THERMALLY INDIFFUSED $TM^{3+}LiNbO_3$ WAVEGUIDE LASERS

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Rare earth doped $LiNbO_3$ is an interesting laser host as it has nonlinear, electro-optic and acousto-optic properties. Low-loss waveguides can also be made in this material and then combined with thermal indiffusion of the laser dopant (1). $LiNbO_3$ can also be periodically poled for quasi-phase matching and/or reduced photorefraction (2). We report the first room temperature lasing of Tm^{3+}:$LiNbO_3$, and the first periodically poled Ti waveguides formed by electric field poling. Lasing was observed at 1.85μm in a Ti-indiffused waveguide with rare earth doping performed by thermal indiffusion.

Three samples were fabricated, the first, sample 1, was made from an x-cut wafer. Sample 2, was made from z-cut material and a number of the resulting waveguides poled with a 9μm period using the wet electrode technique (3), with the intention of investigating the effect on photorefractivity. Sample 3 was made from x-cut material with the rare earth doping carried out at 1210°C, about 70°C above the Curie temperature of $LiNbO_3$. This high temperature allows higher dopant concentrations and shorter total diffusion times, but results in the formation of random domains of around 0.5mm average dimension. Spectroscopic data obtained from the resulting waveguides agreed with that made in Czochralski-grown bulk-doped Tm:$LiNbO_3$(4). Cw lasing was seen with only 17mW of pump light for the single domain channels in sample 2, but photorefractivity lead to fluctuations in output power. Periodically poled channels in sample 2 could only demonstrated brief flashes of lasing; suggesting a greater susceptibility to photorefraction than the single domain guides. The origin of this worsened susceptibility is not yet clear; it may be due to a non optimum mark to space ratio of the periodic poling pattern. A higher laser threshold was seen in Sample 1 and lasing was not cw. In sample 3, however, stable, cw lasing was observed, with no sign of photorefraction. The elimination of photorefractivity in sample 3 is not thought to be explained by the domain structure as the domains are large and irregular. Further work is being carried out to resolve this interesting result. Continuing work is also aimed at achieving reduced photorefraction in periodically-poled Ti indiffused waveguides, with a view to allowing intracavity second harmonic generation.

References.

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