FLEXIT

The high volume production line for Integrated Photonics

Photonic integrated circuits (PICs) play an essential role in finding and developing solutions to many of the world's critical problems, such as reducing energy consumption, improving healthcare, fighting food waste and meeting our continuous hunger for information. However, a generic solution for the assembly and packaging of photonic chips does not currently exist. The FLEXIT project, which runs from January 2022 to December 2023, therefore sees an opportunity to unite high-tech companies in the Netherlands and push forward this highly promising domain.

The FLEXIT project will enable this through the further development of the FLEXIT method to process photonic chips at an industrial level. Through a design tool for product development and the mapping of the entire digital chain, the project will also optimise all production processes in the supply chain. Ultimately, two demo products will be selected to test the supply chain according to a new FLEXIT product standard for mass production, through which manufacturing yield will rise, costs will be reduced and delivery reliability can be maintained for the foreseeable future.

EUROPEAN UNION
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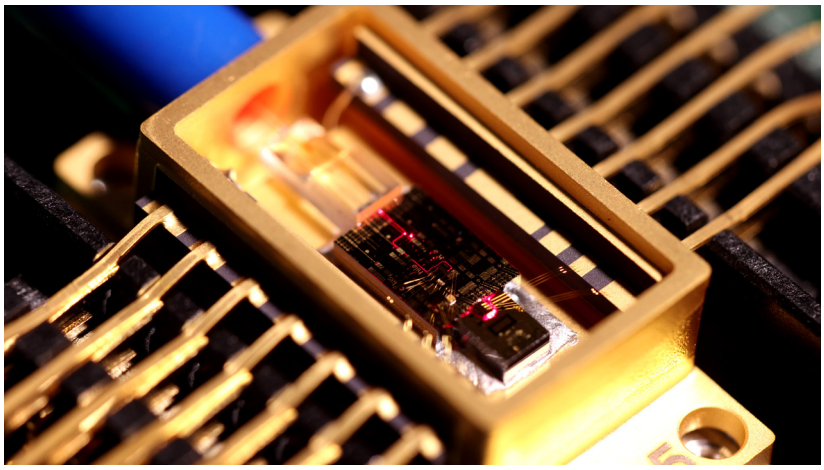
OPoost
operationeel programma oost
European Regional Development Fund

Chilas: a laser-focused role in the FLEXIT project

The Chilas laser is one of the simplest hybrid photonic devices around, consisting of only two photonic integrated chips (PICs). Together, these offer unique characteristics: a wavelength agility with ultra-narrow linewidths of below 1 kHz, providing a very pure colour for a wide range of high-tech applications. Within the FLEXIT project, Chilas aims to adapt these two chips for compatibility with flip-chip assembly methods that rely on passive placing accuracies of ~1 µm for the scalable production of hybrid photonic devices.



Towards the future

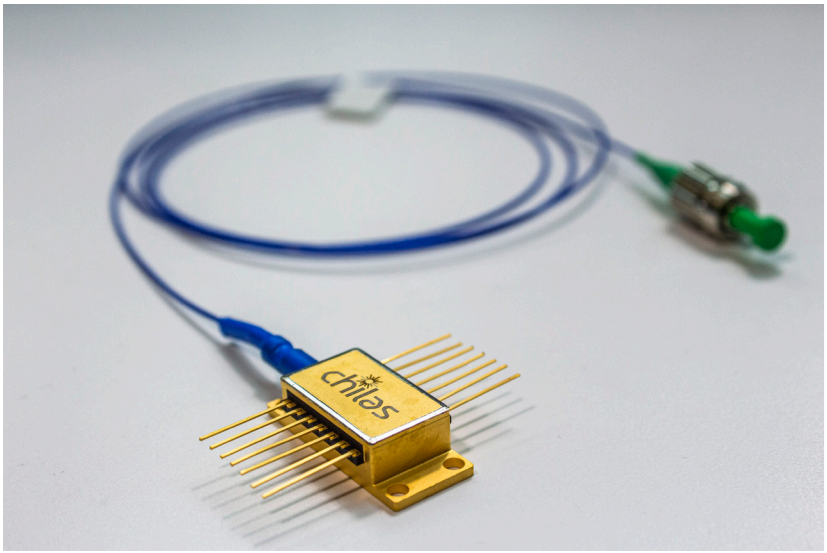
On a technical level, Chilas develops and supplies high-end semiconductor external cavity tunable lasers with ultra-narrow linewidths, which can be tuned over the C-band to cover a wavelength range larger than 100 nm with a linewidth of less than 1 kHz, as well as high output power and low noise. This laser is temperature-stabilised and comes in a 14-pin butterfly package. The external cavity laser (ECL) is constructed via hybrid integration of both an indium phosphide (InP) gain section and a silicon nitride (Si_3N_4) wavelength selective feedback PIC. The InP gain section provides the high-power output (>30 mW with 100 mW under development) over a wide wavelength range, whereas the Si_3N_4 PIC provides the low loss configurable feedback to the gain section.

