

Micro-Transfer-Printing Technology For Implementing Scalable III-V-on-Si Heterogeneous Integration

G. Muliuk^{1,2*}, J. Zhang^{1,2}, G. Roelkens^{1,2}

* Corresponding author

¹Photonics Research Group, Department of Information Technology, Ghent University - imec, Technologiepark-Zwijnaarde 126, 9052 Ghent, Belgium.

²Center for Nano- and Biophotonics (NB-Photonics), Ghent University, Technologiepark-Zwijnaarde 126, 9052 Ghent, Belgium.

*grigorij.muliuk@ugent.be

There is a growing interest from industry in silicon photonics with the demonstration of high-speed transceivers and optical sensors on compact, robust, cost-efficiently fabricated silicon-on-insulator (SOI) and SiN-on-insulator chips [1]. However, the functionality of the platform is currently limited as lasers, optical amplifiers and photodetectors other than Ge photodiodes are unavailable on the platform.

To make the platform complete, a scalable III-V-on-Si integration technology is required. We propose micro-transfer-printing (uTP) [2], which is a versatile technology that combines advantages of flip-chip integration (pre-fabrication and pre-testing) and wafer bonding (high throughput integration) and works by releasing the III-V devices from their source substrate, picking arrays of those devices using a structured elastomeric polydimethylsiloxane (PDMS) stamp and printing these on a silicon photonic target wafer with high alignment accuracy (Fig. 1). This way the III-V active devices can be integrated in a low-cost manner and by efficiently using the III-V material.

In this conference we present the development of the uTP technology for silicon photonic integrated circuits and the latest results. We discuss the uTP-enabling III-V processing, parallel printing and demonstrate the technology in a range of applications.

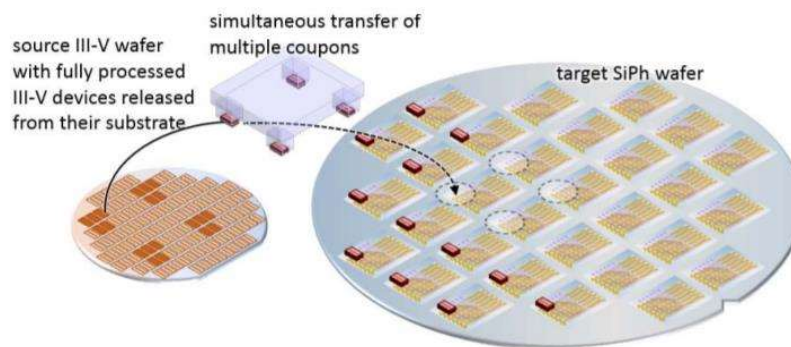


Fig. 1. Principle of micro-transfer-printing of III-V components on a silicon photonic target wafer.

References

1. R. Soref. SPIE 5730. Optoelectronic Integration on Silicon II, 19, 2005.
2. X. Feng, M. Meitl, et al. Langmuir 23(25), 12555–12560, 2007.



- 13:00 **Invited presentation:** Organ-on-Chip in Europe: the way forward, Janny van den Eijnden-van Raaij, NLM1, Netherlands
- 13:25 Nanoimprint As A Large-Area Nanofabrication Technique For Nanostructured Point Contacts In Ultrathin Solar Cells, Tomas Sousa Lopes, INL- International Iberian Nanotechnology laboratory, Portugal
- 13:45 From Electron Beam Lithography to UV-Nanoimprint Metasurface Lens Fabrication for NIR Domain, Dr. Oana Rasoga, National Institute of Materials Physics, Romania
- 2:00pm** Emerging technology in industry 2, chair: Olli-Heikki Huttunen
- 14:00 **Invited presentation:** Path from Lab to Fab for Thermal Roll to Roll Nano- and Microimprinting, Dr. Raimo Korhonen, Iscent, Finland
- 14:20 Machine Concepts For The Future Of UV And Thermal Nanoimprint Lithography, Thomas Exlager, Coatema Coating Machinery GmbH, Germany
- 14:40 Roll-to-Plate Nanoimprinting for High-Volume Manufacturing of AR glasses, Pim Veldhuizen, Morphotonics, Netherlands
- 3:00pm** Advancement in imprinting 6, chair: Anja Haase
- 15:00 Spin-On Thin-Film COC Formulation For Permanent High Temperature Applications And T-NIL Processes, Manuel Thesen, micro resist technology GmbH, Germany
- 15:20 PDMS microstructure replication by Roll-to-Roll imprinting in reduced atmospheric pressure, Olli-Heikki Huttunen, VTT Technical Research Centre of Finland, Finland
- 15:40 How to Keep a Good Skin Without Peeling: Bonding of a Roll-to-roll Extrusion Coated Film on a Back Injection Molded Polymer Body, Helmut Schiff, Paul Scherrer Institut (PSI), Switzerland
- 16:00 Programmable Inkjet Deposition of Resin for Nanoimprint Lithography Applications, Asmae Dahrabou, Stensborg A/S, Denmark
- 4:20pm** Printing towards nanoscale features 2, chair: Tapio Mäkelä
- 16:20 **Invited presentation:** Micro-Transfer-Printing Technology For Implementing Scalable III-V-on-Si Heterogeneous Integration, Dr. ir Grigorij Muliuk, Ghent University - imec, Belgium
- 16:40 Towards sub-um patterning of metals using reverse-offset-printed resist layers, Dr. Jaakko Leppäniemi, VTT Technical Research Centre of Finland, Finland
- 5:00pm - 5:20pm** Closing words
- 17:00 Farewell and towards NNT 2022, Helmut Schiff, Yoshihiko Hirai