A Thermally Bonded Nd:YAG Planar Waveguide Laser and Amplifier

T.J.Warburton, D.P.Shepherd, A.C.Tropper and D.C.Hanna

Optoelectronics Research Centre

University of Southampton, Highfield

Southampton, U.K.

Tel. +44 1703 594527

Fax +44 1703 593142

Email tjw@orc.soton.ac.uk

Abstract

We report laser action in a thermally bonded Nd:YAG planar waveguide at 1.064μm, and small signal gains of 22dB for 230mW of absorbed pump power in a double-pass amplifier configuration.

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Summary

The planar waveguide geometry is an attractive one for lasers [1] and amplifiers [2] since it offers some confinement of the pump and signal fields together with good power handling characteristics. We have demonstrated laser oscillation and amplification in a Nd:YAG waveguide, fabricated from bulk material by a thermal bonding technique. The waveguide, manufactured by Onyx Optics, California, consisted of a 5mm long, 20μm thick, 1at.% Nd:YAG layer sandwiched between two undoped YAG slabs. A feature of this guide fabrication technique is that it does not decrease peak cross section values by introducing additional line broadening.

The laser resonator was formed using thin dielectric mirrors held onto the end faces of the waveguide by the surface tension of a drop of fluorinated liquid. The 807-nm Ti:sapphire pump light was coupled into the guide using a ×5 microscope objective. Using two highly reflecting mirrors an absorbed power threshold of 26mW was measured. The effect of increasing output coupling on threshold and output power can be seen in figure 1. This is the first report, to our knowledge, of laser action in a waveguide fabricated in this manner. From the change in threshold with output coupling a value for the waveguide loss of 2.1dB/cm was deduced.

A double pass amplifier was set up with the Ti:sapphire pump laser launched into the waveguide using cylindrical lenses, so that it was focussed confocally in the unguided plane, and so as to match the waveguide mode size in the confined direction. A 1.064μm signal beam was similarly coupled into the other end of the waveguide, and back reflected using a butt coupled mirror. In this first demonstration, in a non optimised set up lacking, for example, antireflection coated optics, small signal gains of 22dB with ~230mW absorbed pump (~430mW incident) have been observed, as shown in figure 2. We have extracted 7mW of amplified signal output power via a Faraday rotator for <0.1mW launched input.

References

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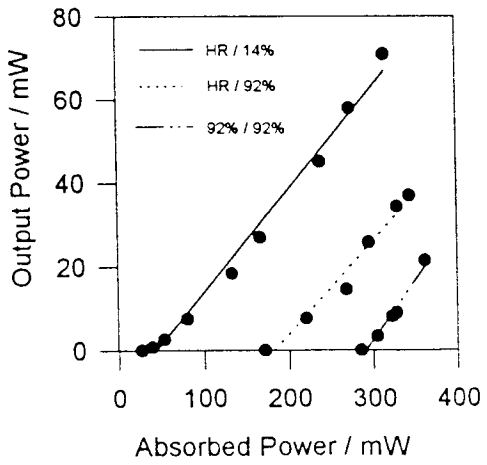

Figure 1.

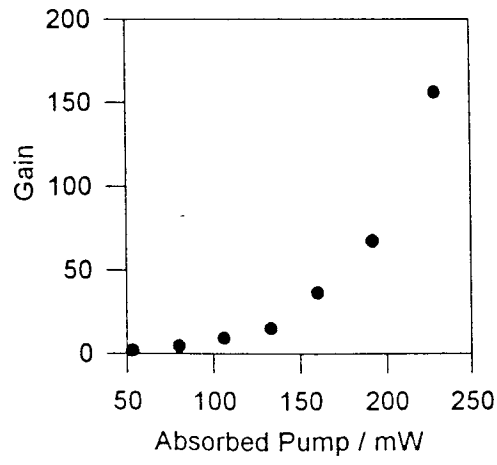

Figure 2.