Study of La^{3+} concentration on the luminescence properties of Tm^{3+} doped Nb_2O_5 prepared by the Non-Hydrolytic Sol-Gel process

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Niobium oxide matrices have emerged as promising materials for multifunctional applications due to its band-gap (3.6 eV), its low cut-off phonon energy (900 cm^{-1}) and its high refractive index (~2.2). Among the various methodologies that are available to synthesize phosphors, the Non-Hydrolytic Sol-Gel process (NHSG) stands out as one of the most advantageous: it yields highly pure products with fewer pores; occurs at relatively low temperatures; dismisses the need for solvents and may reduce or eliminate the formation of residual Metal-OH groups; and is easier to reproduce. In this work, phosphors based on Nb_2O_5:$La^{3+}_{(x)}$, $Tm^{3+}_{(3.0\ \%)}$, (where x = 1.0 or 10.0 % mol) by the NHSG. The obtained materials were annealed at 900°C during 4h and then characterized by X-Ray diffraction (XRD), scanning electron microscope (SEM) and photoluminescence (PL). The obtained materials were annealed at 900°C during 4h and then characterized by X-Ray diffraction (XRD), scanning electron microscopy and photoluminescence (PL). XRD results showed mixtures of crystalline phases of niobium oxide (monoclinic) and lanthanum niobate (orthorhombic). The excitation spectra, Figure 1, presented bands at 360 nm attributed to the Tm^{3+} transition $^3H_6 \rightarrow {}^1D_2$ and at around 260 nm, that was related with charge transfer of NbO_4 and NbO_6 in this $LaNbO_4$ system. This peak is associated with the direct excitation of the $LaNbO_4$ host itself, via the charge transfer transition between Nb and O. The emission spectra presented bands at 454 and 473 nm attributed to the Tm^{3+} transitions $^1D_2 \rightarrow {}^3H_4$ and $^1G_4 \rightarrow {}^3H_6$. In addition, PL spectra show a broad blue emission band a broad corresponding to the self-activated luminescence center of matrix.

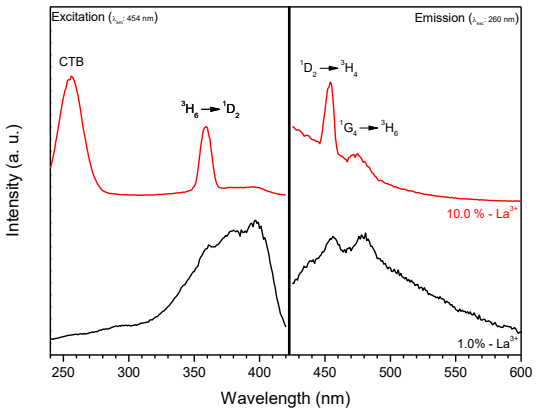

Figure 1: Excitation (λ_{em}: 454 nm) and emission (λ_{exc}: 260 nm) spectra of Tm^{3+} ions for the samples containing different amount of La^{3+}.

References

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