

# Structural properties of MgO Nanoparticles: Synthesized by Co-Precipitation Technique

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**Abstract:** Metal oxide nanomaterials are important and excellent materials, because of its special properties like chemical stability, high photo catalytic activity, high electric permittivity, non-toxic nature. So it is used in various applications like optical, electrical, electronic, antiseptic, antibacterial, environmental, semi conductors and catalytic devices. Present work focused on to synthesis of Magnesium oxide (MgO) Nanoparticles and its applications in the field of environment. These nanoparticles are prepared by simple suitable chemical method like Chemical Co-Precipitation using Magnesium nitrate as core precursor. The synthesized Metal oxide nanoparticles have been characterized by X-ray Diffractometer (XRD), Particle Size Analyzer (PSA), Scanning Electron Microscope (SEM) and Thermo Gravimetric and Differential Thermal Analyzer (TG-DTA) for average crystallite size, average particle size, morphology and thermal stability respectively.

**Keywords:** MgO nanoparticles, Co-precipitation, XRD, SEM, TG-DTA.

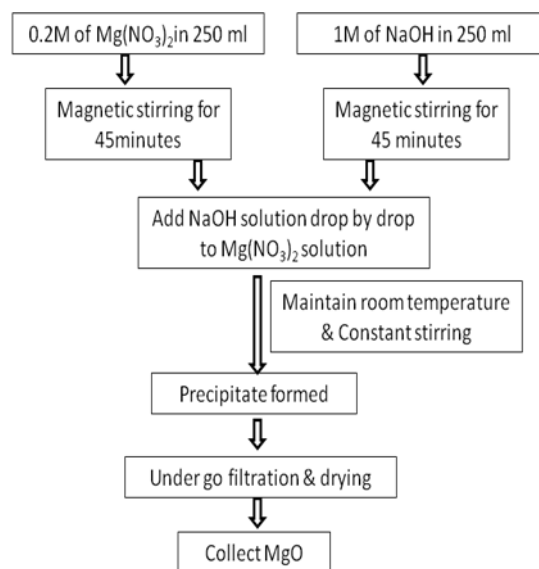
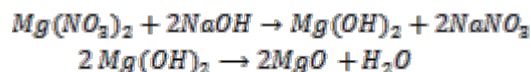
## 1. Introduction

Nanoparticles are having different properties compared with bulk materials. Most of the researchers are working with metal oxide nanoparticles because of their unique properties such as hydrophobic, photo catalytic, stability and etc. Hence they are used in many applications named as coatings, catalysts, anti-bacterial, medical sciences, sensors, semiconductors, capacitors and batteries [1]. MgO is an important material, which used in many applications like catalysis, toxic waste remediation, paint, superconducting products, anti-bacterial activities against food borne pathogens [2-4]. Magnesium is IIA group element with atomic number 12 and Oxygen is VIA group element with atomic number 8. The compound MgO is having boiling and melting points as 3600°C and 2852°C. These oxide materials can be prepared by different synthesis methods such as solution combustion [5], Co-precipitation [6], Sol-Gel[7], hydrothermal[8], Solvothermal[9], Microwave Assisted Sol-Gel[10], green synthesis[11]. In these methods Co-precipitation is a one of the best method to synthesis nanoparticles without agglomeration in the yield, size can be easily controlled. In this present paper, MgO nanoparticles were prepared using initial precursors Magnesium Nitrate and Sodium hydroxide. These samples were synthesized under standard laboratory conditions in clean room and analyzed using analytical techniques such as X-ray Diffractometer (XRD), Thermo Gravimetric-Differential Thermal Analyzer (TG-DTA), Particle Size Analyzer (PSA) and Scanning Electron Microscope (SEM).

## 2. Experimental Details

Magnesium nitrate, Sodium hydroxide purchased from E. merck (India) limited Co. Magnesium Nitrate and Sodium Hydroxide were dissolved in 250ml distilled water into

breakers separately. Stir them separately for half an hour using magnetic stirrer for constant stirring. Add sodium hydroxide solution to Magnesium nitrate solution drop by drop with burette at room temperature. After 30 minutes milky white color precipitate was formed, Collected white color magnesium oxide nanoparticles after filtration and drying.



## 3. Characterization Techniques

The average crystalline size, structure and phase of sample were determined by X-ray diffraction using Bruker D8 advanced X-Ray Diffractometer with CuK $\alpha$  radiation. HORIBA SZ-100 Particle Size Analyser used for measure

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the average particles size. Morphology and size obtained from HITACHI S3400N Scanning Electron Microscope. Thermal properties measured by EXSTAR 6300 TG-DTA.

#### 4. Results & Discussions

The XRD pattern of MgO nanoparticles obtained from coprecipitation synthesis were as shown in Figure 1. The result showed that the structure was in cubic structure and these results were matched with JCPDS card number 75-1525. Peaks were absorbed at 37°, 42°, 62°, 74° and 78° along with miller indices values (1 1 1), (2 0 0), (2 2 0), (3 1 1) and (2 2 2) respectively. As the width of the peak increases size of particle size decreases, which resembles that present material in nano range [12,13].

