

Room temperature cw lasing of Tm:KGd(WO₄)₂ in the 2 μm spectral range

V. Petrov, U. Griebner

Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, 2A Max-Born-Str., D-12489 Berlin, Germany,

F. Güell, J. Massons, Jna. Gavalda, R. Sole, M. Aguilo, F. Diaz

Dept. Química Física i Inorgànica, Física i Cristal·lografia de Materials (FiCMA), Universitat Rovira i Virgili, Pça. Imperial Tàrraco 1, E-43005 Tarragona, Catalunya, Spain

Tm-doped laser materials are emerging as very interesting active media for the 2 μm spectral region due to the possibility for diode pumping near 800 nm and their broad tunability. In monoclinic double tungstates the ³H₆→³H₄ absorption line of the Tm³⁺-ion is broader and shifted to longer wavelengths (more suitable for AlGaAs laser diodes) than in YAG or YLF. The cross sections in these strongly anisotropic biaxial crystals are in general larger and concentration quenching effects are weaker. Recently, the successful growth of Tm:KGd(WO₄)₂ (Tm:KGdW) was demonstrated and the spectroscopic properties relevant to laser operation were studied in the orthogonal frame of the optical indicatrix [1]. A maximum emission cross section of $\sigma_e=3.27\times 10^{-20}$ cm² at 1834 nm was calculated for polarization E//N_m by the reciprocity method from the absorption spectra [1]. The measured decay time of the upper laser level (³F₄) population varies between 1690 and 1530 μs for Tm doping of 5 to 10% [1]. Here we study the cw laser characteristics of Tm:KGdW at room temperature using a tunable pump source in order to compare both polarizations E//N_m and E//N_p with special emphasis on the tuning behaviour for future passive mode-locking experiments.

Uncoated samples of 5, 7.5 and 10% Tm-doping and different orientation were studied in an astigmatically compensated X-type cavity without special cooling using tunable Ti:sapphire laser pumping near 800 nm. The output coupler was varied between T_{OC}=1.5 and 10%.

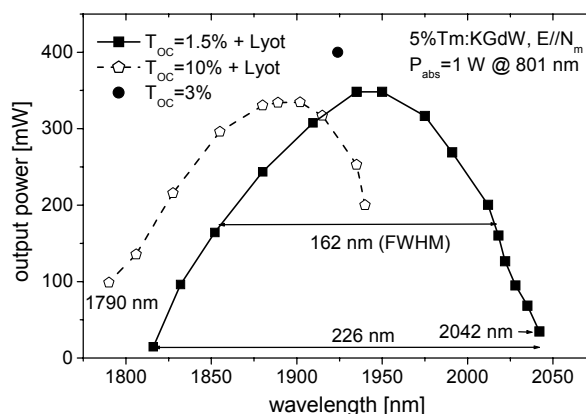


Fig.1: Achieved tunability for T_{OC}=1.5% (squares) and T_{OC}=10% (pentagons) with the 5% Tm:KGdW sample and E//N_m using a 3 mm thick quartz plate. For comparison the generation wavelength and output power obtained without tuning element and T_{OC}=3% are given for the same absorbed pump power P_{abs}=1 W (circle).

The laser threshold for E//N_m and 5% Tm-doped KGdW was P_{abs}=70 mW (T_{OC}=1.5%) and P_{abs}=130 mW (T_{OC}=10%). The maximum output power (400 mW) for E//N_m and P_{abs}=1 W was obtained with T_{OC}=3% (Fig.1) and the corresponding pump efficiency amounts to 40%. The output powers for E//N_p were in general lower but for this polarization lower pump power can be used at 794 nm as compared to 801 nm to achieve the same efficiencies. The 7.5% Tm-doped KGdW samples provided similar results at the same level of pump absorption. No essential differences in the laser performance could be observed for pumping at 806 nm, better suited for laser diodes, the basic dependence being again on P_{abs}.

The FWHM of 162 nm obtained for the tunability curve for T_{OC}=1.5% (Fig.1) is in principle capable of supporting sub-50-fs pulses near 1950 nm if this laser could be mode-locked. Tuning with T_{OC}=10% extends this range down to 1790 nm. In the case of E//N_p the tunability range is shifted to shorter wavelengths. The present results represent an improvement of ≈100 nm in the tuning range and an 8-fold increase in the output power in comparison to previous results with the isostructural Tm:KYW [2].

1. F. Güell, Jna. Gavalda, R. Sole, M. Aguilo, F. Diaz, M. Galan, J. Massons, J. Appl. Phys. **95**(2004) 919.
2. L. E. Batay, A. A. Demidovich, A. N. Kuzmin, A. N. Titov, M. Mond, S. Kück, Appl. Phys. B **75**(2002) 457.