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Full Length Research Article

Detergent (Thf) Mediated Zno Nanoparticles and Their Characterization

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ZnO Nanoparticles are the formost and widely used in the field of biotechnology and molecular Nanoelectronics. Due to increasing demand, highly specified and monodispersed Nanoparticles formation is a revolutionary field. Here ZnO Nanoparticles are prepared by taking Tetrahydrofuran(detergent) as a solution phase instead of DMSO and other wet chemicals. It is proved to be the first preparation of ZnO Nanoparticles via detergent. The results are quite appreciable and less band gap- long range ordered ZnO Nanoparticles are obtained than the conventional route. Nanoparticles are examined through UV-Vis Spectroscopy, XRD and SEM analysis.

Key words: Agglomeration, Anti-microbial, Capping, Purificant, Tetrahydrofuran,

INTRODUCTION

Nanotechnology is the most recent branch which deals with the physical phenomena at nano level [1]. It is proved to be highly successful in improving and managing properties of different materials at ultra small level without affecting the bulk properties. Nanotechnology can be useful in diagnostic techniques, drug delivery, sunscreens, antimicrobial bandages, disinfectant, a friendly manufacturing process that reduce waste products (ultimately leading to atomically precise molecular manufacturing with zero waste), as catalyst for greater efficiency in current manufacturing process by minimizing or eliminating the use of toxic materials, to reduce pollution (e.g. Water and air filters) and an alternative energy production (e.g. Solar and fuel cells) [2].

Zinc oxide Nanoparticles are proved to be widely applicative in the field of science and engineering. Physically ZnO Nanoparticles are white in color and insoluble in water. ZnO is a wide-bandgap semiconductor of the II-VI semiconductor group [3]. ZnO Nanoparticles have applications as water purificant, anti-microbial agent, somewhat anti-fungal agent, food pigment etc. Due to its wide applications, its demand is increasing consistently. For this reason, highly purified monodispersed and size specific Nanoparticles are taken into consideration these days [4,5]. Different methods with different chemical reagent have already been used for the preparation of ZnO Nanoparticles like chemical route, sol gel method, co-precipitation method, physical methods etc. Chemical route is the most easily available and cost favourable method [6]. This method is also easily accessible and also conventional to general labs in comparison to other methods. Here, we have used Tetrahydrofuran as a solvent rather than already used like DMSO. It is the first detergent mediated preparation of ZnO Nanoparticles. Nanoparticles characterization is done via UV-Vis absorption spectroscopy, Photoluminescence, XRD and SEM analysis. All these studies gives a combined view and evidence bout the formation of ZnO nanoparticles by using THF as a solvent [7,8].

Experimental Procedure

ZnO Nanoparticles are prepared by using chemical reagents- Zinc acetate dihydrate [$(CH_3COO)_2Zn.2H_2O$], Potassium hydroxide [KOH], Tetrahydrofuran [THF] and Oleic acid as a capping agent. Capping agent is used to avoid the agglomeration of particles and small sized particles are obtained. In experiment, 0.6M solution of Zinc acetate dihydrate in 60ml THF and 3.6M solution of KOH in 30ml distilled water are mixed together with 0.3ml oleic acid as a capping agent. The total solution is stirred for 6-7 hrs. The whole procedure is followed via the general chemical route. The properties of the particles so formed are analysed and studied via the UV- Vis, XRD and SEM techniques.

RESULTS AND DISCUSSION

UV-Vis Absorption Spectroscopy

Fig. 1 shows the UV-Vis curve of the prepared detergent mediated ZnO nanoparticles. It shows a clear peak at 328 nm. With this curve we are herby able to draw exclusive results regarding the formed particles nature and bandgap. The band gap can be calculated by using Tauc's relation which is:

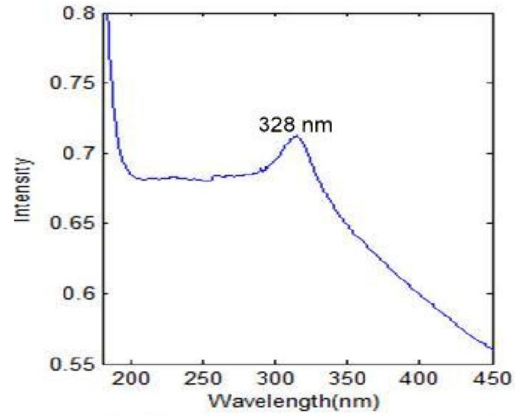

Fig. 1 UV- Vis absorption spectroscopy curve of the ZnO(THF) particles

$\alpha h\nu = A(h\nu - E_g)^n$ (1)

where α is absorption coefficient, h is Planck's constant, ν is frequency of absorption, E_g is band gap energy and n is the transition between the extrema of conduction and valence band. Fig. 2 gives the band gap of the prepared nanoparticles using the Tauc's relation and it is estimated to be 3.85 eV. This shows that the particles so produces are semiconducting in nature and can be used in the electronic applications.

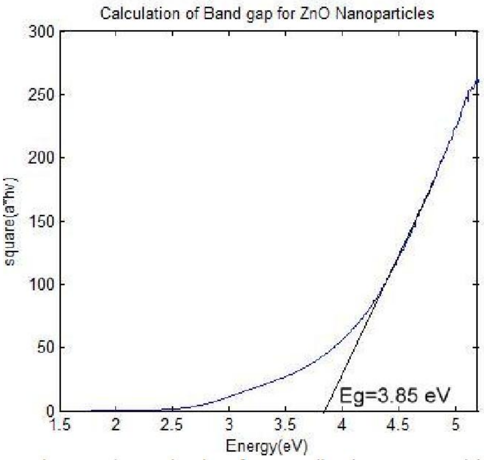

Fig. 2 Bandgap estimation of THF mediated ZnO nanoparticles

X-Ray Diffraction

Fig. 3 shows the X-Ray Diffraction of the THF mediated ZnO nanoparticles. The number of peaks observed are nine which matches the standard results. The maximum peak intensity observed is around $2\theta=36^0$ which also supports the reparation of nanoparticles of ZnO. In standard results peak is observed around 35^0. By this we can calculate the average particle size by using Scherer's Formula:

$T=0.9\ \lambda/\beta \cos\theta$ (2)

(where λ=wavelength of X-Ray, β= full width of half maxima, θ is diffraction angle) Here the λ is 1.54 Å (Cu-Kα) value of β is 0.017 and value of 2θ is 36^0, putting the values particle size obtained is around 85 nm.

