Synthesis of silica nanoparticles by modified sol–gel process: the effect of mixing modes of the reactants and drying techniques

Abstract

A modified preparation of silica nanoparticles via sol–gel process was described. The ability to control the particle size and distribution was found highly dependent on mixing modes of the reactants and drying techniques. The mixture of tetraethoxysilane and ethanol followed by addition of water (Mode-A) produced monodispersed powder with an average particle size of 10.6 ± 1.40 nm with a narrow size distribution. The freeze drying technique (FD) further improved the quality of powder. In addition, the freeze dried samples have shown unique TGA decomposition steps which might be related to the well-defined structure of silica nanoparticles as compared to the heat dried samples. DSC analysis showed that FD preserved the silica surface with low shrinkage and generated remarkably well-order, narrow and bigger pore size and pore volume and also large endothermic enthalpies (ΔH FD = -688 J g^{-1}vs. ΔH HD = -617 J g^{-1}) that lead to easy escape of physically adsorbed water from the pore at lower temperature.

Coswald Stephen Sipaut @ Mohd Nasri