Effect of gadolinium incorporation on the structure and luminescence properties of $GdNbO_4:Eu^{3+}$ phosphor obtained by the Non-Hydrolitic Sol-Gel process

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Solid-state light-emitting devices (LED) are considered the next generation of light sources as a replacement for incandescent and fluorescent lamps used nowadays, because of their advantages as longer lifetime, lower power consumption and better for environment. However, the $Y_2O_2S:Eu^{3+}$ shows low efficiency as a red light-emitting phosphor when compared to blue and green light-emitting phosphors, short lifetime under ultraviolet radiation and instability due to sulfide gas liberation. Consequently, the development of new processes and the search for new materials are indispensable for the obtainment of phosphors with an efficient ultraviolet absorption and suitable emission and stability. Niobium oxide ceramics have suitable characteristics for application in photoluminescence, in addition to their capacity of being influenced by synthesis parameters. Among many existing methodologies for the synthesis of luminescent ceramics, the non-hydrolytic Sol-Gel route stands out as one of the most advantageous processes considering its swiftness and the purity of the final product. In this context, the present study aims to investigate the influence of Gd^{3+} ions concentration on the luminescent properties of $Nb_2O_5:Gd^{3+}$, Eu^{3+} phosphors, obtained by the non-hydrolytic Sol-Gel route. The materials were annealed at 900 °C during 4h and characterized by X-ray diffraction, scanning electron microscopy and Raman and Photoluminescence spectroscopy. The X-ray diffractograms show a mixture of crystalline phases for the niobium and oxides and gadolinium niobate. In addition, increasing of gadolinium concentration favors the onset of gadolinium oxide structure, decreasing the gadolinium niobate phase. The excitation spectra (λ_{Em}= 613 nm) presented the transitions $^7F_0 \rightarrow {}^5L_J$ (L = D, G, e L, where J = 0 – 7) attributed to the Eu^{3+} ions and a broadband at 270 nm, assigned to the transfer to the group NbO_4^{3-}. Emission spectra reveal bands corresponding to the internal configuration transitions $^5D_0 \rightarrow {}^7F_J$ (J = 0, 1, 2, 3 and 4). Moreover, the photoluminescence properties showed a strong red-emission lines at 613 nm (FWHM ~ 5 nm). Finally, the CIE chromaticity coordinates are above the National Television Standard Committee (NTSC) standard values, which confirms the promising LED applications.

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