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NARROW LINEWIDTH InP/Si_3N_4 LASER FOR LIDAR APPLICATIONS

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LIDAR (Light Detection And Ranging) systems are becoming very popular thanks to a growing number of applications such as 3D imaging for autonomous vehicles and robots, remote gas concentration sensing or wind measurements. A high power compact tunable laser source with a narrow linewidth is required to achieve the best performances. But, these specifications are difficult to gather in standard laser sources. That's why we intend to develop an original external cavity laser architecture (fig. 1a) [1] which combines two types of materials: a Reflective Semiconductor Optical Amplifier (RSOA) made of InGaAsP/InP with an optical passive chip on silicon substrate containing a Bragg reflector.

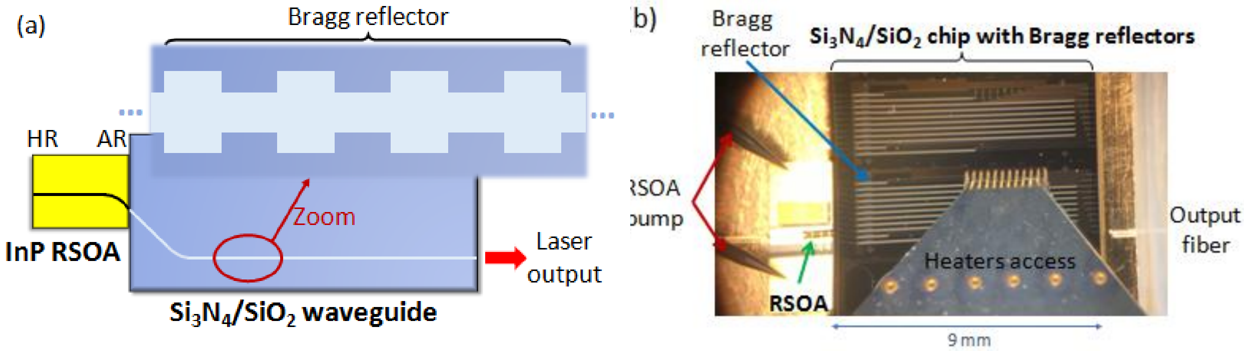

Fig. 1 : (a) Hybrid laser cavity structure, the passive circuit is a waveguide containing a Bragg reflector formed by a controlled indentation of the wave guide. (b) Picture of direct butt coupling between a RSOA and a chip containing Bragg reflectors surmounted by heaters.

The 1 mm-long RSOA is based on an asymmetric semi-insulated buried heterostructure. It provides the gain of the hybrid laser cavity and forms the back mirror of the cavity thanks to the High Reflection (HR) coating on one side, the other side being AR-coated (antireflection). In the passive chip, the 9mm-long silicon nitride waveguide contains a Bragg reflector, in charge of closing the laser cavity and selecting one longitudinal mode. The direct butt coupling of these components has been done successfully (fig. 1b), leading to a compact laser.

We obtained an optical output power of 10 mW, and a threshold around 65 mA. Moreover, the hybrid laser complies with LIDAR specifications since it exhibits a side mode suppression ratio of 60 dB. Finally, thanks to a delayed self-heterodyne workbench, we measured an optical linewidth ranging from 20 kHz to 60 kHz, depending on the quality of the coupling between the RSOA and the Bragg reflector. Such small linewidths demonstrate the spectral qualities of the device. Furthermore, by improving the quality of the passive cavity, we even expect an improvement of the linewidth for the next generation of hybrid laser.

The tunability of the laser has been obtained by changing the bias current of the RSOA on one hand, and by controlling the temperature of the passive waveguide thanks heaters placed over the Bragg mirror on the other hand. Changing the bias current heats the RSOA and increases the length of the cavity, thus shifting continuously the position of longitudinal modes. Whereas, heating the Bragg reflector will affect the reflected Bragg wavelength, thus the position of the Bragg filter can be controlled, and permits to select different longitudinal mode.

[1] A J. Zilkie, et al,"Power-efficient III-V/Silicon external cavity DBR lasers". Opt. Express, vol. 20, p. 23456 (2012).

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