EFFECT OF CAPPING AGENT ON THE SYNTHESIS OF ZINC OXIDE NANOPARTICLES BY PRECIPITATION AND CHEMICAL REACTION METHODS

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Abstract

Zinc Oxide nanoparticles were synthesized by simple and efficient method in aqueous media from zinc nitrate and sodium hydroxide. Zinc oxide is an important chemical substance that is widely used in the production of various industrial products. But, the production of nano particle ZnO remains a challenge. In this study, ZnO nanoparticles were prepared by chemical solution and precipitation methods. The size of the particles was measured by scanning electron microscope and particles size analyzer. SEM analyses revealed that single crystal ZnO nanoparticles were achieved with different crystal size. Experimental results have shown that the prepared zinc oxide nanoparticles by this method are higher in size. Zinc oxide nano particles in small size may be obtained by addition of any reducing agents, which was added to optimize the particle size. The size and density of the particles depends on the temperature, rotation of the magnetic stirrer and reducing agent.

Key words : Zinc oxide, Nano particles,SEM

I. INTRODUCTION

Zinc oxide is an important chemical substance that is widely used in the production of various industrial products. However, to produce nanoparticle, ZnO remains a challenge. This paper describes the synthesis of zinc oxide nanoparticles via precipitation and chemical reaction methods. Semiconductors with dimensions in the nanometer realm are important because

their electrical, optical and chemical properties can be tuned by changing the size of the particles. Optical properties are of great interest for application in optoelectronics, photovoltaic and biological sensing. Most of the ZnO crystals have been synthesized by traditional high temperature solid state method which is energy consuming and difficult to control the particle properties. ZnO

nanoparticles can be prepared on a large scale at low cost by simple solution - based methods, such as chemical precipitation (1-3). It will be very desirable, if we could obtain fine ZnO nanoparticles using capping agents. Low dimension ZnO nanoparticles are expected to enhance the sensing properties due to surface area increase and quantum confinement. Hydrothermal technique is a promising alternative synthetic method because of the low temperature process and very easy to control the particle size. The particle properties such as morphology and size can be controlled via the hydrothermal process by adjusting the reaction temperature and capping agent.

II. EXPERIMENT

Zinc nitrate (AR Grade) and sodium hydroxide (AR Grade) were constantly stirred at room temperature. The white precipitate was formed and it was washed thoroughly with double distilled water to remove all the ions; then it was centrifuged at 3000 rpm for a short time. The procedure was repeated for several times until the precipitate was free from Na^+ and NO^{3-} ions. The obtained sol was dried in hot air oven and further calcinated at a particular high temperature for 3hrs to form ZnO nano crystals. Similarly, the ZnO nano particle had been prepared by the chemical reaction method and the size of the particles were measured by SEM and particle analyzer.

III. RESULT AND DISCUSSION

Zincoxide nano particles were prepared and it was characterized by the scanning electron microscope and particle analyzer. The surface morphology of both the samples was examined by using Scanning Electron Microscope (SEM). The SEM photographs are as shown in the fig.1 & 2., which demonstrates clearly the formation of zinc oxide nanoparticles and in various sizes. The above two methods were independent of the temperature. The nanoparticles were not entirely spherical in shape and have diameters varying between 50 to 450nm, with an average diameter of 58nm. Fig.

2 shows the morphology of nanoparticles obtained after the gradual chemical reactions at room temperature. (4-5). In some regions, we have noticed that big size of nanoparticles are surrounded by smaller nanoparticles. The effect of reaction time plays a crucial role in the morphology of nanoparticles. The influence of reaction conditions on physical properties of synthesized nanoparticles as well as mechanism which is yet to be investigated.

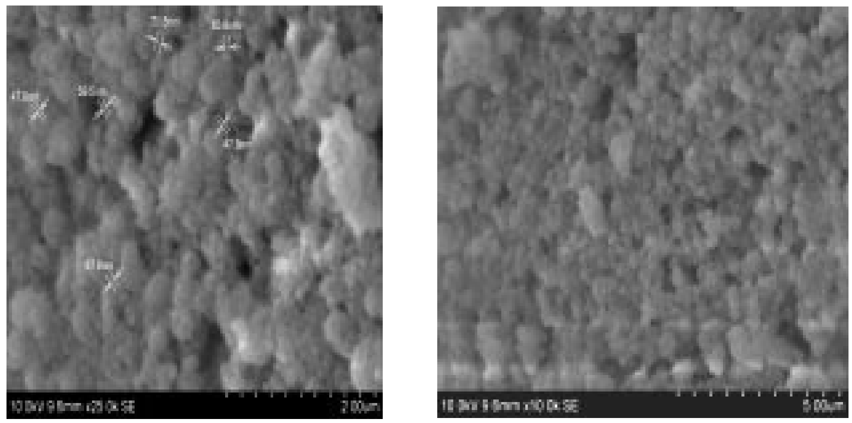

Fig 1(a, b). SEM images of ZnO NPs prepared by precipitate method.

