100mJ Q-Switched Er:YAG diode-pumped laser system

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This work deals with high energy eye-safe lasers for long-distance active imagery purpose. Direct resonant pumping of erbium appears as a very promising technique, either at 1530nm with fibre lasers or at 1470nm with laser-diodes [1-3]. Indeed, the long lifetime (5-10ms) of the upper laser level ensure a favourable energy storage capability and the resonant scheme leads to a reduced thermal loading if compared with usual pumping at 980nm in codoped Er-Yb materials. It is worth noting that only the summary is available for the ref [2] claiming the same energy than presented here.

Our laser system rely on Er:YAG crystals and fibre coupled laser diode bars. The doping level of the gain medium is 0.5%. Each pump fibre (400µm diameter, 0.2 numerical aperture) delivers 120W at 1470nm. Each crystal is end-pumped on its two faces. The laser system (see Fig. 1) consists in an oscillator and to single pass amplifiers. Each pump fibre is imaged with a magnification of 4 (3) in the oscillator (amplifier) crystal. Dichroic mirrors (DM) ensure efficient laser reflection and good pump transmission. The output coupler (OC) has a 40% transmission coefficient and the Q-Switching is performed with an acousto-optic cell (QS). The pump are driven with 6ms pulses at 30Hz. Pair of lenses (PL) are used between the oscillator and each amplifiers to adjust the laser beam size and compensate for thermal lensing in the gain medium.

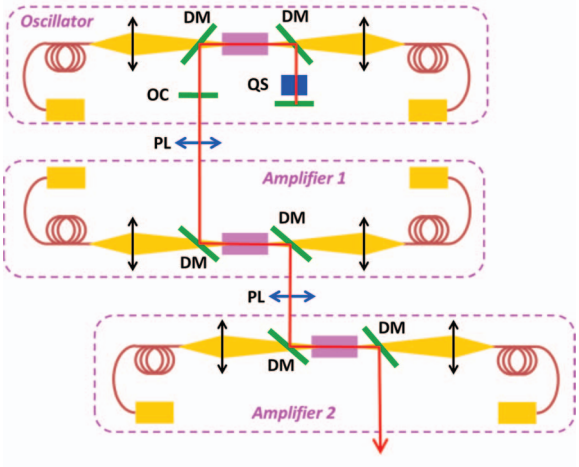

Fig. 1 Laser system architecture comprising the oscillator, the two amplifiers and the beam size adapting lenses (PL).

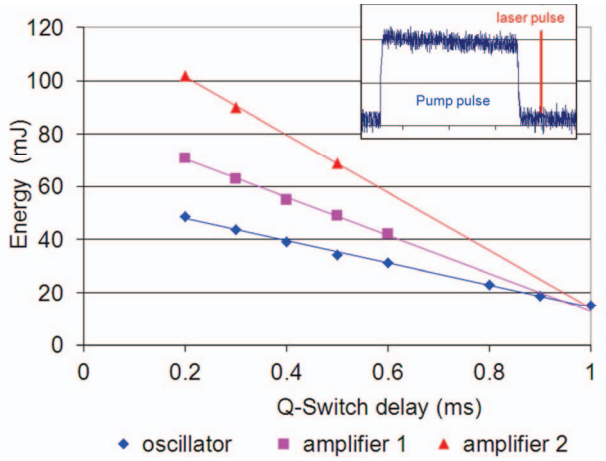

Fig. 2 Output energy of the oscillator and the two amplifiers vs. delay between end of pump pulse and Q-Switch (insert)

Main results are reported in Fig. 2.To avoid damages of the dichroic mirrors, the Q-Switch was activated with a delay after the end of the pump pulse. Reducing this delay increases the output energy and thus the laser fluence. A delay shorter than 0.2ms usually damages the dichroic mirror. We demonstrated an oscillator output energy of 50mJ and a gain of 40-45% for each amplifier, leading to 100mJ output energy for the laser system. The pulse width is 100ns. The beam quality slightly degrades along the amplifier from M^2_x=2.5 / M^2_y=2.0 at the oscillator output to M^2_x=3.7 / M^2_y=3.1 at the laser system output.

Acknowledgement

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References

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