

X-ray and VUV Induced Properties of Undoped $X_2Si_2O_7$ ($X=Lu, Y, Gd$) Crystal

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The study on rare-earth-doped pyrosilicate materials for the scintillator purpose has become more compelling in recent years. In our previous study, the Pr-doped $Lu_2Si_2O_7$ (LPS) was presented good scintillation properties including fast decay time around 20 ns with a scintillation light yield of 9,300 ph/MeV [1]. However, the scintillation spectrum of these materials is still not fully understanding, due to many crystal structures depending on the chemical compositions of the pyrosilicate crystals [2]. For this reason, the investigation on undoped pyrosilicate materials such as LPS, $Y_2Si_2O_7$ (YPS), and $Gd_2Si_2O_7$ (GPS) is necessary. Despite the recent advance in the research of lanthanide-doped rare-earth pyrosilicate materials, we still have room to explore the intrinsic luminescence on both photoluminescence (PL) and scintillation properties of the undoped LPS, YPS, and GPS single crystal.

The undoped LPS, YPS, and GPS single crystal was prepared by the floating-zone method. After obtained the single crystal samples, the powdered XRD analysis was done to confirm the single phase of each material. Figure 1 presents the PL emission spectra of LPS, YPS, and GPS under the 174, 176, and 174 nm vacuum-UV (VUV) excitation, respectively. The LPS and YPS samples present the broad emission at around 350-450 and 320-480 nm, respectively. The GPS sample presents a narrow emission peak at 310 nm with diffraction at around 600 nm. Figure 2 presents the X-ray induced scintillation spectra of LPS, YPS, and GPS samples. The spectral shape of all samples is similar to the earlier VUV-excited PL emission spectra.

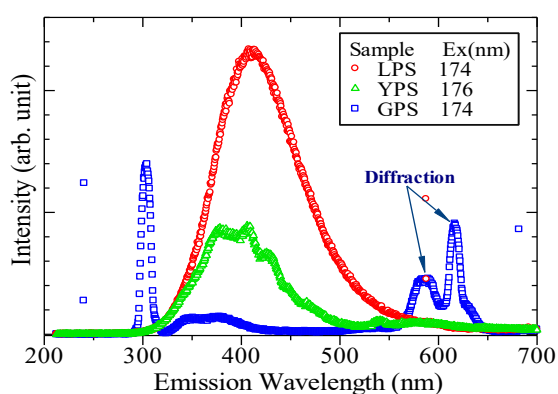


Figure 1. VUV-excited PL emission spectra of LPS, YPS, and GPS samples.

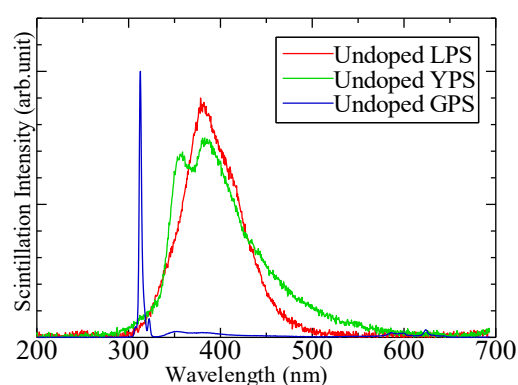


Figure 2. X-ray induced scintillation spectra of LPS, YPS, and GPS samples.

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

[2] T. Yanagida, *et al. Japanese Journal of Applied Physics* 57 (2018): 106401.