Influence of the synthesis process on the structural and optical properties of rare-earth doped yttrium aluminates

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The present work deals with the influence of the synthesis procedure on the structural and optical properties of Eu^{3+} or Tb^{3+}-doped yttrium aluminates ($Y_3Al_5O_{12}$, $Y_4Al_2O_9$ or $YAlO_3$), suitable as phosphors in a new generation of lamps or as scintillators in display devices [1]. The emergence of new lamps is driven by the presence of a toxic chemical element, mercury, in most of lighting sources. Hg-free devices are mainly based on two different excitation sources: a Xe-Ne plasma providing a vacuum-ultraviolet photons excitation as well as blue or UV LEDs. Tb^{3+}- or Eu^{3+}-activated YAG can be combined efficiently with these two kinds of excitation sources and other phosphors to produce white light [2,3].
Among the synthesis methods known to prepare YAG (solid-state, spray pyrolysis, coprecipitation, sol-gel…), the sol-gel and hydrothermal processes appears as the most convenient route since it leads to tunable shapes and allows to prepare sols or colloidal suspensions suitable for coatings. In the present case, the influence of the synthesis process on the structural and optical properties of Eu^{3+} and Tb^{3+}-doped yttrium aluminates has been investigated. In particular, from the same sol obtained by the sol-gel process, from alkoxide precursors [4], two ways have been used: drying and heating in a muffle furnace ("conventional sol-gel route") or mixing with water and heating in an autoclave at temperatures between 250 and 300°C ("hybrid route"). Besides, yttrium aluminates have also been prepared from nitrates or acetates directly put in the autoclave and heated at temperatures lying in 250-350°C range. Different characterization techniques have been employed to compare the obtained phosphors: X-ray diffraction (XRD), Infrared and Raman spectroscopies, scanning and transmission electron microscopies (SEM-TEM) and photoluminescence.
XRD study has revealed that pure $Y_3Al_5O_{12}$ (YAG) phase was easily obtained by the conventional sol-gel route whereas the hybrid one led to other phases. The influence of these discrepancies on the optical features has been studied and will be discussed, regarding to the application foreseen.

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[2] K. Toda, "Recent research and development of VUV phosphors for a mercury-free lamp." *Journal of Alloys and Compounds* **408-412**, 665-668 (2006).

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