

Growth of rear earth metal ion doped ZnSe thin film by chemical bath deposition method

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Abstract

Er doped ZnSe thin films were deposited onto glass substrate by using simple chemical bath deposition method (CBD) in aqueous alkaline medium the bath temperature for 70°C. Chemically deposited ZnSe:Er thin films were annealed at 300 and 400°C in an open atmosphere. Composition of thin films structural and photoluminescence properties were characterized by using X-ray diffractions (XRD) and photoluminescence spectroscopy (PL). XRD study confirmed that 300°C annealed thin film increase crystalline nature and appear ZnO phase, when the films were annealed about 400°C Se metal peaks are presented.

Keywords: Non-conducting glass substrate, ZnSe:Gd thin films, optical transmission and annealed.

1. Introduction

In the last few year have been increase interest in the development of rear earth metal ion doped II-VI semiconductor material because their useful potential application in optoelectronic devices such as red, blue and green light emitting diodes, photovoltaic, laser screen, thin film transistor and photoelectrochemical cells [1-6]. Most of the research in this area of thin film deposition techniques is very much important towards different type of material and doped compound that are used. The rare earth metal doped semiconducting materials have been much potential application, wide band gap and suitable application in electroluminescence. Luminescence efficiency and quantum size effect of metal doped semiconducting materials intensively studied [7-11]. Rear earth metal doped zinc selenide semiconducting material which

acceptable to predict size dependent properties and conversation interaction of wide range of semiconducting material regardless of shape, size, composition and synthesis process [12-19]. In this size regime, the semiconductor energy level become more from each other, in this crystal size is smaller and the effective band gap is increases [20-26]. The wide band gap value is 2.8eV and large binding energy is 21Mev for bulk ZnSe, it make ideal choice of inorganic semiconductor shell and doped semiconducting nanoparticles [27-32]. Therefore rear earth element doping is very much effective approach to improve the particle size and potential application in an optoelectronic device such as optical switches, nonlinear optics and colour thin film electroluminescence devices [33-35].

The verity of deposition methods are used to Zinc selenide thin film deposition process such as molecular beam epitaxy [9], evaporation [36-40], chemical vapour deposition [11], spray spirally[12] and chemical bath deposition method [13] etc. Among them chemical bah deposition method (CBD) provide suitable method because, it's is low cost, easy processing method, good surface coverage, no requirement of sophisticate instrument, low processing temperature and non-polluting properties.

In the present work for the first instance preparation of different mole concentration of Gd doped ZnSe thin films were deposited onto non conducting glass substrate by using the chemical bath deposition method at an alkaline medium[41-45].

2. Experimental section

The chemical bath deposition method was performed in an aqueous alkaline medium, where using commercially available non-conducting glass substrate. The substrate cleaning is significant role in the thin film deposition process. The sodium selenosulfate (Na_2SeSO_3)

solution was prepared by using 0.425g of selenium metal (99.99%) powder and 0.1375g sodium sulphite in 100 mL of double distilled water and the above solution reflux for an about 7 h at 90 °C.

The 100 mL of reaction solution obtained by mixing 10 mL of 0.5M zinc sulphate, 13 mL of 88% hydrazine hydrate solution, 10mL of (1, 3, 5 and 7%) Samarium (III) acetate hydrate solution, 5 mL of 25% ammonia solution, 2M of sodium selenosulphate solution and sufficient amount of double distilled water. Then, the above reaction solution is stirred at ambient conditions for few minute. The solution evaporation was avoided to the beaker was sealed. The Gadolinium metal doped thin films were achieved by chemical bath deposition at 70°C for 1h. The deposited substrates were subsequently removed from reaction solution. The obtained deposited film washed with double distilled water, dried in room temperature few minutes.

3. Result and discussion

3.1. Morphology study

The surface morphology of thin films were premeditated by using scanning electron microscopy (SEM) is an excellent method to study the morphology of sample. The SEM image of Sm doped ZnSe thin films were deposited on non-conducting glass substrate with different mole concentrations of as-deposited thin films are shown in Figure 1. The films were very well spherical particle, pinhole free and no voids are formed onto substrate surface. The ZnSe:Er thin films consisting of different size and morphological of spherical particles are densely backed glass surface very nicely. As-deposited Gd doped thin film each particle is a well formed particle and covered on substrate surface without pinhole and creak is shown in Figure 1.

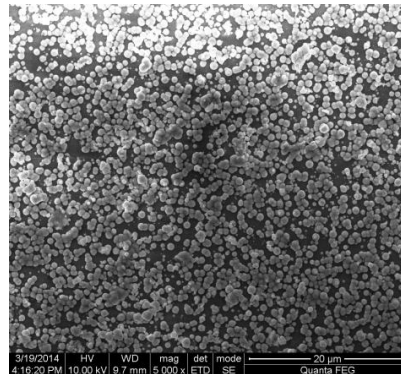


Figure 1. SEM images of Er doped ZnSe thin film

3.2. Structural analysis

The structure characterization of Sm doped ZnSe thin films were studied by using X-ray diffraction technique. Figure 2 are shows the XRD patterns of Er doped ZnSe thin films. The increasing impurity level about 3% hexagonal wurtzite phase only presented.

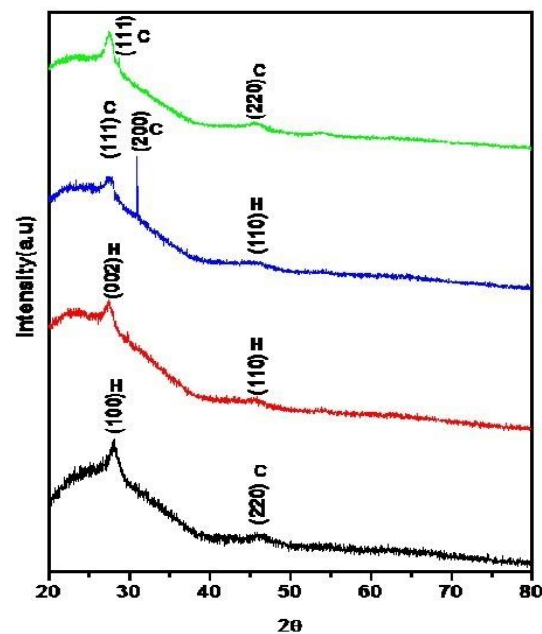


Figure 2. XRD patterns of Er as-doped ZnSe thin films

When film was doped with 5% mole concentration of Er solution the cubic zinc bland with hexagonal wurtzite nature of diffraction peaks are appeared it's shown in figure 4 (5%). The thin films were annealed at 300°C the crystalline nature of film is increased with cubic zinc bland and hexagonal nature of peak are appear and ZnO phase, it is shown in Figure 2. The lattice constant "a" determine for all prepare sample from high intense diffraction peak of (hkl) plane using the following Bragg's equation.

$$\text{Lattice constant (a)} = d (h^2 + k^2 + l^2)^{1/2} \quad (1)$$

where hkl is the miller indices and d is the inter plane spacing of the atomic planes. The calculated lattice constant values are agreement with the sanded values. The reason may be annealed temperatures affect the surface of all prepared thin films.

4. Conclusion

The Er doped ZnSe thin films were deposited onto non-conducting glass substrate by chemical bath deposition method. The effected of Sm solution concentration and different annealed temperature of deposited thin film on optical, structural and morphological properties were studied. From the scanning electron microscopy study, the prepared thin films have been achieved large number of uniform spherical particles. The XRD studies reveal that the crystalline nature of thin films has cubic and hexagonal structure.

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