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International eJournals

International eJournal of Mathematics and Engineering 92 (2010) 873 - 876

ISSN 0976 – 1411

INTERNATIONAL eJOURNAL OF MATHEMATICS AND ENGINEERING

www.InternationaleJournals.com

THERMOLUMINESCENCE PROPERTIES OF $BaMgAl_{10}O_{17}$: Ce

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Abstract:
Thermoluminescence glow curves of gamma irradiated (10^5R) $BaMgAl_{10}O_{17}$:Ce phosphors exhibited good glow peaks. The $BaMgAl_{10}O_{17}$:Ce phosphor exhibits two well defined peaks at 230°C and 330°C along with one hump at 140°C on ascending side of main peak. The TL emission spectra of same phosphor exhibits two emission peak at 516 and 615 nm wavelength. These changes are may be possible due to electronic charges and sizes of these added impurities.

Introduction:

Thermoluminescence radiation dosimetry (TLD) is a very good technique of research in luminescence field. Many researchers have done tremendous work in this field to establish new TLD phosphors. The well known phosphors developed are NaCl:Ca, $LaPO_4$:Tb, NaCl:Tb,$LiYF_4:U^{4+}$,$CaSO_4$:Dy, $LaPO_4$:Ce and aluminates in mono-,dia and tri-valent doped forms. The present paper TL-properties of $BaMgAl_{10}O_{17}$ doped with impurities Ce have been examined in order to investigate the effect of impurities on TL- behavior of BaMg-aluminates and to find out the peak suitable for dosimetric application.

Experimental :

The specimen of $BaMgAl_{10}O_{17}$ doped Ce have been prepared by solid state reaction [15]. The appropriate oxides were thoroughly ground and fired at 1200°C for four hours. The specimens thus obtained have been characterized through standard XRD technique. Thermally stimulated luminescence glow curves was recorded at room temperature by using standard experimental set-up described elsewhere[16].Phosphor under the examination are in the range from 50 - 10^5R Gamma dose.

Result and Discussions :

The TL glow curves observed in Ce activated $BaMgAl_{10}O_{17}$ phosphors under influence of three standard gamma doses, namely; (i) 50 R Low Gamma Dose], (ii) 1000 R [Moderate Gamma Dose], (iii) 10^5R [High Gamma Dose] are presented in Fig.1 (A,B,C).. Figure1A it is very clear that, LGD(50R) does not give appreciable TL, however it develops hump like structure at 330°C. The MGD (1000R) shows measurable TL with well defined peaks at 230°C and 330°Cis shown in figure 1B. It also generates humps at 140°C on ascending side of 230°C glow peak. The 230°C peak is seen as well defined and isolated peak. The HGD (10^5R) develops a strong peak at 230°C and humps on ascending and descending sides of it

around 140°C and 330°C respectively. The 230°C peak seems to be the properly of Ce impurity in BaMg aluminate. The effect of different gamma (γ) doses (50 to 10^5 rads) on the TL behaviors of RE activated barium magnesium aluminate have been examined under identical experimental conditions. The TL-glow curves of $BaMgAl_{10}$ O_{17}:Ce after an exposure to different doses are presented in figure 2A. It shows that TL-intensity increases with increase in gamma (γ) doses (50 to 10^5 rads) with out shifting the position of the TL peak. The plots of dose versus TL intensity of these specimen are displayed in the figure 2 B. The corresponding dose-TL responses (fig.2B) indicate that they are linear in 50-10^5 rads gamma dose range. The plots brings out the fact that the specimens with Ce^{3+} impurity, results good dose-TL response. Ce^{3+} doped BaMg- aluminate displays linear response in the range 50-10^5 rads. The trap parameters viz.: activation energy or trap depth (E), frequency factor (S) are determine by different heating rates method and order of kinetics are determine by peak shape method for the prominent peak are given in Table 1.

Table 1 Trap parameters

Peak Temp (°C)	Activation energy (E) (eV)	Frequency Factor (S) Sec^{-1}	Order of Kinetics 1st order	Probability ρ Sec^{-1}
140	1.9	$9.7x10^{12}$	-	-
230	1.3	$3.1x10^{12}$	0.2	0.295
330	2.0	$1.6\ x10^{16}$	-	-

This experimentally observed changes in TL properties of BaMg-aluminates can be explain on the promise of change in micro-electrical and mechanical fields in host lattice created due to differences in charge and sizes of impurities introduce in BaMg-aluminates. It is believed that the peak around 230°C in doped BaMg-aluminates is isolated, well defined and intense one, therefore it may be useful in TL- dosimetry. Detail and systematic dosimetric studies may strengthen the utility of these phosphors in radiation dosimetry.

