Scintillation Characteristics of Ce-doped Yttrium-Gadolinium Pyrosilicate Crystal

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Radiation is more important than ever before, and the detection of radiation is also significant as radiation itself. Scintillators are materials that can convert the high-energy photons of e.g. ionizing radiation or even charged particles such as α-rays to lower energy photons in the ultraviolet to infrared range. There are many types of materials for scintillators like glass, plastic, transparent ceramics, organic or inorganic compounds, semiconductor, or single crystals. Single crystals are well known for their high light yield and good chemical stability. One interesting host material is the pyrosilicate group $X_2Si_2O_7$. Many promising material compositions are already studied like Ce-doped $Lu_2Si_2O_7$ with fast decay time and high light yield [1] or Ce-doped $Y_2Si_2O_7$ which has an even faster decay time.[2] For a deeper understanding of the behaviour of pyrosilicate host materials, additional study on the host materials is needed. This study is focused on a yttrium-gadolinium pyrosilicate ($Y_{2-X}Gd_XSi_2O_7$) single crystal sample of different ratios of Gd and Y with 2% Ce dopant to investigate the ratio-dependent scintillation properties.

For the example of the result in this study, figure 1 presents the X-ray induced after glow profile of Ce-doped YGPS samples. The samples presented an afterglow level at 20 ms after X-ray irradiation (Af_{20}) at 40–60 ppm. Which is considerably low when compared with the scintillator materials available on the market such as $CdWO_4$. Another highlight property is ^{127}Cs pulse-height spectra presented in figure 2. Ce-doped YGPS has scintillation light yield up to 21,200 ph/MeV when the molar ratio of the Y and Gd are equal ($Y_1Gd_1Si_2O_7$). Apart from the light yield, this study is also containing other comprehensive properties of Ce-doped YGPS for scintillator application including scintillation spectrum and scintillation decay time analysis.

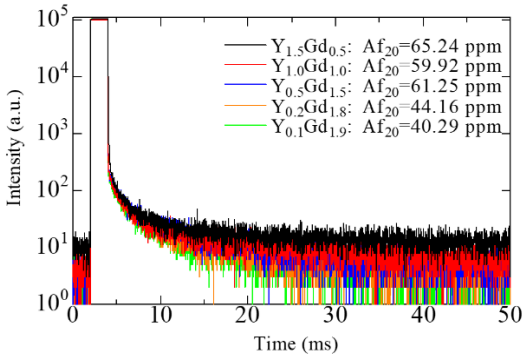

Fig. 1. X-ray induced after glow profile of Ce-doped YGPS samples with Af_{20} values.

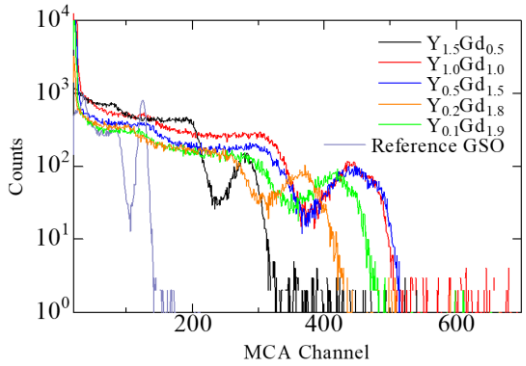

Fig. 2. ^{127}Cs pulse-height spectra of Ce-doped YGPS samples and GSO reference

[1] L. Pidol, *et al. Journal of Physics Condensed Matter* 15 (2003): 2091.

[2] H. Fang, *et al. Japanese Journal of Alloys and Compound* 489 (2010): 645.