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# Optical and Electrical Properties of Neodymium Doped Cadmium Selenide Nanocrystalline Thin Film

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***Abstract:** A well adherent Neodymium (Nd) doped CdSe nanocrystalline thin film was grown onto the glass substrate by chemical bath deposition (CBD) method. The deposition temperature and time is 80°C and 6 h, respectively. Crystal structure was determined by XRD. The emission spectra of photoluminescence (PL) for CdSe:Nd nanocrystalline thin film observed at 601nm. The band edge luminescence is responsible for PL.*
***Keywords:** CdSe: Nd nanocrystalline thin film, Photoluminescence, Electrical properties, Solar Cell*

## I. INTRODUCTION

II-VI Semiconductor are used in many applications such as solar cell, LED, . Semiconductor thin films give better results over microcrystalline thin film. Development of nanocrystalline thin film reduces the size of the electronics devices and enhances the efficiency. Uniform thin film produced by thermal evaporation [1], successive ionic layer adsorption and reaction (SILAR) [2], Physical vapour deposition [3], Electrochemical [4], Photochemical [5], Metal oxide chemical vapour deposition (MOCVD) [6], Photo electrochemical [7], Electron beam evaporation [8] are very costly. High manufacturing cost increases the prices of the devices. To reduce the cost of the devices it is essential to adopt a very cheap manufacturing method of thin film preparation. Chemical bath deposition (CBD) method is very cheap and easy for the development of II-VI semiconductor nano crystalline thin film last decades. It produces stable, adherent and uniform thin film on substrate. By changing the key parameters of deposition like deposition temperature, concentration of ammonia, etc. change the thickness of thin films. the past 3-4 decade, scientist are very much pay attention to increase the performance of thin film. It is found that doping of transition metals and rare earth ions enhance the properties like optical and electrical of nano crystalline thin film[9].CdSe is II-VI semiconductor and have many applications which includes; γ-ray detector [10], thin film transistors [11-12], photoconductors [13-18], sensors [19-20], photonic devices [21-25], memory switching devices [26-29], acousto-optic reflector [30], hydrocarbon detectors [31] and in optical fibres [32-33].The present paper reports the optical and electrical properties of Nd doped cadmium selenide nanocrystalline thin film.

## II. EXPERIMENTAL

Cadmium acetate ($Cd(CH_3COO)_2$), sodium selenosulphate ($Na_2SeSO_3$), triethanolamine (TEA), and ammonia are the precursor materials for the preparation of nanocrystalline thin film. The sodium selenosulphate was prepared by refluxing 4 gm of selenium powder with 50 gm of sodium sulphite ($Na_2SO_3$) in 250 ml of doubled distilled water for 6 hours at 80 °C. The bath mixture was prepared in a 100ml beaker by adding aqueous solution of cadmium acetate, 2ml TEA (triethenolamene), 10ml of 30% ammonia solution and 7ml of sodium selenosulphate. The reaction mixture was maintained at a temperature of 70°C for deposition. Ammonia solution was added in the mixture for adjusting the pH to 11. Substrate coated with CdSe films was removed from bath after a deposition time of 6 hours. 2 ml (0.01M) neodymium nitrate ($Nd(NO_3)_2$) were added into the original mixture. Deposited substrates were washed with doubled distilled water and allowed to dry under ambient condition before film characterization. Deposited thin films were uniform in nature, well adherent and red-orange in color.
Cu Kα radiation source (λ = 1.5406 Å and 2θ range = 10° - 120°). Photoluminescence (PL)spectra was measured by Shimadzu RF-5301 spectrofluorometer.

## III. RESULTS AND DISCUSSION

The crystal structure of deposited thin films was determined by X-ray diffraction technique. The obtained peaks were matched with JCPDS files No. 19–191 and 65–2891, and were found to match with planes of cubic (zinc blended type) structures. The X-ray diffraction (XRD) spectra for Nd doped CdSe thin film is shown in Fig.1. As shown in Fig.1 the diffraction studies exhibit (2θ vs I curve) the highest intensity reflections along the (111) plane and two weak reflections along the (220) and (311) planes. These results indicate that the films prepared were crystalline and composed of CdSe in cubic phase with preferred orientation along the (111) plane.

