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SIZE AND SHAPE DETERMINATION OF ZnO, MgO & CaO NANOPARTICLES BY PARTICLE SIZE ANALYSER & OPTICAL MICROSCOPY

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Abstract

Metal Oxide nanoparticles have been intensively studied within the past decade. Nanosized materials have been an important subject in basic and applied sciences. ZnO, MgO and CaO nanoparticles were synthesized by using chemical precipitation method and have been characterized structurally by Particle Size Analyser (PSA) and Optical Microscopy (OM). The result shows the size and shape of the Synthesisized nanoparticles.

Key words: ZnO, MgO, CaO, Chemical Precipitation, PSA, OM.

INTRODUCTION

Nanotechnology involves the ability to see and to control individual atoms and molecules. Nanotechnology is emerging as a rapidly growing field with its various applications in science and technology for the purpose of manufacturing new materials at the nano scale level. At this scale the surface to volume ratio of materials becomes large leading to unique properties [1]. Nanotechnology can provide unparalleled understanding about materials and devices and is likely to have impact in many fields. We can greatly expand the range of performance of existing chemicals and materials by reducing the structure to a nanoscale. Materials reduced to the nanoscale can show different properties compared to what they exhibit on a macro scale, enabling unique applications. In technological applications, oxides are used in the fabrication of microelectronic circuits, sensors, piezoelectric devices, fuel cells, coatings for the passivation of surfaces against corrosion, and their use in the fields such as medicine, information technology, catalysis and energy storage has driven much research in developing synthetic pathways to such nanostructures.

In recent years a number of investigations have focused on II-VI group metals. In particular, inorganic oxide nanomaterials like ZnO, MgO and CaO have shown potential as effective alternatives in addressing some of the challenges [2-4]. Inorganic metal oxide nanoparticles have attracted increasing attention in medical applications due to their unique properties and

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amenability to biological functionalization. Among the inorganic metal oxide ZnO, MgO and CaO are of particular interest because they are not only stable under harsh process conditions, but are also generally regarded as safe materials to human beings [5, 6]. In the present study we have reported the synthesis of the ZnO, MgO and CaO nanoparticles by chemical precipitation method and to characterize the synthesized nanoparticles by Particle Size Analyser (PSA) and Optical Microscopy (OM).

EXPERIMENTAL PROCEDURE

ZnO, MgO and CaO nanoparticles were synthesized by chemical precipitation method using Zinc Chloride, Magnesium Nitrate Hexahydrate, Calcium Chloride and Sodium Hydroxide as the precursors. The solutions of the materials were made by dissolving them in the milliq water.

The precipitation was induced by drop wise addition of the sodium hydroxide into Zinc Chloride, Magnesium Nitrate Hexahydrate and Calcium Chloride solution for half an hour and then it was kept under constant stirring for 2 hours. After the completion of the reaction, the solution was allowed to settle for overnight. Then the precipitate formed was washed several times with milliq water to remove the impurities formed during precipitation. Then the precipitate was separated and kept in the hot air oven for overnight to dry away the water. Then the obtained particles were grained using mortar and pestle and kept for calcination at 450^0c for 3 hours. During this process the complete conversion of hydroxide into oxide takes place.

RESULTS AND DISCUSSION

Particle Size Analyser

Particle size Analyzer gives us information about what sizes (particle size) of particles are present in what proportions. Here the synthesized nanoparticles was analysed at 100% intensity. ZnO nanoparticles were suspended in isopropanol and kept in ultrasonication for 5 minutes. The size of the particle was studied using particle size analyzer and it is shown in Figure 1. The size of the particle was calculated to be 605.3 d.nm for the synthesized ZnO nanoparticles.

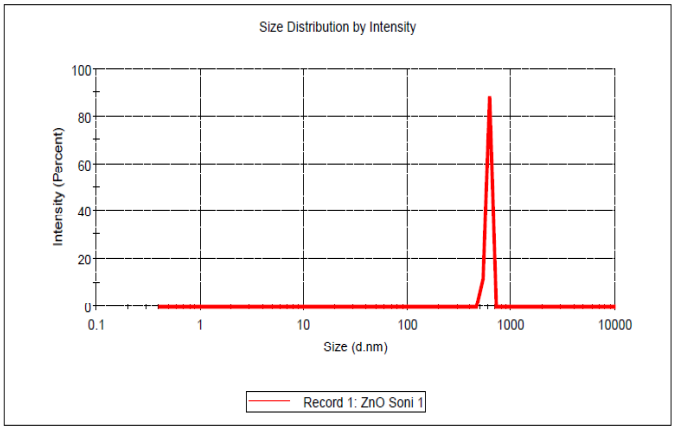

Figure 1. PSA Results of ZnO Nanoparticles

MgO nanoparticles were suspended in water and kept in ultrasonication for 5 minutes. The size of the particle was studied using particle size analyzer and it is shown in Figure 2. The size of the particle was calculated to be 773.3 d.nm for the synthesized MgO nanoparticles.

