Eu concentration effects on the radio–photoluminescence properties in Eu:$Na_2BaSr(PO_4)_2$ ceramics

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Radio-photoluminescence (RPL) is a radiation-induced luminescence phenomenon that has attracted considerable attention for applications in optical memory devices and high-resolution radiation imaging. A key advantage of RPL dosimeters is that they allow repeated readouts without loss of the accumulated dose information [1]. Despite these attractive features, the number of reported RPL materials remains limited, and the exploration of new materials with superior RPL properties remains necessary. In this study, we focused on Eu-doped $Na_2BaSr(PO_4)_2$ ceramics for a new RPL material and demonstrated their pronounced RPL phenomenon. We will report on the Eu concentration dependence of their RPL properties.

Figure 1 shows the photoluminescence (PL) spectra of the 0.3% Eu-doped sample. Following irradiation, a new broad emission band emerges around 470 nm due to the 5d–4f transition of Eu^{2+} ions. This irradiation-induced reduction from Eu^{3+} to Eu^{2+} directly confirms the RPL phenomenon. Figure 2 shows the dose response curve of PL intensity for the 0.3% Eu-doped sample. The sample exhibits excellent linearity above the threshold, demonstrating outstanding performance with a remarkably low detection limit of 6.0 mGy.

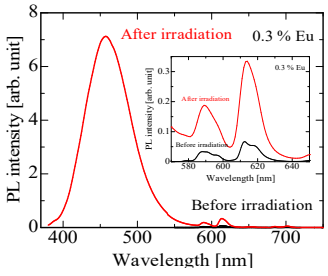

Figure 1 PL emission spectra of the 0.3% Eu-doped $Na_2BaSr(PO_4)_2$ sample before and after X-ray irradiation.

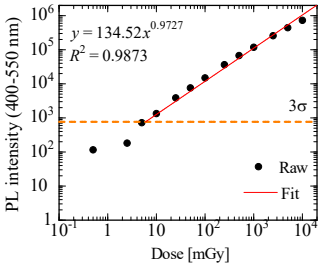

Figure 2 Dose response curve of PL intensity for the 0.3% Eu-doped $Na_2BaSr(PO_4)_2$ sample after X-ray irradiation.

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