ABSTRACT OF THE THESIS

CHAPTER - I

In this chapter the phenomenon of mechanoluminescence is described. The review of work on the ML of phosphors is discussed and emphasis is on the mechanism of ML excitation. The recent trends of research on the ML is described and finally the objectives of the present investigations are clarified. It is mentioned that the main interest of the present investigation are

(i) To prepare intense mechanoluminescent phosphors of Cu, Ag, Mn and Au doped CdS and CdSe (cubic) and to understand the impact velocity dependence, activator concentration dependence, temperature dependence and time dependence (kinetics) of ML in these phosphors.

(ii) To understand the mechanism of ML excitation in doped phosphors of CdS and CdSe.

CHAPTER - II

This chapter deals with the description of phosphors, composition of phosphors and general requirement for the preparation of phosphors. The method for preparing cubic CdS and CdSe doped phosphors are described. The phosphors CdSe: Mn, CdS: Au, CdS: Mn, CdS: Ag and CdS: Cu were prepared in nitrogen atmosphere by firing at 900°C for forty five minutes, having activator concentration of Cu, Ag, Mn and Au from $1 \times 10^{-1}$ to
Sodium Chloride was used as a flux for preparing the phosphors. Then the phosphors were quenched to room temperature. The phosphors prepared by this method were found to behave fairly consistent in responding to their ML emission.

CHAPTER - III

In this chapter the phenomenon of mechanoluminescence (ML) in CdSe:Mn, CdS:Au, CdS:Mn,CdS:Ag and CdS:Cu (cubic) phosphors is described. When the ML is excited impulsively by the impact of a load on the phosphors the ML intensity increases with time, attains a maximum value and then it decreases. In the ML intensity versus time curve, the peak increases and shifts towards shorter time values with increasing impact velocities and the rising portion of the curve follows the relation $I = I_1 \exp(\lambda_1 t)$ and the decaying portion follows the relation $I = I_2 \exp(-\lambda_2 t)$ where $I_1, I_2, \lambda_1$, and $\lambda_2$ are constants. The total ML intensity $I_T$ is defined as the area below the ML intensity versus time curve. Initially $I_T$ increases with impact velocity $V_o$ of the load and then it attains a saturation value for higher values of impact velocities which follow the relation $I_T = I_T^0 \exp(-V_c/V_o)$ where $I_T^0$ and $V_c$ are constants. Total ML intensity increases linearly with the mass of the phosphors for higher impact velocities. The ML intensity $I_m$, corresponding to the peak of ML intensity versus time curve increases linearly with the impact velocities. The time $t_m$ is found to be linearly related to $1000/V_o$. The ML intensity attains an optimum value
for the activator concentration $1 \times 10^{-3}$ in CdSe:Mn, CdS:Au, CdS:Mn, CdS:Ag and CdS:Cu phosphors. CdSe:Mn phosphors is found to be the most intense mechanoluminescent and CdS:Cu phosphors exhibit comparatively weak ML.

**CHAPTER IV**

This chapter deals with the mechanoluminescence and photoluminescence spectra of CdS and CdSe doped phosphors. It is found that PL spectra is similar to ML spectra of the phosphors within the limit of experimental errors. The activator concentration for which the PL intensity attains an optimum value is $1 \times 10^{-3}$ and the ML intensity attains an optimum value for $4 \times 10^{-3}$ concentration. The PL spectra of CdSe:Mn, CdS:Au, CdS:Mn, CdS:Ag and CdS:Cu phosphors have peak centered at 750nm, 760nm, 750nm, 747nm and 760nm respectively at an activator concentration $4 \times 10^{-3}$. It is found that for a given phosphor the critical activator concentration for which the PL intensity attains an optimum value is always greater than that for the ML intensity. The mechanism of PL excitation and concentration quenching are discussed for the Cu, Mn, Ag and Au doped phosphors of CdS and CdSe. It is concluded that the centres which are responsible for PL emission should also be responsible for the ML emission.

**CHAPTER V**

In this chapter the effect of temperature on the mechanoluminescence of doped phosphors of CdS and CdSe are
described. It is found that the ML disappears beyond a particular temperature. The temperature dependence of ML intensity follows the relation \( I = I_T^0 (1 - T/T_C)^n \), where \( I_T^0 \) is a constant, \( n \) is the slope of \( \log I_T \) versus \( \log (1 - T/T_C) \) plot which lies between 0.90 and 1.6 and \( T_C \) is the temperature at which ML disappears. It is found that the ML intensity in CdSe : Mn, CdS : Au, CdS : Mn, CdS : Ag and CdS : Cu phosphors disappears at 322°C, 277°C, 267°C, 264°C and 253°C.

CHAPTER - VI

This is the last chapter of the thesis in which an attempt is made to correlate different results obtained in the present investigation from the ML and PL studies of doped phosphors of CdS and CdSe. For explaining the ML excitation of phosphors, different models are discussed with regard to their suitability. It is concluded that the piezoelectricity during fracture of phosphors may give rise to ML. The correlation among PL and ML of CdS and CdSe doped phosphors are also described. It is shown that although the intense electric field produced during mechanical deformation of solids excites the luminescence, it also increases the probability of non-radiative transitions and therefore the critical value of the activator concentration for which ML intensity attains an optimum value is less than that for the PL intensity.
At the end of the chapter, the various conclusions drawn from the studies on the mechano- and photoluminescence of CdS and CdSe doped phosphors are summarized. It is found that the ML emission is comparable to other well documented and better understood luminescence phenomenon. The difference is in the process of excitation of electrons, while relaxation with photon emission involves the same transition centres as in other types of luminescence.