SPECTROSCOPIC INVESTIGATION OF A POTENTIAL LASER MATERIAL $LaSc_3(BO_3)_4$-Pr^{3+}*

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$LaSc_3(BO_3)_4$ crystals belong to a family of compounds with the general formula $RM_3(BO_3)_4$ (R = Y, La-Lu; M = Al, Sc) with the structural type of the natural mineral huntite. Rare-earth scandium borates are characterized by weak concentration quenching of luminescence. This, combined with their favorable physical properties, make them suitable for use as active media in compact diode-pumped laser systems. The $LaSc_3(BO_3)_4$:Pr^{3+} crystal studied in this paper can be utilized to create laser systems that emit light at a wavelength of approximately 0.65 μm [1]. Furthermore, the wide absorption band in the 1.4 to 1.7 μm range makes LSB-Pr a promising candidate as the crystal matrix for passive Q-switches operating in this wavelength range [1].

As shown in [2], the growth conditions result in three possible structures for $LaSc_3(BO_3)_4$: trigonal (*R32*) and monoclinic (*C2/c* and *Cc*). From the point of view of practical applications, it is of significance to understand the crystal structure and control the quality of single crystals grown. High-resolution spectroscopy has proven itself to be a valuable tool in solving these problems.

Single crystals of $La_{0.99}Pr_{0.01}Sc_3(BO_3)_4$ were grown by the solution-melt method. Experimentally, the primary crystallizing phases from solution-melts with different ratios of $LaBO_3$ and $ScBO_3$ were determined using the method of spontaneous crystallization followed by X-ray phase analysis. In the growth of $LaSc_3(BO_3)_4$ single crystals, a melt solution with a composition of 40 % mass $La_{1.25}Sc_{2.75}(BO_3)_4$ and 60 % mass $LiBO_2$-LiF has been used. The crystallization temperature was 910°C [2]. Based on preliminary data from X-ray phase analysis, it appears that the obtained compounds form in a monoclinic space group *Cc*. The grown crystals exhibit satisfactory optical quality.

In this study, spectroscopic analysis of a $La_{0.99}Pr_{0.01}Sc_3(BO_3)_4$ single crystal has been carried out for the first time,. A specimen in the form of a flat-parallel plate, with dimensions 5.1 x 3.3 and thickness 0.9 mm, was prepared for spectroscopic analysis.

The absorption spectra were recorded in the region from 2,000 to 23,000 cm^{-1} using linearly polarized light on a Bruker IFS 125 HR Fourier spectrometer. The temperature range was between 3 and 300 K. The sample was contained in a closed-cycle Sumitomo SHI SRP092 cryostat. Monitoring and stabilization of the temperature was achieved using a two-channel thermal controller Lake Shore Model 335. The spectral resolution was up to 0.1 cm^{-1}.

As a result of the analysis of the temperature-dependent absorption spectra, the energy scheme of the crystal-field levels for the multiplets $^3H_{4,6}$, $^3F_{2,3,4}$, $^1G_4$, $^1D_2$, $^3P_{0,1,2}$, $^1I_6$ of the Pr^{3+} ion in the $LaSc_3(BO_3)_4$ structure has been constructed for the first time. The spectroscopic data obtained have been compared with the data for $PrFe_3(BO_3)_4$ (*R32* space group) [3]. The monoclinic crystal structure was confirmed.

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