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Growth and spectroscopic investigation of ytterbium doped NaLa(WO₄)₂ single crystals

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Abstract

The incorporation of Yb to NaLa(WO₄)₂ single crystals prepared by the Czochralski method is studied. A congruent melting and crystals free of macroscopic defects are observed for ytterbium concentrations in the melt up to [Yb]_M ≈ 4 wt%. Above this limit, at [Yb]_M = 6.5 wt% inclusions appear and the optical quality of the crystal was deteriorated. A further increase of the concentration, [Yb]_M = 12 wt%, leads to the impossibility to growth a crystal. This behaviour is related to the incongruent melting of the NaYb(WO₄)₂ phase and to the low segregation coefficient of Yb³⁺ in NLW crystal, namely $k_e = 0.6$. The optical absorption of Yb³⁺ is anisotropic. The following relationship between the ytterbium concentration in the crystal [Yb]_C (in atoms×cm⁻³) and the optical absorption coefficient α (in cm⁻¹) have been determined, [Yb]_C = 1.12×10²⁰ cm⁻²· α_σ ($\lambda = 933.6$ nm) and [Yb]_C = 1.30×10²⁰ cm⁻²· α_π ($\lambda = 993.3$ nm). The ²F_{5/2} Yb³⁺ fluorescence lifetime is $\tau \approx 220$ μ s.

Keywords: A2. Czochralski method, A2. Single crystal growth, B1. Double tungstates, B2. Laser materials

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