Tunable Line-Narrowed Lasers Employing Y-Junction Waveguide Resonators

J.S.Wilkinson, E.K.Mwarania, M.Hempstead & L.Reekie

Optoelectronics Research Centre
The University
Southampton
UK

Rare-earth-doped planar waveguide lasers have been realised in many host materials, using a range of waveguide fabrication techniques. Recent advances in this technology exploit the advantages that planar devices have over fibre devices. In particular, electro-optic or thermo-optic modulators may readily be monolithically integrated, complex devices may be defined photolithographically, there is access to the modal fields for surface interactions, and waveguide geometries may be varied along the device for efficient interfacing to external components and for optimisation of individual components on an optical "chip".

Rare-earth-doped multiple-cavity planar waveguide lasers integrated with on-chip phase modulators comprise a new class of integrated optical sources. We have developed a transfer matrix model suitable for the analysis of multiple cavity resonators, and this is used to investigate the spectral characteristics of a resonator incorporating a Y-junction. Such a resonator is shown to be suitable for the realisation of monolithically integrated Q-switched, line-narrowed, and tunable planar waveguide lasers. Q-switching of a neodymium-doped potassium ion-exchanged planar waveguide laser, using rapid variation of the path-difference between the cavities of such a resonator, has been demonstrated. A thermo-optic phase modulator was used to switch the cavity loss of a Y-junction glass waveguide laser between high and low states. Q-switched pulses with durations of 5μs and peak powers of 70mW were obtained, and preliminary results show tuning between 1054nm and 1062nm and line-narrowing to 0.25nm. An outline of current work to improve Q-switching and line-narrowing performance will be given.