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Synthesis and characterization of ZnO and Ammonium doped ZnO nanoparticles by Co-Precipitation method

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Abstract - Nanoparticles ZnO synthesized by co-precipitation method by drop by drop method, the concentration of X is 0.3. The powder samples were characterized by XRD, FT-IR, UV and SEM and EDX. The average crystallite sizes of the particles were determined from X-ray diffraction. X-analysis showed that the shape of the sample. The lattice constant (a0) increased with increase in zinc substitution. The Fourier transform infrared spectroscopy spectra of ZnO range 3434.3 cm^{-1} were reported. Then UV visible spectroscopy finds the visible region of sample. The shape and the structure was analyzing by using SEM. These are using in many field and many application.

Key words: co-precipitation, XRD, SEM, EDX, FT-IR, U-V.

Introduction

Nanotechnology is manipulation of matter on an atomic and molecular in molecular scale. The earliest, widespread description of nanotechnology referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macro scale products. Ammonium acetate and zinc acetate are non toxic elements; it is not dangerous to human health and KOH powder also non toxic element.

The NH4CH3CO2 and ZnC4H6O4 these both elements are diamagnetic and it has diamagnetic properties. The ammonium acetate occasionally employed as a biodegradable de-icing agent, and it is melting at low temperature. Zinc acetate is using for treat a certain liver disease. KOH solution was a good cleanser.

The synthesis of ZnO ultra fine powder by NH4 doped by ZnO co- precipitation method. Nanosize of the ZnO in 40 nm in nanometric scale and band gap energy is 4.2ev.

Nanotechnology may be able to create many new materials and devices with a vast range of applications, such as in nano medicine, nano electronics, and biomaterials energy production and consumer products.

Experimental method:

Ammonium doped zinc oxide nanocrystals have been synthesized in aqueous solution by using zinc acetate, ammonium acetate and potassium hydroxide as the starting materials. 1.834g zinc acetate and 0.7708g ammonium acetate were dissolving in 100 ml of ultra pure water and then 0.1402g KOH was dissolved in 10 ml of ultra pure water. Aqueous solution of zinc acetate and ammonium acetate at 210 ˚C was stirred for about 30 min using a magnetic stirred. Then the KOH solution was added slowly drop wise up to aqueous solution of zinc acetate and ammonium acetate at 100˚C under constant stirring. After 3 hours of the flask was collected and washed with ethanol and deionized water. Finally the precipitated was dried over 50 ˚ C for 6 hours in order to remove the water molecules to obtain the ZnO nanocrystals in powder form. The samples were stored at room temperature.

RESULT AND DISCUSION

Phase analysis using XRD

XRD Analysis of NH4 doped ZnO nanoparticle reaction may lead to changes in molecular and crystalline structure of the nanoparticles and hence an understanding of the molecular and crystalline structures of the nanoparticle and the resulting changes there if would provide valuable information regarding nanoparticle reaction. The XRD pattern of NH4 doped ZnO sample is shown in fig.1

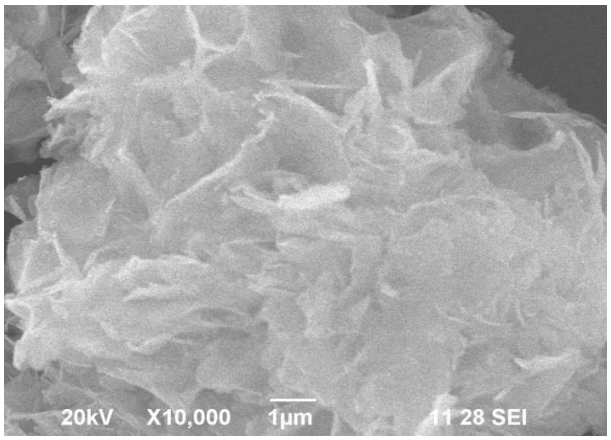

Fig 3 synthesis and characterized sample Zno in 1µm

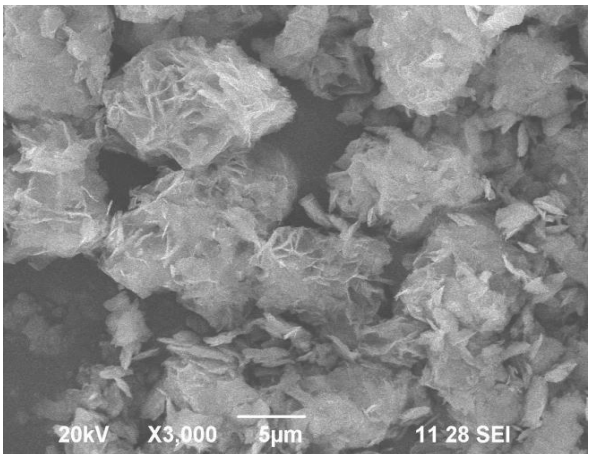

Fig.4 synthesis and characterized sample ZnO in 5µm.