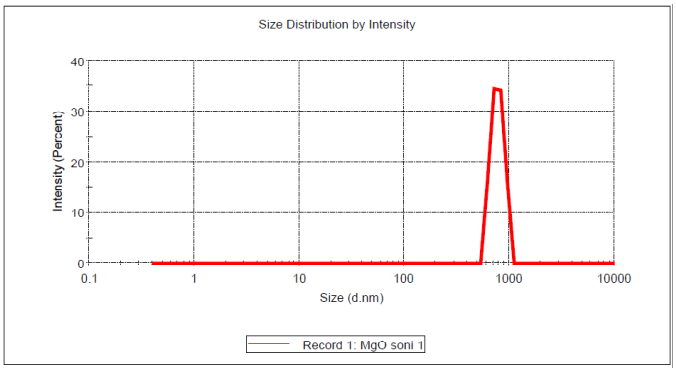

Figure 2. PSA Results of MgO Nanoparticles

CaO nanoparticles were suspended in water and kept in ultrasonication for 5 minutes. The size of the particle was studied using particle size analyzer and it is shown in Figure 3. The size of the particle was calculated to be 919.3 d.nm for the synthesized CaO nanoparticles.

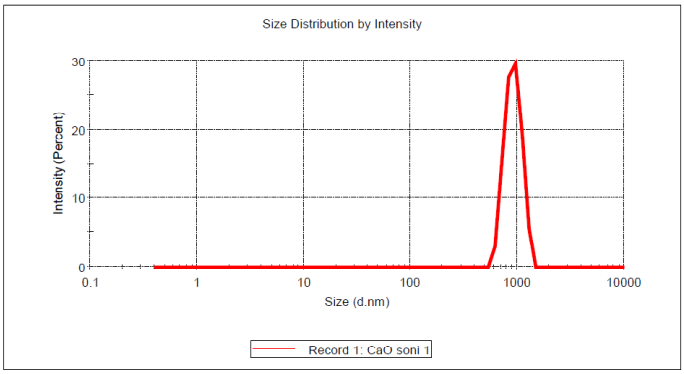

Figure 3. PSA Results of CaO Nanoparticles

OPTICAL MICROSCOPY

Optical microscopy gives us information about the sample's morphology and size. The optical microscopy image of the synthesized ZnO nanoparticles is shown in Figure 4 and it shows that they were lamellar like structure. For MgO nanoparticles is shown in Figure 5 and it shows that they were irregular in shape. For CaO nanoparticles is shown in Figure 6 and it Shows that they were spherical grains with uniform shape.

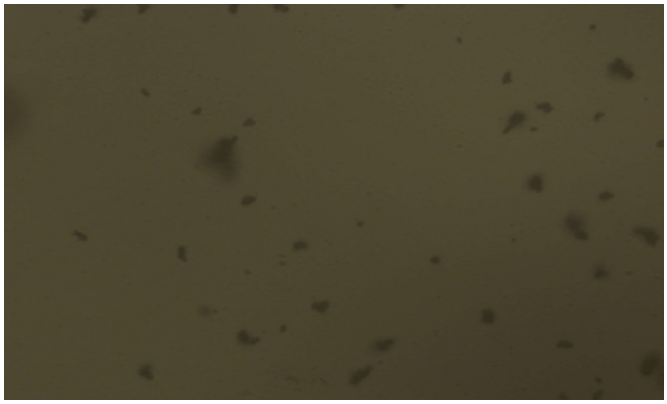

Figure 4. OM Image of ZnO Nanoparticles

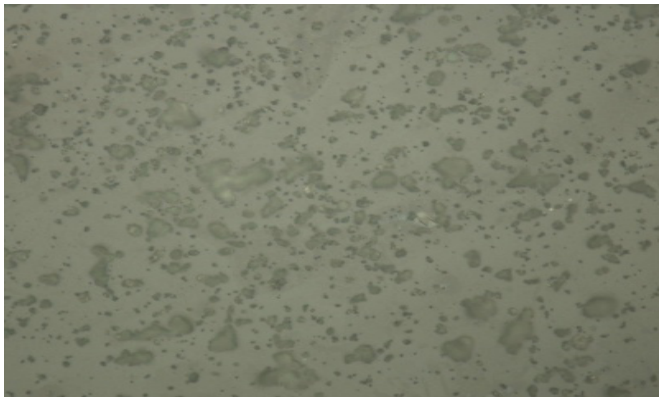

Figure 5. OM Image of MgO Nanoparticles

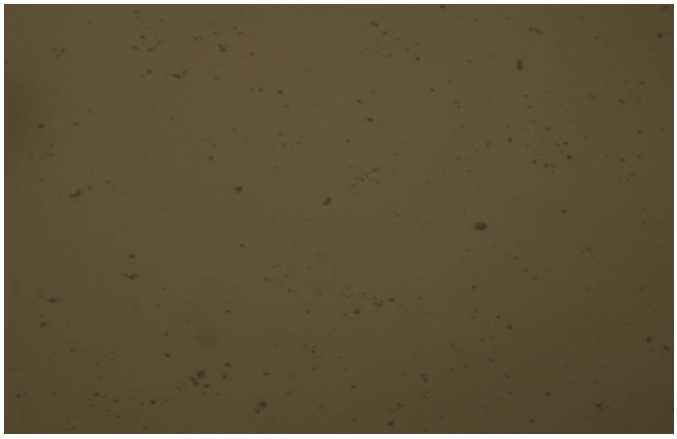

Figure 6. OM Image of CaO Nanoparticles

CONCLUSION

ZnO, MgO and CaO nanoparticles were synthesized by using chemical precipitation method. The PSA results show the peaks at 605.3 d.nm, 773.3 d.nm and 919.3 d.nm respectively for the synthesized ZnO, MgO, CaO nanoparticles. The OM image results show that ZnO were lameller shape, MgO were irregular in shape and CaO has spherical grains with uniform shape. A common feature that these nanoparticles exhibit is they can be used as antimicrobials, fuel cells, catalysis, supercapacitors etc.

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