A tunable laser based on III-V semiconductor integration on a silicon waveguide circuit

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I. Introduction

Photonic integrated circuits offer the potential of realizing low-cost, compact optical functions. Silicon-on-insulator (SOI) is a promising material platform for this photonic integration, as one can rely on the massive electronics processing infrastructure to process the optical components. However, the integration of a Si laser is hampered by its indirect bandgap. Recently, some research groups proposed to integrate a direct bandgap III-V material on top of a SOI waveguide substrate to achieve stimulated light emission and to couple this stimulated emission to the underlying SOI waveguide circuit [1].This technique, semiconductor wafer bonding, allows the dense integration of high-quality III-V epitaxial layers on top of a Si platform by transferring the III-V layer stack from its original growth substrate to the SOI wafer. One of these techniques is adhesive BCB bonding method. In this case the epitaxial III-V structure is bonded on top of the SOI waveguide, using a spincoated DVS-BCB adhesive layer [1]. Due to the use of an additional polymer layer in between the top active layer and the bottom SOI waveguide, achieving high coupling efficiency is still the major challenge in this method. In this paper, we introduce new designs to improve the coupling efficiency and compactness of the design. Furthermore, we propose an electrically pumped optical amplifier as well as a tunable single mode laser based on this technique for telecom applications.

II. Adiabatic III-V/silicon taper Laser

One of the critical issues of hybrid InP/SOI lasers is to design a laser structure, able to generate light in III-V materials and then to couple it efficiently from III-V material to a silicon waveguide. The most efficient solution seems to be a double tapered structure, incorporating mode transformers in both the III-V and silicon waveguide (Fig. 1). Mode coupling occurs in the tapered region, while light generation and amplification takes place in a single mode III-V waveguide. Engineering for high coupling efficiency, at the same time resulting in a short length device and the optimum structure with respect to the fabrication tolerances will be presented and discussed.

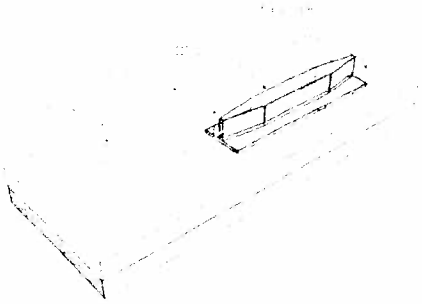


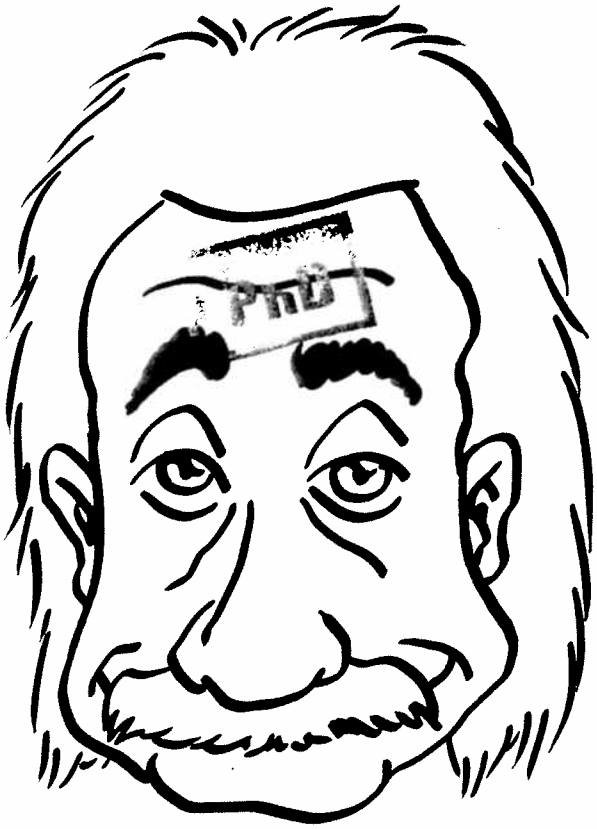
Figure 1.The schematic of an adiabatic tapered III-V/silicon single mode laser.

III. Conclusions

We propose an adiabatically tapered III-V/Silicon laser, based on BCB bonding. Simulation results on performance and tolerance of the structure will be discussed.

References

[1] G. Roelkens, et al., **Laser Photonics Rev.** P.DOI: 10.1002/lpor.200900033 (2010).



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