12 mJ 10 Hz Diode Pumped A/O Q-switched Yb:Er:Glass Laser

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***Abstract*— An eye-safe Yb:Er:glass laser with a repetition rate 10 Hz was developed. The device was a diode pumped Yb:Er:glass laser Q-switched by an acousto-optic gate producing 12 mJ energy and 20 ns FHWH duration pulses of 1.54 um radiation. The laser rod and laser diodes are cooled by a thermoelectric module. The laser head dimension were 180×80×80 mm^3.**

Keywords— Eye-Safe laser; Yb:Er:glass; acousto-optic gate

I. INTRODUCTION

The question of safety of laser sources of radiation is especially critical when it is necessary to use it in dense regions. This fact determines the great interest in lasers with a wavelength of 1.5-2.1 um recently. The most commonly used sources of this wavelength range are lasers with an OPO. In the same time the use of a Yb:Er:glass laser with radiation output at the wavelength of 1.54 um does not require the addition of additional components. However, there are difficulties, primarily related to the development of a laser with pulse repetition rates greater than 1 Hz.

We report on the development of multimode Yb:Er:glass laser with acousto-optic gate capable of stably working at a pulse frequencies greater than 1 Hz with high output energy.

II. LASER DESIGN

The components and appearance of the laser are shown in Fig. 1

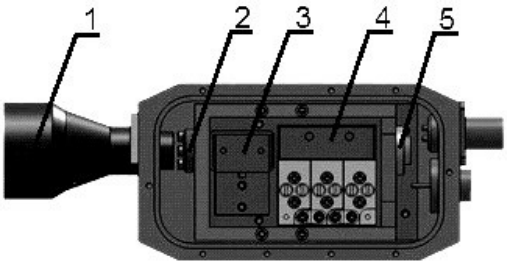

Fig.1 Laser design: 1 – 10^x collimating optical system; 2 – output mirror; 3 – A/O gate; 4 – pumping head; 5 – end mirror

The Yb:Er:glass laser optical cavity was formed by 2 mirrors. The plane output mirror 2 had 85% reflectivity; the end mirror 5 had a radius of 2000 mm. The pumping head 4 consisted of a cylindrical active element mounted in a sapphire glass reflector, three laser diode bars and heat sink. The active element was made of phosphate glass with concentration of Er 2.7×10^{19} cm^{-3} and Yb – 2.2×10^{21} cm^{-3}. Reflection of the outer coating applied to the illuminator from silver was 95% at the pump wavelength. Total peak power from three laser diode bars was 240 W with 5 ms pulse duration. The heat sink on which the diodes and the reflector were mounted consisted of copper and was cooled by a thermoelectric module.

The active A/O gate was used as a Q–switch. The modulation control was produced by an 80 MHz signal with phase amplitude of 30 V. The appropriate A/O aperture operation area corresponded to the maximum intensity of the acoustic wave and was determined in accordance with the data in [1].

III. SUMMARY

As a result we obtained a device with 10 Hz repetition rate producing Q-switched eye-safe output with 1.54 um wavelength. The conversion efficiency from free running to Q-switched regime was 60%. The shape and duration of the laser pulses is shown in Fig. 2.

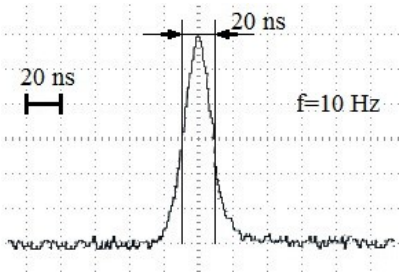

Fig. 2 The shape and duration of the pulse

The output pulse energy had 12 mJ and 20 ns FHWM duration. The divergence was 1 mrad after the collimating optical system. The laser head dimensions were 110×80×50 mm^3. The laser demonstrated stable operation in the temperature range from -40 +60ºC with the preservation of parameters when used in long term operation at over 3×10^5 pulses.

REFERENCES

[1] Magdich, L. N., et al. "Certain features of the effect of diffraction on the acoustooptic interaction in an elastically anisotropic medium." Journal of Communications Technology and Electronics 53.12 (2008): 1442-1446.