Complexing agent effect on the band gap and low-temperature emission spectra of $Y_2O_3:Eu^{3+}$ red phosphor from modified Pechini route monitored by Chemometrics tools

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$Y_2O_3:Eu^{3+}$is a red-emitting phosphor used in lighting; optical display; and luminescent labels in bio-assays. With the purpose for enhanced display luminescence and resolution, phosphor particles with smaller sizes and controlled morphology are needed[1,2]. However, to the best of our knowledge, no data was reported in the literature yet related to the modified Pechini method using sorbitol (SB) to prepare $Y_2O_3:Eu^{3+}$, and a systematic study comparing the effect of this complexing agent in the phosphor properties to the conventional ethylene glycol (EG) one. The aim of this work is the investigation of ethylene glycol (EG) and sorbitol (SB) complexing agents concentration on structural and photoluminescence (PL) of $Y_2O_3:Eu^{3+}$ (2 mol%) oxides obtained by modified Pechini method. In order to facilitate the study of such system the so called design of experiment (DOE), 2^3, was performed, and it was based on the stoichiometric ratio variation between citric acid and rare earths (CA/RE); and between EG or SB and rare earths (EG/RE or SB/RE), and 2 mol% of Eu^{3+}. By reflectance diffuse and $(K/S \cdot h\nu)^2$ *x* $h\nu$ plots, band gap values were determined, 5.6 and 5.7 eV for the Y_2O_3 and 5.2 and 5.0 eV $Y_2O_3:Eu^{3+}$, respectively. So, the presence of Eu^{3+} at the concentration of 2 mol% in the Y_2O_3 network decreases band gap value independently on the complexing agent used. Low-temperature photoluminescence data for all phosphors exhibit the expected red emission in the range of 480–750 nm ascribed to all Eu^{3+} 4*f*–4*f* set of transitions[3], Fig 1 (a). In Fig.1(b), the set of Eu^{3+}excitation transitions are viewed with good spectral resolution. Despite the fact that no detectable difference is observed in the spectra profiles indicating that Eu^{3+} environment should be identical for all samples independent on the agent complex used, phosphors prepared using SB showed the higher relative intensity emission. So, SB complexing agent must be driving the phosphor lattice formation influencing Eu-O arrangement decreasing non radiative losses and enhancing photoluminescent properties. Therefore, $Y_2O_3:Eu^{3+}$ red phosphor from SB has a better optical performance in comparison to EG precursor and also considerably reduces the synthesis cost.

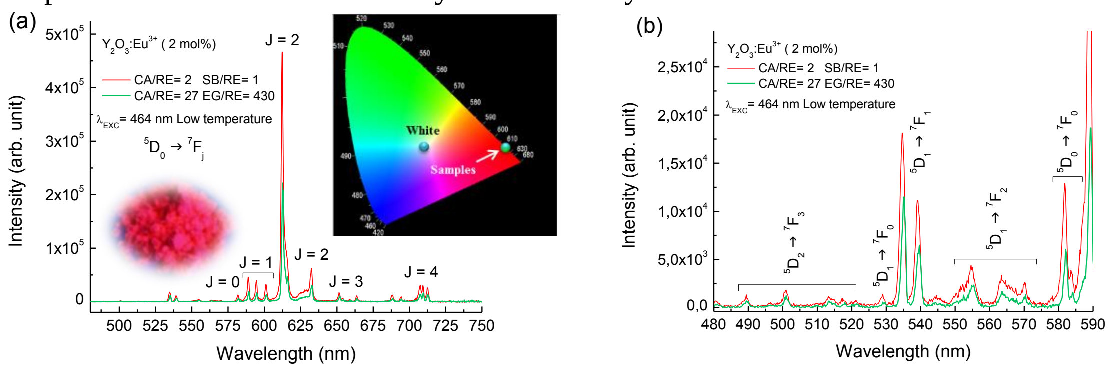

Fig. 1. Low-temperature emission spectra of $Y_2O_3:Eu^{3+}$ (2 mol%) nanophosphors produced with EG and SB, excited in λ_{exc}= 464 nm in range of (a) 480-750 nm and (b) 480-590 nm.

[1]Blasse, G.; Grabmaier, B. C.; *Luminescent Material*, Springer, 1994.[2]Alivisatos, P. et al.; *Nat. Biotechnol.* **2004**, *22*, 47. [3]Kodaira, C. A. et al.; *J. Lumin.* **2003**, *101*, 11.

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