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Infrared spectroscopic and laser characterization of Tm in disordered double tungstates

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Tetragonal double tungstate crystals with formula $M+Tm_3+(WO_4)_2$, shortly MTW, have been recently shown to be efficient tunable laser hosts for Yb^{3+} [1] and Tm^{3+} [2]. Laser emission of Tm^{3+} was shown only for NaGdW, where continuously tunable operation over 212 nm around 1930 nm was achieved. The purpose of the present work is to evaluate the potential of similar Tm-doped hosts, with emphasis on NaLaW.

NaLaW crystals were grown by the Czochralski method with 2.51 mol% of Tm concentration in the crystal. Polarized optical absorption and fluorescence of Tm^{3+} was recorded at 5 K and 300 K. These results allowed the estimation of the laser-related energy level scheme and cross sections associated with the infrared pumping ($^3H_6-^3H_4$) and stimulated emission ($^3F_4-^3H_6$) channels. The maximum absorption cross section $3.94 \times 10^{-20} \text{ cm}^2$ occurs at 794.5 nm for sigma (s) polarization. At the same wavelength for pi (p) polarization it is about three times smaller, $1.39 \times 10^{-20} \text{ cm}^2$. These peak values are larger ($\approx 30\%$) than those observed for NaGdW. Lower differences are found for the emission cross sections, $1.5 \times 10^{-20} \text{ cm}^2$ and $1 \times 10^{-20} \text{ cm}^2$ for s and p polarizations, respectively. Preliminary laser results showed better laser efficiency for s polarization, with a maximum output power of 203 mW at 1888 nm in continuous wave operation and a tuning range from 1789 nm to 1953 nm.

[1] Phys. Rev. B 74, 174114 (2006)

[2] J. Opt. Soc. Am. B 23, 2494 (2006)