International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 11 • Issue 2 pp. 485-486 June 2019-Dec 2019 www.csjournals.com

Synthesis and Characterization of ZnO nanoparticle

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Abstract: One-dimensional ZnO nanostructures have great potential applications in the fields of optoelectronic and sensor devices. Therefore, it is very important to realize the controllable growth of one-dimensional ZnO nanostructures and investigate their properties.The main points for this thesis are not only to successfully realize the controllable growth of ZnO nanorods (ZNRs), ZnO nanotubes (ZNTs) and ZnMgO/ZnO hetero-structures, but also investigate the structure and optical properties in detail by means of scanning electron microscope (SEM), transmission electron microscope (TEM), resonant Raman spectroscopy (RRS), photoluminescence (PL), time resolved PL (TRPL), X-ray photoelectron spectroscopy (XPS) and Secondary ion mass spectrometry (SIMS).

Keywords: ZnO, nanostructures, nanorods, nanotubes.

INTRODUCTION

In recent years, ZnO has drawn a global research interest of researchers due to its unique electronic and optoelectronic properties [1]. The wide band gap (3.37 eV), large exciton binding energy (60 meV), high electron mobility, good transparency, high thermal and mechanical stability, large saturation velocity and low growth cost ensures its suitability for different optoelectronic and nanoelectronic device applications [2–4]. Nanostructured ZnO is an important material for many high technological applications including diodes, solar cells, sensors, actuators, transparent conducting films, photovoltaic devices and so on. Efforts have been devoted by some researchers to produce p-type ZnO thin films in order to fully utilize the potential of ZnO. But the difficulty in producing stable and high quality p-type doping of ZnO has led researchers to grow n-ZnO on different p-type substrates to ensure the usability of ZnO thin films in different photonic and optoelectronic devices. Different heterojunction devices such as n-ZnO/p-Si, n-ZnO/p-SiC, p-SrCu2O2/n-ZnO, p-ZnRh2O4/n-ZnO and p-NiO/n-ZnO have been reported in past [5–8]. Among these, n-ZnO/p-Si heterojunction is a suitable choice due to its cost effectiveness and suitability with mature silicon ICs.

EXPERIMENT (SYNTHESIS)

The zinc oxide nanoparticles were synthesized by wet chemical method using sodium hydroxide zinc nitrate as precursors and starch as stabilizing agent. Diff erent concentrations of starch were dissolved in 1000 ml of distilled water. Zinc nitrate, 29.748 g was added in the above solution. Then the solution was continuously stirred using magnetic stirrer to dissolve the zinc nitrate completely. After dissolution of zinc nitrate, 0.2 M of NaOH solution (25 ml) was added with constant stirring, drop by drop slowly touching the walls of the vessel. This reaction was allowed to continue for 2 Hours after complete addition of NaOH. After the reaction completed, the solution was then allowed to settle and the supernatant was then carefully discarded. The remaining solution was then centrifuged at 10, 000 X g for few minutes and the super natant was again discarded. The nanoparticles obtained were then washed 3 times by distilled water to remove the byproducts and the excessive starch bound with the nanoparticles. Then the nanoparticles were dried at approximately 80 degree C for overnight. While drying, zinc hydroxide was completely converted into zinc oxide.

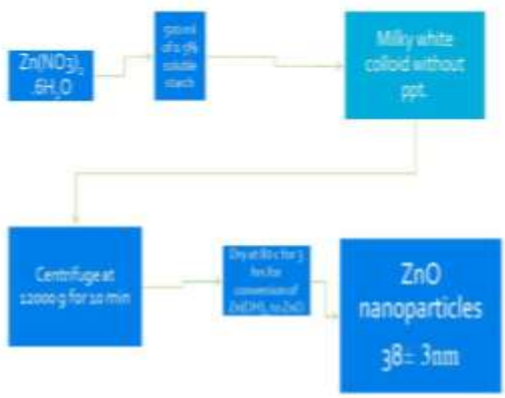


Figure 1: Schematic Diagram of ZnO synthesis

International Journal of Electronics Engineering (ISSN: 0973-7383
Volume 11 • Issue 2 pp. 469-480 June 2019-Dec 2019 www.csjournals.com

CHARACTERIZATION

The scanning electron microscope (SEM) is a type of electron microscope that images the sample surface by scanning it with a high energy beam of electrons in a raster scan pattern [9]. The electrons interact with the atoms to make the sample producing signals that contain information about the sample's surface topography, composition and other properties such as electrical conductivity. The types of signals produced by an SEM include secondary electrons, back scattered electrons (BSE), characteristic x-rays, light (cathode luminescence), specimen current and transmitted electrons. These types of signal all require specialized detectors for their detection that are not usually all present on a single machine.

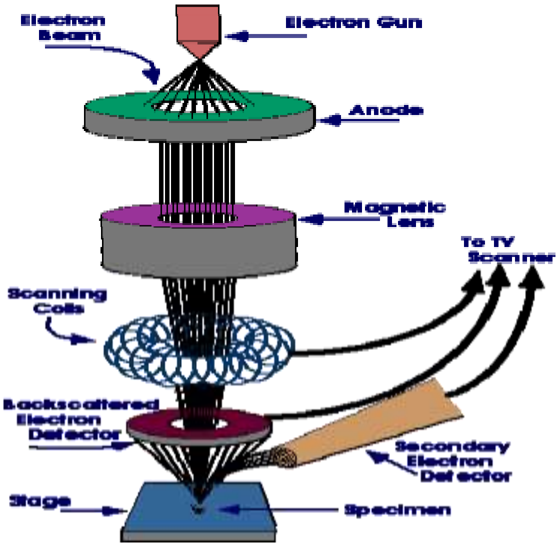
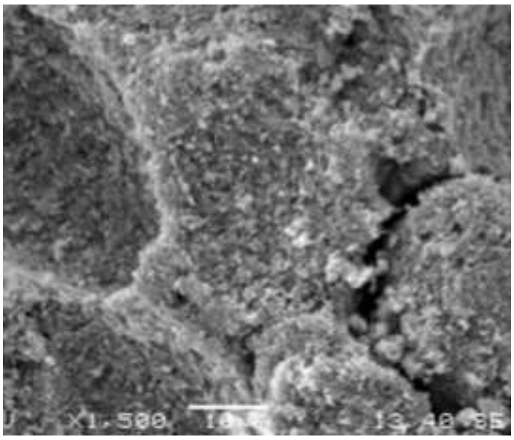


Figure 4.1: Schematic image of SEM

The schematic image of SEM is illustrated in Figure 4.1 in order to show how it works [10]. The SEM uses electrons instead of light from an image. A beam of electrons is produced at the top of the microscope by heating of a metallic filament. The electron beam follows a vertical path through the column of the microscope. It makes its way through electromagnetic lenses which focus and direct the beam down towards the sample. Once it hits the sample, other electrons such as back scattered or secondary are ejected from the sample. Detectors collect the secondary or back scattered electrons, and convert them to a signal that is sent to a viewing screen similar to the one in an ordinary television, producing an image.



SEM Analysis

CONCLUSION

Zinc Oxide was synthesized by precipitation method from Zinc Nitrate and soluble starch using Sodium Hydroxide. A white colour ZnO powder was obtained. Characterization study was carried out using SEM. SEM was used for micro structure study and to find agglomeration. Nano-particles showed small amount of agglomeration. This paper intends to develop an innovative and more appropriate nano-particles synthetic procedure and characterisation under favourable conditions that helps in biological systems.

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