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STUDIES ON PHOTOSENSING AND PHOTOLUMINESCENT PROPERTIES OF SPRAY PYROLYZED CDSSE THIN FILMS

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ABSTRACT
Cadmium Sulpho selenide (CdSSe) thin films were prepared by chemical spray pyrolysis technique. Cleaned non conducting glass slides were used as substrates. The precursors used were Cadmium chloride and selenourea for deposition. Various parameters to synthesize the CdSSe thin films were the surface temperatures, distance between surface nozzle and substrate heater and the pressure were optimized initially out of which substrate temperature was kept constant at 275^0 C $\pm$ 5^0 C, distance between spray nozzle and heater was kept 27 cm. The as deposited thin films of CdSSe were annealed in the nitrogen atmosphere for half an hour before characterization. The nitrogen annealed thin CdSSE films were studied for Photosennsing and Photo luminescent properties. Present investigation describes the effect of increase in incident intensity of li8ght on the CdSSE thin films. The light intensity was varied by using the incandescent bulb, maximum photosensitivity of CdSSe thin films was found to obtained 42000.In Photoluminescence study the peaks observed in were in close agreement with the reported peaks of the photoluminescence spectra for CdSSe thin films.. The blue shift observed in PL emission spectra corresponds to nanocrystalline effect. This indicates that the nitrogen annealed CdSSe thin films Show the best photosensitivity as well as photo luminescent in nature.

KEYWORDS: CdSSe thin films, Spray Pyrolysis, Photosensitivity, Photoluminescence

INTRODUCTION
Cadmium Sulphide (CdS) and Cadmium Selenide (CdSe) are becoming an emerging prominent materials in recent years because of their potential technological importance. The synthesis of binary metal chalcogenide of II-VI semiconductors in thick film, thin film, and nanocrystalline form has been rapidly growing area in the material research due to their important non-linear optical, photo luminescent and other physical and chemical properties [1]. It is found that the band gap of CdSe material is 1.7 eV where as of cadmium Suipphide is 2.4 eV,both these are suitable for solar spectrum. This feature makes these materials useful for solar energy conversion in photovoltaic form [2]. These materials can be synthesized in thin film form from several methods like Thermal evaporation [3, 4], Sputtering, ion, Chemical bath deposition[5], Flux Techniques[6], Molecular beam epitaxy[7], spray Pyrolysis[8].etc., Out of these, spray Pyrolysis is the most promising for producing inexpensive thin films of good quality with various dopents over a large area.
Here the efforts were taken to synthesize the ternery material of Cadmium sulphoselenide by altering the concentration of sulphur and selenium component for the study of effect of the concentration for the change in energy gap and its effect on photosensing and photoluminescent performance of the material
The aim of this work is to produce CdSSe thin films of equal sulphur and selenium concentration by spray pyrolysis and to study photo sensing and Photo luminescent properties.

MATERIALS AND METHODS
The CdSSe films were prepared by spraying equimolar mixture of aqueous solutions of thiourea as source of sulpher, selenourea as source of selenium and cadmium chloride Cd (Cl_2) each of 0.05M as starting solution in deionized water. The proportions of the precursors are maintained such that cadmium precursor is 50% of the composition and remaining 50% composition is of equal parts opf sulpher and selenium precursors. The substrates used were insulated microscopic plane glass slides of area 7.5 cm x 2.5 cm, were heated at the optimized temperature of 275^0C $\pm$ 5^0C. The following reaction was taken place at the surface of heated substrate.
for synthesis of CdSSe thin film by spray Pyrolysis. Following reaction taken place during the synthesis of CdSSe thin film by Spray pyrolysis

$$CdCl_2 + (NH_2)_2CSe + (NH_2)_2CS + 2H_2O \longrightarrow CdSSe + 2NH_4Cl\uparrow + CO_2\uparrow$$

The as deposited thin films were annealed at 500^0C in nitrogen atmosphere. For 30 minutes.
The major preparatory parameters in the spray pyrolytic process are substrate temperature, the concentration and mole ratios of starting solutions. The spray rate was 1.5 ml/min and the distance between the spray nozzle and substrate was 27.5 cm. After deposition, the films were first cooled to room temperature. The texture of the films was observed under Epignost microscope. The films were observed to be quiet uniform and free from pinholes throughout the sample.

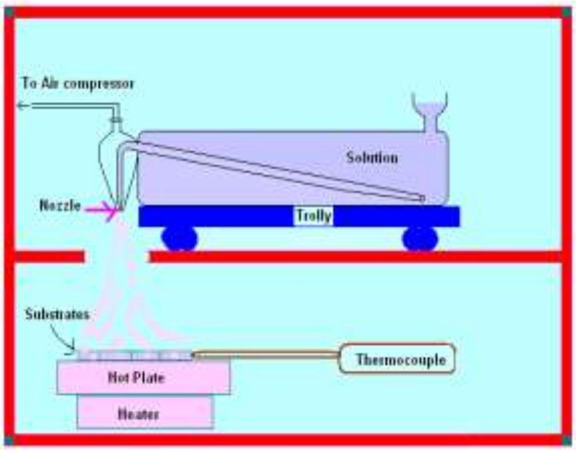


Fig -1 ***Experimental Set up of Spray pyrolysis technique***

Photo sensing performance
When light radiations incident on the semiconducting sample, excess electron hole pairs are created in semiconducting materials, thereby results in increase in conductivity. This gives important applicability to the material as sensors of radiations. During present investigation, the samples were illuminated by 100W tungsten filament lamp as source of light. Incident from 12 cm distance from as deposited CdSe thin films, and the photosensitivity was measured by the equation as shown below:

$$\text{Photosensitivity } (P_s) = \frac{I_{illuminated}}{I_{dark}}$$

Intensity of the light radiation was varied by dimmerstrat. The observations were taken for the intensity of light radiations at 60 V a. c. to 230 V a. c. mains by the step of 10 V a. c.

