Cw-laser operation at 1056 nm in disordered Nd^{3+}-doped $NaLa(WO_4)_2$ crystals

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Nowadays, the interest in disordered tetragonal double tungstate crystals is motivated by their large spectroscopic bandwidths, which suppose favourable diode pumping, potential operation as mode-locked lasers and laser emission tunability [1]. The disordered phases of double tungstate crystals have been less studied than their ordered phases. Most of the work reported deal with phase assessment, crystal growth and spectroscopy. In some few cases like $NaT(WO_4)_2$, (T = Bi, Y, La and Gd), disordered tungstates, preliminary pulsed or cw laser experiences in Nd^{3+} have been reported. Up to now, it is only known the pulsed laser operation at 1063 nm and 1335 nm for the Nd^{3+} ion in $NaLa(WO_4)_2$ (NaLaW) [2]. In this work we show, for the first time to our knowledge, room temperature cw-laser emission for Nd^{3+} at 1.06 μm in a NaLaW single crystal using a quasihemispherical linear cavity. The Nd-NaLaW crystal has been grown in air by the Czochralski method. The concentration of Nd ions measured by proton induced x-ray emission spectroscopy is [Nd] = 2.6×10^{20} cm^{-3}. X-ray diffraction data show that the crystalline structure is tetragonal, space group $I\bar{4}$. The uncoated sample used was a 6.515 mm thick plate, oriented for the π-polarization (E//c). Laser experiments were performed in a quasihemispherical linear cavity consisting of a near-flat dichroic input mirror and a 100 mm radius of curvature output coupler. The output coupler transmission (T_{OC}) used was 0.2% and 3% for the laser wavelength. The pump power incident on the cavity was carried out by a f = 150 mm lens and focused longitudinally inside the $NaLa(WO_4)_2$:Nd^{3+} crystal using a cw Ti:sapphire laser. The cavity length was optimised to 105 mm, and beam waist of the pump was estimated about 45μm.

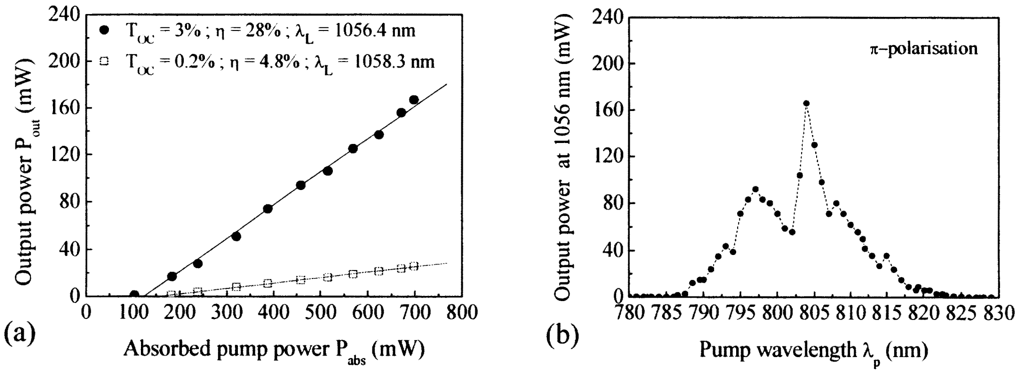

Fig1. (a) Output power (P_{out}) versus absorbed pump power (P_{abs}) (symbols) of the Nd^{3+}:NaLaW laser obtained for E//c. The linear fits give the slope efficiencies η for both used T_{OC}.(b) π-polarised output power versus pump wavelength for an incident pump power (P_{inc}) of 740 mW and T_{OC} = 3% at 1056 nm (filled circles), is shown.

Fig1a shows the results for two different T_{OC} = 0.2% and 3% with a pump wavelength of 804 nm. Laser wavelengths and slope efficiencies were 1058.3 nm and 4.8%, and 1056.4 nm and 28%, respectively. The maximum P_{out} obtained is 167 mW, with T_{OC} = 3% and a Pinc = 740 mW. Further, the threshold power absorbed which the material is lasing corresponds to 103 mW. By other way, the pump tuning range is shown in Figure 1b. The laser emission at 1056 nm is reached from 797 to 824 nm which is really interesting for your applications with diode pump. Improvements in the concentration and size of used single crystal Nd-NLW samples, as well as modifications in the cavity will lead, in a very near future, to the optimisation of the obtained slope efficiencies, threshold and output powers.

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