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**Short Communication**

# Template synthesis and characteristics of nanoparticle MgO

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**ABSTRACT**

Oxide nanoparticles can exhibit unique physical and chemical properties due to their limited size and a high density of corner or edge surface sites. In this study, MgO nanoparticle was synthesized using $Mg(CH_3COO)_2$ and hexamethylenetetramine as starting materials. The structure and optical properties of these particles are investigated by using X-ray diffraction (XRD), scanning electron microscopy (SEM) and UV-Visible absorption. The XRD analysis discloses that MgO nanoparticle is successfully synthesized. Dispersive analysis of X-RAY (EDAX) was used to characterize the size and morphology of the MgO nanoparticle on the template. The morphology of MgO was nanospheres.

**Keywords:** *Nanoparticle; MgO; X-ray diffraction; SEM; EDAX.*

## INTRODUCTION

Porous nanocrystalline inorganic oxides are of topical interest [1] because they exhibit different characteristics in band gaps [2, 3], magnetic moments [1], specific heats [4] melting points [5, 6], surface chemistry [7, 8]. Magnesium oxide (MgO) is an important material for various applications including catalysis, waste remediation, additives in refractory and paint products. Nanoscale MgO powders have attracted great attention owing to its applications in many industrials areas, such as a candidate material for translucent ceramics [9], catalyst, catalyst carriers and absorbent for many pollutants [10]. Thus, many extensive studies have been carried out to synthesize nanoscale MgO powders using various novel wet chemical methods, e.g. sol-gel synthesis, followed by supercritical drying [11]. Generally, MgO nanostructures were synthesized by dehydration of $Mg(OH)_2$ or by decomposition of various magnesium salts using co-precipitation method, thermal evaporation [12], flame spray pyrolysis [13], sol-gel techniques, combustion aerosol synthesis [8], chemical vapor deposition [14], hydrothermal [15], and surfactant methods [16]. These preparation methods involve complex procedures, sophisticated apparatus/ equipments, rigorous experimental conditions, high-temperature annealing.

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Hence, in this work, we have synthesized nanostructures of MgO by a simple reflux method. We demonstrated that hexamethylenetetramine is an appropriate template for synthesizing of MgO nanoparticles.

## EXPERIMENTAL

### *Material*

Magnesium acetate tetrahydrate, $Mg(Ac)_2$.4H2O (99.9% Sigma Co.) and ethanol (99.9% Sigma Co.) were used as received, without further purification. Other compounds used were prepared from MERCK Company.

### *Apparatus*

The morphology of nano structured MgO was determined by using scanning electron microscopy (SEM) of a Holland Philips XL30 microscope. X-ray diffraction (XRD) analysis was carried out at room temperature using a Holland Philips Xpert X-ray powder diffractometer with Cu Ka radiation (λ=0.15406 nm), over the 2θ collection range of 20–80°.

### *Preparation of MgO*

4 mmol NaOH was dissolved in 75 ml distilled water under stirring. Then 4 mmol hexamethylene tetramine was added to the solution. Magnesium acetate tetrahydrate (1 mmol) was added to the mixture. The mixture was refluxed for 4 h in 80 ºC. After cooling to the room temperature, the precipitate was collected by filtration and washed with distilled water and ethanol several times. $Mg(OH)_2$ was obtained by centrifugation and drying of precipitate at room temperature. Then the MgO nanoparticle was obtained via controlled calcination process using muffle furnace for 3hrs at 500 ºC.

## RESULTS AND DISCUSSION

### *Characterization of nanoparticle*

Magnesium hydroxide $Mg(OH)_2$ is considered as the precursor of MgO nanoparticle. $Mg(OH)_2$ has been prepared by stirring at room temperature for 3 hours, a mixture of aqueous solutions of magnesium acetate , hexamethylenetetramine template and sodium hydroxide. The $Mg(OH)_2$ precipitate was filtered and dried at 80 ºC for 1 hour. Then it was calcinated at 500 ºC for 3 hours in a muffle furnace.

The surface morphology of the product was studied by using SEM as showed in Figure 1. The morphology of MgO was nanospheres.

