SCINTILLATING PROPERTIES OF Tb^{3+}, Er^{3+}, Tm^{3+}, AND Nd^{3+} DOPED BaY_2F_8

[1]MELLO, Ana Carolina Santana; [2]NAKAMURA, Ger son .H.;
[2]BALDOCHI, Sönia .L.;[1]VALERIO, Mario Ernesto Giroldo.

(1)Universidade Federal de Sergipe, Departamento de Física, São Cristóvão, SE, Brazil
(2) IPEN-CNEN, São Paulo, SP, Brazil

Barium Yttrium Fluoride (BaY_2F_8 -BaYF) doped with different concentrations of ions Tb^{3+}, Er^{3+}, Tm^{3+} and Nd^{3+} were characterized, aiming the application in radiation detection devices that use the scintillating properties. Two types of samples were produced in the CLA-IPEN-SP, polycrystalline samples, obtained via solid state reaction of BaF_2 and YF_3 under HF atmosphere, and single crystals, obtained via the floating zone melting method also in a HF atmosphere. The samples were characterized using the following experimental techniques: X-ray powder diffraction, Radioluminescence (RL), Optical Absorption and Dispersive X-ray Absorption Spectroscopy (DXAS). The X-ray diffraction pattern showed the presence of the phase BaY_2F_8 and a small amount of the phase $Ba_4Y_3F_{17}$ in the polycrystalline, pure and Tb^{3+} doped samples. The other samples showed only the desired BaY_2F_8 phase. The radioluminescence measurements of the doped BaYF, when irradiated with X-rays, showed emission peaks in energies that are characteristics of the 4f-4f transitions of rare earths. The RL of the samples with 2 mol% and 3 mol% of Tb^{3+} showed quite intense peaks with a maximum emission peak at 545nm. The Tm^{3+} doped BYF showed that the scitillation efficiency is not directly proportional to the doping level, and the highest RL emission were obtained for the polycrystalline samples doped with 1 mol%, showing a maximum peak intensity at 456 nm (the blue region of the visible spectrum). All samples showed a phosphorescent decay time of the order of seconds. Single crystals of BaYF doped with 2 mol% of Er^{3+}, in addition to one of the highest phosphorescence time, presents a quite strong RL in the green region of the spectra. The radiation damage was evaluated by the optical absorption techniques and the results showed that the formation of the absorption bands can be connected to colors centers generated by radiation in the matrix. Measurements of DXAS, done at the LNLS DXAS beamline, revealed that there is no change in the absorption edge of the dopant during irradiation. Among all samples, the Nd^{3+} ones presented the lowest scintillation efficiency with maximum emissions in the infrared region.

References:

Valerio, M.E.G.; Ribeiro, V.G.; Mello, A.C.S.; Santos, M.A.C.; Baldochi, S.L.; Mazzocchi, C.B.R.; Parente, V.L.; Jackson, R.A.; Amaral, J.B. *Optical Materials*, **30**:184 - 187,2007.

Librantz, A.F.H.; Gomes, L.; Baldochi, S.L.; Ranieri, I.N.; Brito, G.E. Journal of Luminescence, **121**: 137 - 148, 2006.

Agnese, A.; Carraro, G.; Guandaline, A.; Reali, G.; Sani, E.; Toncelli, A.; Tonelli, M. *Optic Express*, **12**[16]: 3765 - 3769, 2004.

Blasse, G. Chemistry of Materials, **6**, 1465 - 1475, 1994

Knoll, G.F. Radiation detection and measurement. 2ed. New York. Ed. Wiley, 1989.