White light emission of the single-phased $CaWO_4:Tb^{3+},Eu^{3+},Dy^{3+}$ materials prepared by an environmentally friendly method

Hermi F. Brito[1, *], Helliomar P. Barbosa[1], Maria Claudia F.C. Felinto[2], Oscar L. Malta[3]

[1]*Institute of Chemistry, University of São Paulo, São Paulo, Brazil*

[2]*Chemistry Research Centre and Environment, IPEN, São Paulo, Brazil*

[3]*Dept. of Fundamental Chemistry, Federal University of Pernambuco, Recife, Brazil*

* e-mail: *hefbrito@iq.usp.br*

Trivalent rare earth (RE^{3+}) doped tungstates $[WO_4]^{2-}$ host matrix offers possibility to design new photoluminescent materials.[1] Nowadays, there is an increasing interest of WLEDs to replace the conventional fluorescent lamps due its environment-friendliness and tuneable colours.[2,3] Here we report preparation as well as the spectroscopic properties of the new highly luminescent white emitting materials $Tb^{3+}/Eu^{3+}/Dy^{3+}$ triply-doped in $CaWO_4$ matrix. The materials were prepared by coprecipitation method at room temperature with stoichiometry aqueous solutions of Na_2WO_4, $CaCl_2$ and $RECl_3$ (RE^{3+}: Tb, Eu, Dy with 0.5 to 5.0 mol% of the Ca^{2+} amount). The RE^{3+} doping concentrations were identical for each rare earth ion in the range from 0.5-5.0 mol%. The XPD measurements revealed the as-prepared $CaWO_4:xTb^{3+},xEu^{3+},xDy^{3+}$ (x: 0.5-5.0 mol%) particles belong to the tetragonal scheelite phase with $I4_1/a$ (#88) space group. The average crystallite sizes are ~11 nm.

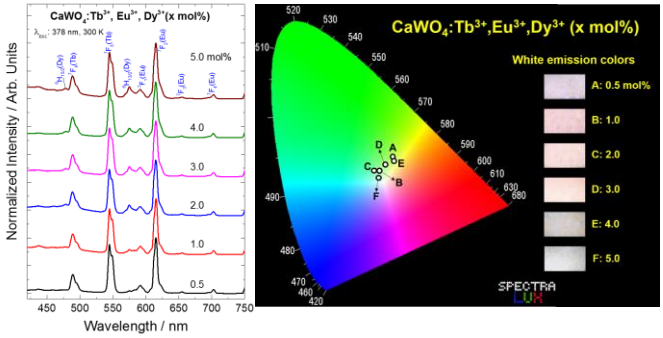

Fig. 1. Left) Emission spectra; right) CIE color coordinates of the $CaWO_4:Tb^{3+},Eu^{3+},Dy^{3+}$ (0.5–5.0 mol%) phosphors under excitation @378 nm.

The white luminescence emission arising mainly from the $^5D_0 \rightarrow {}^7F_2$ (Eu^{3+}), $^5D_4 \rightarrow {}^7F_5$ (Tb^{3+}) and $^4F_{9/2} \rightarrow {}^6H_{15/2}$ (Dy^{3+}) transitions at 614 nm (red), 545 (green) and 488 (blue), respectively (Fig. 1). The emission lifetimes of the $^5D_0$, $^5D_4$ and $^4F_{9/2}$ emitting levels were and their values are reduced when comparing the ratio from 0.5-5.0 mol% of the RE^{3+} ions, respectively. The results indicate the presence of energy transfer processes between RE^{3+}. These values could be assigned to non-radiative energy transfer contributions of the $Dy^{3+} \rightarrow Tb^{3+}$, $Dy^{3+} \rightarrow Eu^{3+}$ and $Tb^{3+} \rightarrow Eu^{3+}$ systems due the cross relaxation. The CIE diagram (Fig. 1 right) exhibits emissions whitish colour indicating that these materials could be suitable for solid state lighting technology.

1. Kodaira, C. A.; Brito, H. F.; Malta, O. L.; Serra, O. A.; *J. Lumin.* **2003**, *101*, 11.
2. Barbosa, H. P.; Kai, J.; Silva, I. G. N.; Rodrigues, L. C. V.; Felinto, M. C. F. C.; Hölsä, J.; Malta, O. L.; Brito, H. F.; *J. Lumin.* **2016**, *170*, 736.
3. Smet, P. F.; Parmentier, A. B.; Poelman, D.; *J. Electrochem. Soc.* **2011**, *158*, R37.

CNPq, CAPES, FAPESP.