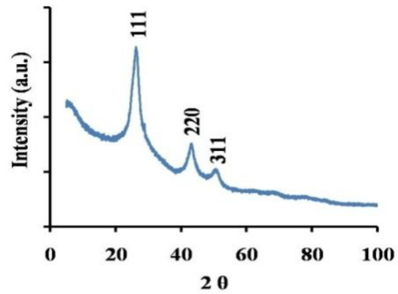


Fig.1 XRD pattern of CdSe: Nd (2ml, 0.01M) nanocrystalline thin films.

Fig.2 shows the photoluminescence (PL) spectra of pure CdSe:Nd nanocrystalline thin films obtained with an excitation wavelength of 395 nm. It shows the emission at 601nm for pure and CdSe:Nd nanocrystalline thin films. No shift observed in the position of PL emission spectra for various concentration of and neodymium nitrate doped thin films. Only intensity variation is observed due to trap of electron in presence of solution of $Nd(NO_3)_2$ in the prepared material. This might have happened because an impurity energy level is formed below the conduction band of pure CdSe. It was reported that this kind of band-edge luminescence can be caused by the recombination of exactions or shallow trapped electron–hole pairs [9,10].

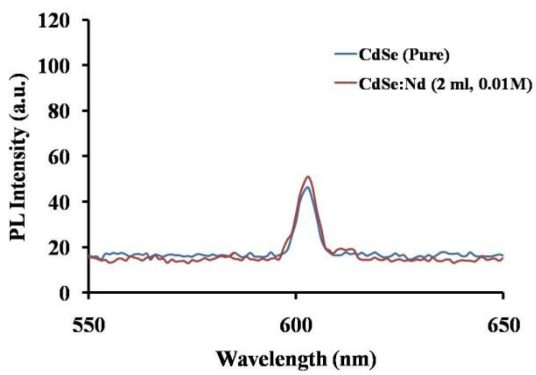


Fig.2 Photoluminescence spectrum of pure and CdSe:Nd (2ml, 0.01M) nanocrystalline thin films.

Fig. 3 shows I-V characteristics curve obtained from the pureand CdSe:Nd nanocrystalline thin films. The contact techniques are most widely used for the measurement of resistivity. In the present work silver paste was used to make ohmic contacts of pure, and CdSe:Nd nanocrystalline thin films. CdSe:Nd (2 ml, 0.01 M) show low dark resistance.The prepared films are have sufficient potential to be used for solar cell applications.

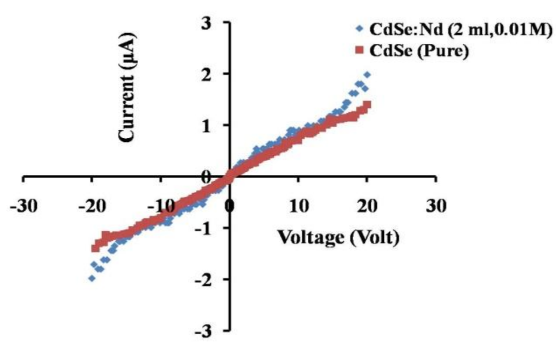

Fig.3 Current–voltage (I–V) characteristics curve obtained from pure and CdSe:Nd (2ml, 0.01M) nanocrystalline thin films deposited on glass substrate.

## IV. CONCLUSIONS

The pure and CdSe:Nd nanocrystalline thin films were prepared by chemical bath deposition method. X-ray diffraction pattern of pureand CdSe:Nd nanocrystalline thin films clearly show the film is sphalerite cubic (zinc blende type) structure. Photoluminescence spectra of pure and CdSe:Nd nanocrystalline thin films were recorded and the strongest PL intensity is found at 601 nm. This might have happened because of another energy level formed between the valence band and conduction band of pure CdSe. The prepared films are having sufficient potential to be used for solar cell applications.

