17p-B2-5

Luminescence and Scintillation Properties of Rare-earth-doped LuF_3-based VUV Scintillation Crystals

NICHe, Tohoku University[1], Institute of Physics AS CR, Czech Republic[2], Tokuyama Corp.[3], IMR, Tohoku University[4] °Jan Pejchal[1,2], Kentaro Fukuda[3], Akihiro Yamaji[4], Shunsuke Kurosawa[1,4], Yuui Yokota[1], Akira Yoshikawa[1,4]

E-mail: pejchalj@imr.tohoku.ac.jp

The new radiation detection systems based on the vacuum ultraviolet (VUV) scintillators have been developed since 2 decades ago. The VUV 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. Wide band-gap fluorides are suitable host crystals for VUV scintillators due to transparency in VUV region and possibility of doping with VUV-emitting rare-earth ions such as Nd^{3+}, Er^{3+} or Tm^{3+}. The rare-earth-doped LuF_3 single crystals have been studied recently by some of us while discovering quite promising scintillation properties. Energy transfer from the Er^{3+} ions to the Nd^{3+} ones has been proved in the doubly-doped LuF_3 crystals and resulted in slight increase of light yield. Similar phenomenon is expected also for the Tm^{3+} codoping ion, whose 4f-level structure is simpler than that of the Er^{3+}, where the energy leak to the 4f-levels was competitive to the energy transfer towards Nd^{3+} ions. In this work we focused on the Tm-doped and doubly Tm,Nd-doped LuF_3 single crystals and their scintillation and photoluminescence properties. The crystals have been grown by modified micro-pulling-down method using LiF flux to diminish the melting temperature below the phase transition from hexagonal to orthorhombic modification. The double Tm, Nd doping was chosen to test the possibility of energy transfer from the Tm^{3+} ion to the Nd^{3+} one. Also Tm-only-doped samples with different Tm concentration will be studied as well to choose the optimal Tm concentration. The X-ray excited radioluminescence spectra of the Tm-doped samples are compared together with that of LaF_3:Nd8% reference scintillator in the figure 1. The radioluminescence intensity the LuF_3 samples is several times higher than that of the LaF_3:Nd. The leading emission peak for Tm-doped sample related to Tm^{3+} 5d-4f emission is placed at 163 nm. The luminescence processes and scintillation properties will be explained and discussed further.

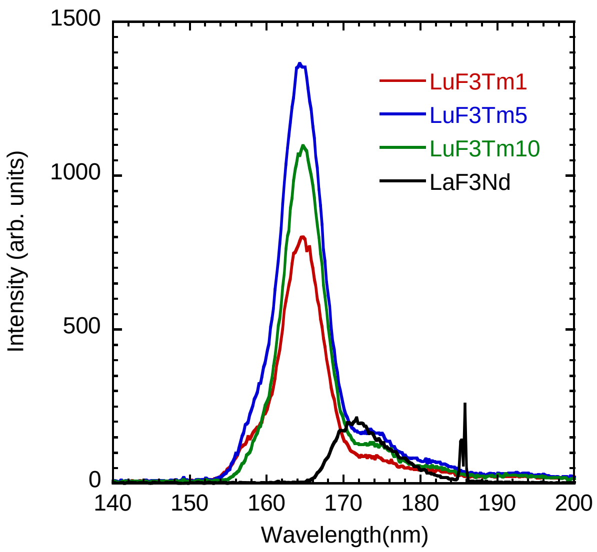

Figure 1. Comparison of X-ray-excited radioluminescence spectra of LuF_3:Tm samples with that of LaF_3:Nd 8% reference crystal