EPITAXIAL GROWTH OF Yb:KY(WO_4)$_2$ LAYERS ON KY(WO_4)$_2$ SUBSTRATES BY LPE

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In recent years, thin-disk laser designs has attracted much attention due the great advantage over rod lasers because of its axial cooling and consequent weak thermal lensing and good beam quality. On the other hand, the Yb^{3+} ion is an interesting dopant for solid state materials because of its small quantum defect for laser emission and the absence of excited state absorption, up-conversion processes, cross-relaxation, and concentration quenching. The magnitudes of the Yb^{3+} absorption and emission cross section peaks strongly depend on the chosen laser host material. The low temperature phase of the double tungstates KY(WO_4)$_2$ (KYW) is a well know host material for doping with rare earth ions which can incorporate high concentrations of Yb^{3+} achieving the stoichiometric composition KY(WO_4)$_2$[1]. The extremely high absorption and emission cross sections of KYW doped with Yb^{3+} permit the use of very thin crystals[2].

KYW single crystals for substrates have been grown by Top Seeded Solution Growth (TSSG) method with high quality, choosing $K_2W_2O_7$ as a solvent[3]. KYW belongs to monoclinic system with the space group C2/c and its unit cell parameters are a=10.6313(4), Å b=10.3452(6) Å, c=7.5547(3) Å and β=130.750(2)°[4]. KYW morphology is mainly formed by {010}, {110}, {310} and {-111} faces.

We have grown Yb:KYW layers on the several faces of KYW substrates by Liquid Phase Epitaxy (LPE). This technique allows doping the layers during the growth with optically active ions, like ytterbium, with high quality. Moreover it is possible to control the layer thickness by adjusting the temperature and the growth time.

The quality of the film on every crystal face was studied as a function of the Yb content in the layer, time of growth and ratio solute/solvent using an optical microscope. The typical defects appeared were only steps of growth.

The composition of the layers was measured by electron prove microanalysis with wavelength dispersive spectroscopy (EPMA-WDS). From this measurements we calculated the distribution coefficient of Yb^{3+} in the layers which is close to unity.

In order to determine the thickness of the layers we cut and polished the crystals perpendicular to the b-axis. After this, we measured the thickness of the epitaxial layers by SEM using backscattered electrons. From the images obtained by SEM, a sharp interface between the substrate and the doped layer can be detected.

Laser operation of a Yb:KYW/KYW epitaxial crystal was achieved for the first time. Continuous-wave lasing at 1030 nm with an output power of 40 mW was obtained at room temperature.

[1] M. C. Pujol, M. A. Bursukova, F. Güell, X. Mateos, R. Solé, J. Gavaldà, M. Aguiló, J. Massons, F. Díaz, P. Klopp, U. Griebner, and V. Petrov, Phys. Rev. B 65, 165121 (2002).
[2] N. V. Kuleshov, A. A. Lagatsky, A. V. Podlipensky, V. P. Mikhailov, and G. Huber, Opt. Lett. 22, 1317 (1997).
[3] R. Solé, V. Nikolov, X. Ruiz, J. Gavaldà, X. Solans, M. Aguiló, and F. Díaz, J. Cryst. Growth, 169, 600 (1996).
[4] M. C. Pujol, X. Mateos, R. Solé, J. Massons, J. Gavaldà, F. Díaz, and M. Aguiló, Materials Science Forum, 378-381, 710 (2001).