

# The Fabrication and Morphology of Sponge-like Polymer Material Based on Cross-linked Sulfonated Polystyrene Particles

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## **Synthesis of cross-linked polystyrene (CP) particles using surfactant-free emulsion polymerization**

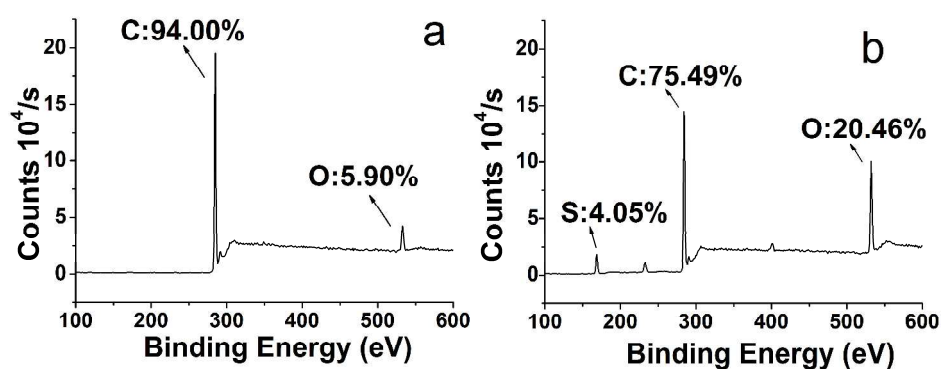
Potassium persulfate (KPS, 0.15 g) and deionized water (300 ml) were mixed in a flask under a mechanical stirring at 300 rpm. Styrene (St, 30 g), acrylic acid (AA, 2.4 g), and divinylbenzene (DVB, 0.6 g) were added into the above solution. Then the system was heated to 75°C and kept for 24 hours under the protection of nitrogen. The CP particles were collected by centrifugation (10000 rpm, 8 min) and washed with ethanol three times. The product then was dried in a vacuum oven at 50°C for 24 hours.

## **The element distribution on the surfaces of CP particles and cross-linked sulfonated polystyrene (CSP) particles**

The element distribution on the surfaces of the CP particles is measured by XPS, as displayed in

Figure S1-a. Because the XPS measurement is carried out under nitrogen atmosphere, the peak of the O 1s should be mainly attributed to the  $-\text{COOH}$  groups, which indicates that the acrylic acid units (necessary component for the surfactant-free emulsion polymerization) stay on the surfaces of the CP particles.

Then the CP particles are sulfonated with the concentrated sulfuric acid for 2 hours. The XPS spectra of CSP particles are displayed in Figure S1-b. Two characteristic peaks for S element appear in the spectra, and the relative intensity of S to C (S:C) of CSP particles is 4.04:75.49. The results imply that the  $-\text{SO}_3\text{H}$  groups have been introduced to the surfaces of the CP particles after the sulfonation.



**Figure S1.** XPS spectra of CP particles (a), and CSP particles (b).

**The digital photos of polymethylmethacrylate (PMMA) and CSP particles before and after rinsed with acetic acid**

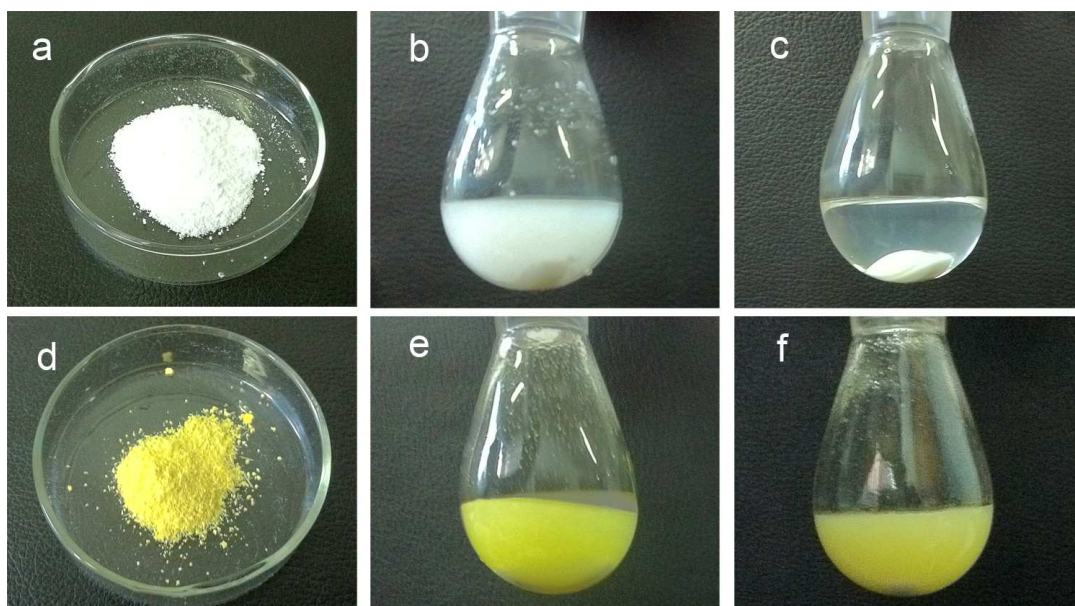


Figure S2. The digital photos of PMMA particles (a), the acetic acid containing PMMA particles after stirring for 0 min (b) and 30 min (c), CSP particles (d), the acetic acid containing CSP particles after stirring for 0 min (e) and 30 min (f) (The white olive-like object in the bottom of the flask is the stirrer).

The white PMMA particles (0.1 g, synthesized by surfactant-free emulsion polymerization, Figure S2-a) and the light-yellow CSP particles (0.1 g, Figure S2-d) are dispersed into acetic acid (10 ml) under ultrasonication for 30 seconds, respectively (Figure S2-b for PMMA particles and Figure S2-e for CSP particles). After magnetic stirring for 30 min, the suspension containing PMMA particles turns to be transparent (Figure S2-c), while the suspension containing CSP particles remains cloudy (Figure S2-f). The result indicates that the PMMA particles can easily dissolve in acetic acid, but CSP particles cannot. The optical photos of the products and the suspensions were taken by a digital camera (Kodak EasyShare Z730).