Facile Fabrication of Magnetically Assembled Colloidal Photonic Crystal Film via Radical Polymerization

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Synthesis of Fe₃O₄@OA Magnetic Nanoparticles.

Fe₃O₄@OA magnetic nanoparticles were prepared by the classical chemical co-precipitation procedure. FeCl₃·6H₂O (4.05 g) and FeSO₄·7H₂O (2.78 g) were dissolved with water (100 mL) by vigorous stirring under N₂ gas protection. Once the solution was heated to 90°C, ammonium hydroxide (15 mL) and OA (0.67 g) were rapidly added in sequence. After stirring for 1h, Fe₃O₄@OA magnetic nanoparticles were obtained. Then the Fe₃O₄@OA nanoparticles were separated by means of magnetic aggregation with a magnet. Next, the nanoparticles were washed with water and ethanol, respectively, and dried under vacuum at 50°C overnight. The dried magnetic nanoparticles were dispersed well in chloroform or cyclohexane.

Preparation of MCNPs by Three-step Miniemulsion Polymerization.

MCNPs were prepared by the three-step miniemulsion polymerization. In the first step, 0.5 g Fe₃O₄@OA were dispersed in 2.5 mL organic solvent, and added drop-wise into 40mL aqueous solution containing 0.05 g SDS under vigorous stirring
for pre-emulsification. After 30 min, the solution was sonicated in ice-water bath for
30 s to get the miniemulsion A. In the second step, 0.1 g MMA and 1.2 g EGDMA
were added into 40 mL aqueous solution containing 0.05 g SDS as in step 1 for pre-
emulsification. Then the solution was sonicated in ice-water bath for 15 s to get the
miniemulsion B. In the third step, a mixture of the magnetite miniemulsion A and the
miniemulsion B was sonicated in ice-water bath for 30 s. After that, the miniemulsion
was transferred into a three neck-bottomed flask, and heated to 70°C under an
atmosphere of nitrogen. Finally, 10 mg KPS was added to initiate polymerization by
stirring at 350 rpm. The polymerization time was 18 h.

**FT-IR characteristic of MCNPs.**

The functional groups of MCNPs were analyzed by FT-IR, shown in Figure S1.
The peaks at 2925 cm\(^{-1}\) and 1453 cm\(^{-1}\) were characteristic peaks for C-H stretching
and bending vibrations. The peak at 1732 cm\(^{-1}\) was attributed to the stretching
vibration of C=O in ester group in EGDMA and MMA. The peaks at 1162 cm\(^{-1}\) was
from stretching vibration of C-O-C in EGDMA. The peaks at 1260 cm\(^{-1}\) might be
characteristic peak of S=O stretching vibration resulted from the surfactant SDS and
the KPS during polymerization. The peaks near 590 cm\(^{-1}\) were characteristic peaks of
Fe-O-Fe in magnetite. All these adsorption peaks confirmed the successful formation
of magnetite @ poly(MMA-co-EGDMA) composite.
Fig. S1 FT-IR spectrum of MCNPs

Table S1 The influence of surfactant concentration on the particle size ($D_h$), polydispersity indexes (PDI), and the content of magnetite

<table>
<thead>
<tr>
<th>Sample</th>
<th>SDS (mmol/L)</th>
<th>$D_h$ (nm)</th>
<th>PDI</th>
<th>TGA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCNP-1</td>
<td>0.87</td>
<td>296</td>
<td>0.340</td>
<td>33.8</td>
</tr>
<tr>
<td>MCNP-2</td>
<td>1.7</td>
<td>166</td>
<td>0.171</td>
<td>38.2</td>
</tr>
<tr>
<td>MCNP-3</td>
<td>2.6</td>
<td>162</td>
<td>0.163</td>
<td>39.6</td>
</tr>
<tr>
<td>MCNP-4</td>
<td>3.5</td>
<td>152</td>
<td>0.160</td>
<td>48.5</td>
</tr>
<tr>
<td>MCNP-5</td>
<td>4.3</td>
<td>152</td>
<td>0.162</td>
<td>45.8</td>
</tr>
<tr>
<td>MCNP-6</td>
<td>5.2</td>
<td>148</td>
<td>0.158</td>
<td>45.8</td>
</tr>
<tr>
<td>MCNP-7</td>
<td>6.1</td>
<td>145</td>
<td>0.151</td>
<td>56.2</td>
</tr>
<tr>
<td>MCNP-8</td>
<td>7.0</td>
<td>146</td>
<td>0.150</td>
<td>60.7</td>
</tr>
</tbody>
</table>