

Optical spectroscopy of rare-earth ions doped KY(WO₄)₂ thin films

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KY(WO₄)₂ (KYW) crystals are promising optical materials for lanthanide-doped solid-state lasers. In particular, KYW crystalline layers doped with different rare-earth ions have attracted much attention because of their potential applications as thin-disk and waveguide lasers.

Optically active layers were grown on b-oriented, undoped KYW substrates by liquid-phase epitaxy (LPE). The ternary chloride eutectic NaCl-KCl-CsCl was used as a solvent. It possesses a low melting temperature of 482° C, which allows for LPE at low growth temperatures. By this method, two series of layers were obtained with thicknesses up to 20 μm and an optical quality satisfactory for spectroscopic investigations: (1) KY_{1-x-y}Dy_xYb_y(WO₄)₂ (x = 0.005, 0.02, 0.05, 0.10 and y = 0, 0.09) and (2) KY_{1-x-y}Tb_xYb_y(WO₄)₂ (x = 0.005, 0.02, 0.10 and y = 0, 0.05). Electron probe microanalysis (EPMA) was used to study the actual dopant incorporation, which was found to be in agreement with the nominal concentrations given above.

A detailed analysis of the absorption, excitation and luminescence spectra of the two series from 10 K to room temperature was carried out. The results obtained for the investigated layers were compared with those given for bulk crystals [1, 2]. As an example, Fig. 1 shows corrected excitation and emission spectra of singly Dy³⁺-doped KYW layers at 10 K. The excitation spectrum (a) was recorded by monitoring the Dy³⁺ ⁴F_{9/2}→⁶H_{13/2} emission. The luminescence spectrum (b) was recorded under excitation at 351 nm. Assignments of the 4f-4f transitions are included. Currently, we are investigating direct energy transfer and energy-transfer upconversion (ETU) to Dy³⁺ and Tb³⁺ after excitation of Yb³⁺ ions in the co-doped layers. Since especially ETU depends strongly on the excitation density, exploitation of the sample geometry as a waveguide by high-intensity end-pumping of the doped thin layers and pump-light guiding through the layers can aid the investigations. Further results of our investigations will be reported at the conference.

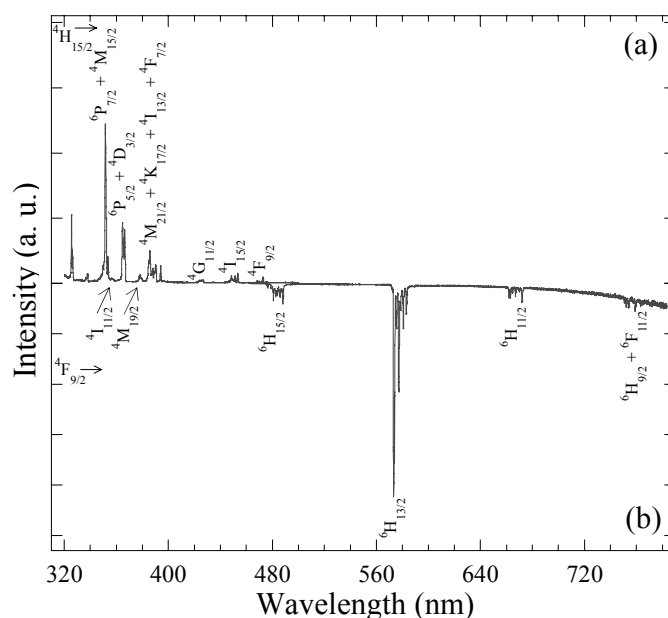


Figure 1. (a) 10 K excitation spectrum of KY_{0.98}Dy_{0.02}W monitoring the Dy³⁺ ⁴F_{9/2}→⁶H_{13/2} emission. (b) 10 K luminescence spectrum excited at 351 nm. Both spectra are corrected.

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