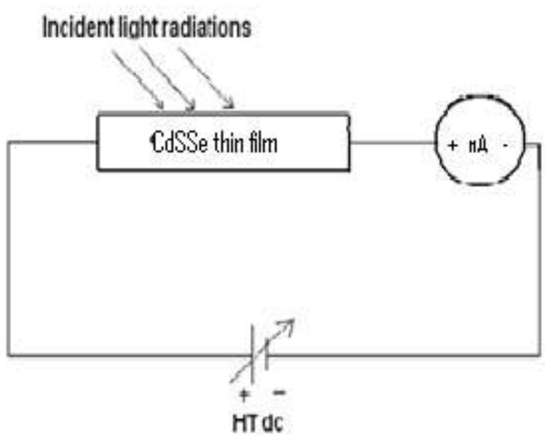
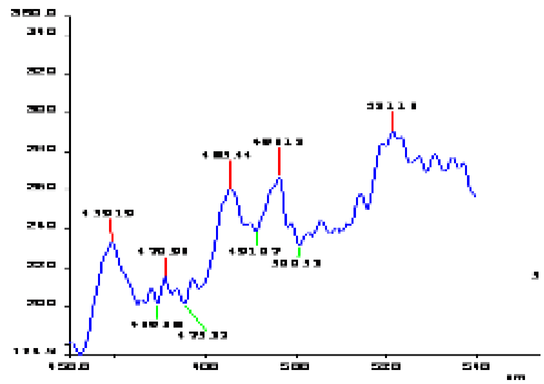


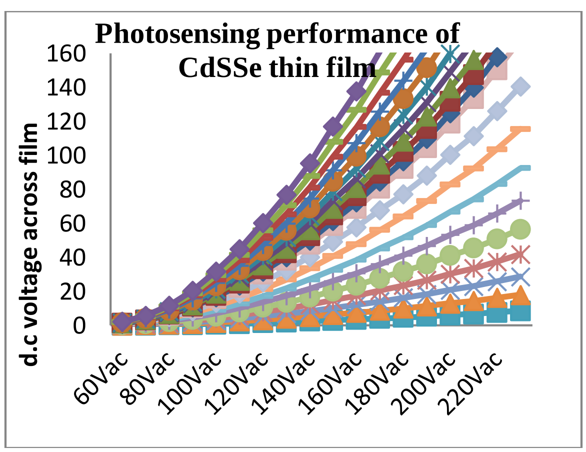
Fig. 2 depicts the experimental setup of measurement of photosensitivity. Light radiations were allowed to incident on CdSSe thin films giving the photosensitivity of the materials. One can customized the photo sensing performance of the thin films by arranging the unimolecular layers of nanostructured materials

The photosensitivity performance of the CdSSe thin film was observed to be maximum, at the 150 Vdc across the film. There are imperfections created in the CdSSe thin film structure. These imperfections associated with the incorporation of atoms of elements other than the host elements can be termed as impurity imperfections or simply impurities. The imperfections associated with structural deviations from atomic arrangement in the compositions create defects in the semiconducting materials sample. This defect category of the imperfections includes vacancies, interstitial atoms, dislocations, etc. there is increasing experimental evidence that similar electronic defects can be caused by both impurities and defects [9,10].

Photoluminescence performance



Optical excitation and PL emission spectra under 389 nm excitation of thin film recorded at room temperature and indicated in figure 4. Figure shows that there intense band in green region at 521 nm, and less intense in blue region at 485 nm. This is in close agreement of the work of R. S. Singh et. Al[11] Figure showing the large stokes shift between optical absorption spectrum and Pl emission band may be attributed to presence of one deep trapping site and electron hole recombination via trap stateor imperfection site (12) Such lattice phenomena is observed in nanomaterials , This predicts the spray deposited CdSSe thin film in present investigation is nanocrysatalline thin film. It is also reported that in nanocrystalline thin films, the deep states are mainly associated with stiochiometric defects or presence of external atoms like oxygen[13]



Figs. 3 indicate that photoresponce of the sample is increases gradually with a. c. voltage, (intensity of light radiation) may be attributed to knocking of charge carriers from the base materials, releasing them from the bulk of the materials and makes available the charge carriers to carry the current independently, which causes to enhance the conductivity of the films. Initially, the sensitivity was observed to increase by negligibly small amount, and then slowly and thereafter the sensitivity increases suddenly with intensity of light radiations. This may be attributed to the creation of EHPs by light agitation. This increases the carrier concentration in the material, which helps in carrying the current, which constitutes the rise of sensitivity. The structural and morphological characterizations are reported elsewhere.

RESULTS AND DISCUSSION

Photo sensing performance of the CdSe thin films shows enhanced photo sensing properties and we can tailor any value of photo sensing property from this material for desired intensity of light. Photo luminescent spectra show the major peak at 485.44 and 511.16, which are in close agreement of the reported peaks of 485nm and 521nm. [14] This indicates that the material has good photo luminescent properties and thus the as formed material is good for phosphor applications

SUMMERY

Results can be summarized as follows.

1) Photo sensing properties of the CdSSe thin films indicates the response of the synthesized material to the incident radiations for equal concentration of sulpher and selenium.

2) A Photoluminescence spectrum shows the peaks in the close agreement of the reported values of CdSSe material.

CONCLUSION

- The spray pyrolysis technique is most promising technique for producing large area as well as large number of inexpensive films of good quality.
- Pure CdSSe showed photosensitive and photo luminescent nature.
- Acceptor levels incorporated as localized levels in the band gap of CdSSe.
- CdSSe would very useful for the fabrication of solar cells and phosphor material.

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