Scanning Electron Microscopy

Fig. 4(a) and 4(b) shows the SEM images of the THF mediated ZnO nanoparticles. Both shows the formation of nanoparticles in which different size distribution is obtained. The maximum probability of the size is around 84.89 nm. The other particles are also formed around 146.1 nm which has less probability. Fig. 4(b) shows the clear view of the shape of the nanoparticles and gives an evidence of the formation of well formed nanoparticles.

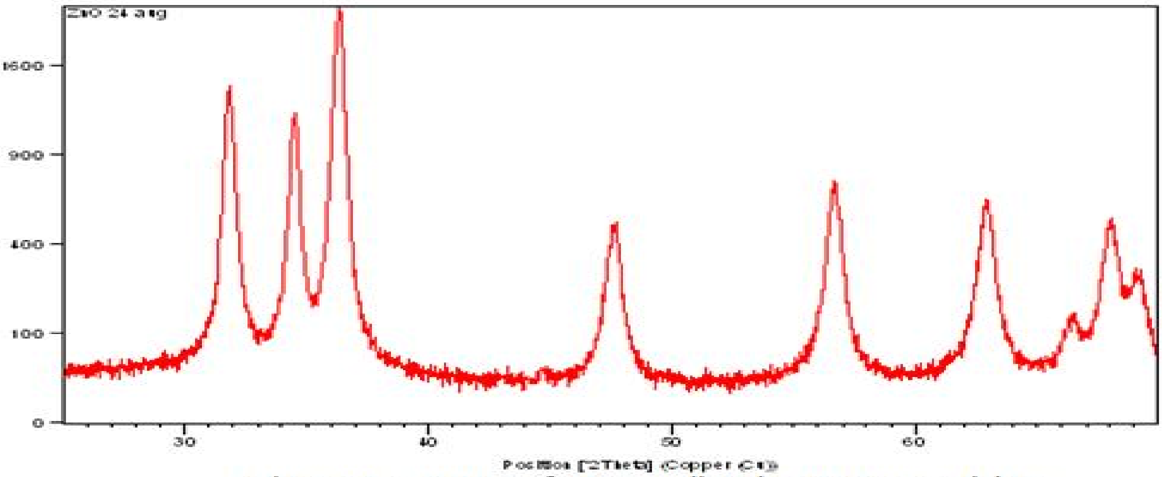

Fig.3 XRD pattern of THF mediated ZnO nanoparticles

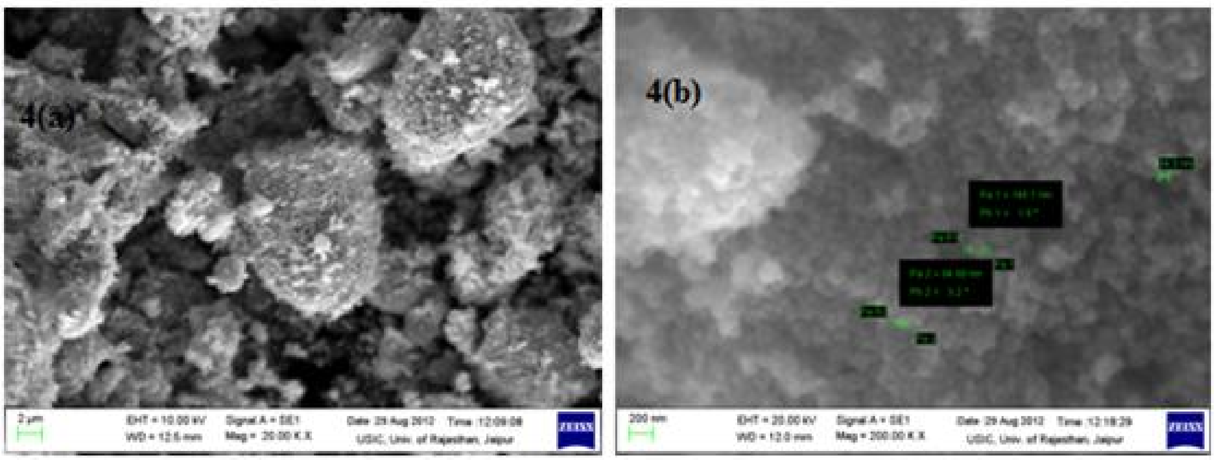

Fig. 4(a) and 4 (b) SEM images of THF mediated ZnO nanoparticles

Conclusion

This synthesis procedure leads to the formation of THF mediated synthesis of ZnO nanoparticles. It is the first time when the ZnO nanoparticles are prepared by using detergent i.e. THF as a solvent. Highly stable and resistant to photo oxidation nanoparticles are obtained. UV- Vis studies confirms the semiconducting nature of the nanoparticles by estimating their band gap to be. XRD studies gives the average particle size of the nanoparticles to be 85 nm. Finally, SEM analysis gives the shape and size of the particles which is tetragonal and around 84 nm (maximum probability). In this way detergent mediated synthesis of ZnO nanoparticles is of low cost and also particles are stable for longer duration.

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