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Synthesis of Zinc Oxide Nanostructures by using Sol-Gel method

* Dharisana.S, Srimeena.S[1]

Department of Chemistry & Physics

Nadar Saraswathi College of Arts and Science.

Vadapudupatti-625531, Theni- (D.t).

ABSTRACT:

Zinc acetate de-hydrate ($Zn(CH_3COO)_2.2H_2O$) as a precursor and ethanol (CH_2COOH) was used as the solvent. Sodium hydroxide (NaOH) and distilled water were used as the medium. Sol-gel method is the simplest method and has the ability to control the particle size and morphology through systematic monitoring of reaction parameters. ZnO nanoparticles were synthesized via sol-gel method using ZnO nanoparticles were characterized by using UV, FTIR XRD and Nano-particles were analysers. The XRD Pattern of ZnO nanostructure results to obtain the Crystalline structure to occurred the particles size were 37.50 nm. UV exhibit the good absorption of ZnO materials and obtained the bandgap of the ZnO is398- 400nm. The functional group of Fourier Transform Infrared Red Spectroscopy (FTIR) 1429.25 is a peak value which is Zn-O Bonding.

Keywords: *Zinc acetate (Zn (CH3COO) 2.2H2O), sodium hydroxide(NaOH) ,UV, XRD, FTIR.*

1. Introduction:

Zinc oxide plays an important role in current industry due to its special characteristics such as anti-corrosion, anti-bacteria, has low electrons conductivity and excellent heat resistance [1]. Therefore, the objective of this study is to synthesize zinc oxide nanostructures with the most practical ways by using sol-gel method and characterize the nanostructures [2]. Nanoparticles differ in characteristics from those of bulk materials [5]. Due to numerous applications, studies on the synthesis, characterization and properties of nanoparticles have received significant attention in the past several years [3]. Among various of nanoparticles, ZnO nanoparticles (n-ZnO) have received more attention. ZnO is a wide band gap semiconductor having large excitation binding energy of 60 meV at room temperature and it has high transmittance and good electrical conductivity also [6]. ZnO's resistance to radiation damages make it useful in various space applications [5]. ZnO nanoparticles have widespread applications as biosensors, gas sensors, solar cells, ceramics, nano generators, photo detectors. In the present work, ZnO nanoparticles have been synthesized by solution-based approach and characterized by various techniques. Further, some of the preliminary experiments have been carried out to investigate the efficiency of synthesized nanoparticles (n-ZnO) for removal of highly toxic metal, Cd(II) from its aqueous solutions[6].

2. Experimental Procedure:

Zinc actetate:

Zinc acetate is a salt with the formula $Zn(CH_3CO_2)_2$, which commonly occurs as the dihydrate $Zn(CH_3CO_2)_2 \cdot 2H_2O$. Both the hydrate and the anhydrous forms are colour less solids that are commonly used in chemical synthesis and as dietary supplements.

Chemical formula: Zn(CH3COO)2(H2O)2 (dihydrate)

Molar mass: 219.50 g/mol (dihydrate); 183.48 ...

Melting point: Decomposes at 237 °C (459 °F; ...

Density: 1.735 g/cm^3 (dihydrate).

Synthesis:

Take 6g of Zinc Acetate and 10g of Sodium hydroxide has been weighted and dissolved with distilled water. 6g of zinc acetate is with 15 ml of distilled water and 10g of sodium hydroxide with 12ml of distilled water. Then it was stirred each at 5 mins and mixed it

together and stirred for 5min. Then burette is filled with 100ml of ethanol and titrate it by drop wise into a solution. stored at overnight, white precipitate was formed. Then precipitate is placed in a watch glass in hot air oven at 80°C for 1 hour, finally the nano powder was formed.

3. RESULTS AND DISCUSSION:

3.1 Uv (Ultra visible spectroscopy):

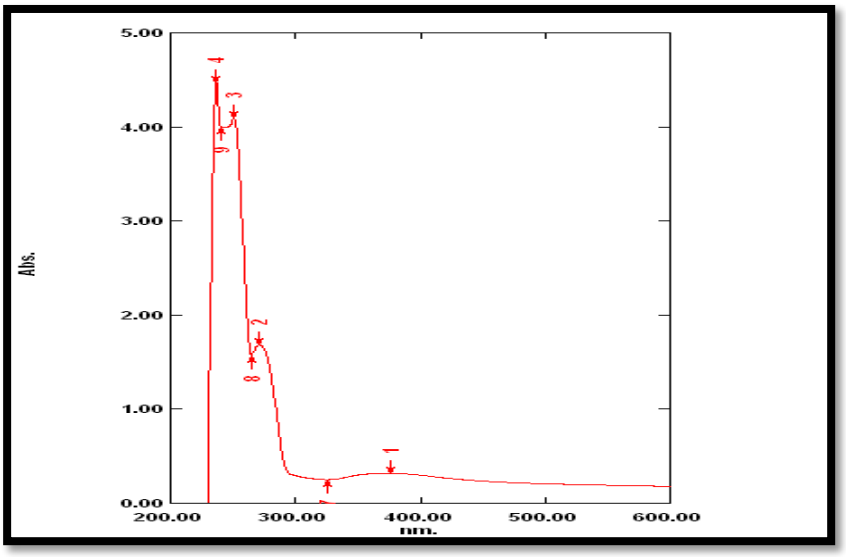

Fig.1 UV pattern of (ZnO) Nanostructures

UV exhibit the good absorption of ZnO materials and obtained the band gap of the ZnO is398-400nm

