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Preparation of ZnO like–Nanoflower by Hydrothermal Method

Abstract- ZnO nanostructure were prepared by decomposing zinc hydroxide $Zn(OH)_2$ using hexanaldehyde at pH 9 and 105 °C for 10 h. Size of ZnO nanostructure can be like flower or rod controlled by pH of the aqueous solution. Nanostructure of ZnO has been studied by (SEM), (XRD) and (FTIR). Synthesized Zinc oxide nanostructures possess a hexagonal quartzite template. ZnO powders were measured by Also using Zeta potential and Particle Size Analyzers and size distribution of the ZnO powder using particle size analyzer (NanoBrook 90Plus Particle Size Analyzer) .

Keywords-: ZnO nanostructure; Nanorod; Nanoflower; Hydrothermal

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1. Introduction

In recent years the chemical engineering witnessed increased interests of scientific community in Nanotechnology especially materials which have many important because of their structure and properties was different from appreciably from bulk materials [1]. The nanotechnology boom has resulted to discovery of a host of forms of nanoparticles nanoaggregates. Some of them are nanopowders, which have many applications [2]. Furthermore, ZnO is one of the most an environmentally cordial material, which have special desirable for many biological applications, as in detection of cancer [3-4]. ZnO have extensive applications in water purification ZnO has many industrial applications, so it has attracted considerable been used as doping with many material such as ceramics, glass, cement, paints, pigments coatings, cosmetics and medicated creams [5]. Extensive work, different nanostructure of ZnO has been devoted to synthesize different dimensional nanostructures; One-dimensional structures make up the largest group, including nanorods [6], nanobelts, nanowires, nanocombs, nanorings nanohelices, nanosprings, nanoribbons, nanotubes.

(2D) structures, such as nanoplate/nanosheet and nanopellets, nanoparticles, nanobridge, nanocages 3D) structures of zinc oxide include, nanodandelion, nanosnowflakes, nanoconiferous urchin-like nanoflowers [7-9]. ZnO structures

have been synthesized with various methods, such as chemical vapour deposition, vapor-phase oxidation of metallic Zn powders [10-12] the catalyst-assisted vapour-liquid-solid process [13], magnetron sputtering, pulsed laser deposition (PLD), sol-gel process and spray pyrolysis [14] and hydrothermal methods [15], which have high temperature processing methods and require costly equipment [16].

2- The Procedure

I. Accessories

Zinc nitrate hexahydrate [$Zn(NO_3)_2 \cdot 6H_2O$], ammonia (NH_3), hexanaldehyde ($C_6H_{12}O$) were supplied by Fluke Company (Germany).

II. Preparation of ZnO nanoflower and nanorod

The preparation of ZnO micro and nanostructure dissolved (1.31g) zinc nitrate hexahydrate [$Zn(NO_3)_2 \cdot 6H_2O$] into 50 ml of D.W. then, 3ml from NH_3 aqueous solution was added drop by drop to an aqueous solution of zinc nitrate the rising solution pH was about 9 performed Zn (OH)₂ sudden was distracted by centrifugation at 2800 rpm to 5 min and thereafter separated in 50 ml of hexanaldehyde ($C_6H_{12}O$). The solution with Zinc Hydroxide sparse has been heated during 105°C unit 6 h in a sealed glass flask. The resulting solid product was filtered and washed using filter paper (2 μ) with water and ethanol to remove the lasing ions in the ultimate production,

and lastly, the deposit was dehydrated at 50°C until 5h. Mechanism and Structural composition of reaction has expressed as showing in Figure 1.

III.Characterization Techniques

The crystalline structure of the powder has been determined by using x-ray diffraction, the surface morphology and optical properties were examined using: Scanning Electron Microscopy (SEM the VEGA easy probe), also by Fourier Transform-Infrared Spectroscopy (FT-IR) from (Shimadzu Irtaffinity) probes the molecular vibrations of molecules for samples prepared). Particle size and size distribution of the ZnO powder were analyzed using particle size analyzer and Zeta potential (NanoBrook 90Plus Particle Size Analyzer).

3. Result and Discussion

Figure 2 shows XRD pattern of synthesized ZnO. The pattern shows that the entire pattern indexed to the hexagonal phase of pure ZnO with a wurtzite structure. Moreover, there is no pattern belong to free Zn or any other defect may be spotted in the peaks, this in result points to the excellent quality of the synthesized products. Furthermore, the obvious and acute peaks too appeared into ZnOnanoflower have a rise crystalline goodness.

