Y_2O_3 matrix simultaneously doped with Eu^{3+}, Er^{3+} and Yb^{3+}: optical and structural effects on the produced phosphor

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High efficient phosphors should have suitable activator ions and sensitizers homogeneously distributed in the host lattice using appropriate synthetic routes in order to improve optical features. Y_2O_3 is an excellent matrix to host lanthanide ions individually or combined, due to the ionic radii similarities. So, this work reports on the structural and optical studies of Y_2O_3:Eu^{3+}phosphors codoped with different combinations of$Er^{3+}$and Yb^{3+}produced by modified Pechini method. So, Y_2O_3 doped with Eu^{3+}, $Er^{3+}$and/or Yb^{3+}phosphors were obtained by Pechini modified method using sorbitol as complexing agent.[1]Optical band gap of all phosphors was estimated from reflectance UV-Vis spectra and crystallite size values were evaluated from Scherrer equation applied on XRD data. Selective excitation allowed monitoring $Er^{3+}$and Eu^{3+}transitions in the green and in the red spectral region, and Yb^{3+} codoping ion quenching effect onboth $Eu^{3+}$and Er^{3+}emissions. However, when 250 nm UV CT band excitation is used, Eu^{3+} emission is preferentially observed, so Ω_2 and Ω_4[2] intensity parameters related to the $Eu^{3+5}D_0 \rightarrow {}^7F_{1,2\text{and }4}$ transitions could be evaluated. Fig. 1 summarizes all results comparing the different codoping and the different parameters analyzed.Band gap values of phosphors codoped with Er^{3+}or $Er^{3+}$and Yb^{3+} in comparison to the one doped only with Eu^{3+} slightly increase, but no significant variation is observed among codoped samples. On the other hand, crystallite size decreases when Er^{3+} and Yb^{3+} are added to the phosphor composition, and the smallest value is exhibited by the sample with lower percentage of Eu^{3+} and Er^{3+}, and higher percentage of Yb^{3+}. This is an indicative that the matrix network must contracts when Yb^{3+} ion is inserted. All Ω_2 values are similarsuggesting that the same dynamic coupling mechanism is quite operative in these systemsand that the $Eu^{3+}$is in a highly polarizablechemical environment. However, the Ω_4 values decrease with the presence of codoping ions, indicating thatthe covalence degree nearest Eu^{3+} decreases due to the presence of Er^{3+} and Yb^{3+}. In conclusion, the simultaneously doping with different activators must be very well monitored because the interactions among them play an important role in the final structural and optical properties of the produced phosphors.

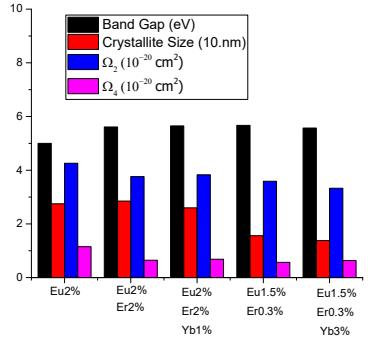

Fig. 1 – Monitored parameters of all produced samples.

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