

Study of Antibacterial Activity of Nanostructured MgO Powder Prepared by Sol-gel Method

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ABSTRACT: In this article, nanostructured powder of MgO have been prepared by sol gel method and tested for antimicrobial properties. The synthesized powder was fired at temperature 500°C. The prepared sample was characterized using various analyzing technique including X-ray diffraction, Scanning Electron Microscope[SEM] and Transmission SEM and TEM show the morphology and nanostructure. The prepared powder show antibacterial activity against E-coil.

KEYWORDS: MgO, Sol-Gel, XRD, SEM, TEM.

I. INTRODUCTION

Nanotechnology is the area of science which deals with developing and producing extremely small tool and machine by controlling the arrangement of individual atoms through, inexpensive control of structure of matter, based on molecule –by- molecule control of products and by products: products and process of molecular manufacturing including molecular machinery. Nano medicine is defined as the monitoring, repair, construction and control of human biological system, molecular level using engineered Nano device and nanostructure [1]. Effect of MgO nanoparticle on water sample results revealed that growth of bacteria is completely inhibited when higher concentration of MgO nanoparticle [2]. Antibacterial medicine plays the very important role in field of medicine. But control rate of antibacterial are very important. So it is necessary to study about the implementation of nanotechnology and nanomaterial to create antibacterial Nano medicine that increased effectiveness of efficiency [3, 4]. The antimicrobial properties of MgO nanoparticles were studied and they were found to be highly effective against bacterial [5-9]. MgO has been used as catalyst and catalyst support for various organic reaction[10] as an adsorbent for removing dyes, heavy metals from waste water and detection of toxic metals ions [11], as an antimicrobial material [12] and many applications.

It is widely accepted that the properties of MgO nanostructured depend strongly on the synthesis methods and the processing conditions. Therefore the synthesis of nanostructured MgO with small crystalline size and homogenous morphology has much attention due to their properties of high surface area-to-volume ratio. Very much effort has been devoted to synthesis of nanostructured using various method such as chemical vapour deposition [13], sonochemical[14], electrochemical [15] etc. Sol-Gel method is promising technique for the formation of MgO followed by annealing at suitable temperature to form MgO. The advantages are its simplicity, cost-effective, low reaction temperature, high surface area-to-volume ratio, narrow particle size distribution and high purity of the final product.

In this article, a simple efficient low cost, sol-gel process used to synthesize nanostructured MgO and morphology of the synthesis powders were investigated. The synthesis powder was tested against antibacterial activity.

II. EXPERIMENTAL

Commercial available A.R. grade magnesium chloride [MgCl₂] and ethanol were used for synthesis. 0.5 M solution of MgCl₂ and ethanol was kept under constant stirring using magnetic stirrer for complete dissolution of

contents for 30 minutes. This solution was kept for drying at room temperature for 24 hour; the gel was collected in the form of powder. Again dried under IR lamp for 1 hour. The MgO powder was wash; dried and sintered under temperature 500^oC for half an hour.

III. STRUCTURAL STUDIES

The structure of the powder was analyzed with High Resolution X-ray diffractogram [DS ADVANCE Bragg – Brentano Diffractometer] using CuK α radiation with wavelength of 1.5406 Å. The voltage applied to the X-ray tube was 30 KV and the current 30 mA.

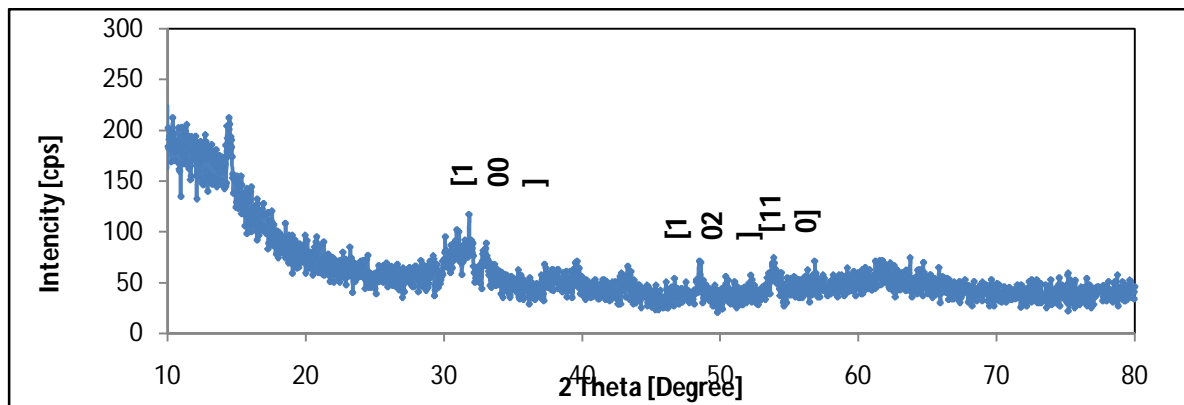


Fig 1 XRD pattern of 0.5 M MgO powder fired at 500^oC

The Peaks [111], [102] and [110] are well matching with JCPDS card file no. 45-0946 [1]. Fig 1 shows XRD pattern of MgO powders prepared by sol-gel method. It shows amorphous structure. The crystalline size was estimated by fitting the width of dominant [100] diffraction peak using Scherer’s formula and is found to be nearly equal to 68 nm.

