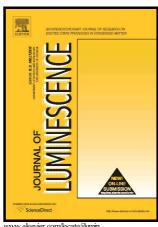
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Optical spectroscopy and crystal field calculation of Tb³⁺ doped in YAl₃(BO₃)₄ single crystal

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Abstract

Single crystals of YAl₃(BO₃)₄ doped with 2.8% Tb³⁺ were grown by spontaneous nucleation from K₂Mo₃O₁₀ and B₂O₃ flux. The electronic structure of Tb³⁺ ions doped in YAl₃(BO₃)₄ crystals are investigated using photoluminescence (PL) and photoluminescence excitation (PLE) spectroscopies. Emission spectra at room and low temperature were measured and were identified from the excited ⁵D₄ to the ground state multiplets ${}^{7}F_{0.1,2,3,4,5,6}$. The main emission detected around 540 nm corresponds to the ⁵D₄-⁷F₅ transition. Calorimetric parameters of the Tb³⁺ ions green emission in YAB are calculated (x = 0.30, y = 0.67). The corresponding decay time around 2.74 ms is fitted with a simple exponential curve. The observed transitions are assigned and analyzed on the basis of group theory assuming that Tb³⁺ ion occupies a D₃ symmetry site. The experimental Stark energy levels of the Tb³⁺ manifolds are established. The crystal field parameters were determined. A best fit between theoretical and experimental energy levels is obtained. The general trend of the crystal field parameters of rare earth ions in YAB host is confirmed. The calculated N_v crystal field strength parameters present a linear variation with 4f electrons number over the rare earth series.

Key words: Optical spectroscopy, Crystal field, Rare earth ions, YAB: Tb³⁺.

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