Optical and scintillation properties of Tm doped $Lu_2Si_2O_7$ single crystal

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Scintillator material is a luminescence material which can convert a high energy photon and particle of the ionizing radiation to the lower energy photons such as ultraviolet and visible light immediately after the absorption of the ionizing radiation. The emitted photons will be collected by photodetectors such as photomultiplier tube (PMT) and converted to the electrical signal for radiation detection purpose [1]. The single crystal type scintillators using the rare earth ions as a luminescence center have been commonly investigated. As such an emission center ion, Tm^{3+} is well known for clear visible light emission in the blue range which is nessecery in the display and other blue phosphors related devices [2]. For the host materials, $Lu_2Si_2O_7$ (LPS) has been selected in this study due to the high effective atomic number and good scintillation properties when doped with Ce^{3+} ions such as a short decay time and a high light yield [3].

In this study, we focused on the optical and scintillation properties of Tm-doped LPS (Tm:LPS) single crystal synthesized by the floating zone method. Figure 1 represents the photoluminescence (PL) emission map of Tm:LPS crystal. Several emission bands appeared at 350 and 450 nm due to Tm^{3+} 4f-4f transition with different ground states, and an intense emission band at 800-900 nm came from the LPS host emission. Figure 2 presents X-ray induced scintillation spectra of Tm:LPS and undoped LPS crystal. The Tm doped sample showed similar emission peaks with those in the PL emission map. Intense peaks appeared at 350 nm and 450 nm due to the $^1D_2 \rightarrow {}^3H_6$ and $^1D_2 \rightarrow {}^3F_4$ of Tm^{3+} 4f-4f respectively [4].

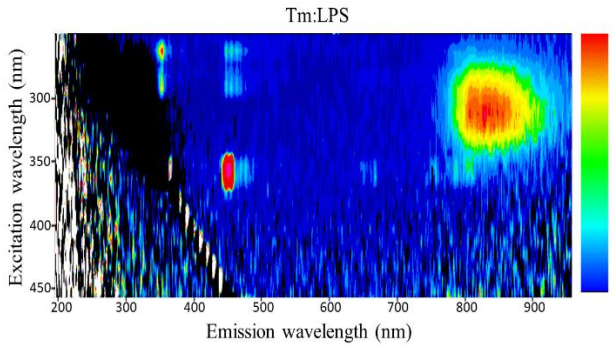

Figure 1. PL emission map of Tm:LPS crystals.

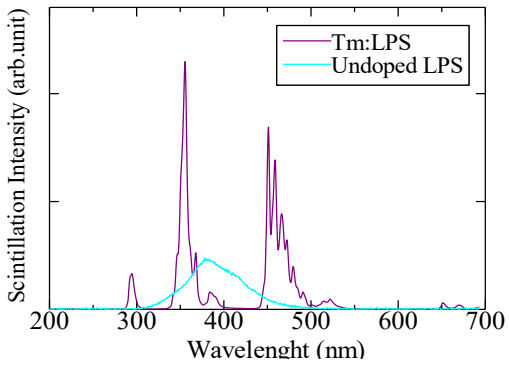

Figure 2. X-ray induced scintillation spectra of Tm:LPS and undoped LPS crystals.

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