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Determination of the trape depth of (ZnS) $_{1-x}$ (MnTe)$_X$ Using theromoluminescence.

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Abstract
Thermoluminescence (TL) is a thermally stimulated light emission following the removal of excitation from an insulator or semiconductor. For luminescence emission,excitation is provided by irradiating the sample with X-ray or other ionizing radiation like α,β and ΄Y –ray. It should be noted that once heated to excite the light emission, the material can not be made to emit the thermoluminescence again by simply cooling the specimen and reheating.

Keywords: Thermoluminescence, radiations

INTRODUCTION

Thermoluminescence (TL) is a thermally stimulated light emission following the removal of excitation from an insulator or semiconductor. For luminescence emission ,excitation is provided by irradiating the sample with X-ray or other ionizing radiation like α,β and ΄Y –ray. It should be noted that once heated to excite the light emission, the material can not be made to emit the thermoluminescence again by simply cooling the specimen and reheating.

Thermoluminescence process is useful to identify the three basic elements of luminescence (i) traps (ii) recombination centre (iii) mobile entity. Most of the carriers produced, recombine immediately, when ionization takes place some free electron are produced, which captured in certain defect location in the solid sample which depends upon the stability of the configuration. During heating the electrons are detrapped from the trapping sites and they recombinant emitter site giving rise to luminescence, called thermoluminescince (TL). Thus TL is phosphorescence with iong delay, The sites at which the charges exist before heating and are released during heating, are called traps. These traps may be shallow or deep. The shallow traps have liss lifetime and gives fluorescence. The defect at which the charges recombine are called as recombination sit4es.

In thermoluminescence the emitted light is a measure of the radiation dose absorbed by the crystals after the last heating of the sample. This dose can be estimated if TL response to unit radiation dose (Tl-sensitivity) is known. Due to this the TL techinique is widely used in dationg of archaeological obejects.(Aitken 1968)

Thethermoluminescence studies used in two important aspects(i) utilization of thermoluminescence phosphor for various applications like dosimetery, geology, geochronology, forensic sciences archaeology etc(ii) to improve of TL phenomenon by analysis TL glow curves, TL emission spectra, supplementary complementary experimental results, leading to identification of TL process and the probable models depicting the TL mechanism.

EXPERMENTAL

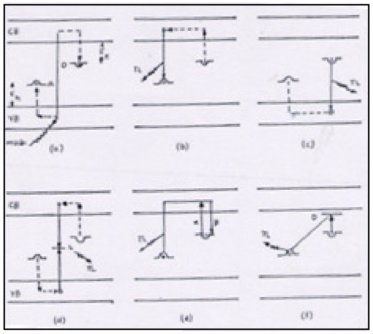
In the Synthesis of (ZnS)1-x(MnTe)x we used $Zn(CH_3COO)_2$.2H (A.R. Himedia Laboratories., 99.5%) , $Mn(CH_3COO)_2.4H_2O$ (AR s.d. fine-chem Limited., 99.5%), Na_2S9H_2O(Flakes, . Himedia Laboratories Pvt Ltd.) and TeO_2 as(. Himedia Laboratories Pvt Ltd.97.0%) as a starting materials. Firstly, a certain molar proposition of $Zn(CH_3COO)_2$.2H2o and ,$Mn(CH_3COO)_2$. $4H_2O$(Mn/Zn molar ratio =5%) were dissolved in water at room temperature with continuous stirring. (Solution 1). Similarly, Na_2S9H_2O an TeO_2d TeO_2 (Te/S molar ratio=5%) were dissolved in water with continuous stirring. (Solution 2). Then Solution 1 and solution 2 were mixed together with continuous stirring. Where by we found the precipitate of the materials. Then this resulting precipitate was washed many times. After the washing we separated the precipitate by centrifugation. After that the precipitate was dried in vacuum. Finally, the dried precipitant was then mixed with activated charcoal, and then the precipitant was fired at 850^o C for 10 h.

Thermally stimulated luminescence glow curves were recorded at room temperature by using TLD reader 11009 supplied by Nucleonix Sys. Pvt. Ltd. Hyderabad. The obtained phosphor under the TL examination is given UV exposure of 365nm

RESULT AND DISCUSSION.