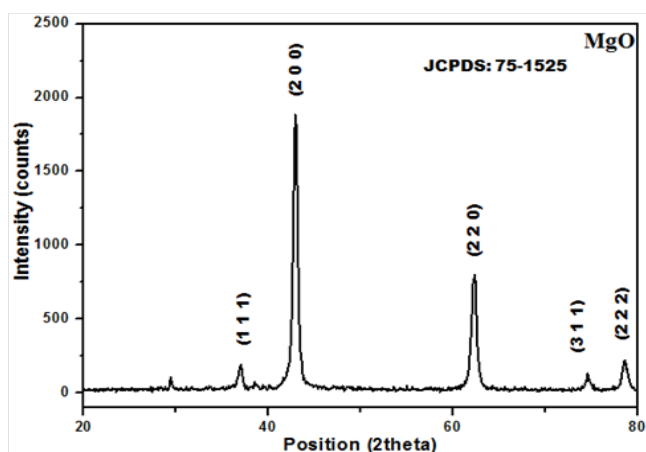


Figure 1. XRD Pattern of MgO nanoparticles

The lattice parameters were obtained  $a=b=c=0.4195$  nm. The average crystallite size was measured by Debye-Scherrer's equation as mentioned below.

$$D = \frac{K \cdot \lambda}{\beta \cos \theta}$$

where  $D$  is the average crystallite size of the particles,  $K$  is Debye Scherrer's constant ( $=0.94$ ),  $\lambda$  is the wavelength of the  $\text{CuK}\alpha$ - radiation ( $=0.154$  nm),  $\beta$  is the full width half maximum (FWHM) of the peak,  $\theta$ -is the Bragg's angle.

The average crystallite size was measured as 18 nm.

The average particle size was obtained by Particle Size Analyzer. That material was dispersed in distilled water using ultra-sonicator. Figure 2 shows that the histograms of the dispersed particles.

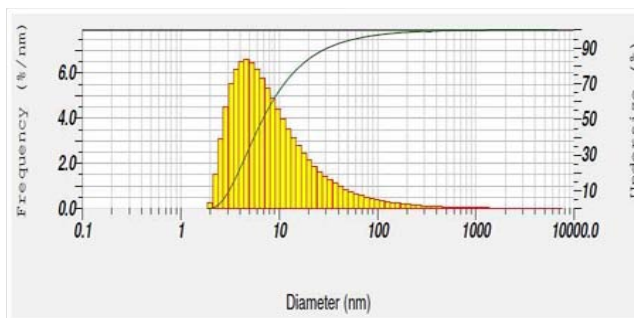


Figure 2. PSA results of MgO nanoparticles

The average particle size was obtained 21 nm. These results were nearly equals to XRD average crystalline size [14].

The morphology and size of the sample were investigated by Scanning Electronic Microscopy shown in figure 3. The MgO nanoparticles are showing spherical granules structure. The size was ranging 100 nm to 120 nm [15].

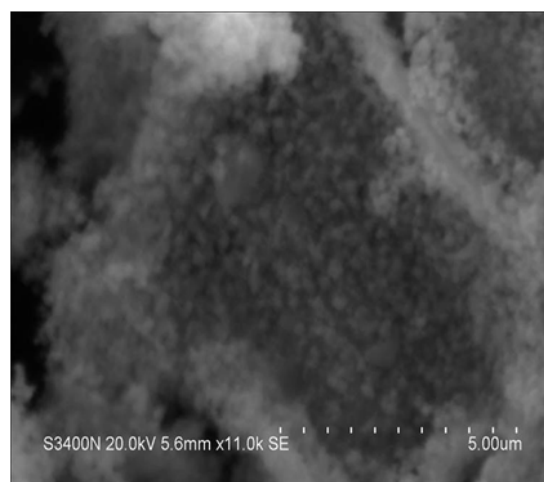


Figure 3. SEM images of MgO nanoparticles

The thermal properties were calculated for the sample using TG-DTA and the result were shown in the figure 4. TG analysis was observed from room temperature to 800°C. The weight loss of the sample observed at room temperature to 100°C due to the evaporation of water molecules, whereas 100°C to 400°C the weight loss caused by evaporation of inorganic materials [16].

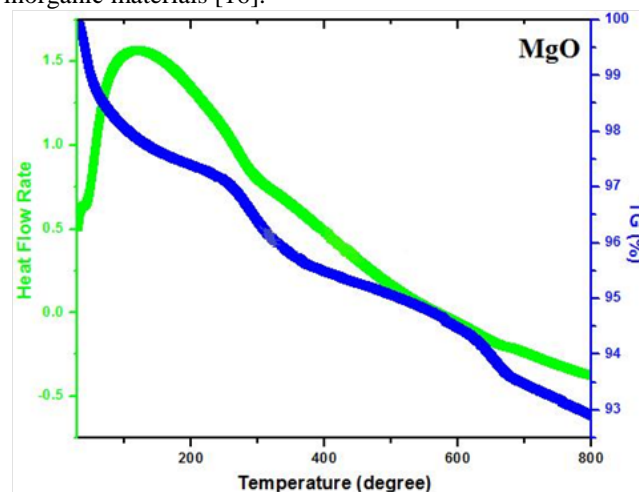


Figure 4. TG-DTA results of MgO nanoparticles.

After 400°C the weight loss occurs due to the evaporation of unreacted materials which is involved in the sample. The DSC curve shows that the corresponding weight loss was observed. The weight loss of the sample was obtained 7.2%.

## 5. Conclusions

MgO nanoparticles were successfully synthesized using co-precipitation method. From XRD analysis average crystallite size of the sample was 18 nm. The average particle size was estimated 21 nm from particle size analyzer. The structure and morphology obtained by SEM. It observed that cubic structure and spherical granules shape. The weight loss was measured by TG-DTA curves as 7.2%. These above results showed that as prepared MgO particles were in the nano range.

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