IV. SEM ANALYSIS

The morphology, structure and size of the sample were investigated by SEM. The average particle size calculated from is about 22 to 35 nm.

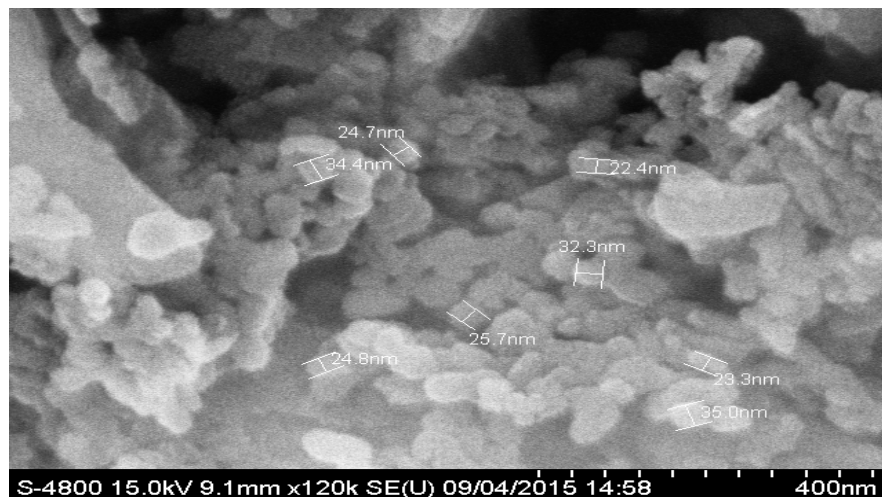


Fig 2 SEM image of 0.5 M MgO powder fired at 500^oC

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Fig. 2 depicts the SEM images of MgO powders consists of randomly distributed grains with smaller size and shape distribution. It shows more porosity, giving largest effective surface area. This enables larger surface for the antimicrobial activity to react giving more response.

V.EDAX ANALYSIS

The quantitative elemental composition of the nanocrystallineMgO powder was analyzed using an energy dispersive spectrometer. Stoichiometrically expected atomic percentage of Mg and O are to be observed.

Element	Atomic Wt. %
O	50.49
Mg	49.51

VI.TEM ANALYSIS

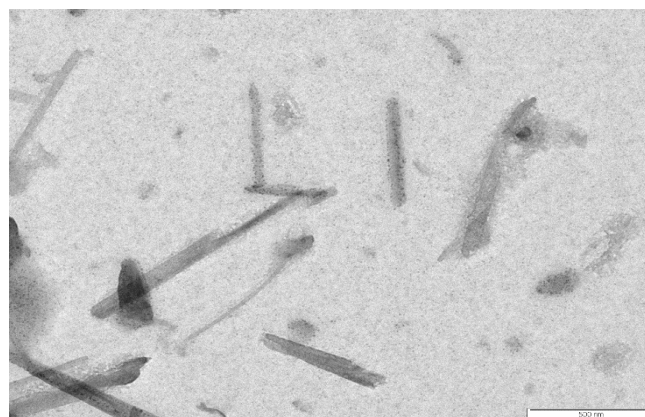
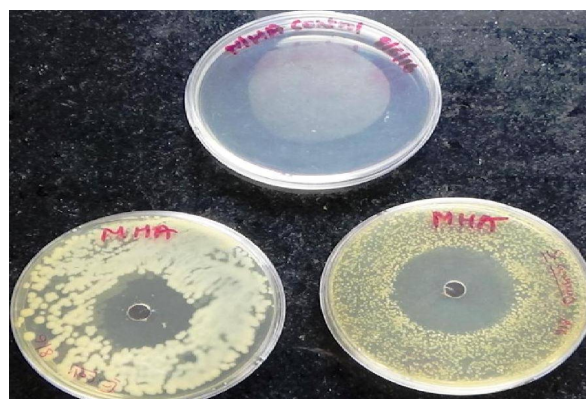


Fig 4 0.5 M MgO powder fired at 500⁰C
Fig 4 shows TEM analysis of 0.5 M MgO powder

Fig 4 shows TEM analysis of 0.5 M MgO powder fired at 500⁰C shows nanorods.

VII. ANTIBACTERIAL ACTIVITY



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Fig 5 shows Antibacterial activity of MgO nanoparticle against E-coli and Staphylococcus aureus was tested by well diffusion method at Ashwamedh Laboratory, Nasik. MgO particle shows antibacterial activity about 37.5 mm and 44 mm.

VIII. CONCLUSION

In summary, fine MgO powder of 0.5M was synthesized using precursor MgCl₂. The prepared MgO powder is nanostructured and shows antibacterial activity against E-coli and Staphylococcus aureus.

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