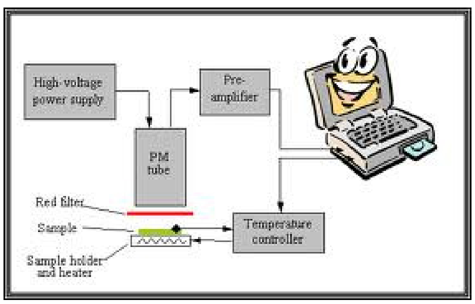
The phenomenon of thermoluminescence(TL) is usually qualitatively explained using the band picture of the solids . The forbidden band gap can be imagined to contain some accepter /donor metastable levels which are basically responsible for the observed TL. Fig shows the band model diagram for the TL process in an insulating crystal. Fig represents the process upon radiation and Fig. are the alternative processes upon heating.

The interaction of ionizing radiation with the solid results in transfer of sufficient energy of sufficient energy to the electrons in the valence band (VB) for transferring them to the conduction band(CB) . This process usually requires energies around to eV in a typical ionic crystal and is affected by secondary by secondary electrons which are produced in the environment of the primary photo-electron of the charged particle tracks. A good number of these "liberated" electrons return immediately to the ground state accompanying energy emission causing phosphorescence /internal heating. However, a fraction of these can be captured at donor level D with the corresponding holes at accepter level A.



Band model diagrams for the TL process in an Insulating crystal (a) – upon irradiation, (b) – (f) alternative processes upon heating.

If the traps are not very deep, detrapping and recombination may already occur at a substantial rate around room temperature resulting in the release of the stored energy. Ysually this is called phosphorescence, but strictly it is room temperature thermoluminescence. On the other hand, if the traps are deep enough to cause sufficient storage stability at room temperature , the effect becomes of dosimetric interest.



Block Diagram of the TL glow curve reader

The phosphor was given a UV irradiation with source with heating 5min, 10min, 15min, 20min, 30min.Every time 2mg of weighted phosphor was taken for TL measurements.

In this paper we have calcutaled the trapping parameters like trap depth(E) ,escape frequency factor (S) and order of kinetics for glow peaks obtained under ultraviolet excitation.

The TL glow curve of $(ZnS)_{1-x}(MnTe)_X$ phosphor is found to be a very good yellow colour phosphor.

The following are the results of the phosphor for the different UV exposure time is shown in figure

Finding The trap depth with

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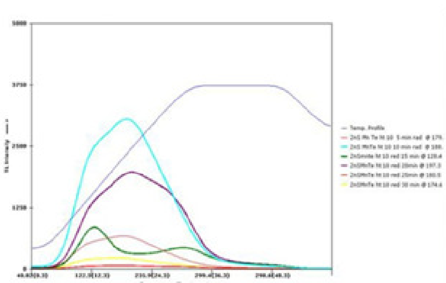
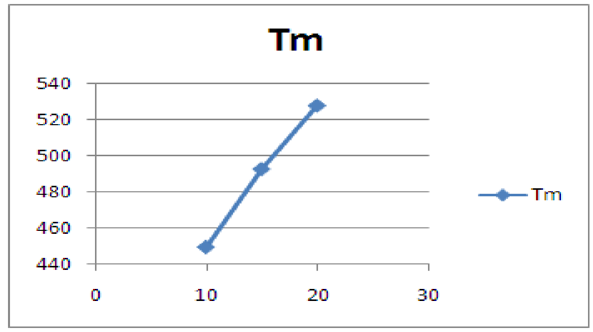
$$E(ev) = \frac{2KT_m^2}{\delta}$$



UVmin	Ti	Tm	T2	ζ	δ	ω	μ= δ/ ζ	Actovatopm Energy	Frequncy factor
5	85	179	263	94	84	178	0.4827586	0.41836	
10	95	188	265	93	77	170	0.4529411	0.474722	
15	112	177	260	65	83	148	0.56081081	0.4196385	
20	104	197	294	93	97	190	0.51052631	0.304275	
30	84	174	268	90	94	184	0.51086956	0.365607	



Heating rate Vs. Tm Diagram

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