Scintillation properties of Sm-doped lutetium pyrosilicate single crystal

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Scintillator material is a luminescence material which can convert a high energy photon and particle of the ionizing radiation to the lower energy photons such as ultraviolet and visible light immediately after the absorption of the ionizing radiation. The emitting photons will be collected by photodetectors such as photomultiplier tube (PMT) and converted to the electrical signal for radiation detection purposes. The single crystal type scintillators using the rare earth ions as the luminescence center have been commonly investigated.[1] For the host materials, $Lu_2Si_2O_7$ (LPS) has been used due to the high effective atomic number and presents good scintillation performance such as short decay time around 20 ns and highest light yield of 9,700 ph/MeV when it is activated with Pr^{3+} ions compared with the other Orthosilicates host [2]. For the luminescence center, the Sm^{3+} has been selected due to the strong and stable intense reddish-orange emission. This study has the aim to be the first report on Photoluminescence (PL) and scintillation properties of Sm-doped LPS. The focus properties are including PL emission map, PL decay time, X-ray-induced scintillation spectra and decay time, afterglow analysis, γ-ray-irradiated pulse-height spectra, and scintillation light yield. Figure 1 presents the PL emission contour graph. The 4 narrow emissions that appeared in the PL emission map total of 4 peaks at 563 ($^4G_{5/2} \rightarrow {}^6H_{5/2}$), 599 ($^4G_{5/2} \rightarrow {}^6H_{7/2}$), 645 ($^4G_{5/2} \rightarrow {}^6H_{9/2}$), and 706 ($^4G_{5/2} \rightarrow {}^6H_{11/2}$) nm.[3] Similar trends also appeared in the X-ray induced scintillation spectra of the Sm-doped LPS sample which presents in figure 2.

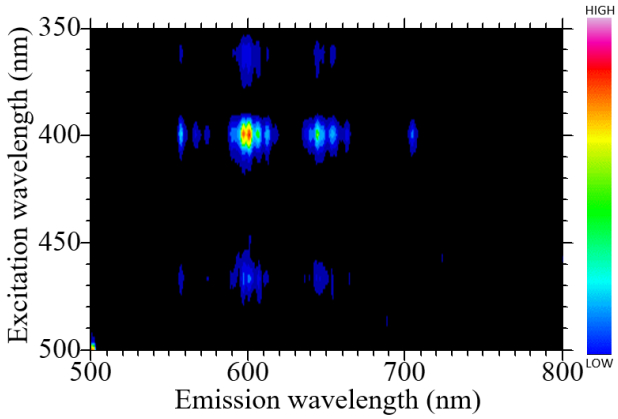

Fig. 1. PL emission contour graphs of Sm-doped LPS samples.

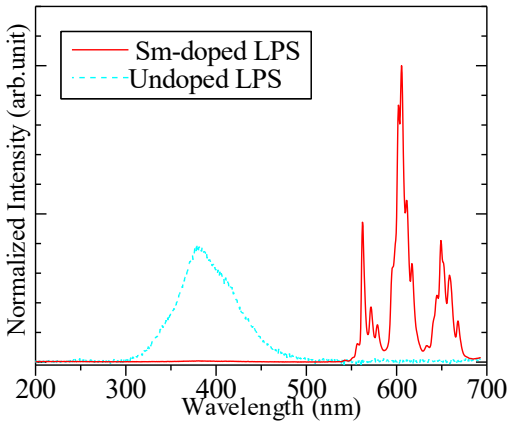

Fig. 2. X-ray induced scintillation spectra of Sm-doped LPS sample.

[1] T. Yanagida, *Proceedings of the Japan Academy, Series B* 94 (2018): 75.

[2] P. Kantuptim, *et al. Radiation measurements* 134 (2020): 106320.

[3] P. Limkitjaroenporn, *et al. Radiation Physics and Chemistry* 192 (2022) 109887.