MODIFIED STRUCTURE LUTETIUM OXYORTHOSILICATE: SYNTHESIS AND INVESTIGATION OF LUMINESCENCE PROPERTIES

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Scintillators have already been used for decades. They are included in computed tomography (CT) instrument detectors, positron emission tomography (PET), and are the basis for devices that measure and detect radioactive contamination. Scientists are putting a lot of work into the development of scintillation agents, which are materials for devices that can help preserve health, detect cellular changes, cancer or alert to imminent health threats. In addition to the need for intensive emission, the decay time of the compounds is very important and should be as short as possible. Material with short decay times can capture more signals at the same time, resulting in a brighter and higher contrast image on CT or PET devices, or a higher quality result on radioactive contamination [1].

One of the materials, which can be used as a scintillator is cerium doped lutetium oxyorthosilicate (LSO:Ce). This compound as compared to a very popular and useful cerium doped yttrium aluminium garnet has better energy resolution and higher material density [2]. Because of these advantages and good luminescence properties, cerium doped LSO scintillators are widely used in PET and radioactive contamination detection equipment. All of the important characteristics can be modified by introducing other elements into the structure. Co-doping with ions such as Mg^{2+} potentially might improve the physical properties. The decay time would decrease and emission intensity would be better than without the extra dopant. Magnesium's contribution to the improvement of luminescence properties is obvious, such results have been reported in [3]. Other, not as investigated opportunity to obtain better properties of scintillators is to incorporate boron into the crystal lattice. This element effects inside lutetium aluminium garnet matrix was studied but to a lesser extent as compared to Mg^{2+}, and off course, it gives better luminescence characteristics [4]. In our study, we believe that the synthesized LSO:Ce:B, together with the extra magnesium dopant would exhibit the desired property improvement.

For this project, different cerium doped lutetium oxyorthasilicate compounds were prepared using sol-gel method. These phosphors could be used in scintillators and show faster decay times than the silicates without boron/magnesium. Samples were analyzed by x-ray diffraction (XRD) and scanning electron microscopy (SEM) in order to determine phase purity and structure as well as particle morphology. Luminescence properties such as quantum efficiency, decay times, emission and excitation spectrum were also measured.

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