THE INFLUENCE OF CRYSTAL STRUCTURE ON LUMINESCENCE PROPERTIES OF Tb^{3+} IN DOUBLE MOLYBDATES

M. U. Jamal[1,*], V. Nagirnyi[1], D. Spassky[1]

[1]*Institute of Physics, University of Tartu, W. Ostwaldi 1, 50411 Tartu, Estonia*
** muhammad.usama.jamal@ut.ee*

In this work, a comparative luminescence study of Tb^{3+} ions embedded in two distinct crystal structures is performed. The experimental study reveals the effect of crystal structure type on luminescence properties and energy transfer processes in $K_5Tb(MoO_4)_4$ and $KTb(MoO_4)_2$ representing the palmierite and scheelite types, respectively[1,2]. Various spectroscopic techniques were employed to obtain the emission and excitation spectra as well as decay curves of both crystals. Emission spectra revealed several bands of different intensities in the 380-640 nm range, which correspond to the intra-configurational 4f-4f transitions of Tb^{3+} ions in both materials. The emission bands of different structures in the green spectral range 480-640 nm are attributed to the $^5D_4$–^7F_J transitions which give an estimation of the site symmetries of Tb^{3+} ions in both materials. The relative intensity of the bands that appear due to the $^5D_3$–^7F_J transitions in the blue 380-440 nm region is shown to be dependent on the concentration of Tb^{3+} in the crystals. The excitation spectra measured in the VUV-Vis range showed similar band positions for the f-f transitions for both structure types, however a prominent difference of ~0.2 eV in the onset of the fundamental absorption edge was observed, indicative of different energy band gap values of the crystals studied. The decay kinetics study shows that the $KTb(MoO_4)_2$ crystal has a shorter luminescence decay time of green emission (~0.5 ms) as compared to that in $K_5Tb(MoO_4)_4$ (~1.5 ms), which is in line with previous observation of the dependence of the decay time of the green emission on impurity concentration in Tb^{3+} doped oxides[3]. The shortening of luminescence decay time supports the idea of concentration quenching of Tb^{3+} in the crystal. Based on the obtained results, the processes of energy transfer to the Tb^{3+} luminescence center and the symmetry of these centers dependent on the identified crystal structure are analyzed in detail.

References

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