FABRICATION AND CHARACTERISATION OF ER^{3+} : YB^{3+} CODOPED PHOSPHOSILICATE OPTICAL FIBRES FOR AMPLIFIERS AND LASERS

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Sensitising erbium doped fibres with ytterbium significantly relaxes constraints in pump wavelength and device length. This makes versatile compact lasers and optical amplifiers operating at the important telecommunications window of 1.5 μm a reality.

We have developed ultra high power amplifiers (a saturation power of 27 dBm is commercially available) pumped by high power Nd^{3+} doped solid state lasers under contract with ATx Telecom Systems (Amoco, Inc.). Collaboration with Micron Optics, Inc. led to a 142 μm long Fabry Perrot laser with continuous tuning over 1.45 nm and we have demonstrated last year in the ORC the first Er^{3+} : Yb^{3+} distributed feedback fibre laser with a linewidth of 300 KHz showing potential as a WDM source.

We have recently fabricated by the rod in tube technique an all glass double clad structure compatible with newly available multiwatt diode array or diode bar pump sources. As a result, we have demonstrated an all glass 980 nm cladding pumped Er^{3+} : Yb^{3+} laser exhibiting a slope efficiency of 45% in term of absorbed power. This work should enable power scaling to 10' s of watts with the aim of extending the range of applications from the established telecom base to such areas as laser radar, surgery, and laser marking.

The preform fabrication technique used for our phosphosilicate Er/Yb-doped fibres uses predeposition of a frit, followed by solution doping. Critical parameters affecting reproducibility are the frit porosity, solution concentration and hydroxyl contamination. The latter is observed to reduce the lifetime of the metastable level of the erbium ions and to increase the loss around 1.5μm.

Adding aluminium to the solution provided a way to broaden the narrow phosphate like spectrum of the fluorescence around 1.55 μm, an important issue for commercial amplifiers and future WDM systems. We observed an increase in thermal expansion coefficient and a decrease in NA with increasing aluminium solution strength which was attributed to the formation of AlPO4 units. Addition of aluminium was also seen to increase the background loss, which started to affect significantly the device performance over 0.5dB/m for fibres containing 1 mol% ytterbium pumped with a Nd : YAG laser.