The FTIR spectrum of zinc oxide nanostructures like flower are shown in Figure (3) that was possessed in a chain absorption summit from 400 to 4000 cm^{-1} . Bands of 417, 437, and 740 cm^{-1} spectra of ZnO and 1540.1, 1492.9, 1357, 1043.49, 833.25 a companion with expansion oscillation of crystalline hexagonal ZnO expansion vacillation. The broad absorption peaks at the range (3200-3600 cm^{-1}) belong to the presence of hydroxyl group of vibration at the surface of ZnO samples. The FTIR observation backing the XRD outcome.

Figure 4(a,b) show SEM images at different magnification where SEM micrograph of the ZnO nanostructure. Many beautiful nano flowers and nanorod can be seen. There are two typical types of ZnO nanoflowers like rose and nanoflowers inside large numbers of small nano rod, the nanoflowers and nanorod were in the range of 30.4nm- 130nm representative. The SEM images of nanoflowers and nanorods forming the crystalline. The particle size histograms of ZnOnanoflower (illustration in Figure 5) shows that the particles range in size from 40.4 to 99 nm and the particles range in size from 105 nm to 240 respectively, with mean diameter 93 nm. We expect higher baseband solution (NH_3) lead more

size would become larger due to higher nucleation and aggregation processes to take place in the formation of ZnOnanoflower.

Figure 6 show ZnO like nano flower has been specified at pH 9 average-16.93mV and 93.nm for with zeta potential and particle size respectively. The most important result that have been obtained from the examination of Zeta potential. This value lies within the range of potential indicative high Zeta Potential value equal to (-16.93 mV). The stability of suspended means preprocessing disinclination nanoparticles to assembled and get stronger electric repulsion between then and this is very important in a many applications.

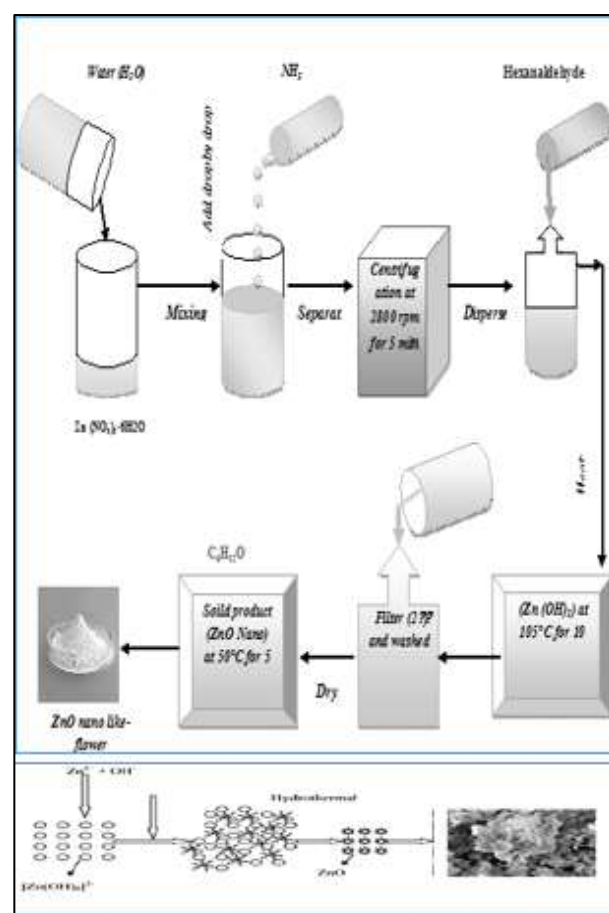


Figure 1: Schematic diagram of the preparation and formation mechanism of ZnOnano like-flower

