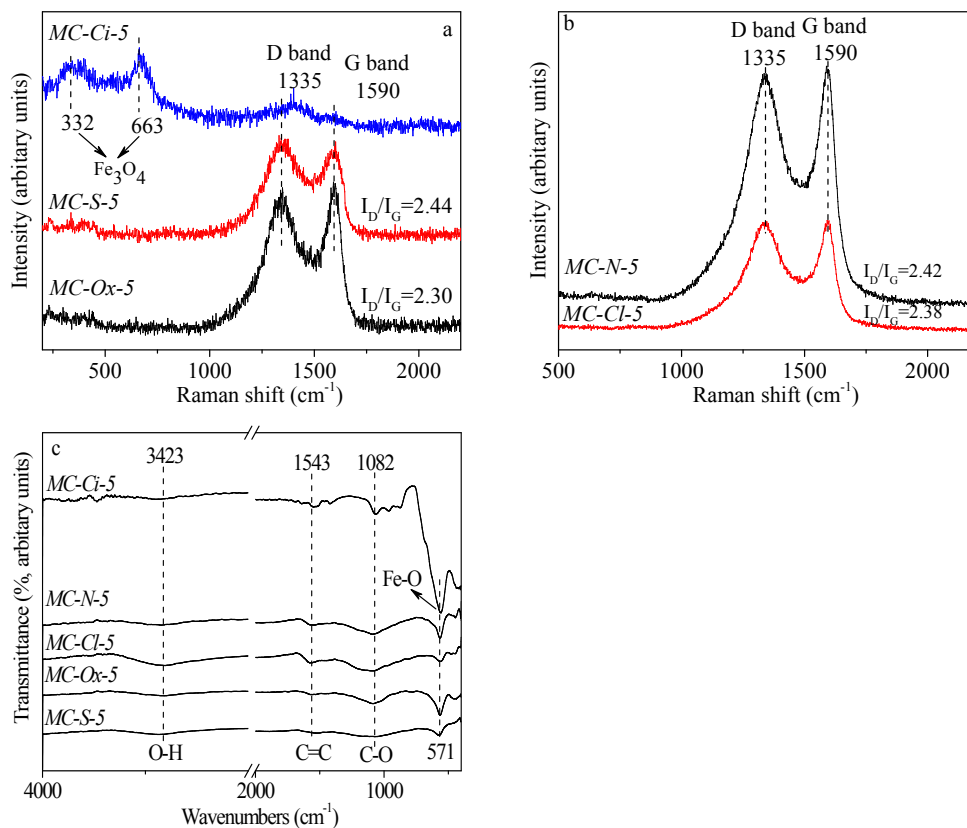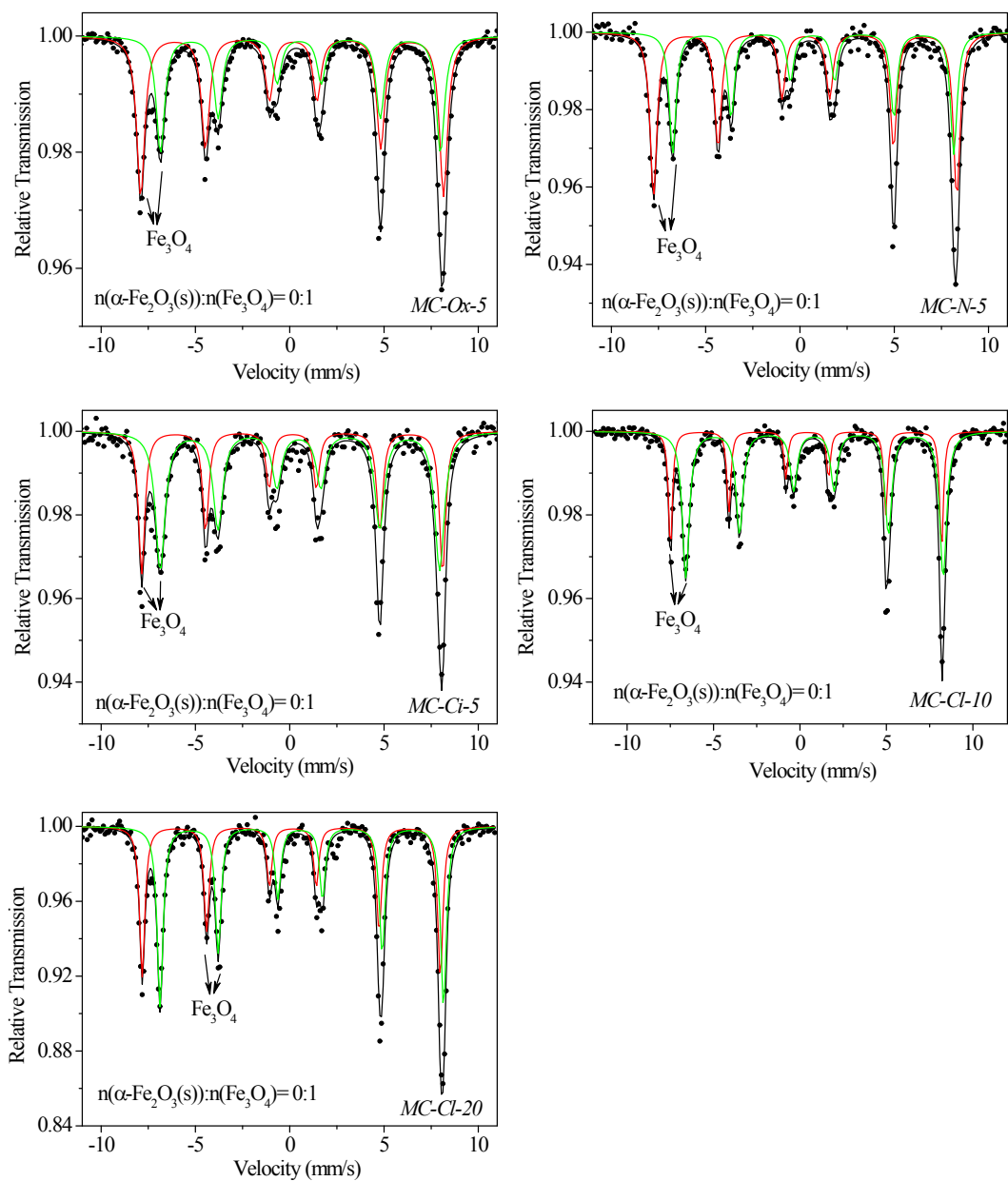
Fig. S3 (a, b) Effect of iron salt types on the Raman spectra of the resulting MCs, (c) effect of iron salt types on the FTIR spectra of the resulting MCs (750°C of activation temperature and 2 h of hold time).

