Supporting Information

Super-adsorbent based on functional polymer particles with multilevel porous structure

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FT-IR spectra of the PMS particles, the core-shell particles and the anhydride/carboxylate functionalized MSPPs

![FT-IR spectra](image)

Figure S1. FT-IR spectra of the PMS particles, the core-shell particles and the anhydride/carboxylate functionalized MSPPs.

**Determination of content of anhydride groups in the MSPPs**

Table S1. The elemental analysis data of MSPP.

<table>
<thead>
<tr>
<th>Sample#</th>
<th>N [%]</th>
<th>C [%]</th>
<th>H [%]</th>
<th>O [%] a</th>
<th>MAH [%] a</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSPP-A</td>
<td>0.093</td>
<td>68.53</td>
<td>5.565</td>
<td>25.812</td>
<td>52.7</td>
</tr>
<tr>
<td>MSPP-B</td>
<td>0.177</td>
<td>69.15</td>
<td>5.522</td>
<td>25.151</td>
<td>51.3</td>
</tr>
<tr>
<td>MSPP-C</td>
<td>0.082</td>
<td>67.98</td>
<td>5.98</td>
<td>25.958</td>
<td>52.9</td>
</tr>
</tbody>
</table>

a. The oxygen content was calculated from the elemental results, and the content of MAH was calculated based on the oxygen content.
Isotherms for $b$-MB adsorption onto the carboxylate functionalized MSPPs

Figure S2. Linearized Langmuir isotherm for $b$-MB adsorption by the hydrolyzed MSPPs at different pH values (a) 7.0, (b) 10.0. Linearized Freundlich isotherm for dye adsorption by the hydrolyzed MSPPs at different pH values (c) 7.0, (d) 10.0.
The adsorption kinetics of \( b \)-MB onto different adsorbents

Figure S3. The adsorption kinetics of \( b \)-MB onto (a) carboxylic acid functionalized MSPP, (b) non-hollow mesopore-free carboxylate functionalized DVB-MAH nanoparticles, and mesoporous carboxylate functionalized MSPPs with lower surface area (c) MSPP-D and (d) MSPP-E.

\( \text{N}_2 \) isotherms and pore size distribution for MSPP-D and MSPP-E

Figure S4. \( \text{N}_2 \) isotherms of the mesoporous MSPP-D (a) and MSPP-E (b) at 77 K, and the inset is the size distribution of the mesopores in the shell layer. The surface area for MSPP-D and MSPP-E were 8.3 and 14.7 m\(^2\) g\(^{-1}\), respectively.
The colloidal stability of the hollow polymer particle suspension

![Figure S5](image)

Figure S5. The slope of n \((d(\log A)/d(\log \lambda))\) as a function of (a) MSPP concentration and (b) solution pH.

The stability and charge properties of the adsorbents

![Figure S6](image)

Figure S6. The zeta potentials of the as-prepared carboxylate functionalized MSPPs in a wide range of pH 1.0-10.0. The sample containing 0.02 g L\(^{-1}\) MSPP particles was suspended in a 0.01 mol L\(^{-1}\) NaCl solution and the aqueous suspension was equilibrated for 24 h. Then, the zeta potential at different pH values was determined.
The optical image of b-MB solution (500 mg/g) before and after centrifugation

Figure S7. The suspension of MSPPs in b-MB (500 mg/g) before and after centrifugation.

The amount of b-MB adsorb/desorbed at different b-MB concentrations

Figure S8. The adsorption-desorption behavior of b-MB on the MSPPs at pH=7.0 and 2.5, respectively. The desorption process was carried out in acidic ethanol 4 times (pH=2.5).
Figure S9. The optical image of the carboxylate functionalized MSPPs before, after adsorption and after desorption.

Figure S10. FT-IR spectra of $b$-MB, the carboxylate functionalized MSPPs before and after adsorption of $b$-MB, and the regenerated MSPPs after desorption.
Thermal stability of the PMS and MSPP

Figure S11. TGA patterns of the PMS and MSPP under N$_2$ atmosphere.