

High slope efficiency in epitaxially grown $\text{KY}(\text{WO}_4)_2:\text{Yb}^{3+}$ waveguide laser

Y.E. Romanyuk[†], C.N. Borca[†], M. Pollnau^{†*} and S. Rivier[‡], V. Petrov[‡], U. Griebner[‡]

[†]*Ecole Polytechnique Federale de Lausanne, CH-1015 Lausanne, Switzerland*

[‡]*Max-Born-Institute, D-12489 Berlin, Germany*

One way of increasing the slope efficiency and decreasing the laser threshold is the use of a waveguiding structure. One of the active materials that can be efficiently exploited in the waveguide geometry is $\text{KY}(\text{WO}_4)_2$ doped with Yb^{3+} (KYW:Yb). Thin layers of KYW:Yb can be grown by liquid-phase epitaxy (LPE) on undoped KYW crystals. Recently, their continuous-wave (CW) laser operation under longitudinal pumping normal to the layer has been demonstrated [1]. Next step is the realization of a waveguide laser with end-face pump coupling and pump absorption along the whole waveguide length, which we report in the present work.

Epitaxial surface and buried layers with thicknesses $d = 10$ to $100 \mu\text{m}$ and Yb^{3+} concentrations ranging from 1.2 to 2.4 at% were produced by LPE. The planar waveguides were positioned at Brewster's angle in a Z-shaped laser cavity and pumped with a tunable CW Ti:Sapphire laser. Independent of the chosen output coupler transmission, stable CW oscillation near $\lambda = 1025 \text{ nm}$ could be achieved for all waveguides investigated. The best laser performance was achieved with the $17\text{-}\mu\text{m}$ thin surface waveguide doped with 1.2 at% Yb^{3+} . Its laser threshold was reached at an absorbed pump power of 80 mW. Using a 3.7%-transmission output coupler the maximum output power amounted to 290 mW, resulting in a slope efficiency of $\eta = 67.4\%$. For the output coupler transmission of $T = 6.2\%$ corresponding to a pump efficiency of 58.9%, the maximum slope efficiency of 80.4% was obtained, which is the highest value ever reported for a KYW:Yb laser.

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*Electronic address: m.pollnau@ewi.utwente.nl