Integration of GaSb photodetectors on SOI: Towards mid-infrared photonic integrated circuits

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PHOTONICS

I. Introduction

Recently, the demands in sensing biological and biochemical substances which have molecular absorption features in the mid-infrared wavelength region have increased significantly. Integrated photonic circuits could potentially be used to realize this functionality in a compact and low-cost fashion.

Silicon-on-insulator (SOI) has several advantages such as high refractive index contrast which allows for low-cost, compact integrated circuits, fabricated using a CMOS compatible process. Integration of SOI passive and mid-infrared active devices will allow the realization of a compact mid-infrared photonic circuit.

In this paper, we present the integration of GaSb p-i-n photodetectors on SOI waveguide circuits.

II. Integration and Fabrication Process

In this work, GaSb epitaxy and SOI are fabricated by University of Montpellier II, France and IMEC, Belgium respectively. The heterogeneous integration is based on a die-to-wafer bonding process using DVS-BCB as adhesive bonding agent. Using this method, ~150 nm bonding thickness is achievable [1]. After the bonding process, the substrate of the GaSb die is removed by mechanical grinding and chemical etching (HF and chromic acid). After the substrate removal, the photodetector is fabricated using a standard process flow.

III. Design and Simulation

The design is based on an evanescent coupling approach. As shown in figure 1, light from the SOI waveguide is coupled to the photodetector when phase matching is achieved between the SOI waveguide and the photodetector waveguide. The simulation result shows that the absorbed power efficiency depends on BCB thickness and intrinsic region thickness of the photodetector [1].

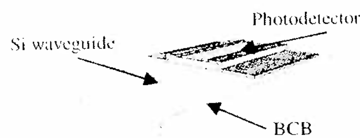


Figure1. Schematic of the integrated device

IV. Conclusion

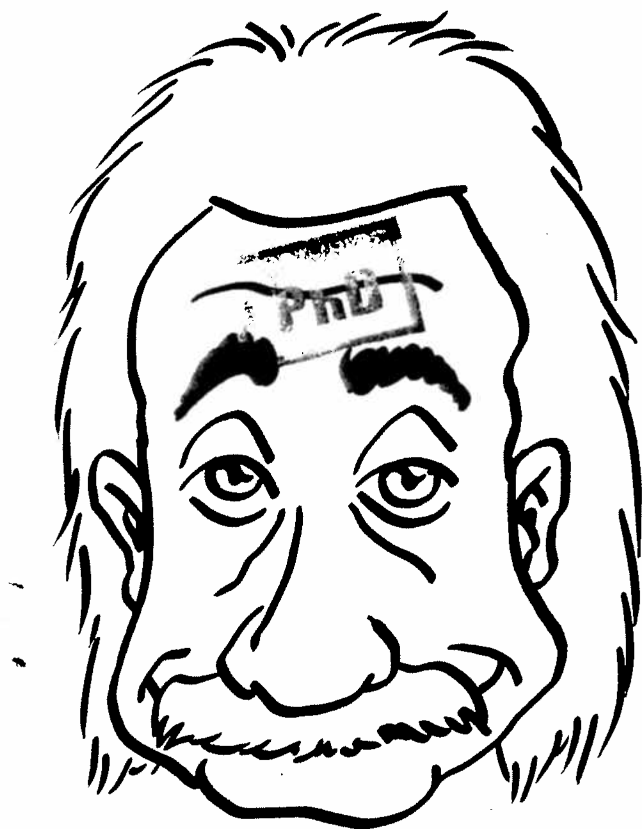
We present the integration and fabrication process of GaSb photodetectors on an SOI integrated circuit. With the BCB bonding approach, ~150nm thickness can be achieved. The device design is also discussed.

Acknowledgements

The author acknowledges IWT-SBO project Glucosens for a research grant.

References

[1] N. Hattasan et al., 10th International Conference on Mid-Infrared Optoelectronics: Materials and Devices, China, p.90-91 (2010).



11de FirW Doctoraatssymposium

Aula, 1 december 2010