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First order kinetics in thin films of KCl using thermo luminescence technique

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ABSTRACT

The thermo luminescence of several thin films of KCl has been studied. The thermo luminescence of thin films KCl shows a prominent glow pick at 462 K. Chen's Formulae were used extensively to calculate the trapping parameters for observed glow peaks. It has been concluded that the thermo luminescence of thin films of KCl is monomolecular processes and it obeys the first order kinetics.

PACS: 78.60.Kn, Thermo luminescence; 61.72.J- Point defects and defect clusters.

Keywords: Characterization, Doping, First order Kinetics, thermo luminescence

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INTRODUCTION

Luminescence is the phenomenon in which a substance absorbs energy in some form or the other and reemits a fraction of it as visible or near visible radiation [1].Thermo luminescence is a form of luminescence that is exhibited by certain crystalline materials, such as some minerals, when previously absorbed energy from electromagnetic radiation or other ionizing radiation is re-emitted as light upon heating of the material. The phenomenon is distinct from that of black body radiation.

Thermo luminescence has become an important tool to study the color centers in alkali halides. Most of the work on thermo luminescence study of alkali halides has been confined to single crystal or microcrystalline powder. The thermo luminescence of thin films of alkali halides shows quite interesting results. In this paper an attempt has been made to report the thermo luminescence of Thin Films of KCl. The Trapping parameters are calculated for the main glow peak using Chen's formulae.

A brief review of the history of luminescence and display materials was given [2] in conjunction with a summary of the activities in the luminescence field. Thermo luminescence glow curves depend on the spatial distribution of traps and recombination centres. Trap depth and trap density [3] were found by using the thermally stimulated luminescence technique. For first order peaks, the method [4] of finding the glow parameters by measuring the shift of the maximum temperature with changing heating rate was generalized. Methods for evaluating activation energies and escape frequency factors from glow curves by the use of various heating rates were also discussed. Most of the work on thermo luminescence study of alkali halides has been confined to single crystal or microcrystalline powder. Less attention has been paid so far, to the thermo luminescence study of thin films of alkali halides. Limitation of peak fitting and peak shape methods were discussed [5] for determination of activation energy of thermo-luminescence glow peaks. Optical properties of thin films [6-9] of different material have been studied by different workers. Monte Carlo calculations [10] were performed for thermo luminescence and trap assemblies. A mechanism for the long-duration phosphorescence has been studied by evaluating the energy level and the density of the traps

generated by the auxiliary activators. Nowadays nano crystalline, nano particle thin films [11-14] were also studied by many workers. In this paper the thermo luminescence of thin films of KCl has been reported.

MATERIALS AND METHODS

KCl Thin Films

The pure KCL powder of GR grade (Sarabhai Chemicals Comp) has been used as a starting material. The Thin films of KCl were grown by Vacuum deposition technique. The Pressure was of the order of 0.15 to 0.20 micron and the substrate used was aluminum foil (New Indal Foil, super strong). The substrate temperature was maintained around 573K (±5K), using a Digital temperature Indicator (Indotherm -700).After deposition, the thin films were annealed in vacuum about an hour at 573K (±5K).These freshly prepared thin films of KCl were exposed to γ rays from Co^{60} source for 45 minutes. The irradiation dose rate was 8000 rad/Hr.

Thermo luminescence Recordings

The thermo luminescence glow curves of the irradiated thin films of KCl were recorded using TLD Reader System [15]. A linear heating rate of 491.75K/Min coupled with a chart speed of 2.5cm/min was employed. The thermo luminescence was detected by EMI 9514 S Photomultiplier tube using DIGILOG OMNISCRIBE two pen recorders. A constant Nitrogen flux was circulated through the photomultiplier housing, during all the thermo luminescence recordings.The thermo luminescence of several thin films of pure KCL grown under similar conditions was recorded .The thermo luminescence of thin films of KCl shows quite interesting results. The following Figure represents the thermo luminescence of thin films of KCl.

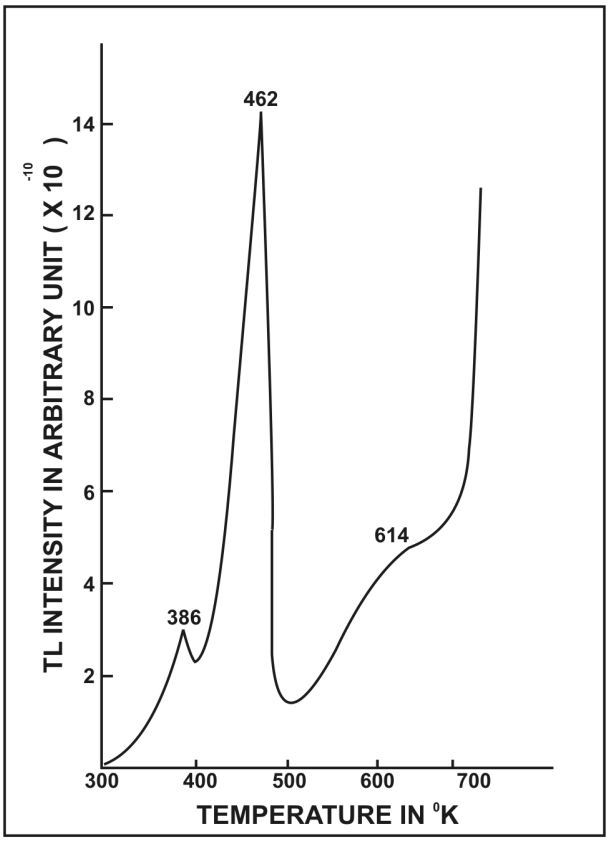

Fig. (a) : TL GLOW CURVES OF THIN FILMS OF KCl

Table-I. Trap Depth Values (in eV) for the glow peaks of the thin films of KCl using Chen's formulae [16-18]

Thin Film	T_m	T_1	T_2	T	δ	w	μ_g	E_T	E_δ	E_w
KCl	462K	438K	480K	24K	18K	42K	0.4286	1.0633	1.0610	0.9852

RESULT AND DISCUSSION

The thermo luminescence of the several thin films of KCl grown under same conditions was recorded. The figure (a) shows the thermo luminescence glow curves of the thin films of KCl.

A prominent glow peak at 462K,asmall peak at 386K and a small shoulder around 614K are observed in all the recordings. The trapping parameters are calculated using Chen's formulae for the main glow peak at 462K.Table –I. Thermo luminescence of the thin films of KCl shows new and interesting results. From the table –I it is clear that the thin films of KCl are monomolecular processes and they obey the first order kinetics.

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