Study of functional organo-silica spherical particles synthesized using a reaction field of W/O emulsion

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Organo-silica is useful because of its flexibility, high specific surface area and high reflective index. Using a reaction field of a W/O emulsion, monodispersed organo-silica spherical particles were synthesized from typical organo-alkoxysilane, methyltrimethoxysilane (MTMS), without using any acid and base catalysts. Such particles doped with organic dyes were also synthesized and investigated.

Organo-silica spherical particles of 1 to 80 m in diameter were obtained. Particularly, monodispersed such particles of 1.6 to 3.7 m in diameter were prepared from a W/O emulsion composed of 10 wt% sorbitantrioleate (SPAN85R), 60 wt% n-octane and 30 wt% H2O. The formation mechanism of these particles can be explained in terms of three processes: hydrolysis of MTMS, formation of spherical pre-polymers and growing of spherical particles.

On the heat-treatment effect of the organo-silica particles, from 100 to 300 °C, both a slight decrease in the particle diameter and an increase in the specific surface area were observed, and the Si-OH and Si-OCH3 groups existing in the particles were converted into the Si-O-Si bond due to condensation polymerization. Around 430 °C, CH3 in the Si-CH3 was eliminated due to the oxidation.

Organo-silica spherical particles doped with organic dye of Rhodamine B (RB) were synthesized by mixing a hydrophobic mixture solution consisting of MTMS, SPAN85R and n-octane with an aqueous solution that has been obtained from hydrolyzing MTMS in an aqueous solution of RB. The particles were monodispersed with fewer pores. Fluorescence due to RB was observed even in the spherical particles heat treated at 350 °C, indicating that RB molecules were sufficiently incorporated into the particles.

We also tried to synthesize spherical particles doped with other organic dyes. Basic dyes could be doped in the particles, while acid dyes and oil-soluble dye couldn't. The reason is probably that the basic dyes form dimer in the aqueous solution, resulting in the interaction with silanols through a cross-linkage like Si-O---[(dimer)]2+---O-Si.