Note: The Raman spectrum of *MC-Ci-5* showed two intense peaks at around 332 cm^{-1} and 663 cm^{-1}, which were attributed to be E_g and A_{1g} vibrational modes of the Fe_3O_4 phase (Fig. S3a and S3b). The disappearance of the D band (1335 cm^{-1}) and G band (1590 cm^{-1}) confirmed the over-activation of the *MC-Ci-5* sample, which was further validated by the strong Fe-O stretching (571 cm^{-1}) in the FTIR spectrum of the *MC-Ci-5* sample (Fig. S3c).
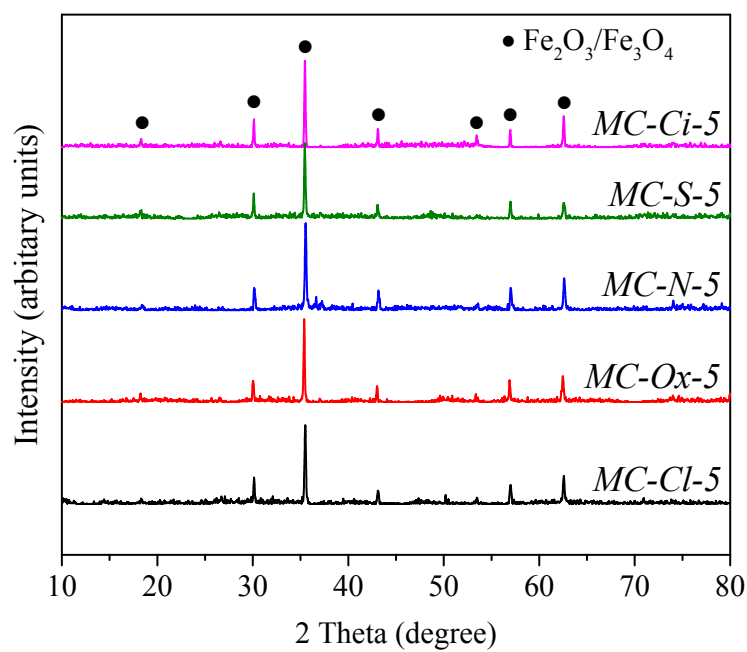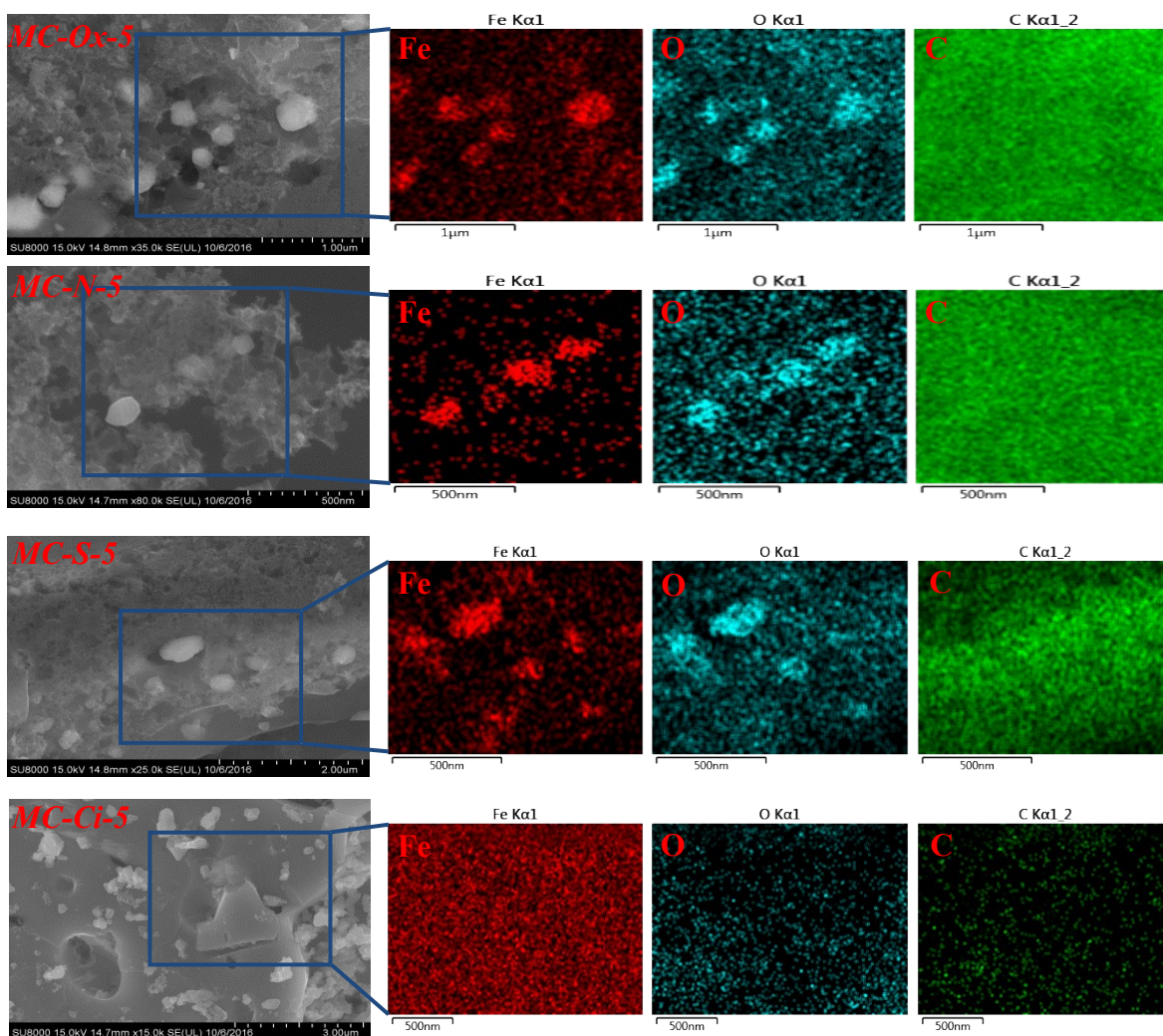
Fig. S4 Effect of iron salt types on the XRD patterns of resulting MCs (750°C of activation temperature and 2 h of hold time).

