Supporting Information

Microwave synthetic mesoporous carbon sponge as an efficient adsorbent for Cr(VI) removal

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Figure S1. UV-vis absorption of the Cr (VI) solution treated with different MCS (1.0 g L^{-1}) within five minutes.

Figure S2. Mechanisms of electrophilic rearrangement of PVA–OH and PVP–C═O.

Figure S3. EDS images of the composition of MCS (PPN-C).

Figure S4. UV-vis absorption of the Cr (VI) solution treated with different biochar sponges.

Table S1. Composition of carbon sponges.

Table S2. Comparison of adsorption capacity and rate constant with other materials.

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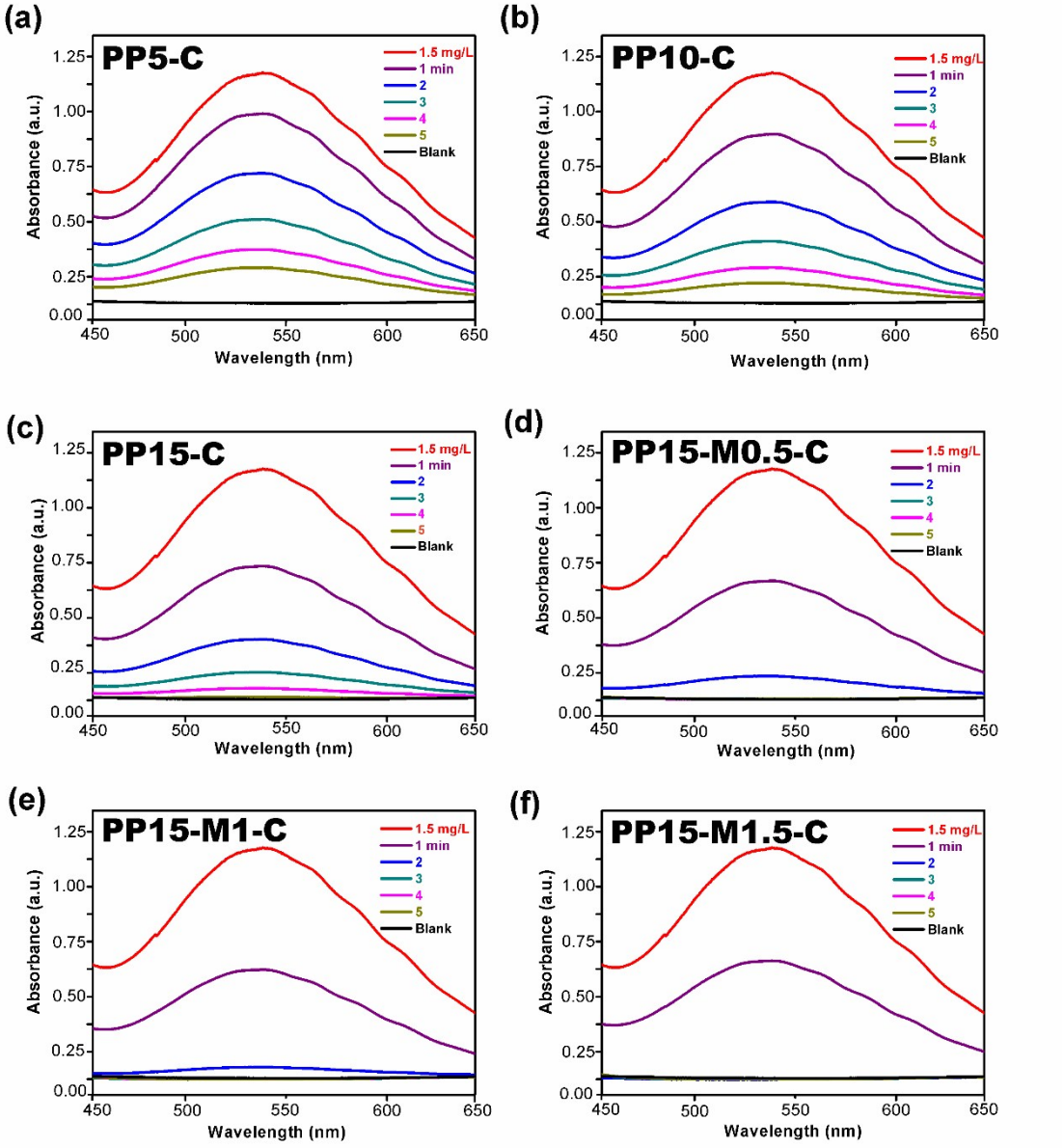

Figure S1. UV-vis absorption of the Cr (VI) solution treated with MCS (1 g L^{-1}) within five minutes.

