ULTRASHORT-PULSED CHIP-SIZED LASERS FOR TWO-PHOTON EXCITED FLUORESCENCE IMAGING.

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1. ABSTRACT

Two-photon excited fluorescence (TPEF) microscopy requires the use of high peak power laser systems to enable the generation of nonlinear optical effects as the light interacts with the specimen. At present, most ultra-short pulsed laser systems used for this purpose are expensive, bulky and maintenance intensive. To address this, we developed a picosecond quantum-dot external-cavity passively mode-locked laser with a center wavelength of 1.26 µm for TPEF imaging. The system consists on a two section super luminescent diode (chip length is 4 mm), and a chirped Bragg grating coupler used as the output facet of the external cavity [1]. The repetition rate was ~648 MHz and the output and peak power was ~1.1 W. For further pulse power amplification we coupled this output towards a tilted and tapered quantum-dot semiconductor optical amplifier (SOA) (chip length is 6 mm), enabling to obtain up to 30.3 W peak power. Based on the work reported on [2], the obtained peak power from this system is enough to produce TFEF if the two-photon action cross-section of the fluorescent dye is matched. We present preliminary results of Two-photon fluorescence images of crimson beads (typically used for blood flow determination). To the best of our knowledge this is the first demonstration of TPEF imaging obtained with a 1.26-µm wavelength chip-scale semiconductor ultrashort pulsed laser and SOA. The further development of such system could potentially lead to the replacement of the currently available ultra-short pulsed laser systems, and find possible applications in devices such as micro endoscopes.

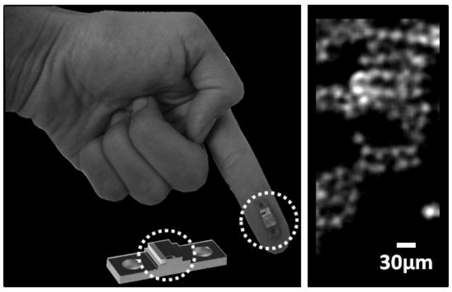

Figure 1: Ultrashort-pulsed chip device used for TPEF imaging. Right panel: crimson fluorescent beads. sample.

2. REFERENCES

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