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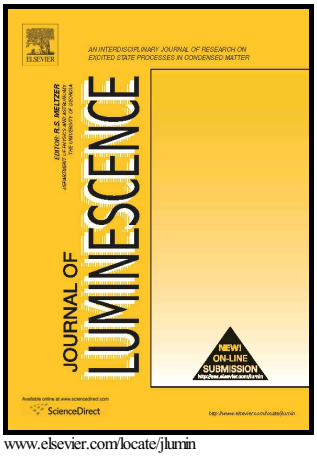

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Luminescent properties of $(La,Lu,Gd)_3(Al,Sc,Ga)_5O_{12}$:Ce mixed garnets under synchrotron radiation excitation

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Abstract.

The phosphors based on the single crystalline films (SCFs) of Ce-doped mixed garnets with the $La_{1.5}Lu_{1.5}Sc_2Al_3O_{12}$:Ce, $La_{1.5}Lu_{1.5}Sc_2Ga_3O_{12}$:Ce and $Gd_{1.75}Lu_{1.25}Sc_2Al_3O_{12}$:Ce nominal content were crystallized by the liquid phase epitaxy (LPE) method onto $Gd_3Ga_5O_{12}$ (GGG) substrates from melt-solutions based on the $PbO-B_2O_3$ flux. The luminescent properties SCFs of these mixed garnets were investigated under e-beam and synchrotrons radiation (SR) excitation and compared with the properties of LuAG:Ce and YAG:Ce counterparts. The basic optical characteristics of the $La_{1.5}Lu_{1.5}Sc_2Al_3O_{12}$:Ce, $La_{1.5}Lu_{1.5}Sc_2Ga_3O_{12}$:Ce and $Gd_{1.75}Lu_{1.25}Sc_2Al_3O_{12}$:Ce garnets, e. g., the energy of formation of excitons bound with the Ce^{3+} ions and the decay time of the Ce^{3+} luminescence, were determined using excitation by SR with an energy of 3.7-25 eV in the range of the fundamental absorption edge of garnet hosts. We have also found the significantly larger influence of Pb^{2+} flux related impurity on the LY of the Ce^{3+} luminescence in SCFs of the mentioned mixed garnets, grown onto GGG substrates, in comparison with the YAG:Ce and LuAG:Ce SCFs analogues, grown onto YAG substrates. The best light yield (LY) (7-9% in comparison with YAG:Ce SCFs) under excitation by α–particles of Pu^{239} source is observed in the $La_{1.5}Lu_{1.5}Sc_2Al_3O_{12}$:Ce SCFs.

Keywords: garnets, liquid phase epitaxy, single crystalline films, mixed garnets, Ce^{3+} dopant, synchrotron radiation.

1. Introduction

The development of micro-imaging techniques using X-ray radiation strongly demands new single crystalline film (SCF) scintillating screens with the high ability of X-ray absorption for 2D/3D imaging with the submicron spatial resolution [1, 2]. The SCFs based on the mixed garnet compounds as well as SCF-substrate epitaxial structures are also interesting for the development of composite scintillators for registration of the different component of the mixed ration fluxes [2] as well as for the luminescent converters in high-power white LED (WLED) light emitting sources [3]. Meanwhile, the demand for creation of the new luminescent materials in the SCF form for different conventional and novel application still is very large.

Our work presents the results of research directed on the development of new types of luminescent materials based on SCFs of Ce doped $(La,Lu,Gd)_3(Al,Sc,Ga)_5O_{12}$ mixed garnets grown