Fig. S5 Room-temperature Mössbauer spectra of selected MCs (750°C of activation temperature and 2 h of hold time).
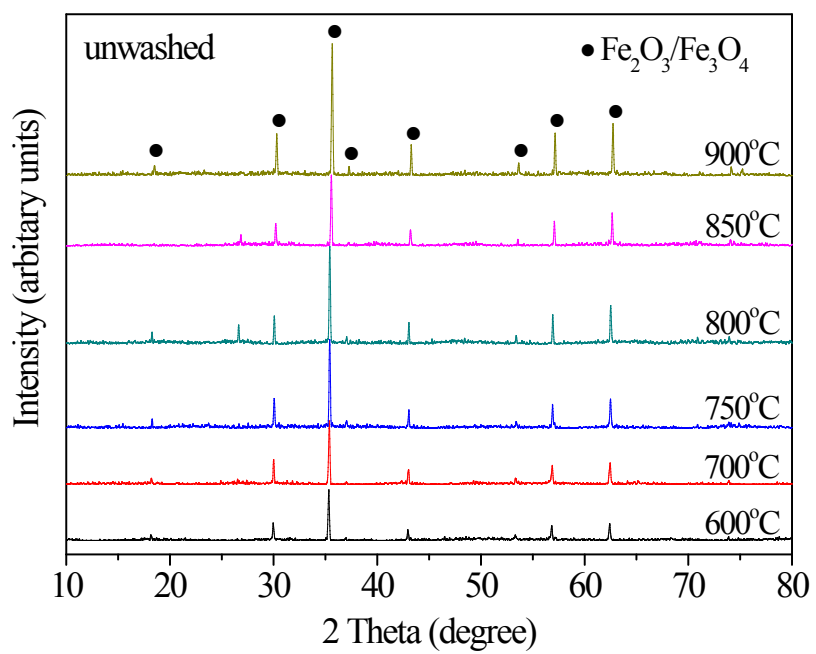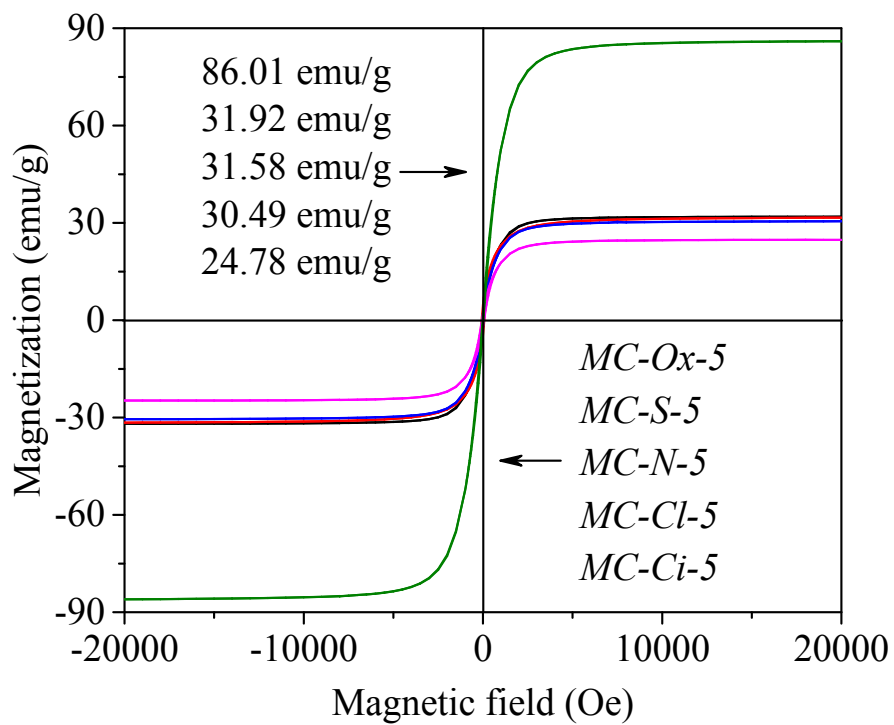
Fig. S6 Effect of activation temperature on the XRD patterns of unwashed MCs (MCs were fabricated by 5 mmol of $FeCl_3$ for 2 h).