Figure 2 shows the XRD pattern of MgO with typical morphology synthesized by reflux method. As shown in this Figure 2 MgO nanoparticle was formed. Average crystallite sizes of products were calculated using Scherrer's formula: $D=0.9\lambda/\beta Cos\theta$ [17], where D is the diameter of the nanoparticles, λ (Cu Kα) =1.5406 Å and β is the full-width at half-maximum of the diffraction lines. The calculated average particle is 7 nm. Based on Figure 2, there are three typical diffraction peaks which are assigned to the characteristic peak of cubic MgO crystals. Dispersive analysis of the X-Ray (EDAX) for MgO is shown in Figure 3.

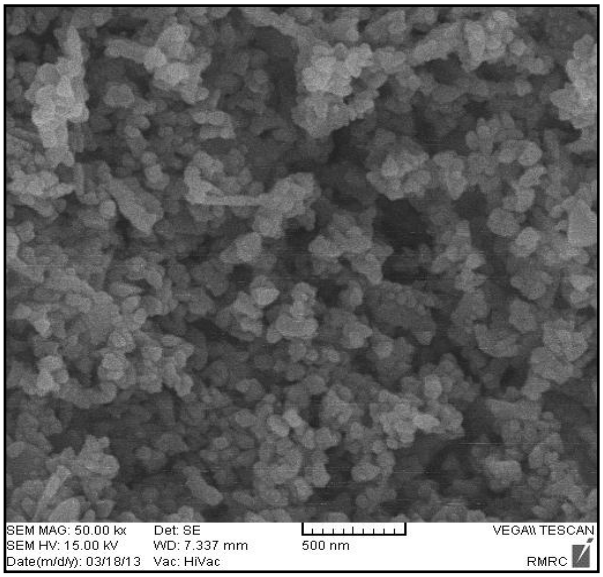


**Fig. 1.** SEM image of MgO.

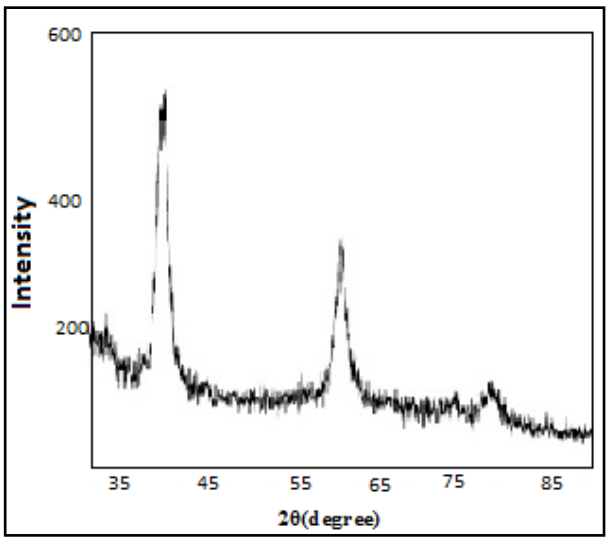


**Fig. 2.** X-ray diffraction pattern of MgO.

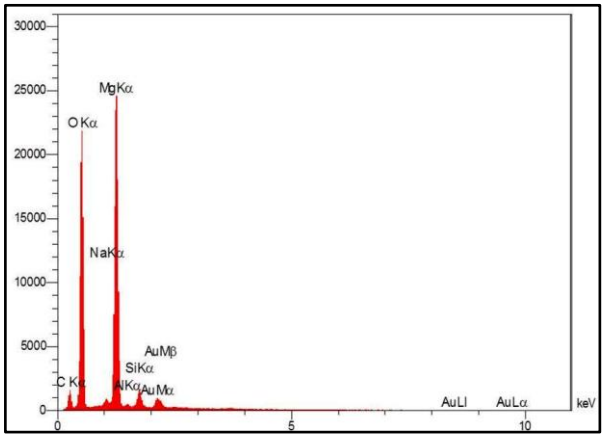


**Fig. 3.** Dispersive analysis of X-Ray (EDAX) of MgO.

## CONCLUSIONS

The results obtained proved that nano MgO was successfully prepared via simple reflux and using template. The XRD data shows the optimum temperature for the decomposition $Mg(OH)_2$ to form nano MgO. Calculation from XRD proved the formation of nano MgO with particle size *ca*7 nm. Based on Fig. 2, there are three typical diffraction peaks at 42.605 º, 61.755 º and 78.155 º, indicating the presence of cubic MgO and the peaks can be assigned to a pure phase of periclase MgO which are in good agreement with the standard JCPDS card (No: 78-0430) , (2θ = 42.94°, 62.09° and 78.44°).

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