EFFECTS OF BORON ON LUMINESCENCE PROPERTIES OF YTTRIUM/LUTETIUM ALUMINIUM GARNETS SCINTILLATORS

Greta Inkrataitė[1], Anatoli Popov[2], Ramūnas Skaudžius[1]

[1]Institute of Chemistry, Faculty of Chemistry and Geosciences, Vilnius University, Naugarduko 24, LT-03225 Vilnius, Lithuania

[2]Institute of Solid State Physics, University of Latvia, 8 Kengaraga street, LV-1063, Riga, Latvia

greta.inkrataite@chgf.vu.lt

Nowadays light based technology is very popular and can be used in different aspects of life. One of the areas, where light based technologies can be used is scintillators, which are made from luminescent materials. That is the base for devices, which are used for detecting and measuring radioactive contamination, monitoring nuclear materials and computed tomography. The most common scintillators are usually made from inorganic compounds. Materials for this case are variuos alkali-metal halides, alkali earth halides, lanthanide halides, transition metal, post–transition metal, rare-earth oxyorthosilicates or elpasolites [1]. Recently, garnets are one of the most popular materials applied as scintillators. In this work presented garnets are cerium doped yttrium aluminium garnet (YAG:Ce) and lutetium aluminium garnet (LuAG:Ce). Cerium activated scintillators have been investigated for thermal neutron and high energy radiation (X-ray, γ ray) detection [2]. In order to get wide spread application and fast scintillators it is very important to improve their light yield, self-absorption and decay time. These properties could be enhanced by co-doping garnets with boron. It is important that absolute light output is increased due to improved energy migration when garnets are doped with boron, which leads to better performance of scintillators [3]. One of the biggest drawbacks of these phosphors is long decay time. When it is too long, one image could be superimposed on another and this problem may also be solved by incorporation of boron into the garnet structure. Fast response time can allow detection of rare events in particle physics [4].

For this project different compounds were prepared, which could be used in scintillators in order to increase their light yield and self-absorption, also reduce phosphor decay time. The chosen compounds were, YAG:Ce and LuAG:Ce co-doped with boron. Phosphor powder was synthesized by sol-gel method and heated under different atmospheres. Samples were analyzed by x-ray diffraction (XRD), scanning electron microscopy (SEM) and high energy radiation detection was measured. Of course, quantum efficiency, decay times, emission spectrum have also been investigated.

[1] D. S. McGregor, Materials for Gamma-Ray Spectrometers: Inorganic Scintillators. Annual Review of Materials Research, **48**: 13.1–13.33 (2018)

[2] A.D. Sontakke, et al., A Comparison on Ce3+ Luminescence in Borate Glass and YAG Ceramic – Understanding the Role of Host's Characteristics. The Journal of Physical Chemistry C: 1-41 (2016)

[3] C. Foster, et al., oron Codoping of Czochralski Grown Lutetium Aluminum Garnet and the Effect on Scintillation Properties. Journal of Crystal Growth, **486**: 126-129 (2018)

[4] H. S. Yoo, et. al., Preparation and photoluminescence properties of YAl3(BO3)4:Tb3+, Bi3+ phosphor under VUV/UV excitation. Optical Materials, **31**: 131-135 (2008)