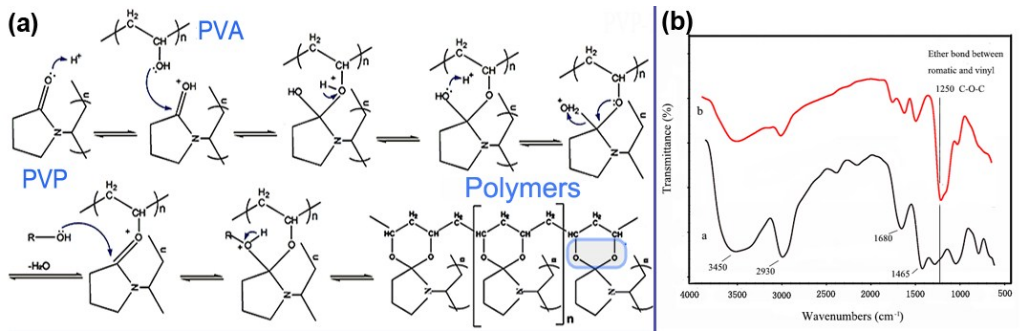

Figure S2. (a) Electrophilic rearrangement of PVA–OH and PVP–C═O to generate homogemeous

network polymers; (b) FT-IR spectra of the polymers (a) before and (b) after self-assembly.

In this work, the alcoholic hydroxyl side-groups of the PVA chain and ketone groups of the PVP chain induced the self-assembly under acid catalysis, obtaining a 1,3-dioxane polymer (Fig. S2a). As shown in the FT-IR spectra (Fig. S2b), the absorptions of the –C═O (1680 cm $^{-1}$) stretch at 1680 cm^{-1} and the OH (3450 cm^{-1}) stretch located at 3450 cm^{-1} decreased after the self-assembly reaction. A new absorption peak of the C–O–C stretch appeared at 1250 cm^{-1}, indicating that the functional groups were consumed along with an appearance of new functional group during the reaction.[1,2]

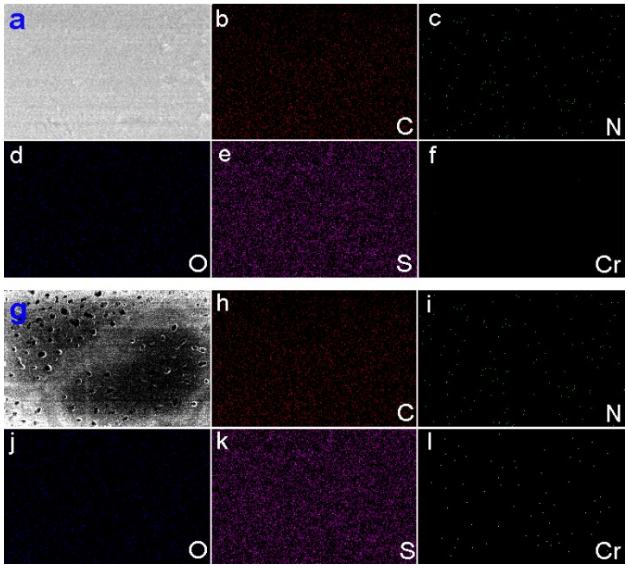

Figure S3. EDS images of the composition of MCS (PPN-C) (a)-(f) before and (g)-(l) after Cr(VI) removal (b/h C map, c/i N map, d/j O map, e/k S map, f/l Cr map).

