Pr concentration dependence of scintillation properties on Pr-doped $La_2Si_2O_7$ crystal

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Scintillator is a luminescence material which can convert a high energy photon and a 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 emitted photons are collected by photodetectors and converted to electrical signals for radiation detection purpose. At present, the single crystal type scintillators using the rare earth ions as the luminescence center have been commonly investigated from a fast response time, high light yield, and high effective atomic number. Among luminescence center ions, Pr^{3+} is one of the highly attractive ions for this purpose from the result of fast scintillation decay time. In 2018, the Pr-doped $Lu_2Si_2O_7$ study had shown a very fast scintillation decay time around 15 ns with a light yield of 9,700 ph/MeV [1].

Form these great results, the searching of new host materials for Pr is becoming very interesting for the fast decay time scintillator. From the similar ionic radius between Lu and La, the lanthanum pyrosilicate ($La_2Si_2O_7$, LaPS) is expected to has high scintillation characteristics when doped with the Pr. This study has an aim to be the first report on Pr-doped LaPS focus on both optical and scintillation properties. Figure 1 presents the x-ray induced scintillation spectra of Pr-doped LaPS, multiple scintillation emission has been observed including 260-300 nm from Pr^{3+} 5d-4d transition, 350-380 from host emission, and several emissions from Pr^{3+} 4f-4f transition at 500 and 600 nm [2]. Figure 2 present the ^{137}Cs γ-ray pulse height spectra of Pr-doped LaPS samples. The 3.0 % Pr-doped LaPS present the highest scintillation light yield among the Pr-doped LaPS samples at 3200 ph/MeV. This work is also covered the other properties including PL emission spectra and decay time, scintillation decay time, afterglow, and more.

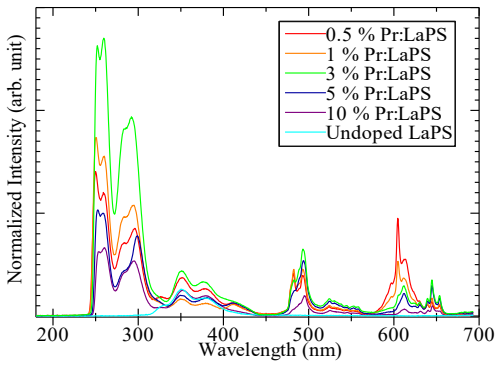

Figure 1. X-ray induced scintillation spectra of Pr-doped LaPS crystals.

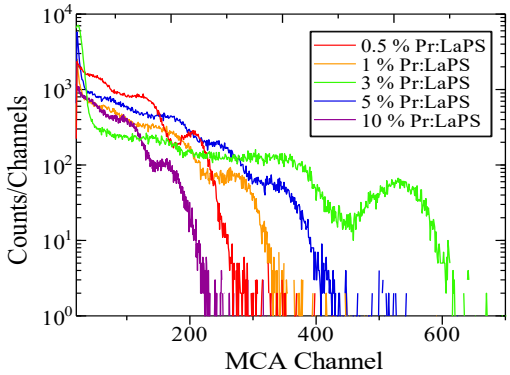

Figure 2. ^{137}Cs (662 keV) pulse height spectra of Pr-doped LaPS crystals.

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

[2] H. Feng, *et al. Journal of Rare Earths* 30 (2012): 775.