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Luminescence and Scintillation Properties of Gd,Nd-codoped $BaLu_{1.2}Y_{0.8}F_8$ Single Crystals

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The development of new radiation detection systems based on the vacuum ultraviolet (VUV) scintillators has been started recently. These scintillators can be coupled with advanced VUV photodetectors such as position-sensitive gas electron multipliers (GEM), micro-pixel chambers or VUV-sensitive photomultipliers with CsI-coated photocathodes. One of the promising candidates for the VUV scintillator can be the Nd-doped $BaLu_{1.2}Y_{0.8}F_8$ (BaYLuF). The fast VUV emission around 185 nm with a decay time of several nanoseconds is due to the allowed 5d-4f transition of the Nd^{3+} ion. Recently, we tried to improve the energy transfer from the host matrix to the Nd^{3+} luminescence center by Tm-codoping. As the Tm^{3+} 5d-4f emission spectrum coincides with the Nd 4f-5d absorption band, the energy would migrate over the Tm^{3+} 5d levels to the Nd^{3+} ones. This was successfully proved. However, the improvement of the overall scintillation efficiency was not significant, even if it was as high as that of LaF_3:Nd8% reference scintillator. We tried to search for new suitable codopant and replaced Tm with Gd. Some positive effects of Gd in Nd-doped $LiLuF_4$ crystals were recently reported by some of us. The comparison of the radioluminescence spectra of Gd1%-doped BaYLuF together with the Gd1%Nd1% doubly doped crystal and LaF_3:Nd8% reference scintillator is shown in the figure 1. Slightly increased intensity of the Gd1%Nd1% sample with respect to that of LaF_3:Nd 8% can be observed. Also, the Gd^{3+} 4f-4f emission intensity is significantly lower in the doubly doped sample when compared to the Gd-doped one. This might point to existence of a mechanism preventing the excitation energy to be transferred to the 4f-levels of Gd^{3+}. The more detailed results on luminescence and scintillation performance of such crystals will be presented and discussed using also the data on samples with different dopants and different dopant concentrations.

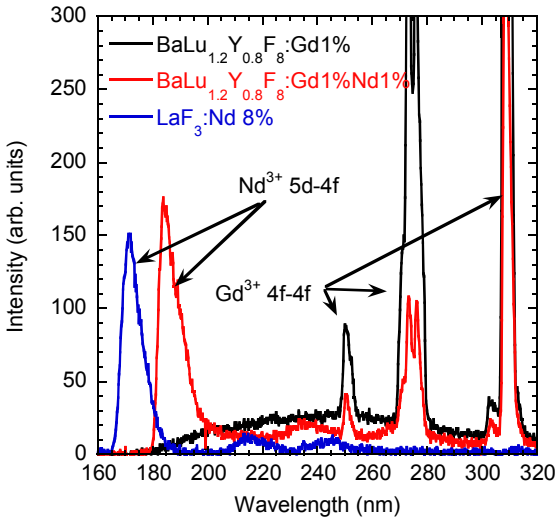

Figure 1. Comparison of X-ray-excited radioluminescence spectra of $BaLu_{1.2}Y_{0.8}F_8$:Gd1%, $BaLu_{1.2}Y_{0.8}F_8$:Gd1%Nd1% samples and LaF_3:Nd 8% reference crystal