Red luminescence on YAG:Sm^{3+} and YAG:Eu^{3+} co-sintered with borophosphate glass in phosphor-in-glass system for LED applications.

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Abstract

In modern society, the presence of lighting technology is essential for the development of human activities, with materials capable of emitting light in various devices. The development of LEDs with high-power and high-brightness requires highly stable color converters to further extend the applications of these devices. A recent solution is the use of inorganic color converters obtained from phosphor-in-glass (PiG) [1,2]. In this work, PiGs materials were developed from borophosphate glass and YAG doped with Sm^{3+} or Eu^{3+} (Sm, Eu = 0,01 mol). The glass with composition of $40B_2O_3$-$25P_2O_5$-$15CaF_2$-18NaO-$2Al_2O_3$ in mol% was made by the conventional melt-quenching method and the doped YAGs were synthesized by the sol-gel method. For the preparation of the PIGs, an amount of 7 wt% of doped YAG was added to the glass matrix (93 wt%). The synthesized glass showed an amorphous characteristic verified by the XRD data and the phosphors showed a XRD pattern corresponding to the pure YAG phase. The PiGs analyzed by XRD showed characteristic peaks of crystalline materials from the YPO_4 phase. YPO_4 is an interesting material in photonic applications and can be used in many applications. It has the ability to resist the structural damage induced by high energy radiation and the YPO_4 matrix has excellent optical and physical properties such as its high chemical durability, high thermal stability (melting at ~1600 °C) and low phonon energy (~1080 cm^{-1}) [3,4]. YPO_4 can be easily doped with trivalent rare earth ions, which is favored by the ionic radius and valence of lanthanides similar to Y^{3+}. Extensive studies are focused on this doped material with a potential in a variety of optoelectronic applications such as scintillators, LEDs, lasers and display devices, with much work also focused on thermally stimulated luminescence (LTE) [5] .The PIG samples showed good transparency in the UV-visible region. In the FTIR spectra, it was verified that the profiles of the samples of YAGs correspond to the FTIR spectra reported in the literature, as well as the synthesized glass and PIGs have characteristic bands of borophosphate glasses. The excitation and luminescence spectra for samples YAG:Sm, YAG:Eu, PIG:Sm and PIG:Eu showed characteristic bands of Sm^{3+} and Eu^{3+} ions with high brightness. These results show that Sm^{3+}/Eu^{3+}-doped PIG materials are good candidates for optical and photonic applications, with wide possibilities.

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