



TL Characteristics of BaMgAl₁₀O₁₇ doped with Ce, Eu and Ce:Eu Phosphor

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Abstract:

The present paper reports single and double rare-earth elements doped with BaMgAl₁₀O₁₇ of synthesized phosphor with Co⁶⁰ gamma irradiated (10 KGy) were investigated. All phosphor exhibits emission peak in the form 140 to 330°C peak. The BaMgAl₁₀O₁₇: Eu phosphor exhibits two well defined peaks at 180°C and 330°C are observed. Ce doped BaMg- aluminate exhibits three peaks at 140, 230 and 330 °C. But double doped Ce:Eu phosphor exhibits two emission peak at 140 and 340°C. These changes are may be possible due to electronic charges and sizes of these added impurities.

Key wards: Rare- earth, Thermoluminescence, impurities, temperature

Introduction:

TL 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⁽¹⁻⁶⁾. The well-known phosphors developed are CaSO₄: Dy, LaPO₄: Ce NaCl: Ca, LaPO₄: Tb, NaCl: Tb, LiYF₄:U⁴⁺ and aluminates in mono-,dia and tri-valent doped forms. This paper reports TL-properties of BaMgAl₁₀O₁₇ doped with rare-earth impurities 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 synthesis of BaMgAl₁₀O₁₇ doped with single and double rare-earth impurities have been prepared by solid state reaction⁽⁷⁾. 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⁽⁸⁾. Phosphor under the examination are at 10 KGy Gamma dose and all TL glow curves are recorded at room temperature.

Result and Discussions:

Figure exhibits the TL glow curves observed in rare-earth impurities activated BaMgAl₁₀O₁₇ phosphors

under influence of standard gamma dose 10 KGy (High Dose). The speed of X-Y recorder was 1 mv/cm. The main glow peaks exhibit by the phosphors at 300°C /min heating rate. Figure1 it is seen that Eu doped BaMg- aluminate phosphor irradiated at 10 KGy exhibits two well isolated peaks at 180°C and 330°C as The peak 180°C is more intense than 330°C peak. The TL-glow curve of BaMgAl₁₀O₁₇: Ce after an exposure to 10 KGy dose are exhibits three 140, 230 and 330 °C presented in figure 2. But double doped Eu: Ce phosphor exhibits two emission peak at 140 and 340°C as shown in Figure 3. Due to Ce doped 180°C peak of Eu doped phosphor is suppressed and 230°C peak is suppressed in Ce doped phosphor.

The peak exhibited by different impurities curves are not same. The effect of different gamma (γ) dose 10 KGy on the TL behaviors of RE activated barium magnesium aluminate have been examined under identical experimental conditions. 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 and Table 2 shows the intensity, relative intensity, TL emission and PL emissions of main TL peak.

Table 1 Trap parameters

Peak Temp (°C)	Activation energy (E) (eV)	Frequency Factor (S) Sec ⁻¹	Order of Kinetics 1 st order	Order of Kinetics 2 nd order	Probability ρ Sec ⁻¹
180	1.12	9.04x10 ¹¹	-	0.42	0.343
230	1.3	3.1x10 ¹²	0.2	-	0.295
170	1.0	0.69x10 ¹¹	-	0.54	0.296

Table 2 TL Emission

Sr No.	Synthesized phosphors	Main TL peak temperature (°C)	Intensity	Relative sensitivity	Main TL emission λ (nm)	PL Emissions main λ (nm)
1	BaMgAl ₁₀ O ₁₇ :Eu	180	13.9	5.0x10 ⁻³	507(G), 607(OR)	610(OR)
2	BaMgAl ₁₀ O ₁₇ :Ce	230	17.3	1.27x10 ⁻³	516(G), 615(R)	676(R)
3	BaMgAl ₁₀ O ₁₇ :Ce:Eu	170	2.9x10 ⁻⁴	2.05x10 ⁻³	565(G), 670(R)	587(G), 611(R)

The order of kinetics are determined by peak shape method. 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 170°C and 180°C in Eu and Pr 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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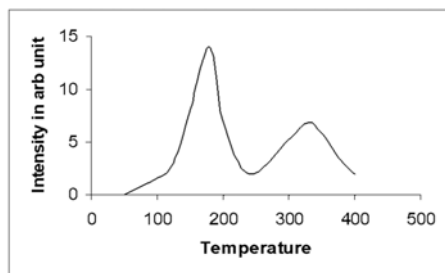


Figure1 represents TL glow curve of BaMgAl₁₀O₁₇:Eu - γ dose 10 K Gy

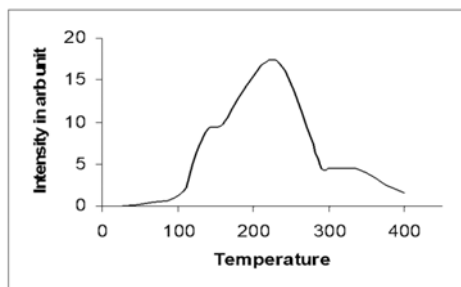


Figure 2 represents TL glow curve of BaMgAl₁₀O₁₇:Ce - γ dose 10 K Gy

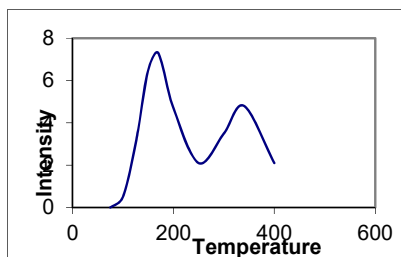


Figure 3 represents TL glow curve of BaMgAl₁₀O₁₇:Ce:Eu - γ dose 10 K Gy