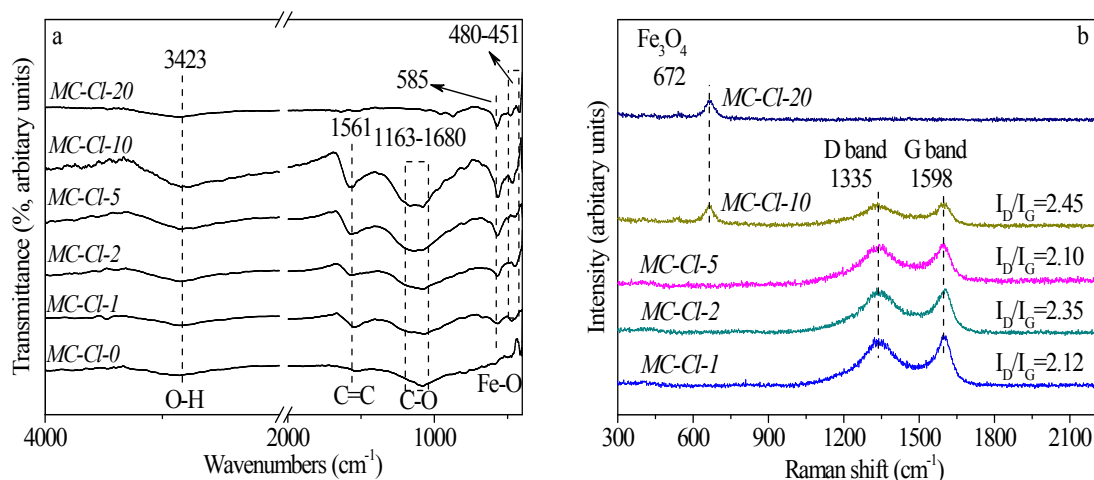
Fig. S7 SEM images and elemental mapping (Fe, O and C) images of different iron salts derived MCs.
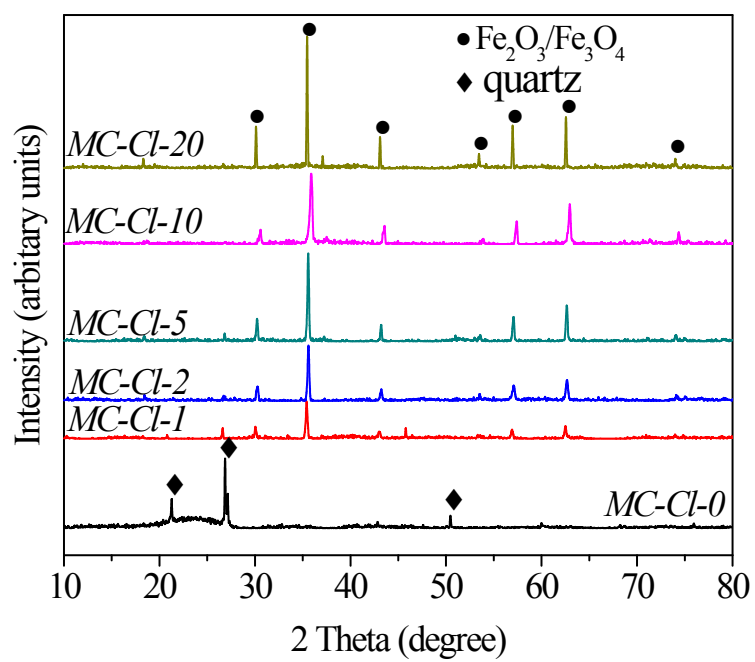
Fig. S8 The hysteresis loops of the MCs derived from different iron salt types under 25°C (750°C of activation temperature and 2 h of hold time).

Fig. S9 (a) Effect of FeCl$_3$ content on the FTIR spectra of the resulting MCs and (b) effect of FeCl$_3$ content on the Raman spectra of the resulting MCs (750°C of activation temperature and 2 h of hold time).

Note: As shown in Fig. S9a, the C=C stretching in aromatic groups and C-O vibration (~ 1561 cm^{-1} and 1163-1180 cm^{-1}) disappeared in *MC-Cl-20* sample. However, Fe-O stretching in Fe$_3$O$_4$ (585 cm^{-1} and 480-451 cm^{-1}) became stronger, indicating that less carbon matrix was retained in the *MC-Cl-20* sample. Likewise, the Raman spectrum of *MC-Cl-20* sample was dominated by the Fe$_3$O$_4$ signal (Fig. S9b). The FTIR and Raman spectra further confirmed the evolution of reaction between carbon matrix and CO$_2$ gas, influenced by the FeCl$_3$ content.

