Towards a quantum dot mode-locked laser integrated on the Silicon-On-Insulator platform

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I. Introduction

Mode-locked lasers (MLLs) are able to emit ultrashort light pulses with repetition rates of tens to hundreds of GHz. Because of the excellent characteristics of the generated pulse train, such a laser has many applications in both telecommunications and optical signal processing[1]. Most of these applications require also a complex network of passive components. Therefore, integrating such a MLL on the Silicon-On-Insulator (SOI) platform would be very beneficial. Early experimental results have furthermore shown that using quantum dots (QDs) as an active material makes mode-locking easier and yields better pulse characteristics. In a first step however, we will design a regular laser, without mode-locking capabilities.

II. Laser layout

A regular laser typically consist of a gain section between two sections that provide feedback. In our case, we use reflecting Si gratings to provide the necessary feedback to achieve lasing (see figure 1). By choosing a lower number of grating periods in the left grating, a part of the generated light is transmitted and coupled to a Si waveguide.

III. Gain section

Although QDs have many advantages to achieve mode-locking, they also have an important drawback: the density of dots that can

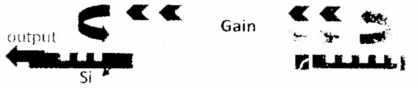

Figure 1. Basic structure of the laser cavity.

currently be achieved is quite low. Therefore the optical confinement of the lasing mode in the dots is typically very low, which leads to a low maximal modal gain that can be achieved. To address this, we should keep absorption losses (metals, doping) minimal and optimize the confinement in the active region. A way to do this, is by etching the top contact p-InP layer. In this way, the mode is pushed down into the active region and at the same time kept away from the heavily absorbing metals (see figure 2), which leads to an improvement of 40% in the achievable net gain.

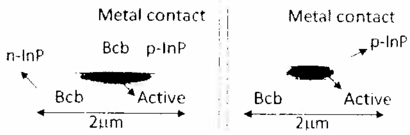

Figure 2. Mode profile in two optimized designs.

Acknowledgments

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References

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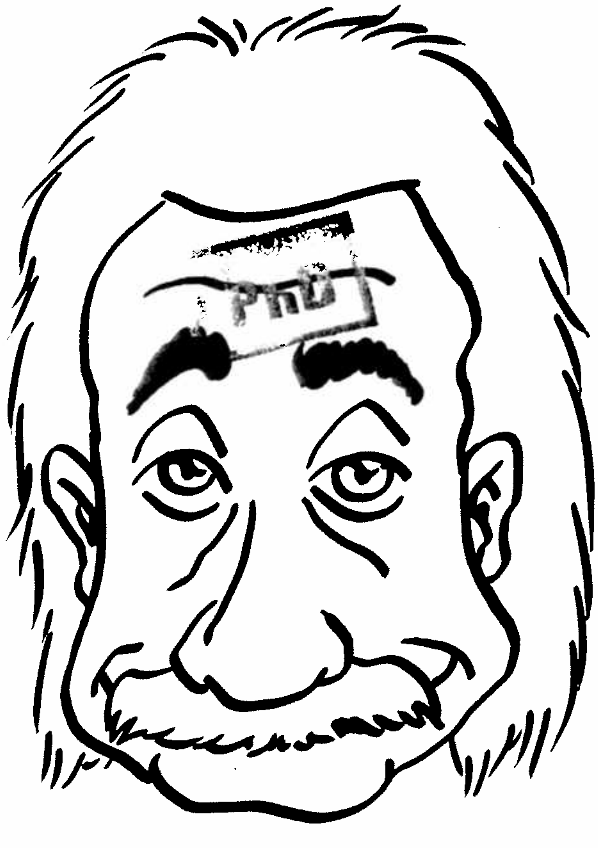

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