

LUMINESCENCE PROPERTIES OF $\text{Ca}_{3-x}\text{Cd}_x\text{Ga}_2\text{Ge}_3\text{O}_{12}$ GARNET SYSTEM DOPED BY Eu^{3+} IONS

L. Kostyk¹, A. Luchechko¹, O. Tsvetkova¹, B. Kuklinski², A. Vas'kiv¹

¹ Ivan Franko National University of Lviv, Lviv, Ukraine

² Institute of Experimental Physics, University of Gdansk, Gdansk, Poland

E-mail: kostyk@electronics.wups.lviv.ua

The rare-earth activated complex oxides with garnet structure are well known in phosphor and solid state laser applications. In particular, Eu^{3+} -doped phosphors are of strong interest for the application in UV and blue LEDs, since they exhibit a high quantum efficiency and photostability. In phosphor-converted LEDs a luminescent layer is applied on top of a semiconductor chip. As the luminescent layer can be used phosphor powder or a ceramic body.

The results of luminescence studies of ceramic garnet system $\text{Ca}_{3-x}\text{Cd}_x\text{Ga}_2\text{Ge}_3\text{O}_{12}$ doped by Eu^{3+} (0.001-0.1 mol. %) are presented. The ceramic samples of pure and activated with Eu^{3+} ions $\text{Ca}_{3-x}\text{Cd}_x\text{Ga}_2\text{Ge}_3\text{O}_{12}$ garnet were prepared by the method of solid state reaction at $\sim 1100^\circ\text{C}$ using high purity starting materials. The XRD patterns showed all samples to be homogeneous.

Luminescence spectra are observed in the region between 570-720 nm and due to the typical ${}^5\text{D}_{0-7}\text{F}_j$ ($j=1-4$) transitions of Eu^{3+} , while emission lines originating from higher excited ${}^5\text{D}_1$ and ${}^5\text{D}_2$ levels are absent. The excitation spectra of samples for monitoring the ${}^5\text{D}_{0-7}\text{F}_4$ emission of Eu^{3+} (705 nm) show the dominant sharp line at around 395 nm (${}^7\text{F}_0-{}^5\text{L}_6$) besides a weak lines at 469 nm (${}^7\text{F}_0-{}^5\text{D}_2$) and broad charge transfer band in UV range. The relative intensity of the 4f-4f transitions depends on the Ca/Cd ratio. Decay kinetics under excitation at 395 nm is characterized by one exponent with $\tau=3.15$ ms at 300 and 77 K. The characteristics of Eu^{3+} luminescence allow suppose the formation of one type of Eu^{3+} centre in $\text{Ca}_{3-x}\text{Cd}_x\text{Ga}_2\text{Ge}_3\text{O}_{12}$ ceramics in contrast to $\text{Ca}_3\text{Ga}_2\text{Ge}_3\text{O}_{12}$ single crystals, in which at least three type of activator centres are revealed [1, 2].

The $\text{Ca}_3\text{Ga}_2\text{Ge}_3\text{O}_{12}$ samples are nonluminescent. The pure $\text{Ca}_{3-x}\text{Cd}_x\text{Ga}_2\text{Ge}_3\text{O}_{12}$ samples show a broad defect emission at UV or X-ray excitation. The possible mechanism of this luminescence is discussed.

The investigated luminescent materials show efficient red emission and can be suitable for the application in UV-emitting LEDs.

References

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