

Afterglow Phosphorescence of $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$ prepared in air.

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Abstract – $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$ was prepared by state solid reaction and submitted at different thermal treatment in air. The phosphorescent specimens were prepared with different composition of Eu and Dy. X-ray diffraction and phosphorescence spectrum were employed. The afterglow phosphorescence of $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$ were discussed.

The afterglow phosphorescence or Persistent Luminescence are a long phosphorescence lasting at room temperature after stopped the irradiation. Since Matsuzawa et al¹ that reported persistent luminescence properties from $\text{SrAl}_2\text{O}_4:\text{Eu}^{2+};\text{Dy}^{3+}$ and $\text{CaAl}_2\text{O}_4:\text{Eu}^{2+};\text{Dy}^{3+}$, many others compounds based on the simultaneous doping of Eu^{2+} and Dy^{3+} were found to exhibit intense persistent luminescence in the literature^{2,3}.

The composition of Al/Ba in the $\text{BaAl}_2\text{O}_4:\text{Eu}^{2+};\text{Dy}^{3+}$ material play a role on the long afterglow properties of the phosphors since Al-rich compounds have much better phosphorescence properties than Ba-rich ones⁴. Recently, the long afterglow properties have been explained as a consequence of ultraviolet light absorption followed by excitation of the Eu^{2+} ion to the $4f^65d$ state (inside the conduction band)⁵. According with this mechanism the electron is trapped by Dy^{3+} to form Dy^{2+} , a ground state located 0.66 eV below the bottom of the conduction band. Persistent luminescence is caused by the thermally activated release of the electron from Dy^{2+} back to the conduction band with subsequent recombination with Eu^{3+} leading to $5d-4f$ emission.

This paper reports the preparation in air of the compound $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$ that presents afterglow phosphorescence. The phosphorescent specimens were prepared by solid state reaction at termic treatment at 1400 °C for 5 h with the following reagents $\text{Ba}(\text{NO}_3)_2$, Al_2O_3 , $\text{Eu}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ and $\text{Dy}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$. Different composition of Eu and Dy were employed as dopant and codopant, respectively.

X-ray diffraction and phosphorescence spectrum were employed to analyze the effect of these compositions on the persistent luminescence and the lifetime of this compound. Fig.1. shows the emission spectrum of the compound which exhibit a characteristic broad band with maximum around 470 nm that is assigned to the interconfigurational $4f^65d \rightarrow 4f^7$ transition centered on Eu^{2+} ion. According to these results, the reduction $\text{Eu}^{3+} \rightarrow \text{Eu}^{2+}$ was complete. The luminescence decay curve of $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$ (Fig. 2.) adjusted well to a monoexponential curve, indicating that the metal ion is in only one site of symmetry.

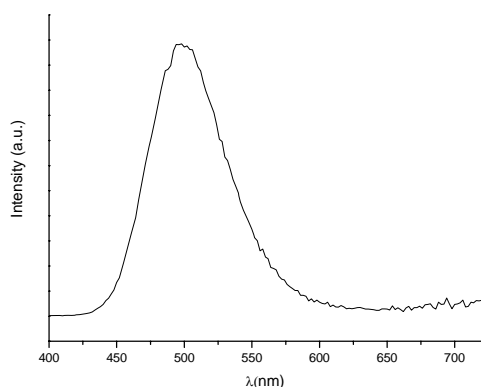


Fig. 1. Emission spectra of $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$ prepared in air.

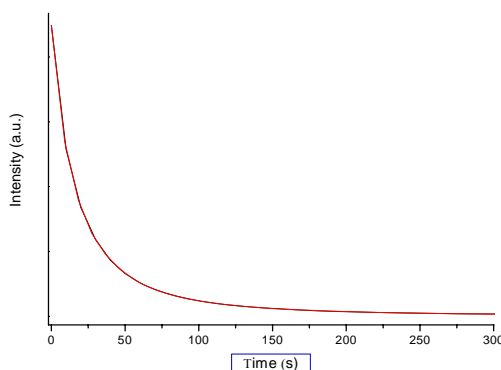


Fig. 2. Decay curve of $\text{Ba}_4\text{Al}_{10}\text{O}_{19}:\text{Eu}^{2+};\text{Dy}^{3+}$.

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