Dynamical characterization of monolithic MOPAs emitting at 1.5 µm

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Eye-safety requirements in important applications like LIDAR or Free Space Optical Communications make specifically interesting the generation of high power, short optical pulses at 1.5 µm. Moreover, high repetition rates allow reducing the error and/or the measurement time in applications involving pulsed time-of–flight measurements, as range finders, 3D scanners or traffic velocity controls [1]. The Master Oscillator Power Amplifier (MOPA) architecture is an interesting source for these applications since large changes in output power can be obtained at GHz rates with a relatively small modulation of the current in the Master Oscillator (MO). We have recently demonstrated short optical pulses (100 ps) with high peak power (2.7 W) by gain switching the MO of a monolithically integrated 1.5 µm MOPA [2]. Although in an integrated MOPA the laser and the amplifier are ideally independent devices, compound cavity effects due to the residual reflectance at the different interfaces are often observed [3,4], leading to modal instabilities such as self-pulsations [5-7].

In this work we study experimentally and theoretically the dynamical characteristics of a monolithic MOPA at 1.5 µm consisting of a DFB section followed by a flared amplifier section [2]. Radio-frequency and optical spectra when both sections are CW biased are reported, evidencing that regimes of self-pulsations occur (see Fig. 1). Competition between the predominant longitudinal modes of the two cavities (DFB and MOPA) is described.

The results are numerically analyzed considering the complete oscillator and amplifier system in a Travelling-Wave Model for semiconductor structures that includes the lateral dependence [8] and the full spectral dependence of the gain and carrier-induced index of the Quantum-Well active region through its optical susceptibility [9].

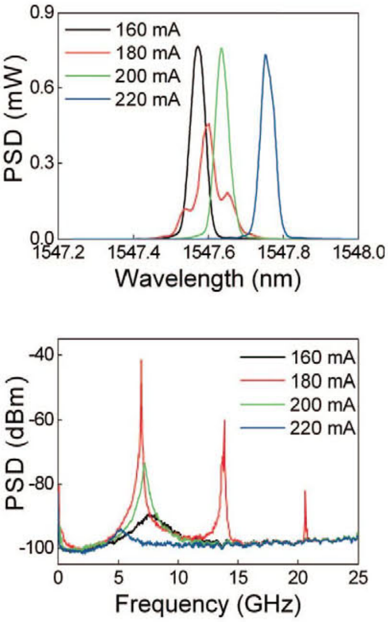

Fig.1: Optical (top) and Radio-frequency (bottom) spectra at a Power Amplifier current of 2.8 A and different values of the DFB current.

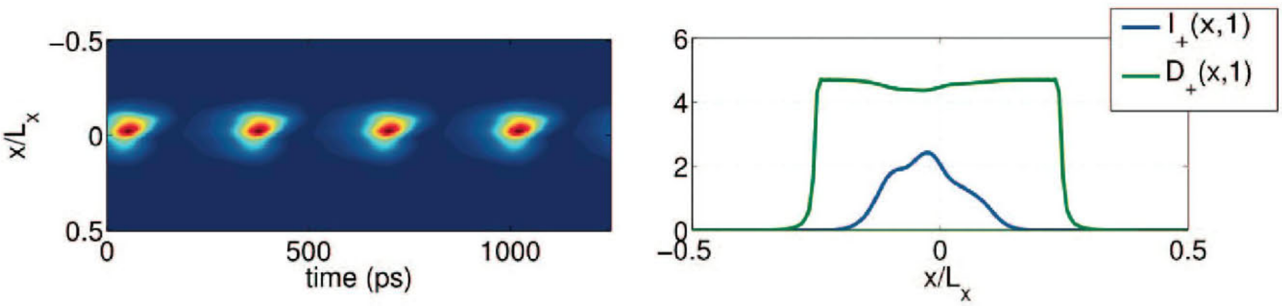

Fig. 2: Left: Numerical simulation of the temporal sequence of the near field profile at the output facet of the Power Amplifier section in a self-pulsing regime. Right: Near field profile (blue) and carrier density profile (green) at the output facet at t=1050 ps.

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