Fig. S10 Effect of $FeCl_3$ loading content on the XRD patterns of resulting MCs.
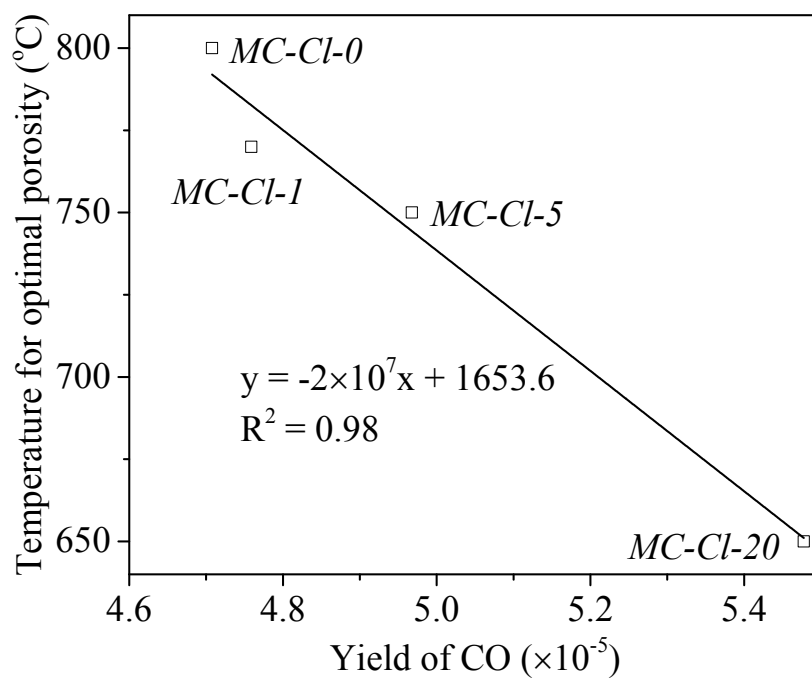
Fig. S11 Correlation between of the yield of CO (integral area of CO release curve) and temperature for optimal porosity of MCs derived from different $FeCl_3$ loading content.
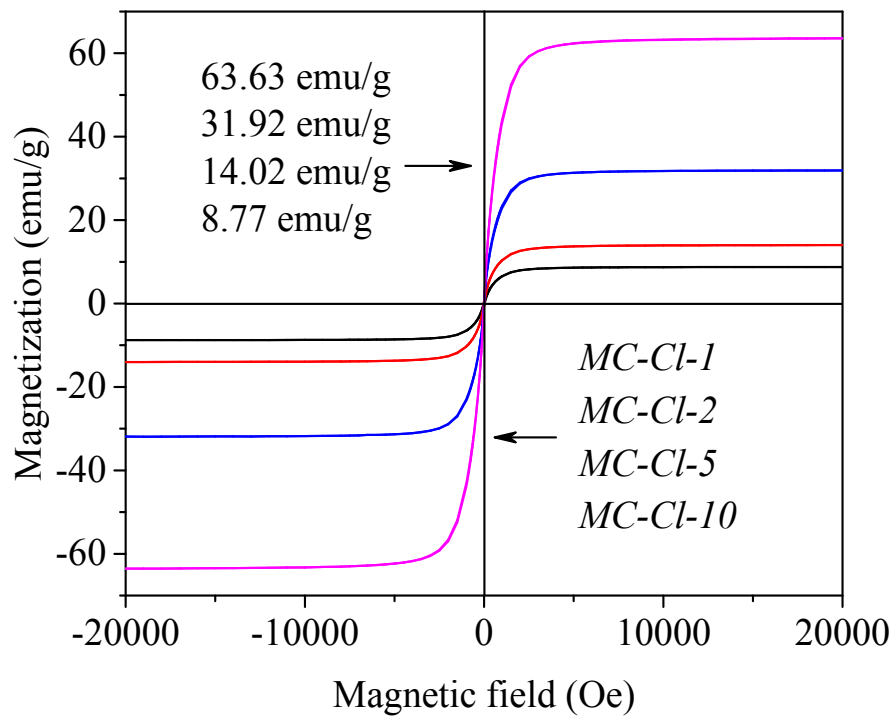
Fig. S12 The hysteresis loops of the MCs derived from different FeCl$_3$ loading content under 25°C (750°C of activation temperature and 2 h of hold time).
