Measurement of Propagation Loss in Rare-earth-ion-doped Potassium Yttrium Double Tungstate (KYW) Waveguides by Optical Low Coherence Reflectometry

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KYW is a promising candidate for diode-pumped solid-state lasers and Raman self converters. The optically active rare-earth ions can easily substitute the Y^{3+} ion with a high doping level. Because of its low laser thresholds, high efficiencies, and third-order nonlinear effects, rare-earth-ion-doped KYW is a promising laser material. By means of UV-photolithography and reactive-ion etching, micro-structured waveguides, either in the form of channels or Y-junctions have been realized from 2-10 μm thick (Lu,Gd)-codoped KYW:Yb thin films grown on a 1-mm thick (010) KYW substrate. The width of the waveguide channels ranges from 2 to 10 μm with a length of about half a centimeter. Given a refractive index contrast of 7.5×10^{-3} of the doped thin film with respect to the undoped substrate, monomode waveguiding has been successfully demonstrated at a wavelength of 980 nm. From the results obtained by optical low coherence reflectometry (OLCR) in reflection mode on those rare-earth-ion-doped KYW waveguides, we have been able to precisely evaluate their length, thickness, birefringence and propagation loss at different wavelengths. The relatively high propagation loss (~ 5 dB/cm @ 1550 nm) of these channels compared to unstructured, 17-μm-thick KYW:Yb planar waveguides (~ 0.1-0.2 dB/cm @ 1020 nm) shows that either the co-doping by Gd and Lu, or the tighter vertical confinement or the microstructuring currently adds additional losses which need to be improved. Generally, these co-doped KYW waveguides open up new possibilities for fabricating lasers and integrated optical devices in rare-earth-ion-doped microstructures.