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PHOTOLUMINESCENCE OF $Lu_3Al_5O_{12}$:Bi AND $Y_3Al_5O_{12}$:Bi SINGLE CRYSTALLINE FILMS

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Bi^{3+}-doped rare-earth aluminate and gallate garnets, where a Bi^{3+} ion substitutes a trivalent rare-earth ion, can be considered as perspective scintillator materials for imaging screens with high spatial resolution due to their high density, good mechanical and chemical stability, and intense and fast Bi^{3+}-related emission [1-3]. Single crystalline films of $Lu_3Al_5O_{12}$:Bi and $Y_3Al_5O_{12}$:Bi have been studied at 4.2-330 K by the time-resolved luminescence spectroscopy methods. Their emission spectrum consists of two types of bands with strongly different characteristics. The ultraviolet band (see Fig.1.) consists of two components, arising from the electronic transitions which correspond to the $^3P_1$ – $^1S_0$ and $^3P_0$ – $^1S_0$ transitions in a free Bi^{3+} ion. At T<70 K, only the lower-energy component with the decay time ~10^{-3} s is observed, arising from the metastable $^3P_0$ level. At T>150 K, the higher-energy component prevails, arising from the thermally populated emitting $^3P_1$ level. The visible emission spectrum consists of two overlapped broad bands with the large Stokes shifts. At 4.2 K, their decay times are ~10^{-5} s and ~10^{-4} s and decrease with an increasing temperature. The both visible bands are assumed to be of an exciton origin. The lower-energy band is ascribed to an exciton, localized near a single Bi^{3+} ion. The higher-energy band, showing stronger intensity dependence on the Bi^{3+} content, is assumed to arise from an exciton, localized near a dimer Bi^{3+} center.

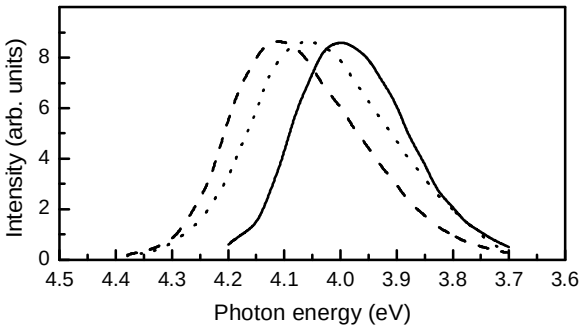

Fig.1. Ultraviolet emission spectra (normalized) of YAG:Bi SCF measured at 80 K (solid line), 150 K (dashed line) and 300 K (dotted line). E_{exc}=4.5 eV.

References

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