FT-IR

FTIR is an analytical technique for analyzing compounds for their chemical structure and particles conformed to the identity of organic and inorganic material. The FTIR spectrum of the NH4 doped ZnO samples were studied. The band range is 3434 cm^{-1} and 3500 cm^{-1}. the stretching bond in present this work the band range 3434.3 cm^{-1} to 3500 cm^{-1} correspond to O-H stretching bond and 2000 cm^{-1} and correspond to C-O stretching bond.

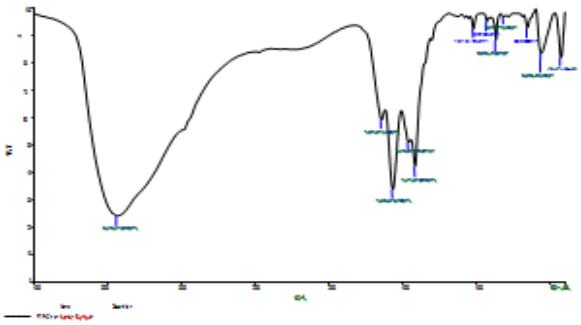

Fig.5 FT-IR spectra of ZnO nanoparticles

UV-visible spectroscopy

The study of is important to understand the behavior of semiconductor nanoparticles. A fundamental property of semiconductors is (the energy separation between the filled valence band and empty conduction band). This feature in the optical spectra of NH4 doped Zn nanoparticles are shown in fig 4.5. it is evident that, the samples exhibit a strong absorption wavelength at 364.1 nm. This wave length has longer wavelength region.

The band gap of nanoparticles is calculated using the formula as follows:

$$Eg = hv = hc/\lambda$$

Where, h,c,λ and Eg are the Planck's constant, the speed of light in vacuum, the optical absorption wavelength and band gap respective. The band gap energy of the samples corresponding to the absorption to the absorption edge is found to be 4.733eV

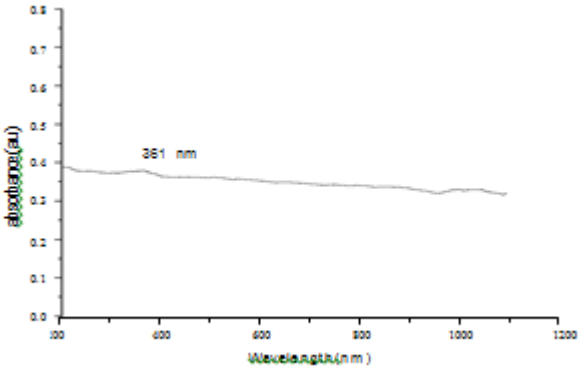

Fig.6 UV- visible spectra of ZnO nanoparticle

EDX

An EDX spectrum was collected at each point identified in the top secondary electron image to individually characterize the wires. The resulting spectra show that the largest diameter wire is Zn, the medium diameter wire is O and another important and useful capability of EDX technique is X ray mapping of elements.

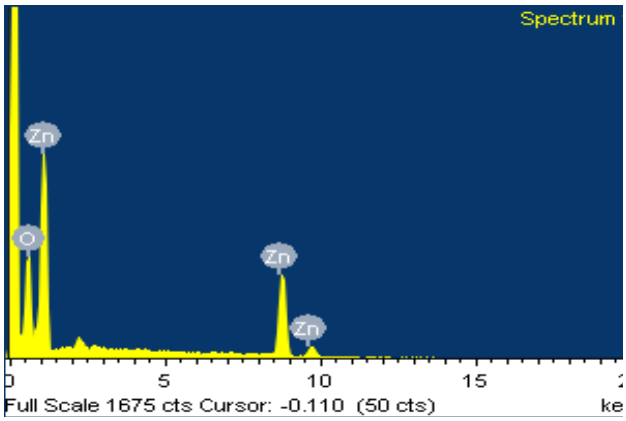

Fig.7 ED spectra of ZnO

The ED spectrum is displayed in digitized form with the X-axis representing x-ray energy and y axis represent the number at counts. Energy resolution is defined as the full width of the peak and half maximum height ZnO at 2.171 KeV.

CONCLUSION

Preparation technique suitable for preparation of NH4-Zn substituted nanoparticles is reported. NH4 and Zn nanoparticles can be prepared by co- precipitation method. The formation of ammonium and zinc acetate was confirmed by the X-ray diffraction. The lattice constant was found to the zinc concentration. This is used in many applications, it is used in buffer solution, and ammonium acetate is useful as a catalyst, medical field and so on. SEM analyze the shape and size, XRD test identify the structure of nanoparticles and FTIR was used to confirm the O-H and C-O bonds are present in this work and it have a water content, UV visible spectra was determine the visible region or invisible region in the nanoparticles.

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