Effect of excitation wavelength on the CIE chromaticity coordinates of $Nb_2O_5:Ln^{3+}$ (Ln = La, Tb and Eu) synthesized by the Sol Gel process

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The phosphor-converted light-emitting diode technique is an important solid-state illumination strategy, bearing in mind that illumination consumes about 33% of all the generated energy, the development of energy-saving systems has become fundamental from a technological standpoint. Nb_2O_5 matrices are transparent over a wide range of wavelengths (0.35-9.0 μm), it has a wide band-gap (3.6 eV), it is stable under near UV radiation, it has a relatively low cut-off phonon energy (900 cm^{-1}), high refractive index (2.4) and undergoes polymorphic transformations induced by treatment temperature. The Non-Hydrolytic Sol-Gel (NHG) process is a versatile way to prepare inorganic oxides during which non-hydrolytic condensation reactions furnish oxides and hybrid organic-inorganic materials; the oxo bonds originate from oxygen atoms of donors other than water. This work describes the effect of excitation wavelength on the CIE chromaticity coordinates of $Nb_2O_5:Ln^{3+}$ (Ln = La, Tb and Eu) synthesized by the NHG process. In this synthesis, the molar ratio of La : Tb : Eu was 1.95 : 3.0 : 0.05, respectively. The obtained materials were annealed at 550°C during 4h and then characterized by X-Ray diffraction (XRD), Raman and Photoluminescence (PL) spectroscopy. The chromaticity coordinates were obtained by the software Spectra Lux 2.0, using the emission spectra of the sample excited in different wavelengths. XRD and Raman results showed that the obtained material presented an orthorhombic structure of (T)-phase Nb_2O_5. The excitation spectra presented broad band at 265 nm assigned to the charge transfer of matrix and bands at 377 nm ($^7F_6 \rightarrow {}^5G_6$) and 485 nm ($^7F_6 \rightarrow {}^5D_4$) related to the Tb^{3+} transitions and 394 nm ($^7F_0 \rightarrow {}^5L_6$) and 465 nm ($^7F_0 \rightarrow {}^5D_2$) nm attributed to the Eu^{3+} transitions. The emission spectra showed a broad blue emission band corresponding to the self-activated luminescence center of matrix and the terbium and europium most intense transitions were also observed at 543 nm ($^5D_4 \rightarrow {}^7F_5$) and 613 nm ($^5D_0 \rightarrow {}^7F_2$), respectively. The intensities of the emission bands varied depending on the excitation wavelengths, generating different CIE chromaticity coordinates as demonstrated in Figure 1.

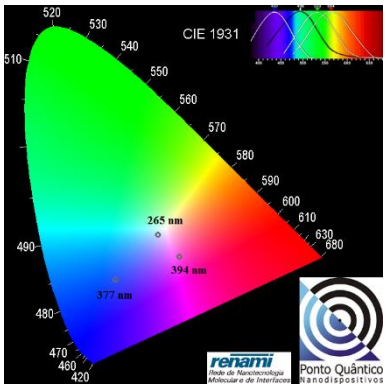

Figure 1: CIE chromaticity coordinates of the sample excited in different wavelengths.