Optical and scintillation properties of Tm-doped $La_2Si_2O_7$ crystal

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Ionizing radiation such as X-ray and γ-ray has been using widely in many fields of expertise. To measuring the ionizing radiation, the Ionizing radiation is needed to convert to the lower-energy photon that detectable by a photodetector. The materials category that has this conversion ability is called scintillator. Single crystalline scintillators are doped with 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 necessary for the display and other blue phosphors-related devices. Also, Our previous study on the Tm-doped $La_2Si_2O_7$ (Tm:LPS) presents decent scintillation properties such as scintillation light yield at 2340 ph/MeV, low afterglow, and good liner relationship between γ-ray energy and photoabsorption peak channel [1]. At this point, the substitutional of Lu by La in the host material is promising to have interesting results.

In this study, we focused on the optical and scintillation properties of Tm-doped $La_2Si_2O_7$ (Tm:LaPS) single crystals synthesized by the floating zone method. Then, we evaluated the photoluminescence (PL) and scintillation properties such as emission spectra, decay time, and pulse height measurement. Figure 1 represents the X-ray-induced scintillation spectra of the undoped and 0.1-5.0 % Tm-doped LPS crystal. Several sharp peaks appeared at 350 nm and 450 nm due to the Tm^{3+} 4f-4f transitions ($^1D_2 \rightarrow {}^3H_6$ and $^1D_2 \rightarrow {}^3F_4$), respectively [2]. Figure 2 presents the PL emission map. Unlike the scintillation spectra, Tm:LaPS sample only exhibits the emissions at 450 nm ($^1D_2 \rightarrow {}^3F_4$). The PL quantum yield of the Tm:LaPS sample is observed at 22.0 %.

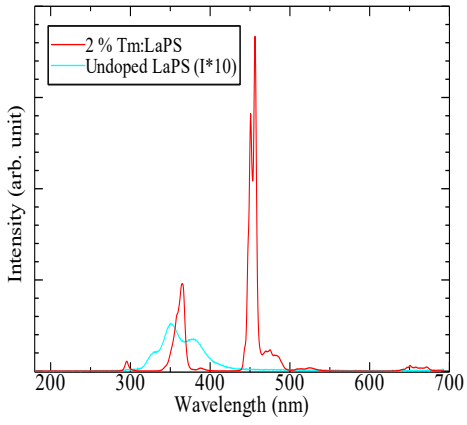

Figure 1. X-ray induced scintillation spectra of Tm-doped LaPS crystals.

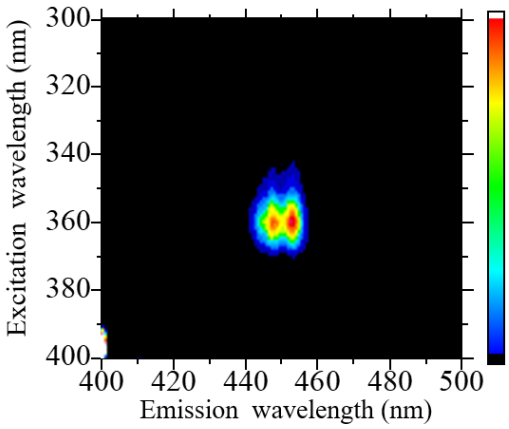

Figure 2. PL emission map of Tm-doped LaPS crystals.

[1] P. Kantuptim, *et al*. *Journal of Alloys and Compounds* 847 (2020): 156542.

[2] L. Macalik, *et al*. *Optical Materials* 28 (2006): 980.