High Pulse Repetition Rate Lasers Modelocked with Quantum Dot SESAMs

Bojan Resan
Time-Bandwidth Products, Switzerland
bojan.resan@jdsu.com

Abstract—We discuss challenges of the high-repetition-rate lasers and focus on quantum-dot SESAMs at 1550 nm. We report on 10 GHz ERGO laser delivering 2 ps pulses when modelocked by InAs/GaAs QD SESAM with saturation fluence of 9 microJ/cm².

Keywords—Ultrafast technology; Ultrafast lasers; Quantum well, wire, and dot devices.

I. INTRODUCTION

Solid-state lasers, fundamentally modelocked by SESAMs [1], exhibit low timing jitter [2], high phase coherence, high temporal pulse quality, and high individual comb line signal to noise ratio (SNR). The high pulse repetition rate lasers are necessary sources for ultrahigh speed transmission systems, optical clocking, multiwavelength sources, and frequency metrology. The ERGO laser enables coherent optical communication systems with bandwidths of 10’s of Tbit/s [3]. Quantum-dot (QD) SESAMs offer many potential advantages for such laser systems. QD technology has the potential to resolve issue of tight focusing owing to much lower saturation fluence (Fsat), when compared to QWs. In addition, the unique characteristic of large inhomogeneous dot size distribution of QD devices offer broader modelocked laser bandwidth and more flexibility in the laser central operating wavelength.

II. RESULTS

Based on our previous work [4] a 1550nm GaAs based In(Ga)As QD SESAM has been developed and implemented in a 10 GHz pulse repetition rate laser. The measured nonlinear modulation depth is 0.4% and the saturation fluence is 9 μJ/cm². When operated with the QD SESAM, the laser shows a lower lasing threshold, when compared to operation with a standard QW SESAM, suggesting that the QD SESAM’s nonsaturable losses are 0.1% or lower. The standard ERGO laser (Fig. 1) is a V-cavity. The laser is fundamentally modelocked, meaning that only one pulse is circulating within the cavity. The cavity length is therefore slightly less than 15 mm. Passive fundamental modelocking with the SESAM enables ultralow pulse timing jitter. In our experiment, the QW SESAM is replaced with the QD SESAM described above and the output is displayed in Figs. 2. The average output power of the mode-locked laser is 8 mW, when pumped by 130 mW pump power. The mode-locked spectral FWHM is 1.4 nm and the pulse duration is 2.4 ps, assuming sech² pulse shape. The Q-switching threshold is at 70 mW of pump power. The pulse duration and the output power are in the same range for the QW and QD SESAM mode-locked 10 GHz ERGO lasers (1.9 ps, 12 mW and 2.4 ps, 8 mW for QW and QD, respectively), but the important feature of the QD SESAM is that the measured Q-switching threshold is halved.

III. CONCLUSION

We have achieved 10 GHz repetition rate QD SESAM mode-locked laser operating at 1550 nm. The lower Q-switching threshold suggests the potential to increase the beam waist diameter on the SESAM in an improved and possibly simpler laser design, enabling simpler building of higher repetition rate (e.g. 25 or 50 GHz) fundamentally modelocked lasers, highly desired in telecom and other applications.

REFERENCES


This work was partially supported by EU FP7 project FastDot, under grant agreement number 224338.