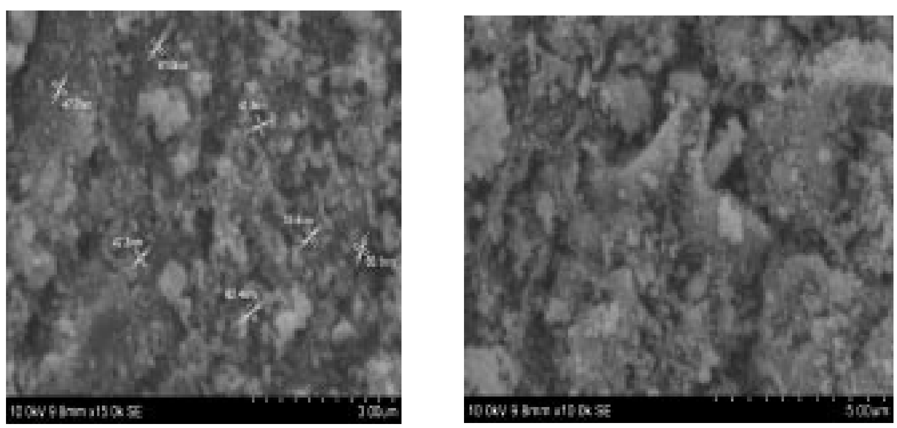

Fig 2.(a,b) SEM images of ZnO NPs prepared by chemical reaction method

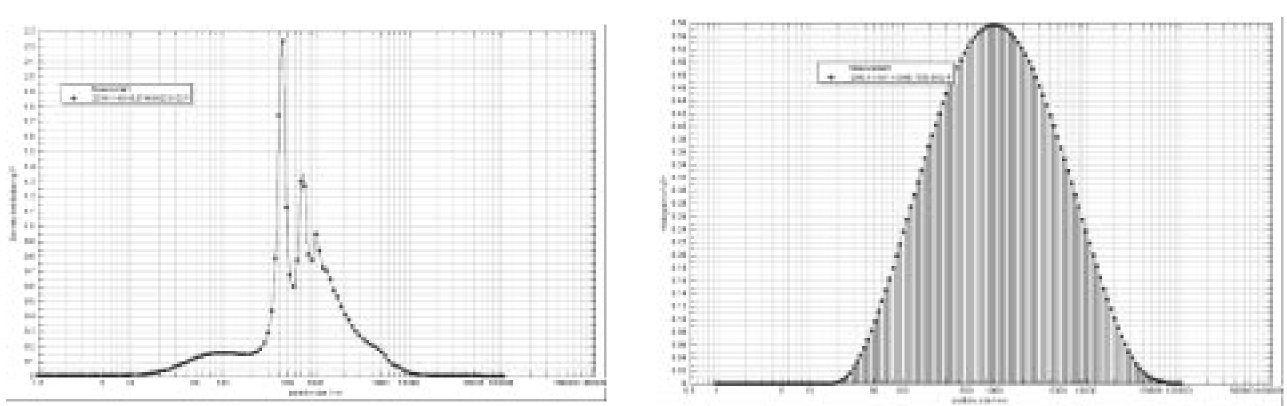

Fig.3 & 4. Size of the ZnO nanoparticles measured by Particle analyzer

The surface morphology as given in Fig. 1 and fig. 2, with different magnifications are recorded for zinc oxide and it shows flower like microstructures. But in some of the flowers agglomeration tendency were also observed. Fig 3 and Fig.4 shows the size of the particles measured by particle size analyzer. The particle size of both the sample ZnO NPs were shown in the below graphs. After analyzing, it was found that, the maximum size of the particles were nearly 500nm (6-8). The photoluminescence (PL) methodology is generally adopted for investigating the radiative recombination emission process due to the excitation, defect and impurity levels in semiconductors. It is well known that there are two kinds of emission bands of UV and visible spectrum in ZnO crystals. The emission in the UV region is attributed to the recombination between electrons in the conduction band and holes in the valence band. The morphology for sample has been recorded and it implies homogenous nature of the zinc oxide (9-10). There are well accepted mechanisms for the synthesis of zinc oxide nano particles even in small size. In this present work, the capping agents and temperature conditions are not considered. And hence; the particle sizes are very high in nature and grouped together.

III. CONCLUSION

The ZnO nanoparticles were successfully prepared by precipitation and chemical reactions methods. The size of the particles were found between 45nm to 450 nm studied by the particle size analyzer. SEM images of the ZnO NPs sample show that agglomerations have been taken place. The particle size was irregular which were prepared by both the methods. Though the samples were same but their sizes were different, it may be the cause of capping agents and temperature. The nanoparticles are not clearly well separated indicating effective capping on the nanoparticle surfaces.

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