Preface

The present thesis deals with photoconductivity and luminescence studies of some chemically deposited films of II-VI compounds in the mixed form. Photoconductivity is concerned with the enhancement of the electrical conductivity of the matter due to irradiation of photons. It is produced by the motion of carriers created by absorbed radiations (Bube, 1960). Photoconducting materials have got tremendous technological applications e.g. xerography, image intensifier and detection of optical signal through electronic processes etc.

The research activity in the area of photoconductivity basically concentrates on:

- to prepare very sensitive photoconductors, which have practical applications,
- as a tool in the understanding of solids.

Photoluminescence is the process of cold emission of light in visible or near visible region due to excitation by photons. Technologically such studies are important because of their applications in lamp-phosphors and display devices such as CRT and TV screens. While in photoconductivity, the enhancement of conductivity is caused due to movement of carriers like electrons or holes in their respective bands, luminescence appears to be caused due to recombination of electrons and holes, which may take place in terms of either band to band transition or band to impurity transition. Thus the two
phenomena appear to be opposite to each-other. In other words, if one is dominant, the other is expected to be reduced and vice-versa.

The present thesis entitled “Photoconductivity and Luminescence Studies of Some Chemically Deposited Films ” concerns mainly with the variety of studies related to sensitization effect due to incorporation of trivalent rare-earth impurities. Regarding technological application, sensitization of photoconducting response, which is obtained experimentally due to the variation of a number of controlling parameters, is an important aspect of study. The total work included in this thesis is divided into six chapters.

The first chapter deals with the introduction of the subject. It contains a brief discussion of various parameters affecting photoconductivity and photoluminescence. Problem undertaken for the present investigation is also discussed in this chapter.

The second chapter deals with the theories used in understanding the phenomenon of photoconductivity and photoluminescence. Theoretical details regarding lifetime, mobility, photoconductivity gain, demarcation and Fermi levels and different models, used to explain these phenomena, are covered in this chapter.

The third chapter concerns with the method of film preparation and various measuring arrangements used in the present investigation. This chapter includes summary of the important methods used in the preparation of photoconducting materials. Summary of different methods of thickness measurement of films is also given. Along with these,
methods of film preparation and thickness measurement, used in the present investigation, are discussed. The films were prepared by taking Cd(S-Se) as base material, CdCl₂ as flux, and Sm and Dy separately as impurities. The films were prepared on glass substrates in water bath at 60°C and at room temperature also. The film-thicknesses were determined by the optical interference method. The various experimental arrangements used in the different studies of the present work are also discussed. The different studies included in this thesis are: photoconductivity rise and decay studies, optical absorption spectral studies, photoluminescence emission spectral studies, XRD and SEM studies.

Results of variation of dark current with voltage, and rise and decay of photocurrent are presented in the fourth chapter. Values of lifetime, mobility of carriers and trap-depths evaluated from the analysis of rise and decay curves are also tabulated in this chapter. Highest gain of the order 10⁶ has been found. The values of trap depths have been found to increase due to addition of impurities. Effect of annealing and irradiation of the films under visible radiations have been studied. It has been noticed that the values of life-time (τ), and mobility (μ) increase due to presence of impurities (Sm and Dy). Intensity of the excitation-source on the samples has been varied by changing the distances between the film and the source, and the rise and decay curves have been studied for different Cd(S-Se) films.
In the fifth chapter, results of optical absorption spectra and photoluminescence emission spectra are presented. From the behaviour of the absorption coefficient, band-gap values of different materials are evaluated. Due to mixing of CdSe, band gap values are found to decrease. Photoluminescence emission spectra have given the nature of the spectral studies for undoped and doped materials. PL emission spectrum of CdS shows maximum peak intensity at 511 nm. PL emission spectra of Cd(S_{1-x}Se_x) films for different value of x, are found to consist of two peaks, one fixed at 494 nm and the other shifting to higher wavelength with increasing proportion of Se. Maximum PL emission is observed for 0.7:0.3 combination of CdS to CdSe and hence this combination was used for further PL studies. PL emission spectra of Cd(S_{0.7-Se_{0.3}}) films consist of two peaks that can be deconvoluted into two Gaussian curves one at 494 nm and the other at 559 nm. In the PL emission spectra of Cd(S_{0.7-Se_{0.3}}):CdCl_2 films for different concentrations of CdCl_2, the highest emission appears at a volume of 2 ml of CdCl_2. Therefore, this optimum concentration of CdCl_2 was used for studies of different concentration of impurities. It is observed that out of the different molar concentrations of the nitrates of Sm / Dy used, (0.001M; 0.005M; 0.01M and 0.05M), highest emission appears corresponding to 0.01M concentration. Highest PL emission is observed at 2ml volume of Sm(NO_3)_3, with one peak remains fixed at 494 nm and three new peaks appear at 563, 595 and 614 nm, as compared to the PL spectra of the base material. In presence of Dy, highest PL emission is observed at 2 ml volume of Dy(NO_3)_3, with the peak at 494 nm, the other peaks observed are at 484 nm and 573 nm respectively.
The sixth chapter concerns deals with the characterization studies. XRD studies have shown prominent peaks of CdS and CdSe. Some peaks of CdCl₂ and some peaks of Sm are also assigned. The crystal structures are found to be a combination of cubic and hexagonal phases. Lattice-constants, particle size, strain and dislocation-densities are also determined and their nature have been discussed. SEM studies have been used to study the topographical features. Formation of cluster of particles along with ball and needle type structure is found. The latter are related to the layered type growth of films.

In the end, future scope of the present work has briefly been discussed.

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