Optical and scintillation properties of Ce doped $La_2Si_2O_7$ crystal

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The scintillator is one of the phosphor materials that has the ability to 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. The study of inorganics scintillator is always looking for new materials that have high light yields, fast scintillation decay time, good energy resolution, and low afterglow. All of these desirable properties can be found in the lanthanide-doped materials, especially Ce [2]. In 2003, the Ce-doped $Lu_2Si_2O_7$ study had shown the high light yield of 26,300 ph/MeV with fast decay time around 40 ns [3]. With similar crystal structure, the La substitution for Lu material such as $La_2Si_2O_7$ (LaPS) is expected to have good scintillation properties.

This research has aim to study and investigate the LaPS for the new host materials for Ce on both optical and scintillation properties. The Ce-doped LaPS single crystal was synthesized by the floating-zone method. Figure 1 presents the Ce-doped LaPS single crystal on both as-grown crystal rod (A) and after cut and polished crystal (B). Figure 2 presents photoluminescence (PL) emission map of Ce doped LaPS observed in 250–400 and 300–700 nm for the excitation and emission wavelength, respectively. The sample has broad emission at 380 nm from Ce^{3+} 5d-4f transition, the PL *QY* observed at around 11.4 %. Apart from the PL emission map, the other measurements in this study were systematically carried out, including PL decay times, scintillation spectra, scintillation decay times, afterglow timing profiles, and γ-ray irradiation pulse height spectra for absolute scintillation light yield.

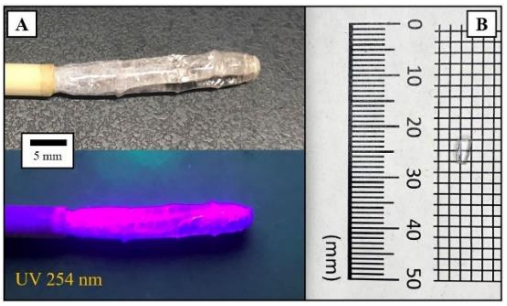

Figure 1. Ce doped LaPS crystals as-grown (A) and after cut and polished (B).

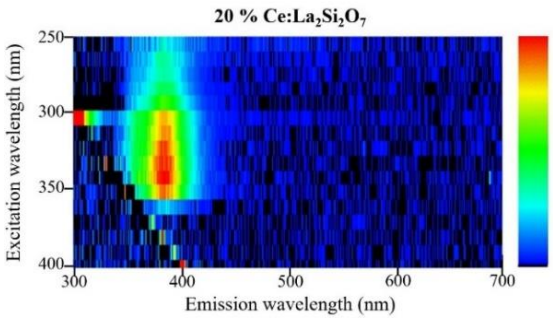

Figure 2. PL emission map of Ce-doped LaPS crystals.

[1] T. Yanagida. *Journal of Luminescence* 169 (2016): 544-548.
[2] C. Dujardin, *et al*. *IEEE Transactions on Nuclear Science* 65 (2018): 1977-1997.
[3] L. Pidol, *et al*. *IEEE Transactions on Nuclear Science* 51.3 (2004): 1084-1087.