

Área: MAT

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## Evaluation of Eu and Dy stability in $\text{Sr}_2\text{MgSi}_2\text{O}_7:\text{Eu,Dy}$ embedded in silicate glass via X-ray absorption nanospectroscopy

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Palavras Chave: Nanospectroscopy, Synchrotron radiation, Persistent luminescence, X-ray absorption.

### Highlights

X-ray nanospectroscopy applied to the study of heterogenous materials;  
Blue-emitting composites based on crystalline solids and glass compounds;  
Eu and Dy-doped SMSO embedded in translucent glass.

### Resumo/Abstract

Persistent luminescence (PeL) materials are widely used in various applications, including bio-imaging, solar cells, optical data storage, anti-counterfeiting, and photocatalysis. Many of these applications require functionalization or incorporation into host matrices like polymers or glass. While glass offers superior durability and heat resistance, its high processing temperatures pose challenges to maintaining PeL properties, as they can alter dopant oxidation states and, consequently, their optical behavior.

Many PeL materials are based on Eu-doped inorganic hosts, and a key concern is maintaining europium in its divalent ( $\text{Eu}^{2+}$ ) oxidation state, as heat treatments often require reducing conditions. In this study, we investigate the oxidation stability of europium and dysprosium, as well as the optical response of commercial blue-emitting  $\text{Sr}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+},\text{Dy}^{3+}$  (SMSO) embedded in soda-lime-silica glass through pressureless viscous sintering under vacuum using X-ray nanospectroscopy.

X-ray absorption near edge structure (XANES) analysis around the  $\text{Eu-L}_{III}$  edge and X-ray excited optical luminescence (XEOL) emission spectra confirmed the presence of both  $\text{Eu}^{2+}$  and  $\text{Eu}^{3+}$ , suggesting local variations in the  $\text{Eu}^{2+}/\text{Eu}^{3+}$  ratio. The result suggests a negative interaction between the phosphor particles and the glass during processing that can be attributed to chemical reactions with residual air or impurities during sintering or from a depth-dependent effect, where the X-ray fluorescence (XRF) attenuation varies with particle depth. Meanwhile,  $\text{Dy}^{3+}$  remained stable in all analyzed samples. XRF analysis provided insights into the chemical distribution of the doping ions and their correlation with the optical response. These results highlight the stability (or instability) of doping ions, their interaction with the host glass, and by XEOL we could probe the variations in optical behavior. Furthermore, this study demonstrates the power of sensitive X-ray techniques, based on synchrotron radiation, combined with an X-ray nanoprobe, utilizing hyperspectral 2D imaging via XRF and XEOL, along with spectral response analysis through energy scans for XANES and XEOL multispectral acquisition.

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