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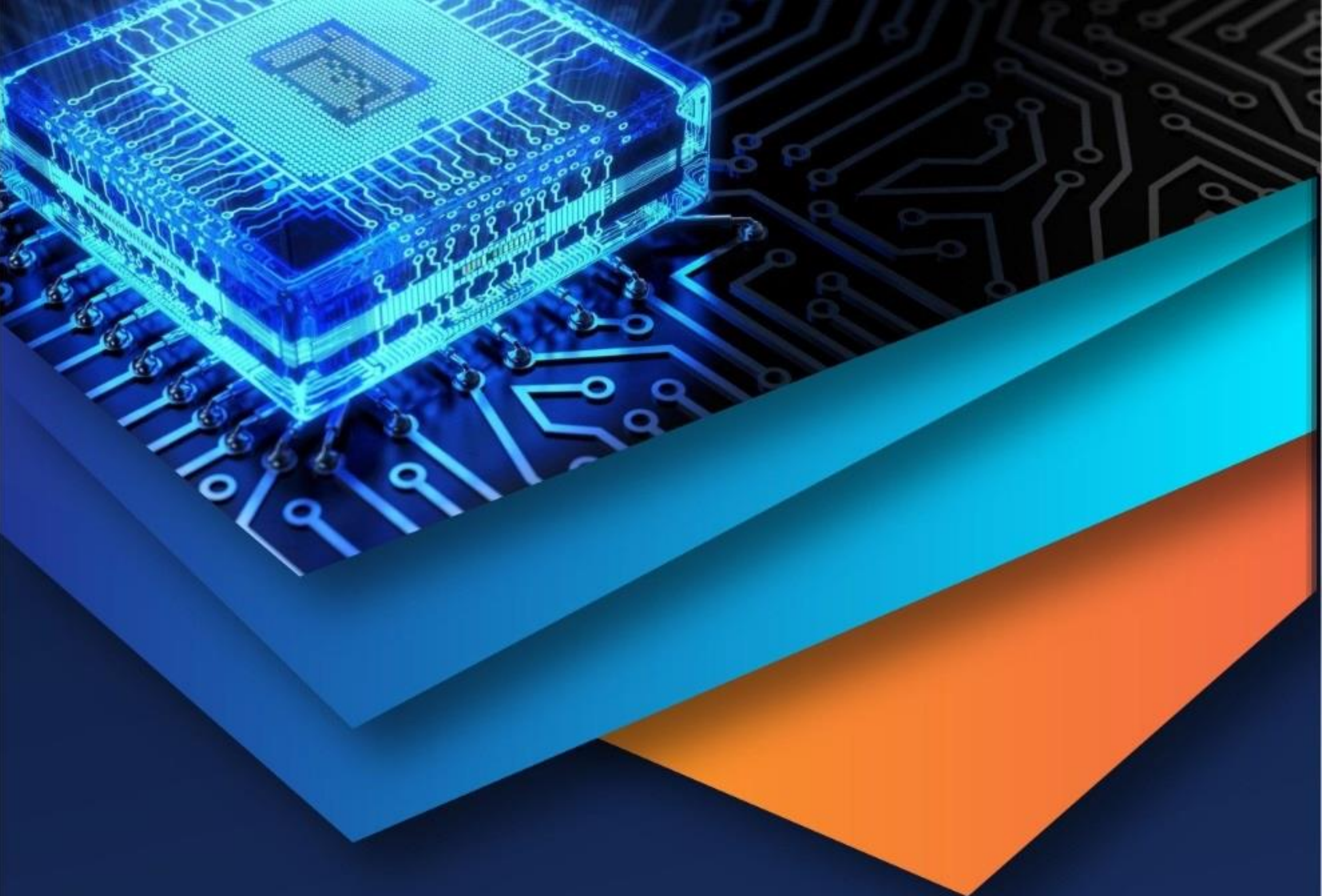

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