

Comparative characteristics of polycrystalline samples doped with Pr³⁺ ion, T= 295 K

Material	Z _{эфф}	λ _{max} , nm	τ, ns	Stokes shift, cm ⁻¹	d-f/f-f
Sr ₉ Sc(PO ₄) ₇ :Pr (1%)	35.3	265; 300	17	4630	0.01
LiSrPO ₄ :Pr (1%)	34.9	265; 269	18	4230	0.5
K ₃ Lu(PO ₄) ₂ :Pr (1 and 5 %)	64.5	280; 320	15-20	2850	10
K ₃ LuSi ₂ O ₇ :Pr (1%)	64.9	284; 330	54	6110	1.4

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LUMINESCENCE OF Li₆Y(BO₃)₃ DOPED WITH Pr³⁺ IONS UNDER X-RAY, ELECTRON BEAM AND ULTRAVIOLET EXCITATION

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This paper reports the spectroscopic properties of praseodymium-doped lithium yttrium triple borates, Li₆Y(BO₃)₃:Pr³⁺(1%). Emission and photoluminescence excitation spectra were measured at room temperature in the near IR and VIS-UV range. For this Pr³⁺-doped triple borates, the interconfigurational 4f¹5d → 4f² transitions with nanosecond decay time were detected. Besides the intraconfigurational 4f² → 4f² transitions in visible and near IR regions were analyzed.

Progress in the development of new luminescent materials is directly related to the understanding of the physical processes of energy absorption and relaxation in solids. The 4f¹5d → 4f² absorption and emission in crystalline hosts is receiving at the present special attention due to the applications in both fast scintillators and ultraviolet (UV) tunable solid-state laser devices.

In the frame of scintillating materials research, a variety of crystalline host and dopant systems are investigated but mainly the Ce³⁺ and Pr³⁺ ions in different host matrices are studied as the most promising materials [1]. However, the knowledge on the spectroscopic properties of such compounds is still limited. In the present report, the Pr³⁺-doped triple borates are the subject of our studies. A high cross section for the interaction of thermal neutrons with crystal-forming atoms may be promising for the conversion of absorbed energy into a scintillation pulse.

Spectra of photoluminescence (PL) upon UV-VUV excitation as well as spectra of X-ray excited luminescence (XRL), pulse cathode beam excited luminescence (PCL) in region of 1.5-5.1 eV were studied at the Laboratory of Solid State Physics, Ural Federal University. Additionally, the luminescence decay kinetics under pulse X-ray excitation and pulse electron beam excitation were investigated.

Some of the main results of this research are presented in Figure 1.

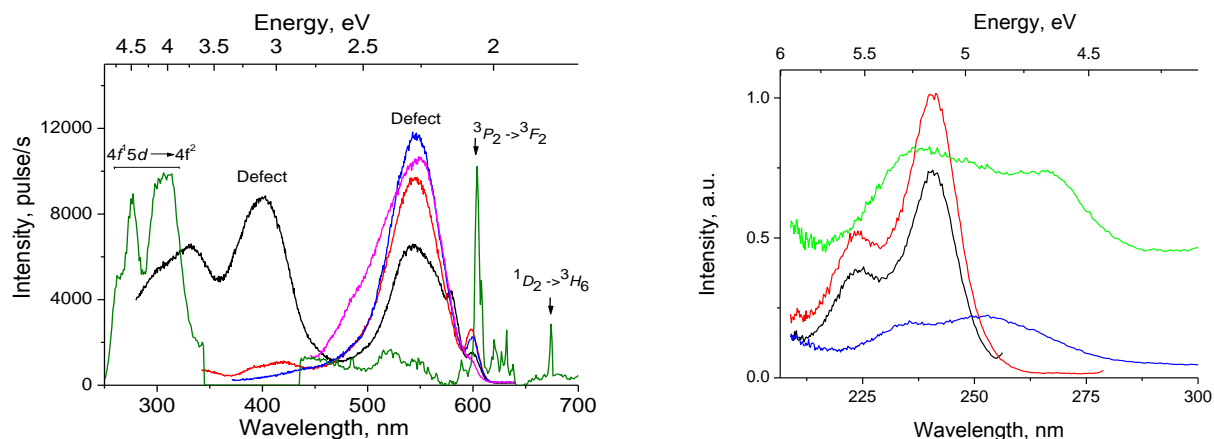


Fig. 1. a – PL spectra upon differ λ_{exc} : black – 242, red – 256, blue – 266, pink – 300 nm; XRL spectrum (green); b – PL excitation spectra measured in differ emission bands $\lambda_{emission}$: black – 270, red = 300, blue – 450, pink – 637 nm. T= 295 K.

Stokes PL spectra at different energies of exciting photons as well XRL and PCL spectra contain a set of wide bands and lines corresponding to radiative transitions in the Pr^{3+} ions as well as defect-related luminescence band. Wide bands in UV region (270-310 nm) with nanosecond decay time connect with interconfigurational $4f^{15}d \rightarrow 4f^2$ transitions with different Stokes shift. Narrow lines in visible region correspond to intraconfigurational $4f^2 \rightarrow 4f^2$ transitions in Pr^{3+} ions. The identification of $4f^2 \rightarrow 4f^2$ transitions based on Dike's diagram [2] is shown in Fig.1,a. We believe that wide emission bands in region of ~ 400 and 500 nm due it specific characteristics corresponds to defect-related luminescence. The presence of defects was shown with thermally stimulated luminescence (TSL) measurements. The study of TSL shows effective light storage, the recombination of charge carriers occurs at the Pr^{3+} centres. The trapping parameters of the charge carriers were calculated.

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