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Synthesis and Characterizations of Silica Nanoparticles by a New Sol-Gel Method

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Abstract

Silica nanoparticles were synthesized by chemical methods from tetraethylorthosilicate (TEOS), polyethylene glycol 5% and hydrochloric acid 0.001 N. The sol-gel process was applied for the preparation of nano silica gel. This method is hydrolysis and condensation reactions of TEOS as precursor of silica. The optimal synthesis conditions for the preparation of silica nanoparticles were obtained and the produced silica nanoparticles were characterized by x-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The results indicated that the silica nanoparticles were successfully formed. The prepared samples change from amorphous to α-crystallite phase. The XRD analysis indicated the amorphous structure of the synthesized silica nanoparticles while the SEM and TEM images exhibited monodispersedNano sized silica particles with a size about 34 nm. In this study, the soft process of sol-gel reaction is favourable from a view point of energy conservation. Additionally, the advantages of this technique were the purity of products and ability to control nanometer sized internal structure.

Keywords. *Silica nanoparticles, Tetraethylorthosilicate, Sol-Gel process, Characterization.*

Introduction

FNanoporous materials have stimulated increasing interests due to their extensive applications in the fields of catalysis, drug delivery, chemical sensors, chromatography, microreactor and biological images [1-6]. Nano silica has been proven to be a very promising material due to its low density, good thermal and mechanical stability, and chemical inertia [7-9].

The sol-gel methods are the most general method of synthesis silica nanoparticles. Appetence in the sol-gel processing of ceramic and glass materials started in the half of 1800s by Ebelman and Graham's researches on silica gels [10]. The sol-gel technique is inexpensive and the silica gels manufactured are non-poisonous matters [11-16].

Stober supplied monodisperse and nonporous silica spheres with the hydrolysis of

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