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PHOTOLUMINESCENCE OF OXYGEN CENTRES IN LITHIUM FLUORIDE CRYSTALS WITH METAL IMPURITIES

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Multivalent metal impurities, in the form of oxides, are known to be injected into LiF crystals. Different forms of luminescent oxygen centers, including those with scintillation properties, can be created. The nature of the injected metal type's influence on centre structure, and also the regularity of LiF-Me scintillator emission characteristics fluctuation, are undetermined.

In the present study the results of luminescence properties of LiF-Fe_2O_3, LiF-TiO_2 and LiF-WO_3 crystals under selective photo-excitation in the range of 200 ... 350 nm (impurity absorption) at temperatures of 80 ... 300 K. A Cary Eclipse spectro-fluorimeter was used for the investigations.

It has been established that photo-excitation in the range of 4.0...6.0 eV causes the formation of two photo-luminescence bands (PLBs) with similar but distinct maximum and half-width values in all crystal types. Parameters of the bands in the studied crystals at 80 K are given in the table. The characteristics of LiF-Fe_2O_3 band 1 are identical to those of (O^{2-}-Va^{+})-center.

Crystal	Maximum band 1	Maximum band 2	Half-width band 1	Half-width band 2
LiF-Fe_2O_3	3.10 ±0,04 eV	2.60 ±0,04 eV	0.7 ±0,05 eV	0.68 ±0,05 eV
LiF-TiO_2	3.00 ±0,04 eV	2.60 ±0,04 eV	0.58 ±0,05 eV	0.58 ±0,05 eV
LiF-WO_3	2.93 ±0,04 eV	2.55 ±0,04 eV	0.54 ±0,05 eV	0.48 ±0,05 eV

Luminescence excitation bands (LE) were studied and determined. Their number depends on the type of metal: in LiF-Fe_2O_3 - 2; in LiF-TiO_2 - 3; in LiF-WO_3 - 4. The parameters of the bands in LiF-Fe_2O_3 are close to the parameters of the first (beginning with the high-energy) two bands in LiF-TiO_2, while the parameters of the bands in LiF-TiO_2 are close to the parameters of the first three bands in LiF-WO_3. The ratio of the PL band intensities depends on the excitation band and the temperature of the crystal. Examples of PL and LE spectra are shown in Figures 1 and 2.

The analysis of kinetic curves of PL attenuation under excitation in the range of 3.0....6.2 eV, and regularities of luminescence attenuation parameters in the temperature range 80...300 K, showed similar parameters and characteristics of PL and LE spectra for all crystals.

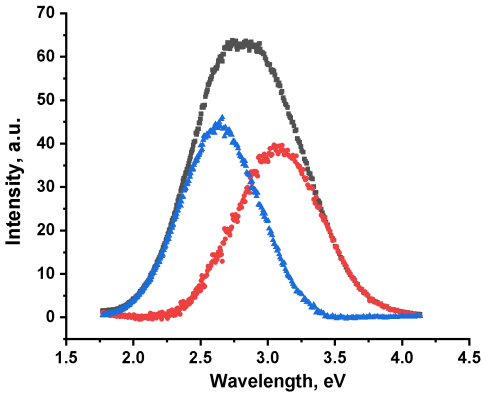

Fig.1. PL spectra of LiF-TiO_2 at 300K with excitation in the region of 230nm.

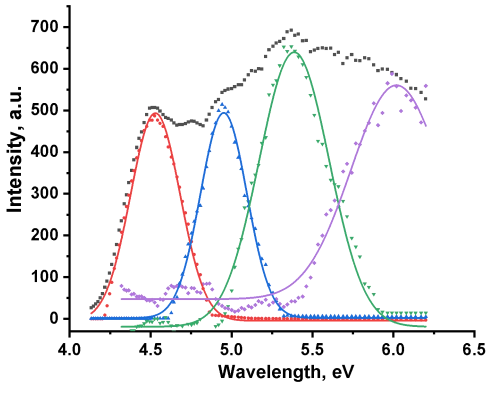

Fig. 2. LE spectra of LiF-WO_3 at 300K with luminescence monitoring in the 430nm region.

According to the research, all types of luminescence centres in all crystals contain a fragment of (O^{2-}-Va^{+})-center perturbed to different degrees by impurities, i.e. (O^{2-}-Va^{+}). The number of possible luminous center configurations is governed by the configuration of defects created to compensate for the excess charge of injected metal and is dependent on the type of injected metal. The metal's purpose is limited to facilitating the introduction of an oxygen center into the LiF crystal.