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THERMOLUMINESCENT PROPERTIES OF CALCIUM FLUORIDE DOPED WITH LANTHANUM AND ALUMINUM

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Calcium fluoride is one of the most widely studied material concerning the thermoluminescence (TL) emission, mainly in the form of solid solutions with rare-earth, yttrium and manganese fluorides. Commercial TL dosimeters are available by doping CaF_2 with Dy (TLD-200), Tm (TLD-300) and Mn (TLD-400) ions. Sunta [1] presented, in a review paper, the main features of the known characteristics of the TL emission and a discussions of the proposed models for the mechanism of the TL in this material. From all the published results it is clear that the dopant always plays an important role in the TL processes in CaF_2 being the recombination as well as the luminescent center [1].

However, very few works are available in the literature dealing with dopants that differs from the above mentioned metallic ions of the rare-earth family or yttrium and manganese. In the present work we studied, for the first time, the characteristics of the TL emission of the CaF_2 doped with Al^{3+}. As a matter of comparison, we also study pure and La^{3+} doped CaF_2 samples.

The samples were grown by a standard Stockbarger technique in a graphite crucible and in Ar atmosphere. The nominal concentration of Al^{3+} and La^{3+} in the samples are 0.1 mol %. Neutron activation method was employed to analyze the grown crystals. The samples were than powdered and only the grains between 0.075 and 0.149 mm were used. The samples were divided in 5 groups: 1- "*as received*" samples; 2-samples with doses of 200Gy from a ^{60}Co source; 3- samples thermally treated at 600°C for 10 minutes followed by a fast quenching and than irradiated with a dose of 200Gy of gamma rays; 4- samples submited to the same thermal treatment followed by an ilumination for 1 hour of visible light; 5- samples with the same thermal treatment as the ones of the groups 3 and 4, followed by UV irradiation with a Hg lamp for 1 hour.

From the results it is possible to conclude that: i) there are at least 8 different TL peaks in the samples around 55, 80, 100, 125, 160, 185, 200 and 240 °C; ii) the relative intensities of these peaks vary from sample to sample. For the same sample, the peak intensities depend on the combinations of thermal treatment, irradiation with gamma-rays, UV or visible light; iii) the Al^{3+} induces a very intense TL signal in the CaF_2 when exposed to gamma rays with TL peaks 10 times greater than the corresponding peaks of the La^{3+} doped sample; iv) for the three samples of the group 4, the full area of the TL glow curve is similar although the relative intensities of the individual peaks are very different; and, v) the pure sample has a better sensibility to UV light than the doped ones. The activation energies of the TL peaks as well as other parameters like the order of the kinetics were obtained by different methods.

[1] Sunta, C.M.; *Radiation Protection Dosimetry* 8 -1/2, 25-44, 1984