3.2 VIBRATIONAL STUDIES:

3.2.1 FOURIER TRANS FORM INFRARED SPECTROSCOPY:

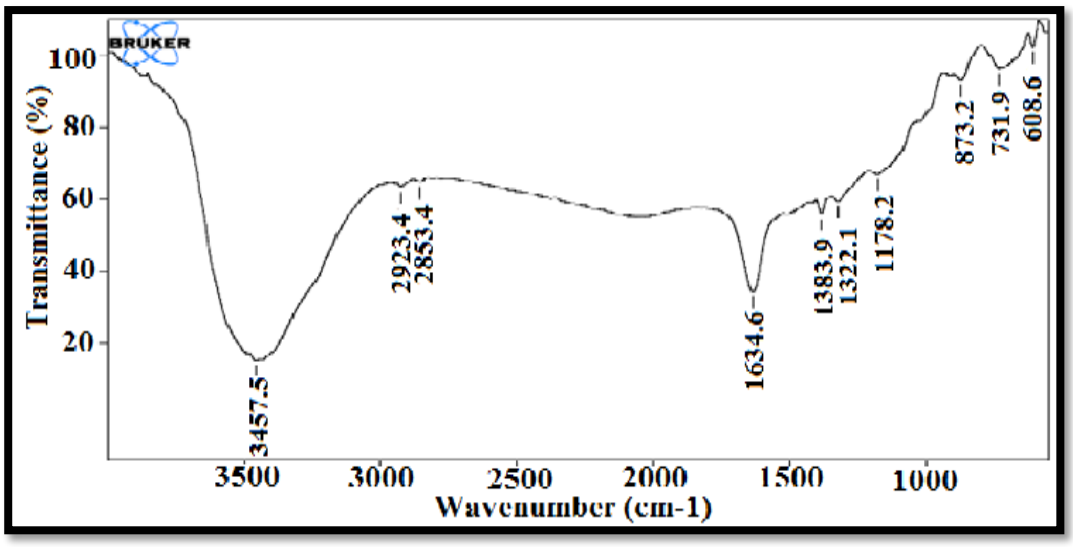

Fig.2 FTIR functional group of (ZnO) Nanostructures

The FTIR Spectrums of the (Zno) samples are shown in fig (2). The absorption peak at very large band around 3457 cm^{-1} is attributed to the stretching of amide stretch, the sharp absorption peak corresponding to C=O stretch was absorbed 2923-2853 cm^{-1}. The small absorption peaks at C=C bond 1634 cm^{-1}. The strong absorption peak between 1383-1322 cm^{-1} belongs to the zinc oxide stretching vibration of (Zno). The wave number873- 701 cm^{-1} indicated the presence of the aromatic compounds. FTIR (Fourier Transform Infrared Spectroscopy) analysis was used to determine the functional groups of ZnO Nanostructures.

3.3 STRUCTURAL STUDIES:

3.3.1 XRD:

It shows the XRD patterns of the Zno nanostructures by using sol-gel method. The major phase corresponds to (100), (002), (101), (102), (110),(103) were found to be matched which confirmed the presence of crystalline structure nanostructures. The Zno (JCPDS NO: 0361451). Well defined sharp peaks in the XRD pattern of sample indicates the good crystalline quality and confirm the formation of nanostructures were determined from the line widths of diffraction peaks using debye Scherer equation.

$$D=K\,\lambda/\beta\cos\theta$$

D- Grain diameter.

B- Half intensity width of relevant diffraction.

λ- X-ray wavelength.

θ- Diffraction angle.

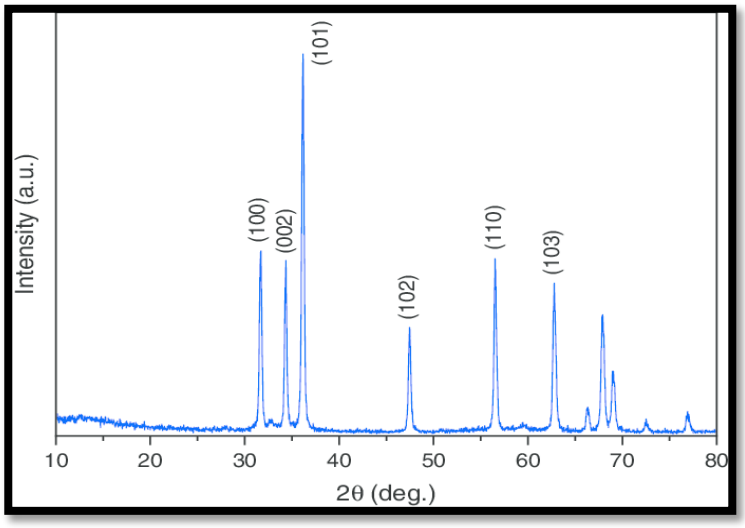

Fig.3 XRD pattern of (ZnO) Nanostructures

4. CONCLUSION:

UV exhibit the good absorption of ZnO materials and obtained the band gap of the ZnO is398- 400nm**.** Fourier transform infrared spectroscopy (FTIR) spectra of (ZnO) 4cm-^{1} indicated the presence of the ZnO Nanostructures. X-ray diffraction (XRD) average crystallite sizes of the particles were37.50 nm.

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