PHASTFlex°

TU/e Technische Universiteit Eindhoven University of Technology

Disruptive technology for packaging of photonic integrated circuits

TU Eindhoven is pleased to report the successful closure of the international R&D project PHASTFlex. This project, which was co-ordinated by TU/e, aimed at a fundamental breakthrough in the way photonic integrated circuits are packaged, making the technology much cheaper to access and bringing all kinds of new, sophisticated products within arm's reach.

Optical chips, chips that work with light signals instead of electronic signals, are in increasing demand for a variety of applications. They are often referred to as Photonic Integrated Circuits (PICs) and these PIC technologies are more and more mature enabling also system level design with dedicated design tools for the main PIC technologies Indium Phosphide, Silicon On Insulator and the Silicon nitride based TriPleX platform. These tools and the mature ecosystem result in application specific designs for a broad range of applications from biophotonics to telecom. PICs are denoted as one of the key enablers enabling the next industrial revolution.

A long standing problem for the deployment of optical circuits based on Indium Phosphide has been the small size of the optical waveguides compared to the standard transmission medium – glass optical fibre. High-precision alignments are needed (certainly better than ±0.25µm), which makes packaging, which achieves the coupling of the light from the PIC to the optical fibre, expensive.

PHASTFLEX has investigated a high precision, cost-effective assembly technology for next generation hybrid photonic packages. In hybrid packages, multiple Photonic ICs are assembled, combining the best of different material platforms for a wide range of applications and performance. In PHASTFlex, InP PICs with active functions have been combined with passive TriPleX^{TM} PICs on a multi-layer ceramic carrier.

The most demanding assembly task for multi-port PICs is the high-precision (±0.1µm) alignment and fixing of waveguides. The PHASTFlex consortium used an innovative concept, in which the waveguides in the TriPleX PIC are released during fabrication to make them movable. Actuators, integrated in the same PIC, place the flexible waveguides in the optimal position (peak out-coupled power) where they are subsequently fixed.

The PHASTflex project had the complete value chain for solving the assembly on board for the different building blocks that have been realized and validated. InP and TriPleX chips have been flip-chip mounted on a multilevel ceramic carrier. The TriPleX chips acts as an interposer between a standard single-mode fibre array and a small-pitch waveguide array on the InP chip. The matching waveguide array on the TriPleX chip has flexible waveguides with thermo-optic MEMS actuators. These waveguides can be accurately positioned, with electrical signals external to the chips, to optimize the coupling to the InP chip. Application specific designs have been realized with Process Design Kits (PDKs) in both PIC platforms and the performance of the realized building blocks was validated. This enables multi-platform design of PIC components.

The consortium, which was led by TU Eindhoven in collaboration with LioniX International BV in the Netherlands consists of nine partners in total; seven industrial (LioniX International, Oclaro Technology, IMST, TELNET, Willow Photonics, AifoTec and FiconTec) of which two provide applications (Oclaro, TELNET), and two are universities (TU Delft, TU Eindhoven). All are recognized to be leading industrial and research entities in the photonics components and systems industry.

The project duration was executed in just over 3.5 years with total cost of ~3.9M€, and the requested EU contribution of ~2.8M€: a modest amount indeed for a project with the potential to open the door to a new market, potentially worth tens of billions of euros.

PHASTFlex: ***P****hotonic* ***H****ybrid* ***AS****sembly* ***T****hrough* ***Flex****ible Waveguides* was funded through EU FP7 (Project Number: 619267)

Website: www.phastflex.eu

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