Development of novel cross-luminescence scintillators

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Scintillators find application in many areas of human activity including medicine, geology, national security, and environmental protection. A large number of scintillators are produced on an industrial level and commercially available, for example, classical scintillators like NaI:Tl, CsI:Tl, $Bi_4Ge_3O_{12}$, and $Y_3Al_5O_{12}$:Ce or state-of-the-art scintillators like (Lu, $Y)_2SiO_5$:Ce, Gd_3(Ga, $Al)_5O_{12}$:Ce, and $LaBr_3$:Ce,Sr. However, new technical challenges, primarily from the fields of medical imaging and high-energy physics, require timing performance that these scintillators cannot fulfill. Therefore, new so-called "ultrafast" scintillators must be developed. One of the material groups promising ultrafast scintillators are cross-luminescence scintillators. Cross-luminescence is a fast radiative recombination between electron in the valence band and hole in the uppermost core band. It was first observed as a fast component of the scintillation pulse of BaF_2 single crystals in 1982. Since then, it has been intensively researched, but found little industrial application, mainly due to its emission in the deep UV. Nevertheless, cross-luminescence scintillators based on cesium chloride and fluoride could overcome this problem by redshift of the emission. Moreover, complex compositions containing heavy elements could decrease attenuation length for high-energy photons which is a crucial parameter in medical imaging. In this contribution, I will present my work on the development of a novel cross-luminescence scintillator and outline perspectives/obstacles for future development.

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