

Abstract

Optical, spectroscopic and thermo-mechanical properties of monoclinic $\text{Li}_6\text{Eu}_{1-x}\text{Gdx}(\text{BO}_3)_3$ ($x = 0, 0.25, 0.35$) bulk single crystals, grown to be used in the design of heat-scintillation cryogenic bolometers (HSCBs), were investigated. The linear thermal expansion was determined along the a , b , c and c^* directions over the temperature range 303-873 K, and its tensor principal coefficients were calculated for both $x = 0.25$ and $x = 0$. In addition, the anisotropic thermal conductivity was measured over the temperature range 20-400 K in $\text{Li}_6\text{Eu}_{0.75}\text{Gd}_{0.25}(\text{BO}_3)_3$ (LGEB7, $x = 0.25$), and the principal components of its tensor at 300 K were established. Spectroscopic properties such as polarized absorption, polarized emission, Raman spectroscopy and optical refractive indices are also reported for the first time. Based on the polarized emission spectra, the line and oscillator strengths, the radiative lifetimes and fluorescent branching ratios were obtained. The intensity parameters Ω_λ ($\lambda = 2, 4$) were obtained and then predicted via the Judd-Ofelt theory. The crystal field parameters and the ${}^7\text{F}_1$ level splitting were discussed using the simple overlap model (SOM) and the method of equivalent nearest neighbours (MENN). The 613 nm emission originates from the ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$ transition and the associated stimulated emission peak cross section reaches its maximum value in π -polarization, $\approx 1.07 \times 10^{-20} \text{ cm}^2$ in LGEB7. The thermomechanical characterizations and spectroscopic analysis in LGEB7 suggest that this crystal has better optical properties than the Eu^{3+} -doped $\text{Li}_6\text{Y}(\text{BO}_3)_3$ crystals. However, its potential for solid-state laser applications is still quite speculative, unless a clever thermo-mechanical management of the crystal under laser operation is designed