11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Luminescence Properties of Er^{3+} and Tm^{3+} Doped BaY_2F_8

A.C.S. Mello(1)*, M.E.G. Valerio (1), A.B. Andrade(1), G.H. Nakamura (2) and S.L. Baldochi (2)

(1) Universidade Federal de Sergipe, Departamento de Física, São Cristóvão, 49.100-000, SE, Brazil, e-mail: acarol_mello@yahoo.com.br
(2) CLA, Instituto de Pesquisa Energéticas e Nucleares, São Paulo, SP, Brazil, e-mail: baldochi@ipen.br
* Corresponding author.

Abstract – Barium Yttrium Fluoride (BaY_2F_8 -BaYF) doped with different concentrations of Er^{3+} and Tm^{3+} ions were studied due its potential use as a scintillator in radiation detection. Two types of samples were studied as powder: polycrystalline and single crystals. The samples exhibit an intense luminescence when irradiated with X-rays, showing emission peaks in energies that are characteristics of the 4f-4f transitions of rare earths. The radioluminescence (RL) of the samples with $Er^{3+}$and Tm^{3+} ions showed a maximum emission peak at 554 and 456 nm, respectively. All samples showed a phosphorescent decay time of the order of seconds.

In the present work, we report the luminescence properties of Barium Yttrium Fluoride (BaY_2F_8 -BaYF) doped with different concentrations of Er^{3+} and Tm^{3+} ions, 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 (DRX), radioluminescence (RL), thermoluminescence (TL), optical absorption and dispersive X-ray absorption spectroscopy (DXAS).

The X-ray diffraction pattern showed only the presence the desired BaY_2F_8 phase in the all polycrystalline and single crystals samples. The RL measurements of the doped BaYF, when irradiated with Cu Kα X-rays, showed emission peaks in energies that are characteristics of the 4f-4f transitions of rare earths. The RL of the samples with Er^{3+} displayed quite intense peaks with a maximum emission at 554nm (Fig. 1).For the Tm^{3+} doped BYF, the scitillation efficiency is not directly proportional to the doping level, and all polycrystalline samples, the highest RL emission were obtained for BaYF with 1 mol% of Tm^{3+}, The RL spectra of the Tm^{3+} doped samples showed a maximum peak at 456 nm, in the blue region of the visible spectrum (Fig. 2). 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 indicated 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 meaning that there is no change in the dopant valence. (Work supported by CNEN, FINEP and CNPq)

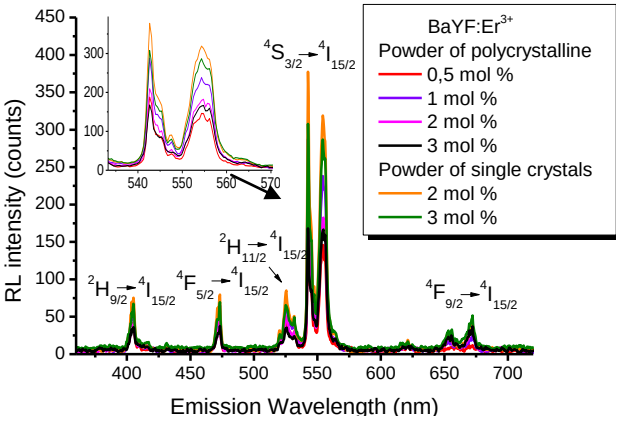

Figure 1: RL spectra of the BaYF:Er^{3+} single crystals and polycrystalline with different concentrations.

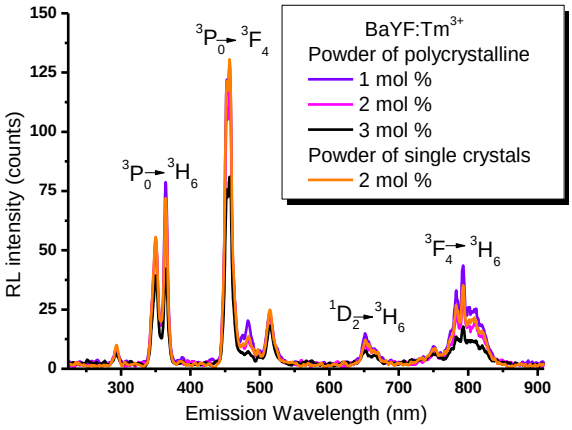

Figure 2: RL spectra of the BaYF:Tm^{3+} single crystals and polycrystalline with different concentrations.