A novel route to highly monodispersed mesoporous silica spheres consisting of nano-sized particles

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We have been conducting the research on the synthesis of highly monodispersed mesoporous silica spheres, termed as MMSS hereafter, by optimizing synthesis conditions [1-3]. Although the pore size of MMSS is tuned by changing the alkyl-chain length of the surfactant, the maximum pore size of MMSS was limited to 2.5 nm. We previously reported the pore expansion of MMSS by the surfactant exchange method and swelling agent incorporation method [4,5], and the pore sizes were expanded to ca. 6 nm. Here, we report the novel synthesis of MMSS with pore size larger than 10 nm. MMSS with unexpectedly large pore size was obtained by a simple hydrothermal treatment under acidic condition. As can be seen from Figure 1, the highly monodispersed shape was retained after the treatment. However, the pore diameter was enlarged and the nitrogen adsorption isotherm changed drastically. It is obvious from TEM images that a particle before the treatment is consisted of honeycomb type mesopores, however, the honeycomb structure disappeared and several ten nm sized silica particles appeared after the treatment. The effects of many factors such as temperature, pH on the pore size and morphology, and some applications will be presented.

Figure 1. Changes in morphology and adsorption property after pore enlargement of MMSS. SEM and TEM images for MMSS before (a), (c), (e) and after (b), (d), (f) hydrothermal treatment. (g) Nitrogen adsorption isotherms of MMSS.