Concentration-dependent luminescence and scintillation properties of Tb-doped $KGd(PO_3)_4$ glasses

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Glass scintillators are attractive radiation detection materials because of their high formability, large-area processability, and low fabrication cost. However, their light yield is generally lower than that of single-crystal scintillators due to structural disorder and defect-related energy loss in the glass network. To address this issue, we have focused on a crystal-stoichiometric composition design, in which the glass composition is based on that of a known efficient luminescent crystal. In this study, Tb-doped $KGd(PO_3)_4$ glasses were prepared, and the effects of Tb concentration on their luminescence and scintillation properties were investigated.

Fig. 1 shows the photoluminescence (PL) spectrum of the Tb-doped glass sample. All the Tb-doped samples showed characteristic Tb^{3+} emission arising from the $^5D_4$–^7F_J transitions under excitation of the host Gd^{3+} ions. The emission intensity and quantum yield changed systematically with Tb concentration, indicating that the luminescence process was strongly influenced by the balance between Gd-to-Tb energy transfer and concentration quenching. The scintillation spectra also showed intense Tb^{3+} emission under X-ray excitation (Fig. 2), and the light yield reached a maximum for the 1.0% Tb-doped sample, with a value of 5500 ph/MeV. Detailed concentration dependences of the emission spectra, decay profiles, and light yield will be discussed in the presentation.

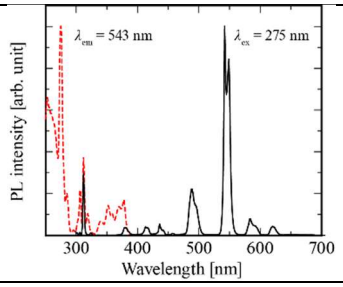

Figure 1 PL spectra of 3.0% Tb-doped $KGd(PO_3)_4$ glass sample.

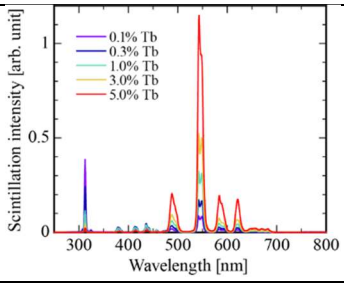

Figure 2 X-ray induced scintillation spectra of Tb-doped $KGd(PO_3)_4$ glass samples.

[1] G. Lakshminarayana, et al., (2009) J. Alloys Compd., 476, 720–727.

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