Optical and Scintillation properties of Pr-doped $Y_2Si_2O_7$ single crystals by the floating zone method

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The Scintillator material is a luminescent material emitting photons such as ultraviolet and visible light from the excitation by high energy photons or charge particles [1]. The emitted photons will be collected by a photodetector then converted to the electrical signal for radiation detection purpose. The single crystal type scintillators using the rare earth ions as the luminescence center have been widely used. Among rare earth ions, Pr^{3+} is one of the suitable ions for this purpose from the result of fast scintillation decay time around 10-20 ns [2]. In other side, yttrium pyrosilicate $Y_2Si_2O_7$ (YPS) is a potential host for luminescent materials including scintillators because of high luminescence efficiency as well as thermal and chemical stability studied for upconversion [3].

In this study, we investigated both physical and scintillation properties of YPS single crystals grown form the floating zone method with a variation of Pr-doping concentrations to investigate the optimum concentration as a scintillator purpose. Figure 1 shows PL emission map of the 1.0% Pr doped sample. The emission bands appeared around 270-300 nm upon 250-260 nm excitation due to Pr^{3+} 5d-4f transitions. Emission around 580-620 nm upon 420-460 nm excitation were caused by Pr^{3+} 4f-4f transitions. Scintillation spectrum is shown in Figure 2. Upon X-ray excitation, we detected two emission peaks at 270-300 and 340-400 nm, and the emission origin was Pr^{3+} 5d-4f transitions from our recent interpretation [2].

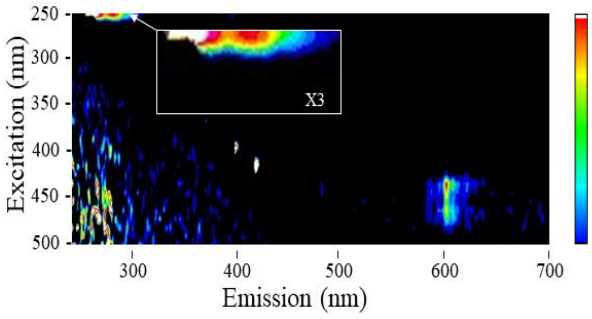

Figure 1. PL emission map of 1.0% Pr:YPS sample. The horizontal and vertical axes show emission and excitation wavelength, respectively.

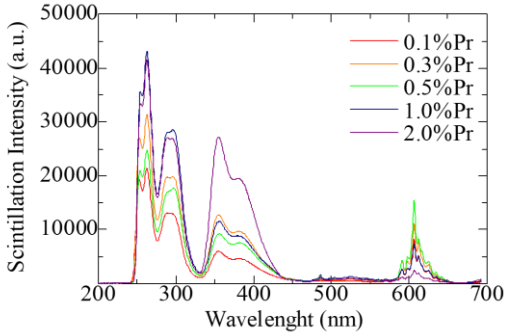

Figure 2. Scintillation spectra of all Pr:YPS samples under X-ray irradiation.

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

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

[3] J. Sokolnicki, *Mater. Chem. Phys.* 131 306-312 (2011)