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EFFECT OF Ag DOPING ON STRUCTURAL AND OPTICAL PROPERTIES OF ZnO NANOPARTICLES

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ABSTRACT:

Nanocrystals of undoped and silver doped zinc oxide ($Zn_{1-x}Ag_x$) were synthesized by co-precipitation method. The samples were calcined at 550°C. The samples were characterized by Ultraviolet Visible Spectroscopy (UV-Vis.) and Particle Size analyzer. The band gap values of as prepared undoped and doped with silver samples are found to decrease with increase in temperature on 300 -550°C.The Particle size analyzer studies confirmed that ZnO as a nanoparticles. The ZnO nanoparticle may be used to apply photo degradation of removal of dyes and also make nanorod sensor.

Keywords: Nanomaterials, Co-precipitation method, UV-Visible Spectroscopy, Particle Size analyzer and photodegradation of dyes

1.INTRODUCTION

Among the metal oxides (ZnO, TiO_2 , WO_3 , CeO_3 and SnO_2etc), ZnO and SnO_2 are an important n-type semiconductors with wide energy bandgap (3.6eV)from experimental calculations **[1-3]**.Because of its optical transparency in the visible region, it has a wide range of applications in gas sensors, optoelectronic devices, dye base solar cells, secondary lithium batteries and catalysts. Many methods have been developed to prepare silver doped ZnO nanoparticles, including the Sol-gel and microwave method **[4,5]**, evaporative decomposition of solution **[6],** template-assisted growth **[7]**, wet chemical synthesis **[8]** and gas-phase reaction **[9,10].** Among these methods we have adopted chemical co-precipitation method for the synthesis of Silver doped ZnO nanoparticles because it is most effective and simple due to its capability in controlling the structural and surface properties of nanoparticles.

In this paper Silver doped ZnO have been prepared by Co-precipitation method. XRD, FTIR, UV- Visible spectra and

Particle Size Analyzer (Model SHIMADZU 2300) techniques are used to characterize the structural, Chemical and Optical properties of ZnO and SnO_2 nanoparticles. A detailed discussion about the ZnO and SnO_2 nanoparticles is given.

2.EXPERIMENTAL DETAILS

Nanoparticle samples of $Zn_{1-x}Ag_xO$ were prepared by Co-precipitation method. The starting materials are Zinc Chloride $ZnCl_2$/$AgCl_2$ and Sodium hydroxide (NaOH). We dissolved 1M of$ZnCl_2$ in 100 ml H_2O under heating and continuous stirring of 30 minutes. Then, various concentrations (x=1 and 3%) of silver nitrate [$AgNO_3$] were used for preparing the doped samples. Then sodium hydroxide(0.5 mol) was dissolved in 100 ml of distilled water and added drop wise to the stirring solution of Zinc chloride and the mixture was stirred using magnetic Stirrer for 2 hours. The precipitate was filtered and annealed at 80° C. The dried sample was also calcined at 550° C.

3.RESULT AND DISCUSSION

UV –visible spectra analysis

The absorption spectrum of Silver doped ZnO (1% Ag) nanoparticles is shown in Fig1. The figure shows high absorption coefficient in the UV region, whereas it's transparent in the visible region**[11].**

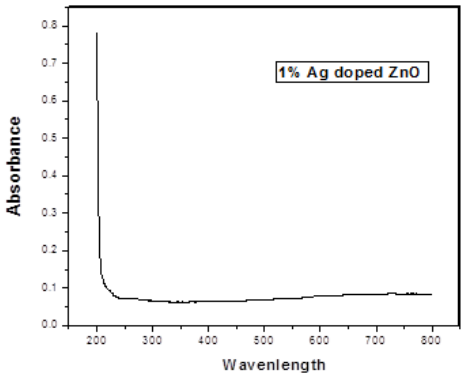

Figure1. UV diagram of silver doped zinc oxide (1% Ag)

The optical band gap energy (Eg) of the semiconductor is calculated from Tauc relation. A plot of $(\alpha h\nu)^2$ *versus* hυ shows intermediate linear region, the extrapolation of the linear part can be used to calculate the Eg from intersect with hν axis as shown in Figure 2. The resultant values of Eg for silver doped ZnO nanoparticles found to be about 5.9eV**.[11].** The absorption spectrum of Silver doped ZnO (3% Ag) nanoparticles is shown in Figure 3. The figure shows high absorption coefficient in the UV region, whereas it's transparent in the visible region**[12].**

