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Synthesis of magnesium oxide nanoparticles by sol-gel process

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Abstract. Cubic shaped Magnesium oxide nanoparticles were successfully synthesized by sol-gel method using magnesium nitrate and sodium hydroxide at room temperature. Hydrated Magnesium oxide nanoparticles were annealed in air at 300 and 500ºC. X-ray diffraction patterns indicate that the obtain nanoparticles are in good crystallinity, pure magnesium oxide periclase phase with (200) orientation. Morphological investigation by FESEM reveals that the typical sizes of the grown nanoparticles are in the range of 50-70nm. Powder composition was analyzed by the FTIR spectroscopy and the results confirms that the conversion of brucite phase magnesium hydroxide in to magnesium oxide periclase phase was achieved at 300ºC.The Thermo-gravimetric analysis showed the phase transition of the synthesized magnesium oxide nanoparticles occurs at 280-300ºC.

Introduction

Nanoparticles have attracted a great attention in recent years because of their unique physical and chemical properties such as high strength with good thermal conductivity, higher damping property and mechanical stability [1]. The high surface reactivity, high chemical and thermal stability of MgO makes it a promising material for the application in sensors, catalysis, paint and additives etc [2-8]. Magnesium oxide nanoparticles and micro particles are largely used as a reinforcing reagent, as well as a component in super conductors [9]. Due to the high surface reactivity, highly chemical and high thermal stability with the catalytic properties, the magnesium oxide nanoparticles have particular interest [10]. The vast applications of magnesium oxide nanomaterials inclined to work on this material. Various kinds of fabrication techniques are employed to grow magnesium oxide nanoparticles such as vapor-liquid-solid (VLS), chemical vapor deposition (CVD), plasma enhanced chemical vapor deposition (PECVD), Pulsed laser deposition (PLD), laser ablation, molecular beam epitaxy (MBE) and sputtering method have been frequently employed [4]. All these methods require high temperature or sophisticated and/or expensive instruments. The chemical route, Sol-gel processes, has become a promising option for the synthesis and large-scale production of nanostructured materials as well as magnesium oxide. In this paper, we present synthesis and characterization of crystalline cubic shaped MgO nanoparticles by sol-gel method at room temperature.

Experimental

Magnesium oxide nanoparticles were synthesized using magnesium nitrate ($MgNO_3.6H_2O$) as a source material with sodium hydroxide. All the chemicals used for this synthesis were purchased from Aldrich Chemical Corporation and used without further purification. For the typical experimental procedure; 0.2M magnesium nitrate ($MgNO_3.6H_2O$) was dissolved in 100 ml of deionized water. 0.5M sodium hydroxide solution was added drop wise to the prepared magnesium nitrate ($MgNO_3.6H_2O$) solution while stirring it continuously. White precipitate of magnesium hydroxide appeared in beaker after few minutes. The stirring was continued for 30 minutes. The pH of the solutions was 12.5, as measured by the expandable ion analyzer (EA 940, Orian, Korea). The precipitate was filtered and washed with methanol three to four times to remove ionic impurities