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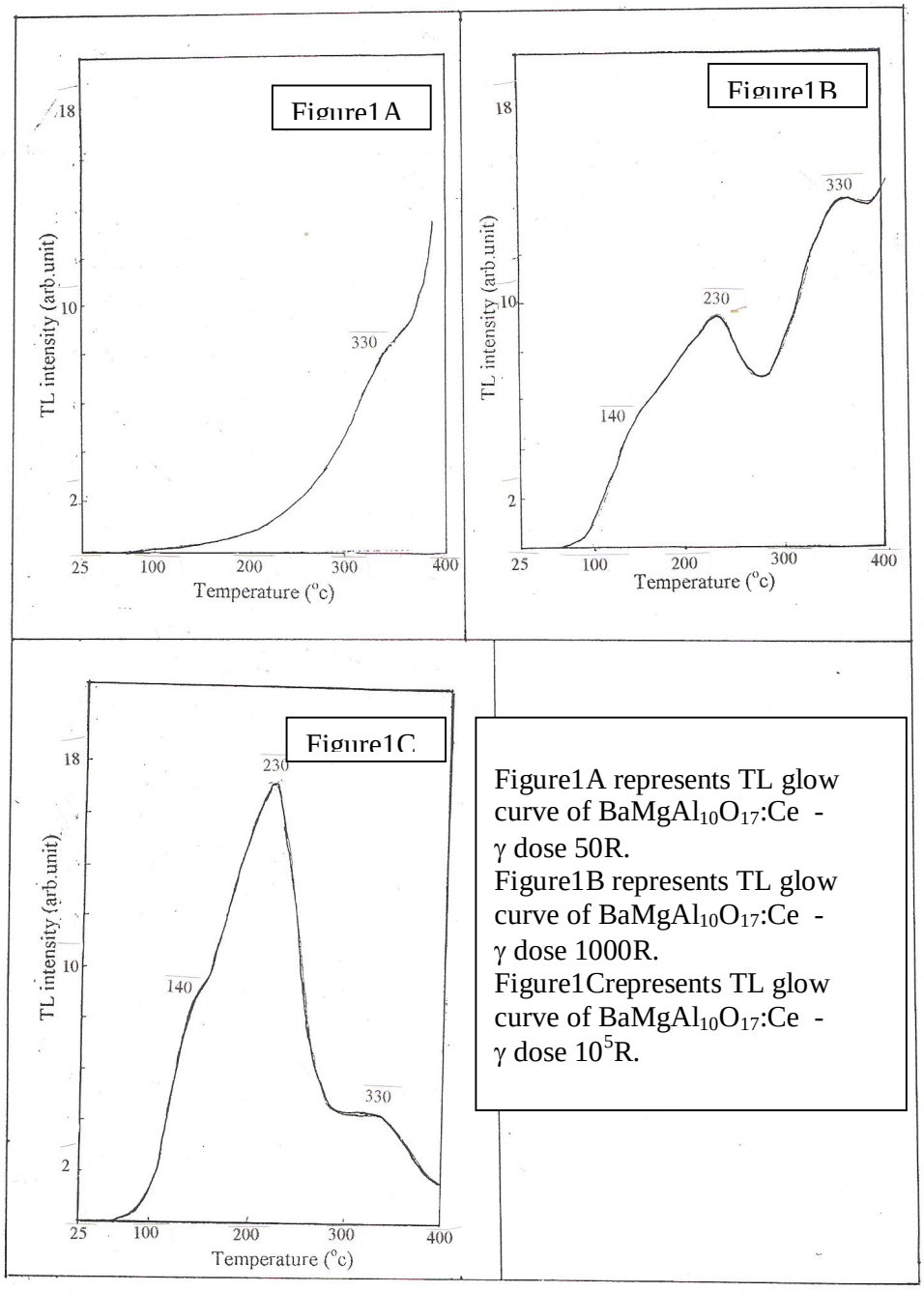
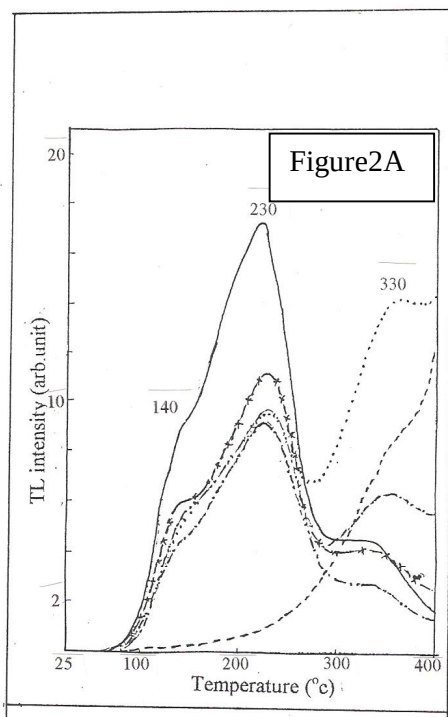


Figure1A represents TL glow curve of $BaMgAl_{10}O_{17}$:Ce - γ dose 50R.
Figure1B represents TL glow curve of $BaMgAl_{10}O_{17}$:Ce - γ dose 1000R.
Figure1Crepresents TL glow curve of $BaMgAl_{10}O_{17}$:Ce - γ dose 10^5R.



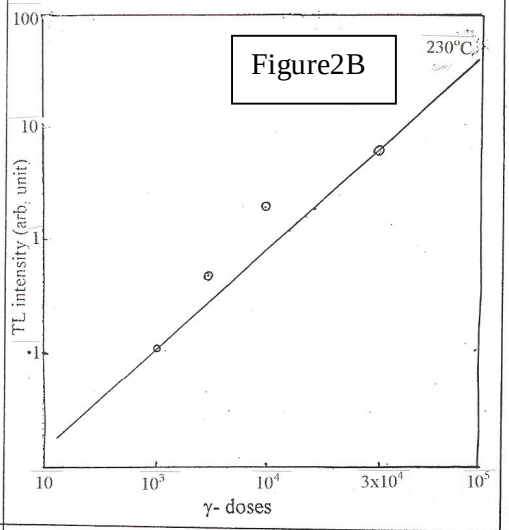


Figure2A represents TL glow curves of $BaMgAl_{10}O_{17}$:Ce after an exposure to different γ– doses.

---------- 50R
…….. 1000R
-.-.-.-.-.-.-.-. $3x10^3$R
-..-..-..-..-..- $1x10^4$R
-x-x-x-x-x- $3x10^4$R
= = = = = = $1x10^5$R

Figure2B represents γ– doses versus TL intensity of $BaMgAl_{10}O_{17}$:Eu