Information and Communication Technologies

3D Photonic integration platform based on multilayer PolyBoard and TriPleX technology for optical switching and remote sensing and ranging applications

Call identifier: H2020- ICT-2017-1

Contract No: 780502

Partners:

- Institute of Communications and Computer Systems/ National Technical University of Athens (ICCS/NTUA) – GR
- LioniX International - NL
- Fraunhofer Heinrich Hertz Institute (FhG-HHI) - GE
- SolMateS B.V - NL
- University of Twente - NL
- Cordon Electronics – IT
- Optagon Photonics – GR
- Mellanox – IL
- Polytec - GE

Timeline: January 2018 – December 2020

Budget:

Overall cost: 3.993.285,00 €
EC contribution: 3.993.285,00 €

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Project website: www.ict-3peat.eu

Motivation

Over the last two decades photonic integration has unleashed the potential of optical technology in many application fields leading to technical breakthroughs with a strong commercial impact. Although telecom and datacom sectors has been benefited from photonic integration technology reaching its maturity level, the case is not the same for a broad range of optical applications like optical switching and remote sensing applications. Therefore, a powerful integration platform that can offer low optical loss and high integration density in order to facilitate a very large number of processing components on-chip, a very broad range of optical functionalities, and very high purity and quality in the generation, processing and detection of light is obligatory. The combination of these requirements is very challenging, and the conclusion is very clear: The necessary photonic integration technology that could exploit the aforementioned functionalities and could enable the commercial uptake of optical switching and remoting sensing is still missing. 3PEAT will develop a powerful photonic integration technology with all size, functionality and quality credentials in order to help a broad range of optical applications like optical switching and remote sensing, to achieve a strong commercial impact.

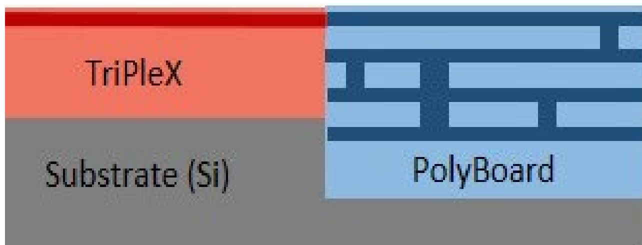

Figure 1: 3PEAT aims to provide single-die hybrid 3D PICs with PolyBoard and TriPleX sections and efficient coupling schemes combining the toolboxes of both platforms for switching and sensing applications.

Concept and objectives

3PEAT introduces a fully functional 3D photonic integration platform based on the use of multiple waveguiding layers and vertical couplers in a polymer technology (PolyBoard), as a means to disrupt the integration scale and functionality. Moreover, 3PEAT combines this powerful 3D photonic technology with a silicon-nitride platform (TriPleX), via the development of a methodology for the deposition and processing of multilayer polymers inside etched windows on TriPleX chips. In parallel with the development of this hybrid 3D technology, 3PeaT brings a number of key innovations at the integration and component level relating to: a) the heterogeneous integration of PZT films on TriPleX platform for development of phase shifters and switches for operation up to 50 MHz, b) the development of a disruptive external cavity laser on the same platform with linewidth less than 1 kHz, c) the development for the first time of an integrated circulator on PolyBoard with isolation more than 25 dB, and d) the development of flexible types of PolyBoards for the purpose of physical interconnection of other PICs.

This enormous breadth of innovations will remove the current limitations and unleash the full potential of optical switching and remote sensing and ranging applications. The main switching module that will be fabricated will be a 36×36 optical switch with 20 ns switching time and possibility for power and cost savings of almost 95% compared to standard electronic solutions. The main sensing module on the other hand will be a disruptive Laser Doppler Vibrometer (LDV) with all of its optical units, including its optical beam scanning unit, integrated on a very large, hybrid 3D PIC.

Exploitation and expected impact

3PEAT aims to industrialize the foreground knowledge that will be generated within the project and establish viable exploitation paths in order to reinforce the European industrial competitiveness. The envisioned industrialization lines are associated with:

- Photonic components and devices
- Photonic integrated circuits technology
- Optical switching modules without waveguide crossings and with low latency, high throughput for the switching of optical packets inside large switching fabrics
- Optical sensing modules with optical beam scanning abilities for compact and self-standing remote sensing and ranging systems.

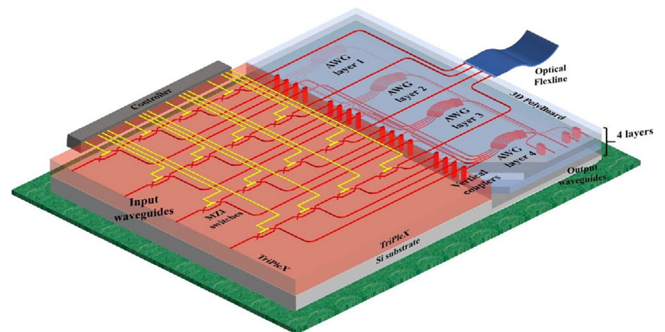

Figure 2: The 3PEAT optical switching module will serve as the active optical switch of optical packets inside large switching fabrics with 20 ns switching time for direct replacement of electrical switches at the higher layers of the reference network.

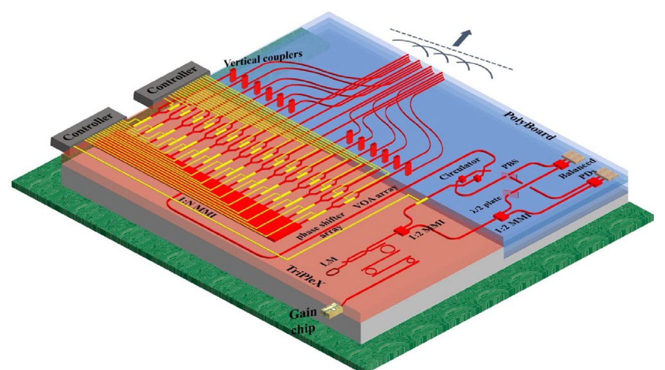

Figure 3: The 3PEAT optical sensing module will serve as the compact and integrated Laser Doppler Vibrometer system, providing advanced optical beam scanning functionalities with field of view close to 10°×10°.