Near-infrared scintillation properties of Er and Nd-doped $Lu_2Si_2O_7$ single crystal

NAIST, ◦Prom Kantuptim, Masaki Akatsuka, Daisuke Nakauchi, Takumi Kato,
Noriaki Kawaguchi, Takayuki Yanagida
E-mail: prom.kantuptim.pf2@ms.naist.jp

Scintillator material is a classification of materials with the ability to convert high energy photons or charged particles to the lower energy photons such as visible and infrared light immediately after the absorption of the ionizing radiation [1]. Recently, single crystal type scintillators generally use rare earth ions as a luminescence center. In this study, $Lu_2Si_2O_7$ (LPS) had been selected for the host materials due to the high effective atomic number, and it presents good comprehensive features such as a short decay time and a high light yield when doped with Pr^{3+} ions compared with the other rare earth pyrosilicate [2].

In this work, Nd and Er were selected for luminescence centers for LPS because they were famous by intense infrared (IR) emissions. Single crystal samples of Nd and Er doped LPS were synthesized by the floating zone method, and after the synthesis, we investigated on both the photoluminescence and scintillation properties. Figure 1 presents X-ray induced scintillation spectra of both samples observed in UV-visible region. Nd:LPS showed the intense emission at 400 nm due to Nd^{3+} $^2F_{5/2}\rightarrow{}^4F_{5/2}$ transition [3]. In Er:LPS, the emission peaks appeared at 400 and 480 nm due to Er^{3+} $^2H_{9/2}\rightarrow{}^4I_{15/2}$ and $^2H_{9/2}\rightarrow{}^4F_{7/2}$ transitions, respectively. Fig.2 shows the emission spectra in IR range. Nd:LPS showed several emission peaks were appeared due to electronics transition of Nd^{3+} $^4F_{3/2}\rightarrow{}^4I_{9/2}$ (910 nm), $^4F_{3/2}\rightarrow{}^4I_{11/2}$ (1064 nm), and $^4F_{3/2}\rightarrow{}^4I_{13/2}$ (1320 nm). In Er:LPS , the emission peaks appeared at 1550 nm due to Er^{3+} $^4I_{13/2}\rightarrow{}^4I_{15/2}$ [4].

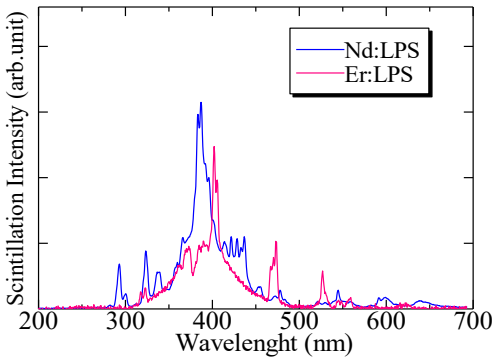

Figure 1. Scintillation spectra of Nd,Er:LPS samples under X-ray irradiation observed in UV-visible wavelength.

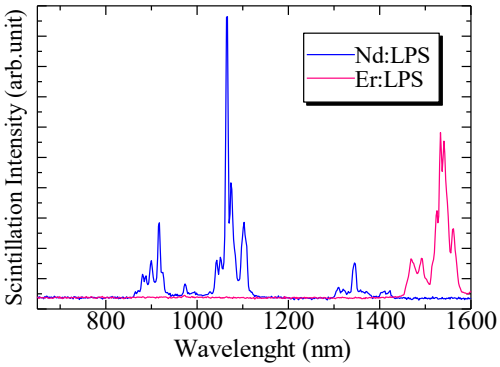

Figure 2. Scintillation spectra of Nd,Er:LPS samples under X-ray irradiation observed in near IR wavelength.

[1] T. Yanagida. *Journal of Luminescence* 169 (2016): 544-548.
[2] T. Yanagida, et al. *Japanese Journal of Applied Physics* 57.10 (2018).
[3] M. Akatsuka, et al. *Sensors and Materials* 30.7 (2018): 1525-1532.
[4] D. Chen, et al. *Journal of Applied Physics* 101 (2007).