Optical and Scintillation properties of Pr-dope $Gd_2Si_2O_7$ single crystals by the floating zone method

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Scintillator is one of the luminescent materials which have an ability to convert high energy photons to the lower energy photons such as visible light or UV. The emitted photons will be collected by a photodetector and then converted into the electrical signal for radiation detection application [1]. The single crystal type scintillators have the rare earth ions for a luminescence center, and Pr^{3+} is one of the highly interest ions for the luminescence center in the scintillator based on the property of a short scintillation decay time around 10-20 ns [2]. At the same time, gadolinium pyrosilicate $Gd_2Si_2O_7$ (GPS) is a great candidate in pyrosiligate type luminescent host, because of greater light output for gramma-rays and charged particles irradiations can be expected when they are doped with Ce^{3+}. But the growth of GPS single crystals was considered higher difficulty [3].

In the present work, the optical and scintillation properties of GPS single crystals grown by the floating zone (FZ) method with various Pr-doping concentrations had been evaluated with aim to investigate the optimum concentration. Figure. 1 shows the photoluminescence (PL) emission spectra under 265 nm excitation. We observed several emission peaks from 275 to 500 nm. Among the present samples, spectral shapes were not different but intensities differed. The emissions due to the 5d-4f transition of Pr^{3+} have been observed with two peaks at around the 310-320 and 340-400 nm. The Scintillation spectra under X-ray irradiation is shown in Figure. 2. Clear emission bands were observed. The emission peak appeared with two peaks at 310 nm and 340-400 nm, and the origins of these emission bands were ascribed to Gd^{3+} 4f-4f and Pr^{3+} 5d-4f transitions, respectively

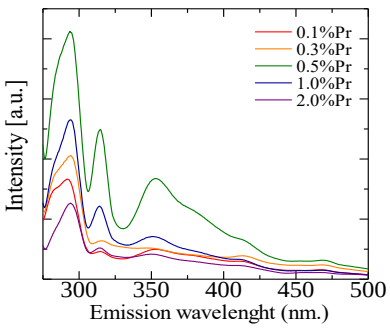

Figure 1. PL emission spectra of Pr:GPS sample

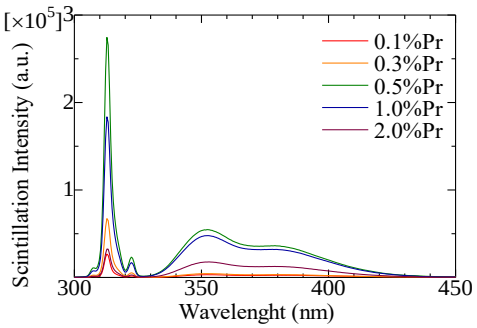

Figure 2. Scintillation spectra of all Pr:GPS samples under X-ray irradiation.

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

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

[3] S. Kawamura, et al. *IEEE Trans Nucl Sci* 54.4 (2007): 1383-1386.