PCSEL pumped passively Q switched Yb:YAG laser

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Abstract: *PCSEL directly pumped passively Q switched Yb:YAG laser by a Cr:YAG saturable absorber is presented. 43.6 uJ/19.2 ns pulses at repetition frequency of 1.95 kHz were obtained.*

1. Introduction

Recently photonic crystal surface emitting lasers (PCSELs) are attracting plenty of attention since they demonstrate excellent output characteristics such as large area coherent lasing, narrow emission spectra, controlled beam shape, small divergence [1]. One can directly use the PCSELs' beam to pump the gain medium without any coupled optics, which simplifies the setup, decreases the cost and results in compact size. Passively Q switched lasers have found wide applications in practice for many years for their high performance such as compact, reliable and high repetition rate. In this letter, we demonstrated a passively Q switched Yb:YAG laser pumped by PCSEL. 43.6 uJ/19.2 ns pulses at pulse repetition frequency (PRF) of 1.95 kHz were obtained.

2. Experimental setup

A schematic diagram of the passively Q switched Yb:YAG laser is shown in Fig. 1. Yb:YAG crystal was used as the gain medium. The crystal was cooled by a liquid nitrogen cryostat. The cavity is a typical plano-concave cavity with length of 35 mm. Cr:YAG crystal was inserted in the cavity as the saturable absorber.

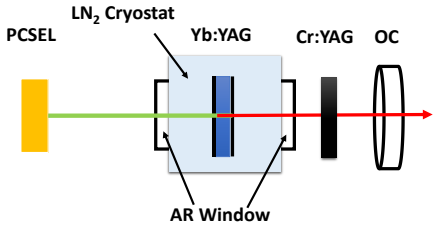

Fig. 1 Experimental set up of PCSEL pumped passively Q switched Yb:YAG laser.

3. Experimental results

Fig. 2 (a) shows the measured pulse duration and PRF as a function of pump power with Cr:YAG initial transmission 80%. We can see that with the increase of pump power, PRF increased almost linearly and the pulse duration almost keep constant. At the maximum pump power, PRF and pulse duration are 1.95 kHz and 19.2 ns, respectively. Fig. 2 (b) shows the pulse energy and peak power as a function of pump power. We can see that with the increase of pump power, pulse energy and peak power almost keep the constant. At the maximum pump power, the pulse energy and peak power are 43.6 uJ and 2.3 kW, respectively. These are considerably high in spite of direct pump from the PCSEL without any optics.

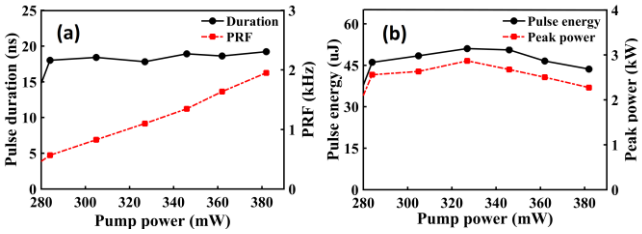

Fig. 2 (a) Pulse duration and PRF along with pump power. (b) Pulse energy and peak power along with pump power.

The oscilloscope records of the Q switched pulses at the maximum pump power with Cr:YAG initial transmission 80% as showed in Fig. 3. The inserted figure is the single pulse shape in nanosecond time regime. The intensity instabilities in the pulse train were <2% RMS (root mean square). The output pulses are quite stable.

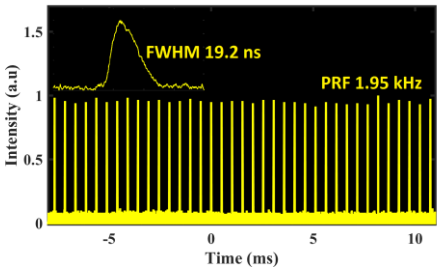

Fig. 3 Stability of the pulse train of the passively Q switched Yb:YAG laser.

4. Conclusion

PCSEL directly pumped Yb:YAG passively Q switched laser by a Cr:YAG saturable absorber is presented. At the maximum 382 mW pump power, the pulse characteristics were 43.6 uJ/19.2 ns at a PRF of 1.95 kHz.

References

[1]. K. Hirose et. al, Nat. Photonics **8**(5), 406–411 (2014).