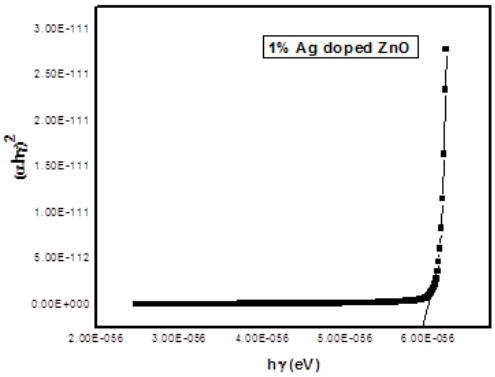

Figure2. Bandgap diagram of silver doped zinc oxide(1% Ag)

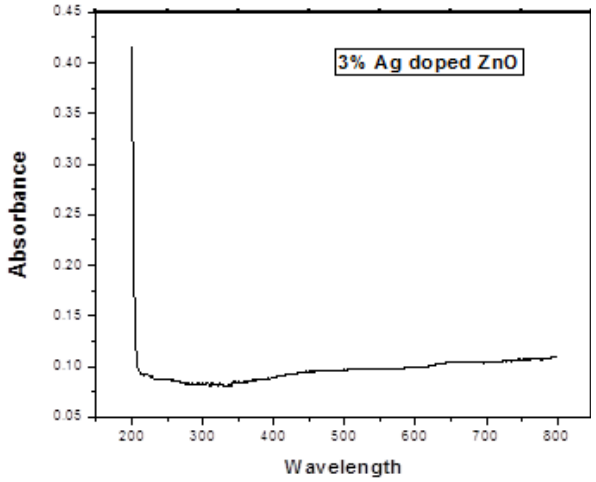

Figure 3. UV diagram of silver doped zinc oxide (3% Ag)

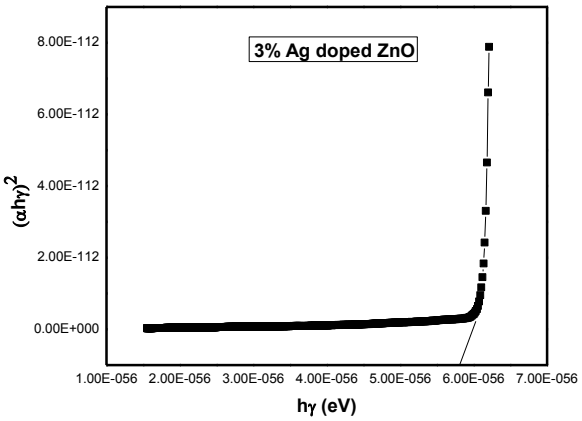

Figure 4. Bandgap diagram of silver doped zinc oxide (3% Ag)

The resultant values of Eg for silver doped ZnO nanoparticles found to be about 5.8eV **[11].**

Particle Size Analyzer

The Particle size of Silver doped ZnO have been determined using particle size analyzer (Shimadzu, Model 2300).

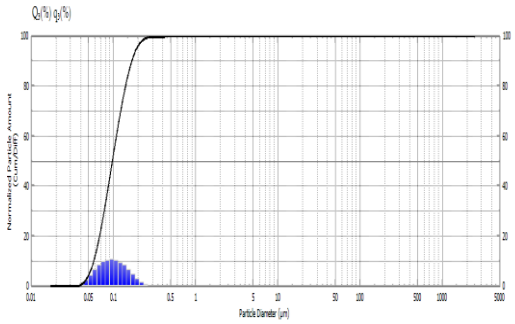

Figure 5. Particle size analyzer for Silver doped ZnO (con 1%)

The particle size of the Silver doped Zinc oxide nano particle was measured at 96nm (*ie*; 0.096 micro meter).

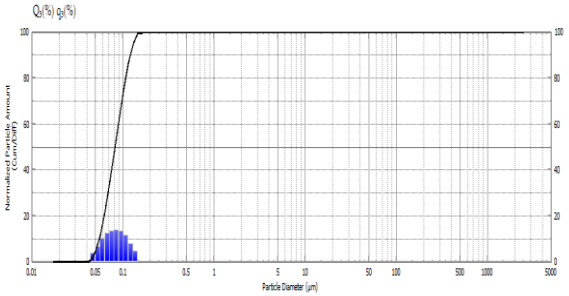

Figure 6. Particle size analyzer for Silver doped ZnO (3% Ag)

The particle size of the Silver doped Zinc oxide nano particle was measured at 81nm (*ie*; 0.081 micro meter).

4.CONCLUSION

The Silver doped ZnO nanoparticles were synthesized using the Co-Precipitation method. The samples were calcined at 550°C. The Particle size analyzer studies confirmed that the Silver doped ZnO as a nanoparticles. The particle size of the Silver doped ZnO nanoparticles (1% Ag and 3% Ag) were 96nm and 81nm. The UV – Visible spectral studies concluded that the optical band gap of Silver doped

ZnO nanoparticles (1% Ag and 3% Ag) were 5.9 and 5.8eV.

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