Optical and Scintillation properties of Pr-doped $Lu_2Si_2O_7$ single crystals by the floating zone method

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Scintillator material is one of the luminescent materials which can convert high energy photons or charged particles to the lower energy photons such as ultraviolet and visible light immediately after the absorption of the ionizing radiation [1]. The emitted photons will be collected by a photodetector such as a photomultiplier tube (PMT) or photodiode (PD) into the electrical signal for radiation detection purposes. The single crystal type scintillators using the rare earth ions as the luminescence center have been commonly used. Among rare earth ions, Pr^{3+} is one of the attractive ions for this purpose from the result of fast scintillation decay time around 10-20 ns [2]. In addition, $Lu_2Si_2O_7$ (LPS) had been used for the host materials due to the high effective atomic number, and it presents good comprehensive features such as short decay time and high light yield when it is activated by Ce^{3+} and Pr^{3+} ions [3].

In this work, we investigated the physical and scintillation properties of LPS single crystals with different Pr-doping concentrations that have been fabricated by the floating zone method to investigate the optimum concentration as a scintillator use. Figure 1 shows the photoluminescence emission map of the 0.5% Pr-doped LPS sample where the emission bands appear around 270-300 nm upon 250-260 nm excitation due to Pr^{3+} 5d-4f transitions. Figure 2. presents scintillation spectra of all the samples. The emission peak exhibited two peaks at 270-300 and 300-340 nm, and the emission origin was Pr^{3+} 5d-4f transitions.

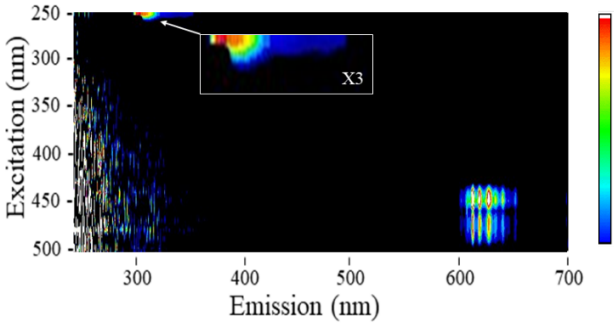

Figure 1. PL emission map of 0.5% Pr:LPS sample. The horizontal and vertical axes show emission and excitation wavelength, respectively.

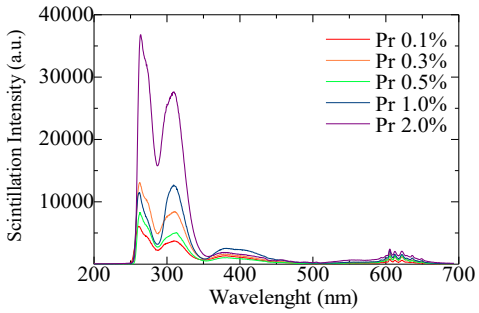

Figure 2. Scintillation spectra of all Pr:LPS samples under X-ray irradiation.

[1] T. Yanagida. *Journal of Luminescence* 169 (2016): 544-548.

[2] T. Yanagida, et al. *Japanese Journal of Applied Physics* 57.10 (2018)

[3] F. He, et al. *Journal of Rare Earths*, 2012, 30.8: 775-779.