

GROWTH, SPECTROSCOPIC AND THERMAL PROPERTIES OF ND-DOPED DISORDERED $\text{Ca}_9(\text{La/Y})(\text{VO}_4)_7$ AND $\text{Ca}_{10}(\text{Li/K})(\text{VO}_4)_7$ CRYSTALS

LOIKO P.A.1, YASUKEVICH A.S.1, GULEVICH A.E.1, DEMESH M.P.1, KULESHOV N.V.1, YUMASHEV K.V.1, KOSMYNA M.B.2, NAZARENKO B.P.2, PUZIKOV V.M.2, SHEKHOVTSOV A.N.2, KORNIENKO A.A.3, DUNINA E.B.3

1 Center for Optical Materials and Technologies, Belarusian National Technical University,
Building 17, 65 Nezavisimosti Avenue

2 Institute for Single Crystals, National Academy of Sciences of Ukraine, 61001 Kharkov

3 Vitebsk State Technological University, 210035 Vitebsk

Abstract

Pure and Nd-doped disordered calcium vanadate $\text{Ca}_{10}\text{K}(\text{VO}_4)_7$, $\text{Ca}_{10}\text{Li}(\text{VO}_4)_7$, $\text{Ca}_9\text{La}(\text{VO}_4)_7$ and $\text{Ca}_9\text{Y}(\text{VO}_4)_7$ single crystals with high optical quality were grown by Czochralsky technique in inert atmosphere. Their polarized absorption spectra were investigated in details. Spectroscopic parameters for Nd^{3+} ion were determined with Judd–Ofelt theory (J–O) and theory of f–f transition intensities for systems with intermediate or anomalously strong configuration interaction (ICI or ASCI approximation). Spectral and temporal characteristics of luminescence associated with $4F_{3/2} \rightarrow 4I_{9/2}$, $4I_{11/2}$ and $4I_{13/2}$ transitions were analyzed, luminescence branching ratios and radiative lifetimes were calculated. Thermal expansion coefficients were determined for $\text{Ca}_9\text{La}(\text{VO}_4)_7$ and $\text{Ca}_9\text{Y}(\text{VO}_4)_7$ crystals in the directions of a and c crystallographic axes. Principal thermo-optic coefficients dn_o/dT and dn_e/dT were measured for $\text{Ca}_9\text{La}(\text{VO}_4)_7$ crystal in the spectral range of 0.4–1.1 μm . The potential of disordered vanadates for laser applications was analyzed from the point of thermal effects.

Keywords

Laser crystal; Vanadates; Absorption; Luminescence; Thermal properties