By harvesting the best of the InP and Si_3N_4, worlds, Chilas' technology serves as the workhorse for a large variety of applications. In Optical Coherence Tomography (OCT), for instance, resolutions can be boosted to microscopic levels via the 100-nm bandwidth, while the ultra-narrow linewidth is essential to applications like quantum computing, quantum sensing and quantum key distribution. The compact, robust character of the laser also allows the sensitivity of metrology applications to be increased in harsh environments. Finally, the ultra-narrow linewidth (over 1 kHz), low relative intensity noise (greater than -155 dB/Hz) and low phase noise meet novel standards for small channel spacing and enable advanced modulation methods ike PAM, PSK and QAM – the future of transceivers.

Fruitful collaboration

For Chilas, the current state-of-the-art assembly method involves chip-to-chip interfacing via end-face coupling. In this process, the two chips are diced, polished and glued together using active alignment, providing the required sub-100 nm placing accuracy. This assembly method enables mid-sized volume production to the tune of 1000 PICs per year. In FLEXIT, flip-chip processing should allow for an expansion of the functionality of the hybrid photonic devices. Through the placement of gain sections, modulators and detectors, the project will pave the way for the development of devices with high optical power, fast modulation and on-chip detection.

Within the project, Chilas fulfils the role of end-user and, as a small team, most of its members are involved: Fathema Farjana, Wilson Tsong, Ian van den Vlekkert, Sami Musa and Dimitri Geskus are all enjoying fruitful collaboration with the other ten partners. In this ecosystem, which brings together key players from across the Netherlands, PHIX Photonic Assembly has created a solid marriage between SMART Photonics' semiconductor InP PICs and LioniX International's Si_3N_4 PICs.



A strong Dutch stake

Already, a new generation of chips have been designed and are being produced, while wafer-scale probing is under development and device performance traceability is being implemented. In the short term, the aim is for the first demo devices to give light. In the longer term, the goal is to develop volume-ready processes for the production of photonic devices. This includes wafer-scale characterisation tools developed by Salland Engineering and the tracing of characterisation data from the component level up to the product level, which is being developed by WorkFloor. Such results and aspirations perfectly illustrate how all partners – Chilas included – are driving FLEXIT's efforts to establish a strong Dutch stake in the new and as-of-yet unmined market in assembly and integration machinery for volume production of photonic systems.

FLEXIT project partners

Chilas
Development and production of semiconductor lasers based on several materials with high power in combination with integrated technology.

IMS
Development of production and assembly lines for hybrid microsystems with added value like lenses for smart phones, medical implants and microsystems.

LioniX International
Develops and commercialises on silicium-nitride (SiN)-based waveguide technology (TriPlex) for a variety of applications and is leading the photonic sector.

PHIX
World-leading packaging and assembly foundry for Photonic Integrated Circuits (PICs), building optoelectronic modules based on all major PIC technology platforms in scalable manufacturing volumes.

Salland Engineering
World-leading in test technology and engineering, specialised in solutions and services to improve efficiency and quality testing at semiconductor manufacturers.

SMART Photonics
The first "pure-play foundry" in the area of InP PIC production and on the verge of scale up.

Synopsys
Supports the project with design software and tools for the development of photonic ICs.

VTEC
Development and realisation of lasers and sensors for various photonic platforms. Assembly and packaging is taken care of including fibre connections.

Workfloor
Supplier of factory data collection systems.

High Tech NL
The national branch association for the Dutch high-tech industry. Its Semiconductors cluster is fully focused on the vast and strong semicon industry, operating as a 'single point of contact' in all steps of the value chain, driving and stimulating (international) cooperation, and initiating and facilitating (international) innovation and crossover projects.

Berenschot
A consultancy company that supports High Tech NL with grant proposal writing and project management and facilitates cooperation between companies and the growth of ecosystems.