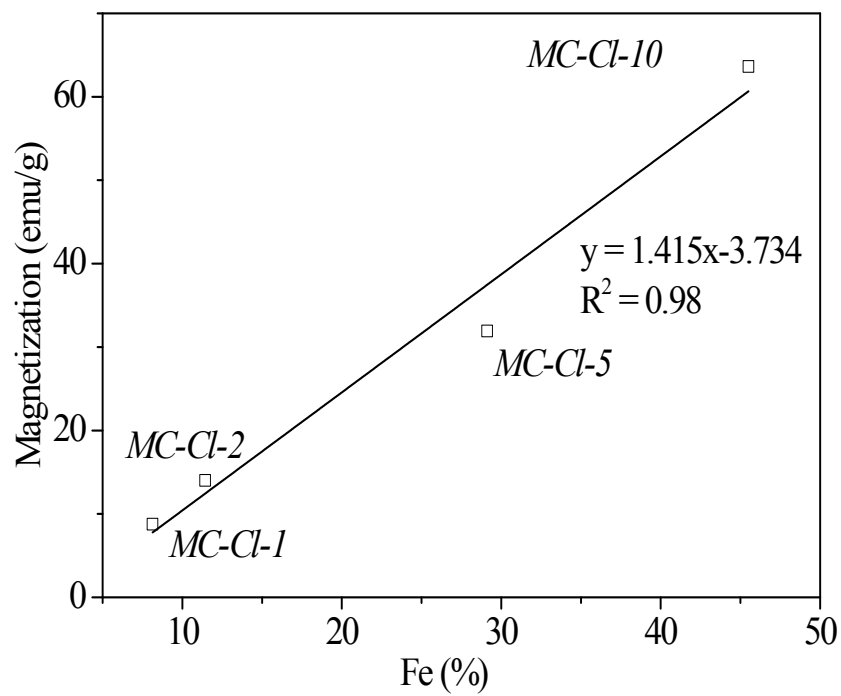
Fig. S13 Correlations between Fe content (%) and magnetization of different $FeCl_3$ loading content derived MCs samples.
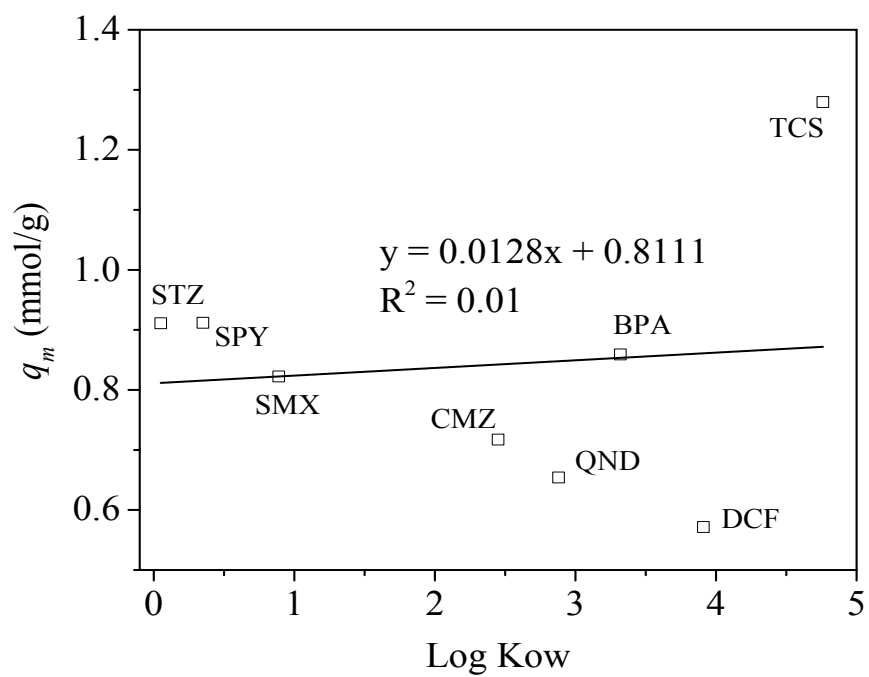
Fig. S14 A linear relationship between Log K_{OW} and q_m of PPCPs on *MC-Cl-5* sample.