OPTICAL PROPERTIES OF $CaAlBO_3F_2$ GLASSY MATRIX DOPED WITH RARE-EARTH ELEMENTS (Eu, Sm, Pr)

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Rare-earth elements (REE) are extremely important components of many technology fields, such as lasers in military and medicine, telecomunication and for LED lamps production. Currently, the most common LED's phosphors are made of materials doped with REE. Futhermore, luminescent materials doped with europium have been used in lighting and displays. For instance, the famous phosphor $Y_2O_2S:Eu^{3+}$ (red emission) has been used in high efficiency flourescent lamps, field emission displays and plasma display panels [1]. The colour emitted by phosphors can be altered by doping with different rare-earth ions [2]. Lanthanides (REE subgroup that includes europium, samarium and praseodymium) are characterised by specific electronic configuration where *4f* shell is not fully filled with electrons and screened by external shells. Therefore, opticaly active *4f* shell electrons are preserved from the influence of the surrounding. This is why mentioned spectacular phenomenon has found various applications including LED lamps phosphors, the most significant from this research point of view.

Latest studies have shown very attractive luminescence properties of materials doped with trivalent rare-earth ions. Many consider europium to be one of the most important activator to produce intense pure red emission [3].

Recently, Solid State Ionic Divison's research showed that the ratio of Eu^{2+}/Eu^{3+} can be controlled by altering synthesis conditions during melt-quenching process [4]. In such action one can obtain glass with continuous photoluminescence spectrum close to visible light spectrum. This leads to the purpose of this research which is investigating another glassy matrix doped with europium and other REE, samarium and praseodymium.

Therefore, CaF_2-Al_2O_3-B_2O_3 glassy matrix doped with 1 wt% of REE oxide (Eu_2O_3, Pr_6O_{11}, Sm_2O_3) was obtained by melt-quenching method. Substrates were melted for 15 min in 1300 °C. In Fig. 1 one can see photographs of samples with visible photoluminescence effect after excitation with 405 nm laser.

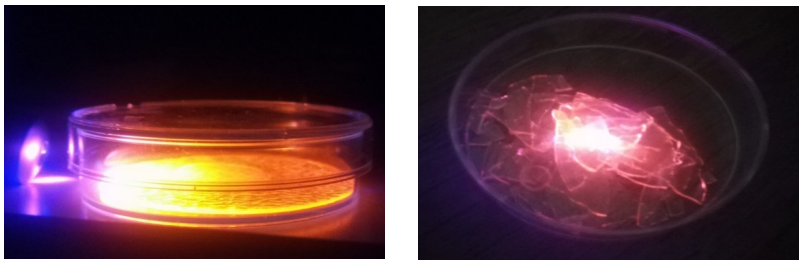

Figure 1. Matrix doped with: left - Sm_2O_3, right: Eu_2O_3.

Obtained materials were investigated using X-ray diffractometry (XRD), differential thermal analysis (DTA) and photoluminescence spectrum measurements (PL). Therefore, aim of this research is to investigate and compare properties of glassy matrix doped with different REE.

[1] Jianwei Qiao, Lei Wang, Yongfu Liu, Ping Huang, Qiufeng Shi, Yue Tian, Cai'e Cui, *Preparation, photoluminescence and thermally stable luminescence of high brightness red $LiY_5P_2O_{13}:Eu^{3+}$ phosphor for white LEDs,* Journal of Alloys and Compounds 686 (2016) 601e607.

[2] Xiulan Wu, Yehui Jiao, Qiang Ren, Ou Hai, Fei Lin, Huanhuan Li, Wenni Bai, *Photoluminescence and energy transfer in $Sr_3La(BO_3)_3$:Ce, Sm and Sr_2TiO_4:Sm, Eu phosphors*, Optics and Laser Technology 108 (2018) 456–465.

[3] Heng Guo, Liangling Sun, Jia Liang, Bin Li, Xiaoyong Huang, *High-efficiency and thermal-stable Eu^{3+}-activated $Ca_3Y(AlO)_3(BO_3)_4$ redemitting phosphors for near-UV-excited white LEDs,* Journal of Luminescence 205 (2019) 115–121.

[4] Tomasz K. Pietrzak, Agata Gołębiewska, Jakub Płachta, Michał Jarczewski, Jacek Ryl, Marek Wasiucionek, Jerzy E. Garbarczyk, *Photoluminescence of partially reduced Eu^{2+}/Eu^{3+} active centers in a $NaF–Al_2O_3–P_2O_5$ glassy matrix with tunable smooth spectra,* Journal of Luminescence 208 (2019) 322–326.