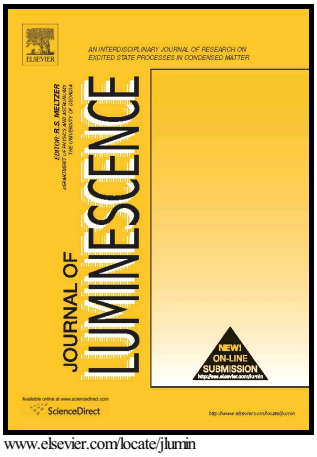

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Crystal growth, spectroscopy and first laser operation of a novel disordered tetragonal Tm:$Na_2La_4(WO_4)_7$ tungstate crystal

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Abstract Tm^{3+}:$Na_2La_4(WO_4)_7$, a disordered tetragonal scheelite-type tungstate crystal, is grown by the Czochralski method. The polarized absorption, stimulated-emission and gain cross-section spectra are determined. The maximum σ_{SE} is 1.62×10^{-20} cm^2 at 1788.6 nm for σ-polarization. The Judd-Ofelt parameters for Tm^{3+} are Ω_2 = 10.321, Ω_4 = 0.183 and Ω_6 = 2.122 [10^{-20} cm^2]. The radiative lifetime of the $^3F_4$ state is 1.63 ms. Raman spectroscopy reveals a maximum phonon energy of 923 cm^{-1}. Laser operation under diode-pumping is achieved with both ***a***-cut and ***c***-cut Tm:$Na_2La_4(WO_4)_7$ crystals, reaching a maximum output power for the ***a***-cut of 715 mW at ~1937 nm with a slope efficiency of 34%. Microchip laser operation using the ***c***-cut crystal yields a slope efficiency of 41%. The Tm:$Na_2La_4(WO_4)_7$ crystal is promising for mode-locked lasers due to its broadband emission.

Keywords: seven tungstates; thulium ions; absorption; luminescence; Judd-Ofelt theory; laser operation.