polynices

POLYmer based electro-optic PCB motherboard integration with Si3N4 Chiplets, InP Components and Electronic ICs enabling affordable photonic modules for THz Sensing and quantum computing applications

Funded by the European Union

Vision

Using the ability of polymer to be spin-coated in almost any surface, the integration methods and functionalities unique to PolyBoard and TriPleX, and the excellent complementarity of the two platforms, POLYNICES will develop a disruptive set of integration and packaging technologies that will allow low-cost photonic system in packages for a range of applications including wide band THz spectroscopy and quantum information processing.

Motivation

Photonic integration technology is evolving from simple photonic integrated circuits (PICs) that involved only few functionalities, with light generation and modulation being the most prominent, towards larger, more functional, and thus more complex photonic integrated modules, opening new application fields next to the traditional telecom application field. However, despite the increasing popularity, photonic integration technology has not yet delivered all required features such as cost-efficiency and compatibility with high volume production, mainly due to the lack of a simple, low cost, wafer scale compatible production process. The reasons can be traced not only in the fabrication processes of PICs but also in the photonic packaging.

Concept – Objectives

POLYNICES aims to address these challenges with the development of a novel general purpose photonic integration technology, compatible with wafer scale processes that will reduce the production costs of photonic modules by at least 10x. POLYNICES will develop for the first time a polymer based Electro-Optic PCB (EOPCB) motherboard that will host Si3N4 chiplets, InP components and micro-optical elements. POLYNICES invests in Si3N4 platform with PZT actuators to realize complex structures in only 1x1 cm2 chiplets with ultra-low power consumption. The chiplets' grid array electrical pads and the use of flip-chip integration on vertical alignment stops will allow optical alignment and electrical connection in one step. The standard size and interfaces of the chiplets as well as the electronic IC co-packaging on the same EOPCB, provides excellent scalability and customization, and significantly simplifies packaging. Dielectric rod THz antennas will be integrated on the EOPCB taking advantage of its good HF properties.

Thanks to the above novel concepts and building blocks, POLYNICES will develop a powerful a fully integrated optoelectronic FMCW THz spectrometer with THz antenna array and beam steering abilities, using a multi-beam optical beamforming network based on Blass-matrix architecture for quality control in plastics, a 16x16 quantum processor with integrated 780 nm light source and non-linear crystals as well as a 24x24 quantum processor with integrated squeezed light state source.

Factsheet

Call identifier: HORIZON-CL4-2021-DIGITAL EMERGING-01-07
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Project No: 101070549
Timeline: January 2023 – June 2026
Overall budget: € 4 963 702
EU contribution: € 4 963 701,75
Project Website: www.horizon-de-polynices.eu
Consortium: 8 Partners (4 countries)

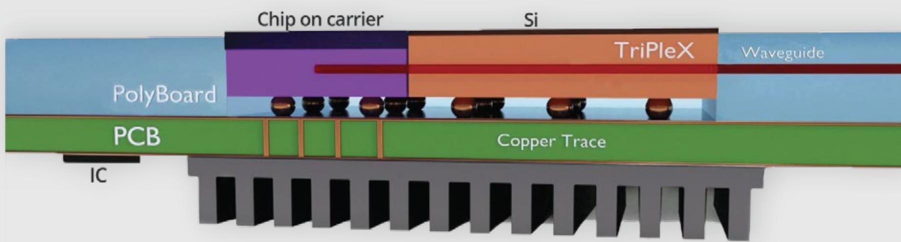
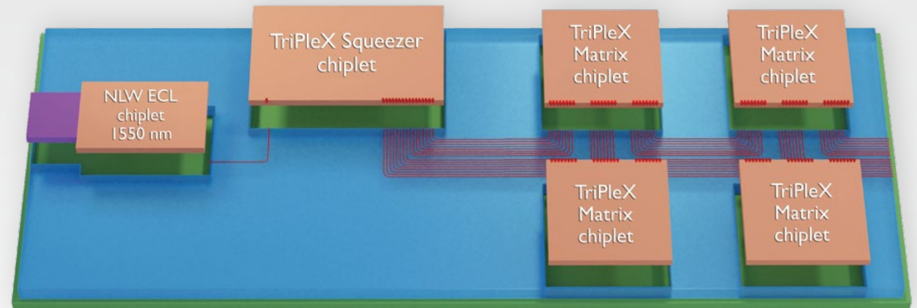


Figure 1

Artistic layout of the flip-chipped ECL chiplet (TriPleX and InP) on the EOPCB, showing the via throughs below the InP element for heat dissipation to the heatsink.

Figure 2

Artistic layout of the POLYNICES electro-optic PCB, implementing a quantum information processor.



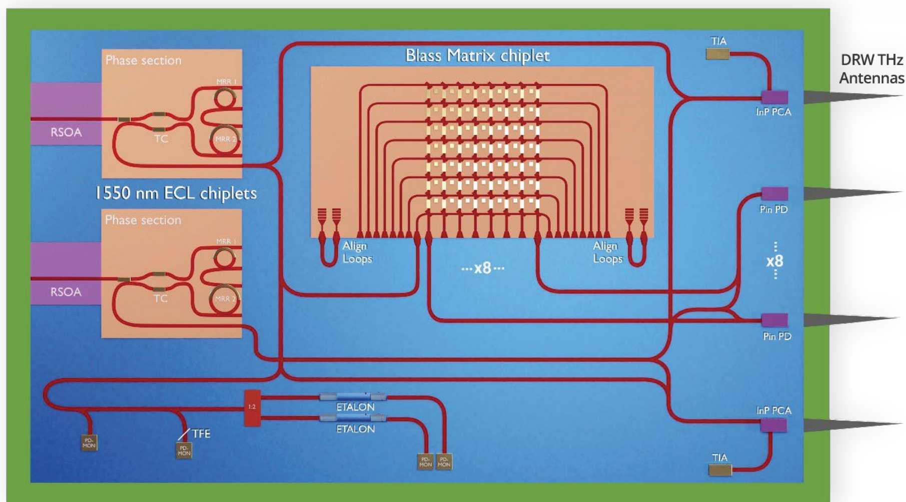


Figure 3

Artistic layout of the Final THz demonstrator with beam former chiplet and wavelength monitor at the lower part (not to scale). Only 2 of the 8 emitters are shown for simplicity. TriPleX chiplets in orange. Grating couplers going through alignment loops on the EOPCB can be seen in the chiplet. The TIAs will be soldered on the back of the EOPCB and connect through vias to the InP photoconductive antennas.

Impact

POLYNICES has the potential to provide a new generation of powerful, vertically integrated PICs and devices that are co-packaged with electronic ICs on the same System in Package. Ultimately, POLYNICES will enable the miniaturization and cost reduction of THz remote sensing systems as well as the efficient scaling of quantum information processors, paving the way for their commercialization.

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