ytterbium- & erbium-doped silica for planar waveguide lasers & amplifiers

The purpose of this work was to demonstrate ytterbium doped planar components and investigate the possibilities of making erbium/ytterbium codoped planar waveguides in germano-silica glass. Furthermore, tools for modelling lasers and erbium/ytterbium doped amplifiers. The planar waveguides were fabricated using plasma enhanced chemical vapor deposition (PECVD) and reactive ion etching (RIE). These processes and the control of the film composition is discussed. Ytterbium doped planar waveguides are demonstrated, and it is shown that codoping with aluminium has a positive influence on the fluorescence intensity of the ytterbium ions. Based on this result ytterbium doped planar waveguides with a net gain of 0.36 dB/cm are made. The glass is sensitive to ultra violet (UV) light, and using UV-writing Bragg gratings are photoimprinted in the waveguides, and a laser is made in a distributed Bragg reflector (DBR) configuration. The laser is shown to have an output power of 19 mW. The results from the laser measurements are in good agreement with the numerical model. The model is then used to propose an improved DBR design optimised with respect to maximum output power. The influence of ytterbium on the fluorescence of erbium is investigated in germano-silicate and phospho-silicate glass, and it is shown that germano-silicate is inefficient, while phospho-silicate has a very good performance. Based on this conclusion, numerical simulations are made for amplifiers and lasers to estimate the effect of codoping with ytterbium if phospho-silicate glass is used.

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