Effect of Concentration on Characterization of MgO Nanoparticles using Chemical Bath Method.

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ABSTRACT
Magnesium oxide (MgO) nano particles were fabricated using chemical bath method in different Concentrations(0.1M) and (0.01M) to investigate its effect on morphologies of MgO. It was found that (0.1M) have larger crystallite size, optical energy gap, and average diameter in comparison with (0.01M) MgO which showed small particle size and lower energy gap that enhance using this molarity in fabrication of this molarity as UV detector.

KEYWORDS: MgO, Concentration, Chemical Bath, Nanoparticles.

INTRODUCTION
Magnesium Oxide is a unique material due to its optical, electrical chemical, and thermal properties. MgO is a member of group II-IV binary compound semiconductor which attracted attention in various applications such as [1]: sensors, catalysts electrode additives and nano devices. Many researchers studied novelty in synthesizing MgO using chemical vapour deposition [2], electrochemical [3], sonochemical [4], microwave [5], electron spinning [6], pulse laser deposition[7], sol gel method[8], Thermal Plasma [9].

The objective of this research is to synthesize MgO in different Concentrations using chemical bath method and its effect on morphologies of MgO then investigate characterization of the prepared samples.

Experimental method:
Procedure:
Magnesium nitrate hexahydrate was dissolved in 100 ml of deionized water with successive stirring then adding Sodium hydroxide at 55 °C for 30 min at PH =12 , the mixture was deposited and calcinated at 500 °C for 3 hours as in scheme.
RESULTS AND DISCUSSION

XRD results:

Diffraction peaks of crystalline MgO nanoparticles were determined according to JCPDS file:45-09456 [10]. In comparison between two molarities it was found that (0.1M) MgO nanoparticles have more sharp peaks in regard to (0.01 M) MgO nanoparticles as in Figure (1). The grain size was calculated using Sherrer’s equation:

\[ D = \frac{K \lambda}{\beta \cos \theta} \]  

(1)

Where K is shape constant of (0.9), \( \beta \) is FWHM in radian, and \( \lambda \) is wavelength of (1.5 Å) as shown in table (1).

**Fig. 1:** XRD pattern of MgO nanoparticles.

**Table 1:** XRD parameters for the prepared samples.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>(0.1M) MgO</th>
<th>hkl</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta ) (rad)</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>( D ) (nm)</td>
<td>18.16</td>
<td>(111)</td>
</tr>
<tr>
<td>( \alpha \times 10^10 ) lines/m²</td>
<td>3.0</td>
<td>(200)</td>
</tr>
<tr>
<td>( \delta \times 10^{15} ) lines/m²</td>
<td>1.85</td>
<td>(220)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>(0.01M) MgO</th>
<th>hkl</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta ) (rad)</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>( D ) (nm)</td>
<td>10.66</td>
<td>(311)</td>
</tr>
<tr>
<td>( \alpha \times 10^10 ) lines/m²</td>
<td>3.16</td>
<td>(222)</td>
</tr>
<tr>
<td>( \delta \times 10^{15} ) lines/m²</td>
<td>8.8</td>
<td></td>
</tr>
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Optical properties:

Optical energy gap was calculated using Tauc plots for two samples of different molarities. It can be found that sample of (0.1M) has larger energy gap (6.15 eV) in comparison with sample of (0.01M) which has (4.95 eV) as shown in Figure (2). This can be due to the smaller nano crystallites size, and band gap narrowing could have occurred due to the large surface areas to volume ratio of the crystallites [11].
Fig. 2: $(a \nu^2)$ versus $(\nu)$ of samples (0.1M) and (0.01M) MgO.

**SEM and AFM results:**

Figure (3) shows scanning electron microscope images of both (0.01M) and (0.1M) MgO nanoparticles. For (0.01M) MgO nanoparticles images show agglomeration of particles forming separated nanoflowers with 45-50 nm diameter.

(0.1M) MgO nanoparticles images indicate forming horizontal tree-like branches and separated nanoparticles here and there with larger diameter about 294 nm with high rate of pores. It is obvious that higher concentration leads to very porous structure and open voids.

Figure (4) illustrates AFM images for (0.01M) and (0.1M) MgO nanoparticles images for comparison. (0.01M) MgO nanoparticles show small average diameter about 76.40 nm with low roughness about 0.995 nm while (0.1M) MgO nanoparticles have higher average diameter about 86.53 nm and roughness of 1.94 nm due to large surface area to volume ratio.

Fig. 4: SEM images of (0.01M) and (0.1M) MgO nanoparticles.
Table 2: AFM parameters for prepared samples.

<table>
<thead>
<tr>
<th>Molarity</th>
<th>Average diameter(nm)</th>
<th>Roughness(nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0.01M)</td>
<td>76.40</td>
<td>0.995</td>
</tr>
<tr>
<td>(0.1M)</td>
<td>86.53</td>
<td>1.94</td>
</tr>
</tbody>
</table>

Fig. 5: AFM images for: a-(0.1M)MgO b-(0.01M)MgO nanoparticles.

Conclusion:
MgO nanoparticles was synthesized using chemical bath method using two different molarities (0.1M) and (0.01M) for comparison and to show its effect on structural, morphological, and optical properties of MgO nanoparticles. Results indicate slight difference in roughness and XRD parameters with different nanostructures but major difference in average diameter and optical energy gap which represent remarkable addition to literature due to potential of fabrication UV-detector using (0.1M) MgO nanoparticles.

Contributions:
The importance of this research comes from ability to fabricate MgO nanoparticles with two molarities with different absorption range according to different particle size. The remarkable addition of this literature is due to potential of fabrication UV-detector using (0.1M) MgO nanoparticles.

REFERENCES


