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Mini Review

Different Morphology of ZnO Nanostructures Using Hydrothermal and Electro-Deposition Technique

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Introduction

The different morphology of ZnO material is possible by using hydrothermal synthesis and electro-chemical synthesis procedure. We have used zinc nitrate ($Zn(NO_3)_2$. $6H_2O$) and hexamethylenetetramine (HMT) ($(CH_2)_6N_4$) salts as starting material for synthesis of ZnO hydrothermal synthesis and electro-chemical synthesis procedure. The field emission scanning electron microscopy (FESEM) techniques was used to observe the effect of precursor variation in hydrothermal technique and deposition time period in electrochemical technique on the morphology of the ZnO nanostructures.

One-dimensional semiconductor nanostructures such as nanorods, nanowires, nanosheets, and nanotubes have attracted much attention due to their unique properties which is useful for various applications [1,2]. Zinc oxide (ZnO) has been widely studied because of its unique properties and applications in the field of optoelectronics, photo detector, photo catalysis, sensors and nanotechnology [1-7]. Solution phase methods have been used to synthesize ZnO nanostructures because of their popular chemical procedure and its simplicity which is carried out at ambient or slightly elevated temperature. Hydrothermal growth technique and electrochemical techniques are found to be a simple and cost-effective technique for preparing ZnO materials nanorods [1,2]. In the present work, ZnO materials of different morphology were prepared by hydrothermal growth technique and electro-deposition technique and the morphology of the ZnO nanostructures/macrostructure have been investigated.

We have already published the synthesis of ZnO via hydrothermal technique [1] and electro-deposition technique [2]. Two samples of precursor concentrations 10mM and 500mM prepared using hydrothermal methods, renamed as 10mM- S1 and 500mM- S2 and two other samples were prepared using electro-deposition technique for 5 minutes and 20 minutes deposition period were renamed as S3 and S4 respectively. The morphology of samples was investigated by field-emission scanning electron microscopy (FESEM).

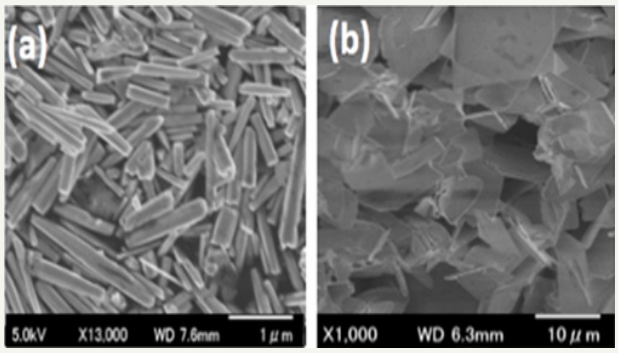

Figure 1: The FESEM image of ZnO nanostructures (a) Sample S1 (10mM concentration), (b) Sample S2, (500mM) concentration.

Figure 1 shows the FESEM images of ZnO materials and the effects of precursor concentration on the morphology of ZnO. Figure 1 (a) shows the morphology of sample S1 where the precursor concentration was chosen to be 10 mM. The length of the nanorods found to be more than2.0 μm and the diameter of the ZnO nanorods are in the range of 60 to 80nm. Similarly, Figure 1 (b) shows the morphology of sample S2 where the precursor concentration was chosen to be 500mM and the micrograph shows, instead of nanorods, macro structure/ thin film like morphology was observed. The increase in precursor concentration increases the availability of nucleation center on the surface of the substrate thus induces different morphology.

Figure 2 (a) shows the morphology of sample S3 where the electro-deposition time was set for 5 minutes and Figure 2(b) shows the morphology of sample S4where the deposition time was set for 20 minutes. This result suggests that, with increase in electro-deposition duration, the rate of growth of ZnO nanorodson ITO substrate can be increased.

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In conclusion, tuning in morphology of ZnO material is possible using hydrothermal and electro-deposition technique by varying the precursor concentration and electro-deposition time respectively.

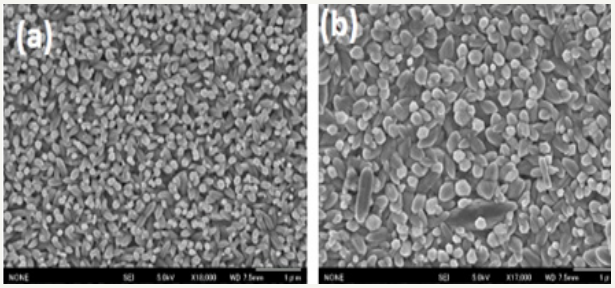

Figure 2: The FESEM image of ZnO nanostructures (a) Sample S3 (5min), (b) Sample S4, (20min) duration.

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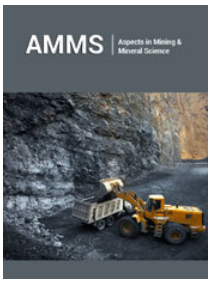

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