Novel near-IR DFB laser-diodes for gas spectroscopy

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1. Introduction

Quartz-Enhanced Photoacoustic Spectroscopy (QEPAS) sensors for methane and nitrous oxide detection in the atmosphere are developed to be potentially mounted on drone to confirm the working ability of the compact, lightweight, and portable sensor head [1]. The 2.3 µm range is very attractive for gas sensing in the atmosphere as several gasses present strong absorption lines within the transparency window for H_2O and CO_2. We have thus focused on the realization of custom near-IR Distributed FeedBack (DFB) laser diodes with a novel structure for better coupling.

2. Custom near-IR laser-diodes simulation

We aim to design and realize custom DFB laser-diodes with a DFB grating on the laser ridge instead of using a wall corrugation along the ridge [2]. To increase the coupling factor between the guided optical mode and the grating, we propose to thin the upper cladding layer of the waveguide. 2D simulations of the laser properties according to different thickness of upper cladding and etching depth. the DFB structure were conducted. On Figure 1 can be seen some results of the simulation of the optical losses and coupling factor (k). Simulations to confirm the single mode operation for different sizes of the ridge were performed as well.

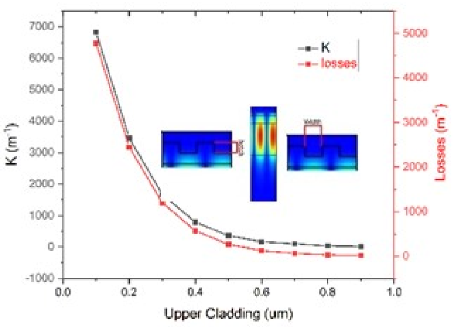

Figure 1. Simulation of losses and coupling factor vs thickness of upper cladding with a fixed etching depth of 0.3 µm

3. Experiment evaluations

Some Fabry-Perot laser-diodes were first processed to evaluate the effect on lasing performances of thin cladding layers and thin top contact layer. They were characterized at different temperatures. The laser bars (1 mm long) were mounted epi-side up. Figure 2 shows the evolution of threshold current Ith against the thickness of upper cladding. Based on the results, the optimal thickness of upper cladding for future DFB laser diodes is chosen to be 0.5 µm and the thickness of top contact layer is 0.2 µm. The DFB devices will then be processed and tested.

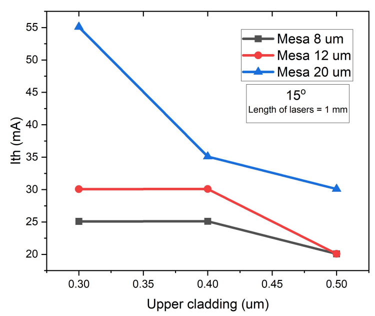

Figure 2. Threshold current Ith vs thickness of upper cladding for different lasers widths (µm)

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4. References

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