Ce concentration dependence on scintillation properties of Ce-doped yttrium pyrosilicate single crystal

NAIST, °Prom Kantuptim, Daisuke Nakauchi, Takumi Kato, Noriaki Kawaguchi, Takayuki Yanagida

E-mail: prom.kantuptim.pf2@ms.naist.jp

The scintillator is one of the phosphor materials that can convert the high energy ionizing radiations such as photons (X- or γ-ray), neutron, or charged particles into lower-energy photons such as ultraviolet, visible, and near-infrared light.[1] The combination of scintillator and photodetector has been widely used for radiation measuring instruments in many scientific fields. In 2003, the Ce-doped $Lu_2Si_2O_7$ study presented the high light yield of 26,300 ph/MeV with a fast decay time of 40 ns.[2] With a similar crystal structure, the Lu substitution for Y such as $Y_2Si_2O_7$ (YPS) is expected to have interesting scintillation properties similar with our previous study on Pr-doped YPS.[3] This study also has the aim to be one of the first reports on Ce concentration dependence of PL and scintillation properties on Ce-doped YPS single crystal. The selected range of Ce-concentration is from 0.5 to 10.0 %. Both PL and scintillation properties are systematically carried out including PL emission map, PL decay time, X-ray-induced scintillation spectra and decay time, afterglow analysis, γ-ray-irradiated pulse-height spectra, and absolute scintillation light yield. This investigation of this study will lead to the better optimized Ce-doped YPS for use as the scintillator in the scintillation detector. Figure 1 represents the excitation and emission contour graph of the 2.0 % Ce-doped YPS sample. The intense PL emission band at 360–400 nm which is found in Ce-doped YPS are originated from the Ce^{3+} 5d-4f transitions. Figure 2 show the pulse-height spectra of the Ce-doped YPS samples. The highest scintillation light yield obtained in this study is 2.0 % Ce-doped YPS at 17,200 ph/MeV.

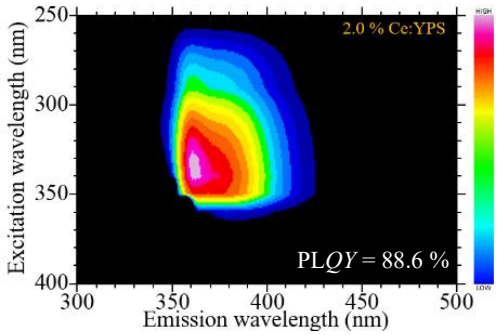

Fig. 1. PL emission contour graphs of Ce:YPS samples.

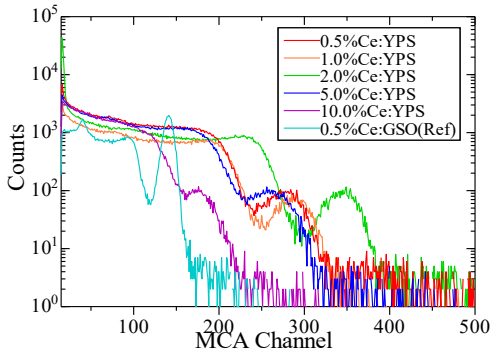

Fig. 2. ^{137}Cs γ-ray pulse-height spectra of Ce:YPS samples with Ce:GSO reference.

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

[2] L. Pidol, *et al*. *Journal of Physics Condensed Matter* 15 (2003): 2091.

[3] P. Kantuptim, *et al*. *Japanese Journal of Applied Physics* 59 (2019): SCCB17.