$KY(WO_4)_2:Yb^{3+}$ buried planar waveguides grown by liquid-phase epitaxy

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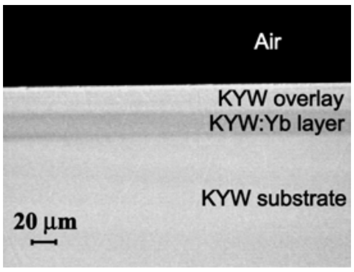
Despite the recent intensive development of thin layer growth from the vapour phase by methods such as PLD, MBE, MOCVD, etc., liquid-phase epitaxy (LPE) remains a reliable and simple method for the fabrication of single-crystal epitaxial layers. Moreover, the right choice of growth parameters enables production of multilayer structures with close-to-perfect interfaces, which are suitable for opto-electronic applications.

LPE of rare-earth-ion doped $KY(WO_4)_2$ (hereafter KYW) layers from a low-temperature chloride flux has been reported recently [1]. However, 3D island nucleation generated many insertion defects, which limited the maximum layer thickness to approx. 10 μm. In the present study, we used $K_2W_2O_7$ as solvent and undoped KYW crystals grown by a modified Czochralski method with laser-grade polished (010) faces as substrates. The vertical dipping technique under constant substrate rotation was applied. Substrate position and rotation rate were optimized by numerical simulation of the liquid flow in the crucible in order to obtain uniform layer thickness. A relative supersaturation of 1.2 mg/(K*g) solution at the growth temperature of 1170 K resulted in layers with thickness up to 100 μm and Yb^{3+} concentrations ranging from 1 to 3 at% with respect to Y^{3+}. Dipping the substrate at 0.1-0.3 K above the saturation point eliminated the surface defects and assured a defect-free interface.

Afterwards, the layer surface was polished to remove flux residuals and growth steps and an undoped overlay of KYW was grown (see the optical microphotograph of the sample).



End-coupling and propagation of laser light at 633 nm or pumping at 981 nm resulted in excellent passive (633 nm) or active (1030-nm Yb^{3+} luminescence) waveguiding performance of the obtained buried $KY(WO_4)_2:Yb^{3+}$ layers.

[1]Romanyuk Y.E., Utke I., Ehrentraut D., Apostolopoulos V., Pollnau M., García-Revilla S., Valiente R.: J. Cryst. Growth **269** (2004) 377-384.