Formation of Cagelike Sulfonated Polystyrene Microspheres via Swelling-Osmosis Process and Loading of CdS Nanoparticles

Hanqin Weng, Xuefeng Huang, Mozhen Wang, Xiang Ji, Xuewu Ge*

CAS Key Laboratory of Soft Matter Chemistry, Department of Polymer Science and Engineering, University of Science and Technology of China, Hefei, Anhui 230026, People's Republic of China

* E-mail: pstwmz@ustc.edu.cn; Tel: +86-551-63600843; Fax: +86-551-63601592

Supporting Information

The Element Distribution on the Surfaces of Sulfonated Polystyrene (SPS) Microspheres

The element distribution on the surfaces of the SPS microspheres, which were sulfonated with the concentrated sulfuric acid for 20 hours, is measured by X-ray photoelectron spectroscopy (XPS), as displayed in Figure S1. Two characteristic peaks for S and C elements appear in the spectra, and the atom ratio (atom%) of S to C (S:C) of SPS microspheres is 2.52:86.23. Because the XPS measurement is carried out under nitrogen atmosphere, the results imply that the $-SO_3H$ groups have been introduced to the surfaces of the SPS microspheres after the sulfonation.

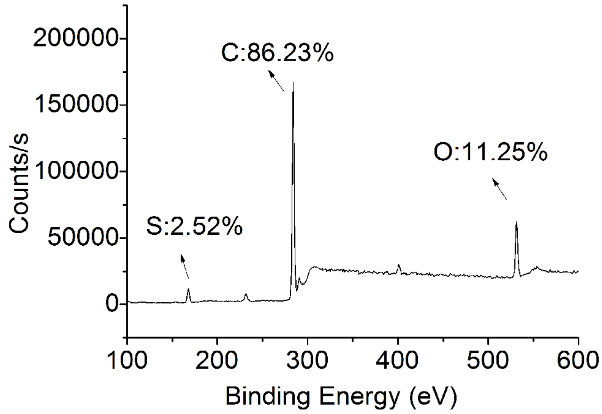

Figure S1. XPS spectrum of the SPS microspheres.

The degree of sulfonation (DS) of these SPS microspheres, defined as the mole fraction of sulfonic groups, is calculated to be 23.38% according to the following Equation S1:

$$DS_{XPS} = 8 \times (\text{atom\%S} / \text{atom\%C}) \times 100\% \qquad \text{Equation S1}$$

The Solubility of Polystyrene (PS) Microspheres in Different Solvent Systems

The prepared PS microspheres (0.02 g) were dispersed in the solvent (10 g). After 4 hours, the digital photos of the systems were taken. The result indicates that water, ethanol and water-ethanol solution were poor solvent for PS microspheres. They cannot dissolve PS even at 70 °C (Figure S2). However, PS microspheres become soluble in heptane at 70 °C. When water is mixed with heptane, the system is separated into two phase. The upper is heptane, which dissolves PS microspheres at 70 ^{o}C. Ethanol can be miscible with heptane, but the mixture cannot dissolve PS microspheres even at 70 ^{o}C.

MMA have a better dissolving capacity for PS microspheres compared with heptane, it can dissolve PS microspheres at room temperature. However, MMA have a better water solubility than heptane. It cannot separate with water completely. Therefore, PS particles cannot be dissolved in water/MMA binary system and water/ethanol/MMA ternary system.

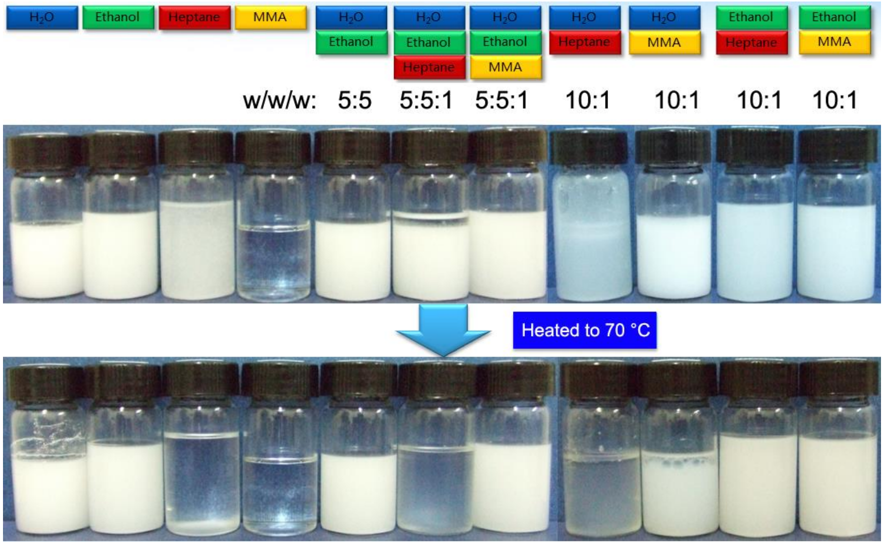

Figure S2. The solubility of PS microspheres in different solvents at room temperature and 70 ^{o}C.

The TGA Measurement of Cagelike CdS-loaded SPS Microspheres

The load capacity of CdS particles (L_{CdS}) on cagelike SPS microspheres were measured by thermal gravimetric analysis (TGA), operated on a TGAQ5000IR analyzer in nitrogen atmosphere at a heating rate of 10 °C/min in the temperature range 50 °C to 600 °C. The L_{CdS} can be calculated according to the following equation:

$L_{CdS} = W_r (\%) / W_{loss} (\%)$ Equation S2

Here W_r (%) is the remaining weight percentage on the TGA curve, and W_{loss} (%) is the weight loss percentage of the whole CdS-loaded SPS microsphere sample.

From the TGA curves in Figure S3, it can be noted that the thermal stability of SPS microspheres will be enhanced in the presence of CdS particles. The loading capacity of CdS particles with a size of 35 nm and 150 nm is calculated to be 12.0% and 18.1% respectively.

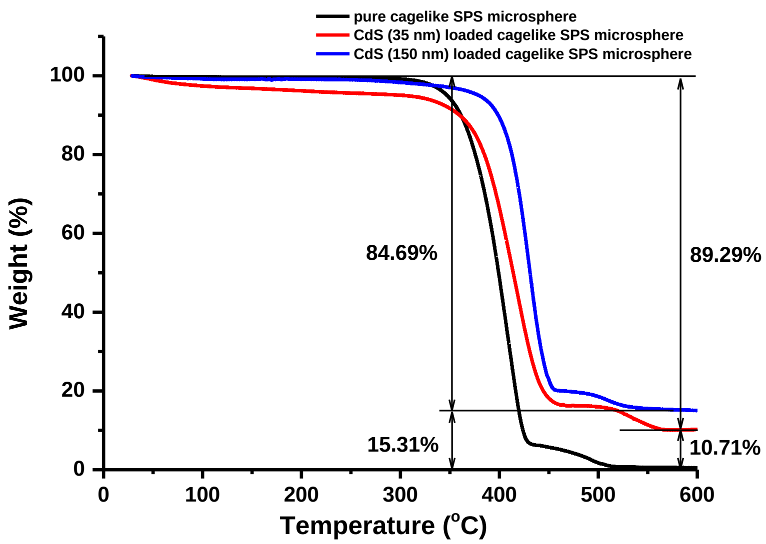

Figure S3. TGA curves of SPS microspheres with or without loading CdS particles.