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PREPARATION AND CHARACTERIZATIONS OF ZINC OXIDE NANOPARTICLES

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***Abstract*— Zinc oxide nanoparticels were prepared by sol-gel technique. Zinc acetate, ethanol and ammonium hydroxide was used as starting precursor. The prepared nanoparticles were annealed at 5000C and were characterized by various analytical techniques such as x-ray powder diffraction, scanning electron microscopy and energy dispersive analysis of x-rays. The shapes of the particles are found spherical in nature having particle sizes in the range of 30 nm. The result were interpreted and discussed.**

***Keywords*— Zinc Oxide, Nanoparticle, Sol-gel technique**

1. INTRODUCTION

Preparation of nanoparticles (NPs) with specific properties attracts a grate deal of attention in all areas of research [1]. Among the metal oxide nanoparticles, zinc oxide nanoparticles have drawn the attention of many researchers for their unique properties which can be easily tuned by changing the size and shape [2]. Zinc oxide nanoparticles have been used in various applications like gas sensor, CWA sensor and medicinal industry [3-5]. Since various attempt have been made in the field of nanoparticle synthesis by different methods. The various methods for the preparation of nanoparticles includes arc discharge hydrothermal, plasma-metal reaction, chemical vapor condensation, spray pyrolysis, ultrasonic atomization and sol-gel [6-8]. In present study, we have used prepared zinc oxide nanoparticles by sol-gel technique and characterized using different analytical techniques.

2. EXPERIMENTAL

Fig. 1 – Preparation of Zinc Oxide Nanoparticles

The schematic route for preparation zinc oxide nanoparticles is shown in figure 1. Sol was obtained from GR grade zinc acetate [$(CH_3COO)_2$ $Zn.2H_2O$], ethanol and ammonium hydroxide (NH_4OH) solutions. The pH of the sol was set at 7.2 by varying the quantity of ammonium hydroxide. The gel was obtained by adding 5 gm of polyethylene glycol (PEG) in water. The sol was mixed into gel. The so obtained sol-gel was allowed for aging for 5 hrs. The sol-gel was dried, washed and annealed at 500^0C for 2 h to obtain the ZnO powder.

3. RESULTS AND DISCUSSION

3.1. X-RAY DIFFRACTOGRAM

Fig. 2 show the X-ray diffractogram of zinc oxide nanoparticles The diffraction peaks from

various planes and d values are matching well with reported JCPDS data for ZnO [9], which confirms the formation of ZnO. The grain size was determined using Scherer formula and was observed to be 27 nm.

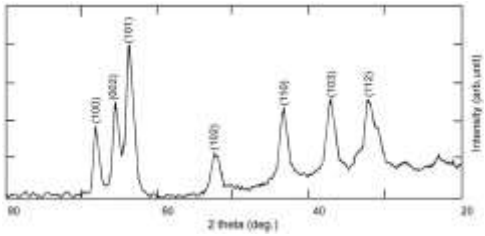

Fig. 2 – XRD pattern of zinc oxide nanoparticles

3.2. SCANNING ELECTRON MICROSCOPY

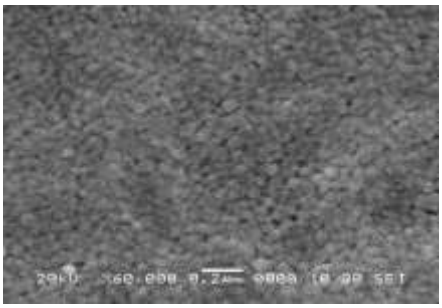

Fig. 3 – SEM image of zinc oxide nanoparticles

Figures 3 show the SEM images of zinc oxide nanoparticles. The average particle size was observed to 30 nm. The particle size distribution seems to be reasonably narrow. The SEM images clearly indicate the spherical shaped nanoparticles.

3.3. ELEMENTAL ANALYSIS BY EDAX

The elemental composition from Table 1 indicates that the film is zinc deficient (oxygen rich) is nonstoichiometric in nature

Table 1 – Elemental compositions of ZnO films

Mass %		Atomic %	
Zinc	Oxygen	Zinc	Oxygen
70.41	29.59	36.65	63.35

CONCLUSIONS

1) Zinc oxide nanopartciles was prepared by sol-gel technique.
2) The grain size was determined using Scherer formula and was observed to be 27 nm.
3) The average particle sizes observed from SEM was observed to 30 nm.
4) The particles were observed to be spherical in shape.
5) Zinc oxide nanoparticles were observed to be nonstoichiometric (Zinc deficient) in nature.

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