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Synthesis of Zinc oxide nano flower for photovoltaic applications

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Abstract

In the present work, ZnO nanoflowers have been synthesized with a single precursor at relatively low temperature by using ammonia. As-prepared ZnO nanoflowers were characterized by X-Ray Diffraction, Fourier Infrared Transmission and UV–visible spectroscopy. X-raydiffraction studies confirm that as-synthesized ZnO nanostructures are highly crystalline with a hexagonal wurtzite phase. The grown nanoflowers are of immense technological applications in the field of photovoltaics.

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*Keywords:*XRD; Nanoscience; UV; ZnO

1. Introduction

At room temperature, Zinc oxide has wide band gap (3.37), high excitation binding energy (60 meV) large surface area and hydrophilic nature. It possesses excellent chemical and thermal stability. Recently different ZnO nanostructures(nanowire, nanoneedles, nanoflower, nanobelts, nanorod, nanotube) have also been synthesized by various research groups[1-5].The physical and chemical properties of nanoparticles are determined by size and shape of the particles [6]. Numerous techniques have been applied togrow ZnO nanostructures such as thermalevaporation, hydrothermal process, chemical vapor deposition, sol-gel synthesis andsolution growth. Nanostructures are of prime interest for DSSC applications dueto their unique optical, electronic, mechanical

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properties.However, the uses of ZnO nanoflowers having outstretched branches have also been reported for high efficiency in Dye sensitized solar cells as one-dimensional structures cannot capture the photons efficiently due to the presenceof intervalspresent in the morphologyitself. Thenanoscale branches of nanoflower structurefill the intervals which results in a larger surface area and provide a direct pathfor transport of electron along the channels through the branched petals [7]. In the present work, ZnO nanoflowers have been grown by hydrothermal method and their structural and optical properties has been studied.

2. Experimental

The chemicals as purchased were used for synthesis without further purification. 2.6 g of zinc nitrate hexahydrate is dissolved into 100ml distilled water. Then 100ml ammonia solution (3%) is added to it. As a result $Zn(OH)_2$ precipitate forms which is separated by centrifugation. The precipitates are then dispersed in 50ml 1,4-butanediol. The solution containing dispersed $Zn(OH)_2$ is then heated on a hot plate at 100^0C for 36 hours in a closed glass flask. The obtained particles were then separated by 100ml ammonia solution (3%). White precipitates were obtained by centrifuging the above solution which is further dried at 80^0C for 12 hours.

3. Results and discussions

The crystalline structure of as grown sample is characterized by X-ray diffraction(XRD) technique as shown in Fig1.The prepared sample shows good crystallinity as indicated by the observed sharp peaks.All peaks of the sample are corresponding shows the peaks corresponding to (100), (002),(101), (102), (110),(103) and (201) to ZnO crystal faces. The peak corresponding to 32^o,34^o,36^o, 48^o, 56^o, 63^o, 68^o which are in good agreements peaks of bulk ZnO[6, 8].

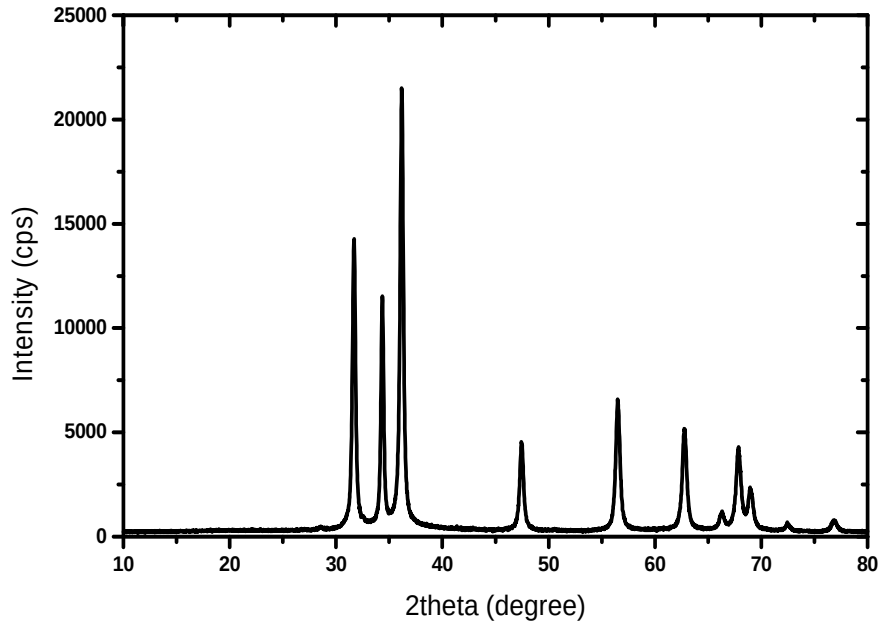

Fig. 1. XRD spectra of ZnO nanoflower

Figure 2 shows Fourier transform infrared (FTIR) spectroscopy that depicts the quality and composition of the sample. ZnO and KBr pellets (1:100) are used for FTIR measurements are done in range of 400-4000 cm^{-1}.Hydroxyl mode of vibration at the surface of ZnO sample is confirmed by the broad absorption at 3000-3600 cm^{-1}whereas the peak at 896.95 cm^{-1} confirms the synthesis of ZnO as reported in reference data [12].