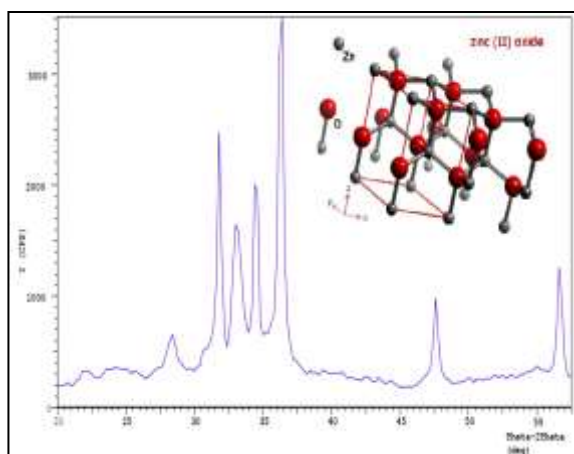


Figure 2: XRD patterns of ZnO nanostructures

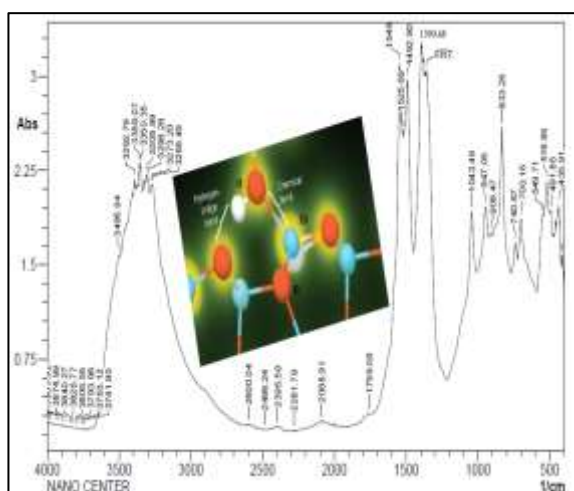


Figure 3: FTIR spectrum of zinc oxide nanostructures

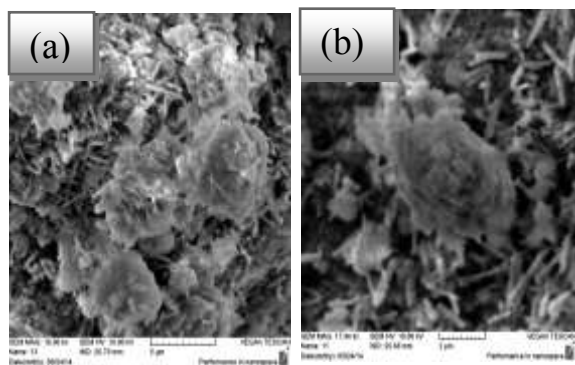


Figure 4: (a & b) show SEM image of ZnO nanorod and nanoflower at different magnification

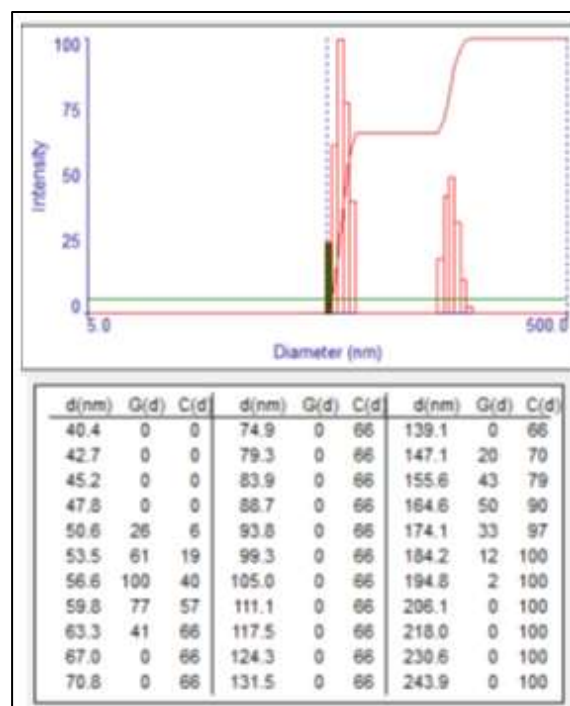


Figure 5: Show that the particles size analyzer size distribution using the software of (PSA)

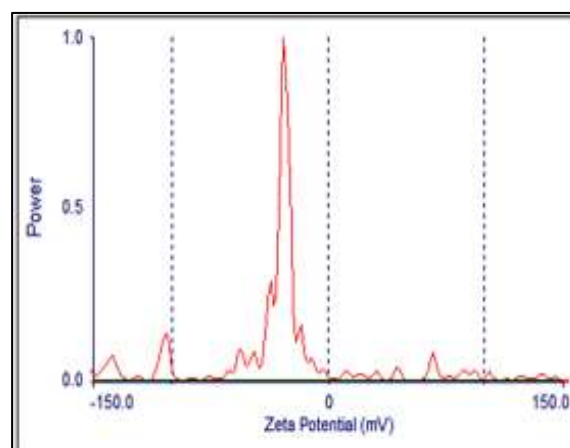


Figure 6: Zeta potential of ZnO nanostructures

4. Conclusion

In summary, we have demonstrated the synthesis of ZnO nanoflowers. XRD pattern shows that all peaks of diffraction can be indexed to the hexagonal phase of pure ZnO with a wurtzite structure. Proven results of each XRD and FTIR that it bonds chemical and structures properties return to zinc oxide. The SEM images for nanoflowers and nanorods were in the range of 30.4 nm - 130 nm representative. Using particle size analyzer surely the range of particles size from 105 nm to 240 nm respectively, with mean diameter 93 nm.

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