A 1.54 μm Erbium Glass Laser Pumped by a 1.064 μm Nd:YAG Laser

D.C. Hanna, A. Kazer and D.P. Shepherd
Department of Physics
University of Southampton
Highfield
Southampton SO9 5NH
United Kingdom
Tele. 0703 559122

Abstract

An actively mode-locked and Q-switched 1.54 μm Yb:Er laser, longitudinally pumped by a 5 msec pulsed 1.06 μm Nd:YAG laser, has produced stable mode-locked pulses of full width half maximum duration ~ 80 ps and up to ~ 20 kW peak power.

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Summary

The current interest in optical communication systems operating around 1.5 μm has generated a requirement for coherent sources in this spectral region. Given the variety of measurements and investigations to which such sources would be applied, there is a need for a convenient versatile source, capable of operating cw, pulsed, mode-locked and Q-switched. With such a source in mind we have looked at the possibilities of an Erbium glass laser pumped by a Nd:YAG laser operating at 1.064 μm.

This paper reports results obtained from a commercially available Er glass rod, sensitized by co-doping with Yb. The rod is longitudinally pumped by a Nd:YAG laser, whose radiation is absorbed by the Yb and then transferred to the Er. Using a pulsed Nd:YAG laser with 5 msec pulse duration, threshold for Er oscillation at 1.54 μm has been achieved with as low as 20W of Nd:YAG laser output for a 2.5 cm long Yb:Er rod. It is possible that even lower thresholds may be obtained by the use of shorter rods.

Mode-locked and Q-switched operation has been achieved by the use of an acousto-optic modulator and a $LiNbO_3$ Pockels cell. Stable mode-locked pulses have been observed of FWHM duration ~ 80 ps, measured by background free second harmonic autocorrelation. Peak powers of ~ 20 kW when Q-switched and mode-locked, and ~ 20 W when quasi-cw mode-locked, are readily available.

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Lasing has also been achieved using a commercially available 10W cw Nd:YAG pump laser. To avoid thermal effects in the Er glass rod the pump laser has been chopped at 1Hz. Under these conditions oscillation of the Er glass laser is sustained for ~ 100 ms. Further investigations are aimed at achieving genuine cw operation.

The peak powers presently available from the quasi-cw mode-locked Yb:Er laser have been enough to show a factor of ~ 2× pulse compression in an external length of silica optical fibre.