

Spherical Silica Nanoparticles by Modified Stöber Process Assisted by Organic Ligand:

Synthesis and Characterization of

Tahereh Gholami, Masoud Salavati-Niasari*

Institute of Nano Science and Nano Technology, University of Kashan, Kashan, P. O. Box. 87317-51167, I.

R. Iran.

*Corresponding author. Tel. +98 361 5555 333; Fax +98 361 555 29 30.

E-mail address: salavati@kashanu.ac.ir

Silica nanoparticles can be obtained through two principal approaches: the Stöber synthesis and the microemulsion method. The Stöber method was firstly introduced using ammonia catalyzed hydrolysis and condensation of ethoxysilanes in low molecular-weight alcohols as solvent to produce uniform silica particles. The Stöber synthesis has the advantage of being easily scaled up for commercial applications and the possibility to effortlessly transfer the nanoparticles into aqueous solutions. Hence, in this study a modified Stöber synthesis is proposed and a systematic study of the different parameters has been reported, which provides a better picture on the influence of time, power, and molar ratio of organic Schiff base ligand to silica precursors on the final morphology of the product. This modified Stöber synthesis including using TEOS (tetraethyl orthosilicate), methanol and ethylenediamine (en) in water and in the presence of organic Schiff base ligand (Salpn-NO₂) has been reported for the first time than the typical Stöber synthesis. There has not been any report for precipitation of spherical SiO₂ using only ultrasonic process assisted by organic ligand, so far.

Spherical silica nanoparticles were synthesized via a sonochemical method based on modified stöber process the reaction between TEOS (tetraethyl orthosilicate), methanol and ethylenediamine (en) in water, in the presence of organic Schiff base ligand (Salpn-NO₂). The effects of preparation parameters such as: ultrasonic power, ultrasonic irradiation time and molar ratio of organic Schiff base ligand to TEOS were

investigated to reach the optimum conditions. It was found that morphology, particle size and phase of the products could be affected by these parameters. The results exhibited that optimum conditions were 15 min, 60 W power and 1/10 molar ratio. The as synthesized spherical silica nanoparticles were characterized by X-ray powder diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FT-IR), ultraviolet–visible (UV–Vis) spectroscopy, and X-ray energy dispersive spectroscopy (EDS).

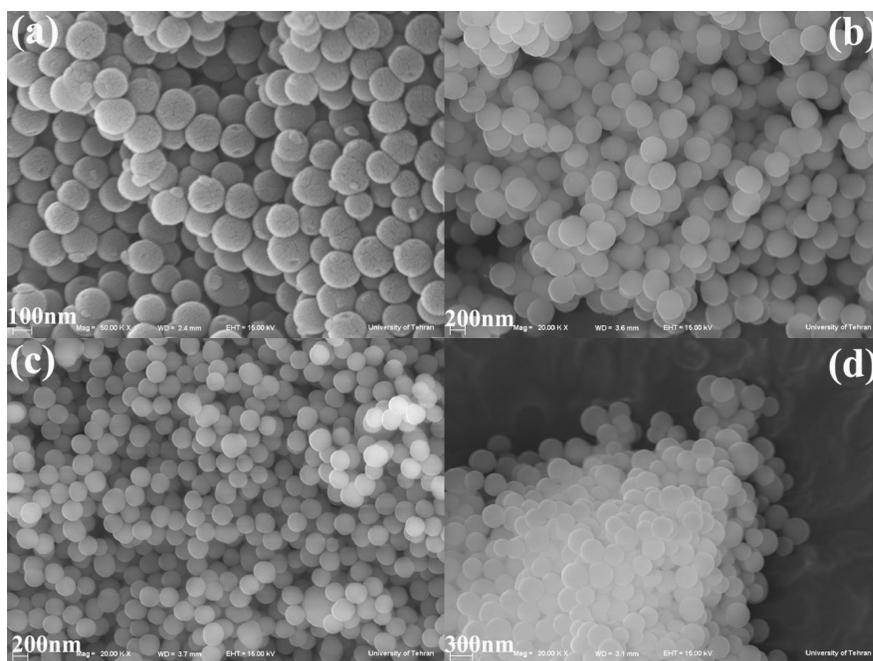


Fig. 1. SEM images of spherical SiO₂ nanoparticles in (a) 15, (b) 25, (c) 35 and (d) 45 min.