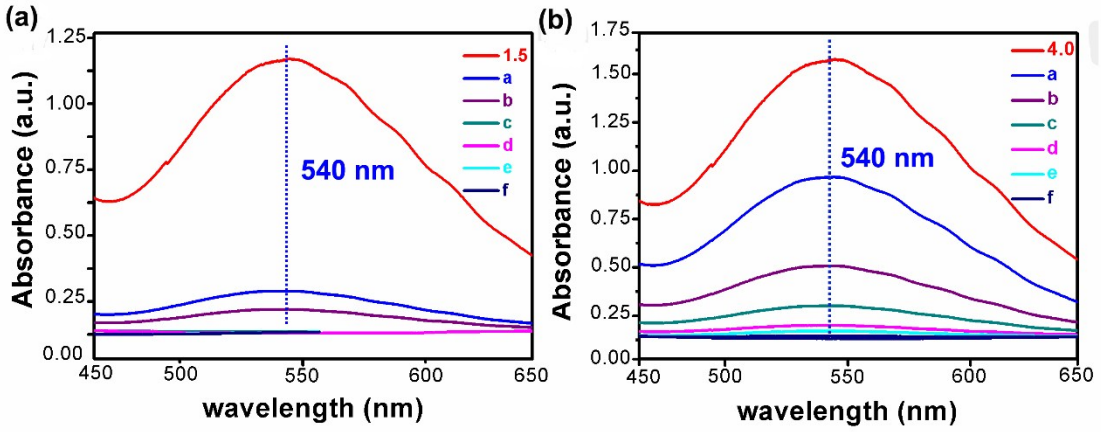

Figure S4. (a) and (b) UV-vis absorption of the Cr (VI) solution treated with different biochar sponges (Adsorbent: 1.0 mg L^{-1}, Cr(VI): 1.5 mg L^{-1} and 4.0 mg L^{-1}, treating time: 5 min). (a, b, c, d, e, and f represents PP5-C, PP10-C, PP15-C, PP15-M0.5-C, PP15-M1-C, and PP15-M1.5-C, respectively).

Table S1. Composition of carbon sponges.

Code	$^{a}\omega_{PVA}$ (%)	$^{a}\omega_{PVP}$ (%)	V_{PVA}:V_{PVP}	$^{b}\omega_{MCC}$ (%)	$^{c}\omega_{sulfuric\ acid}$ (%)
PP5-C	8	5	7:3	—	1.5
PP10-C	8	10	7:3	—	1.5
PP15-C	8	15	7:3	—	1.5
PP15-M0.5-C	8	15	7:3	0.5	1.5
PP15-M1-C	8	15	7:3	1	1.5
PP15-M1.5-C	8	15	7:3	1.5	1.5

[a]The mass fraction (ω) was calculated by the following equation, $\omega = [m_{solute}/(m_{solute+mdeionized\ water}]\times100\%$. [b]The mass fraction (ω) was calculated by the following equation, $\omega = [m_{MCC}/(m_{MCC}+m_{(mixture\ of\ PVA\ and\ PVP)})]\times100\%$, [c]The mass fraction (ω) was calculated by the following equation, $\omega = [m_{10\%\ sulfuric\ acid}/(m_{10\%\ sulfuric\ acid}+m_{(mixture\ of\ PVA\ and\ PVP)})]\times100\%$.

Table S2. Comparison of adsorption capacity and rate constant with other materials.

Materials	Adsorption capacity ($mg\ g^{-1}$)	Adsorption rate ($mg\ g^{-1}\ min^{-1}$)	Ref.
MCS (in this work)	93.96	18.79	
Core@double-shell nanoparticles	0.75	0.15	3
Magnetic carbon nanocomposite fabrics	3.74	0.38	4
Aluminum–magnesium mixed	105.3–112.0 [a]	N/A	5
PAMAM-g-CNFs	377.36[b]	~ 0.62	6
Activated carbon	112.36[c]	<0. 93	7

[a]The large adsorption capacity of aluminum–magnesium mixed hydroxide is due to the ion exchange mechanism rather than adsorption which results in the very low adsorption rate. [b] In the process of Cr(VI) removal, the part of Cr(VI) ions been reduced to Cr(III), which meant that PAMAM-g-CNFs for Cr(VI) removal is chemisorption and the adsorption kinetics doesn't follows the pseudo-second-order model. [c]Activated carbon exhibits a very high specific adsorption capacity due to their extremely low densities. Nanocomposites with metal oxides have significantly higher densities. Therefore, the specific adsorption capacity based onunit mass is much lower.

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