MEKOPP

Metrology Equipment for critical scale up of PIC Production

Photonic integrated circuits (PICs), combining photonics with chips, are a technology for which the Netherlands enjoys a leading position. With chips that use light instead of electricity, many new and improved applications can be realised in healthcare, energy, automotive, agrifood and IT. PICs also drive the global internet infrastructure and are highly suitable for the large amounts of data collected and combined in the Internet of Things. The MEKOPP project will therefore facilitate sustainable economic growth by preparing metrology equipment for the efficient production of PICs and reduction of production defects.

In doing so, MEKOPP brings together ten expert partners and focuses on two machines: a Photonics Test Prober and a Photonics Visual Inspection Tool. These will enhance PIC production sustainability, potentially reducing material, energy and water usage by 50%. Indirectly, the project will contribute to PIC market adoption and scaling, which are vital for digital communication infrastructure efficiency. And with an expected 21-31% year-on-year market growth for PICs, the consortium expects to achieve an annual revenue of over €100 million by 2030 and create ~400 jobs in the eastern Netherlands.

EUROPEAN UNION
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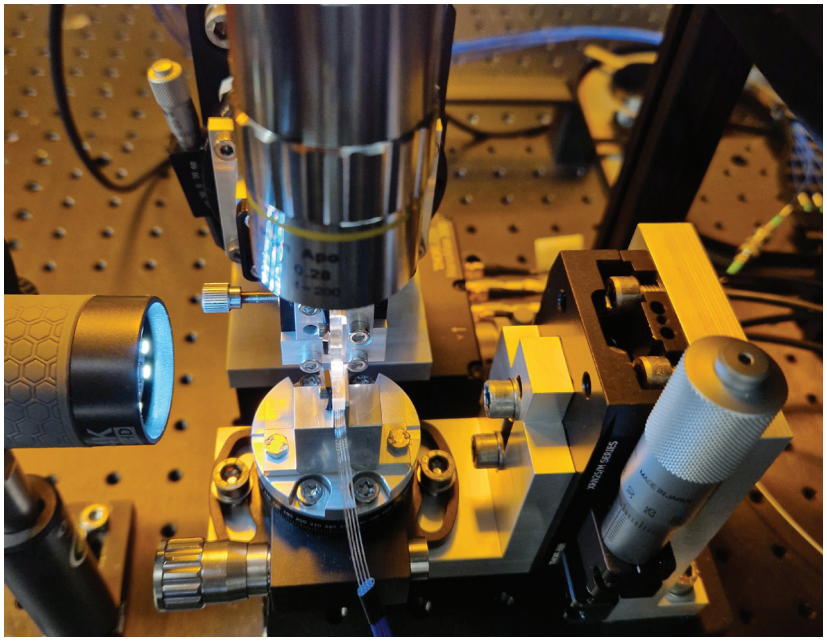
OPoost
operationeel programma oost
European Regional Development Fund

TNO: securing sustainability in the MEKOPP project

The *Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek* – or TNO for short – is no stranger to shared innovation projects, having worked in the realm of research and development since 1932. In their modern form, sustainability is a key objective and their efforts are often focused on new technologies that contribute to the energy transition through greater efficiency and less waste. This aligns them perfectly with the goals of the MEKOPP project.



High expectations

As an independent knowledge institute, TNO provides a broad set of optics, opto-mechatronics and nano-instrumentation expertise and many years of experience in the research and development of high-tech semiconductor equipment and space instruments. In the emerging field of photonic integrated chips (PICs), TNO has carried out several activities with an excellent group of researchers and engineers, drawing from a pool of some 4000 employees. On the topics of high-end optics modelling and experimental evaluations related to PIC equipment development – as in the MEKOPP project – TNO is thus a logical project partner to connect the right level of optics expertise to systems engineering, thereby supporting the collective MEKOPP goal of developing prototypes for industrial PIC inspection applications.

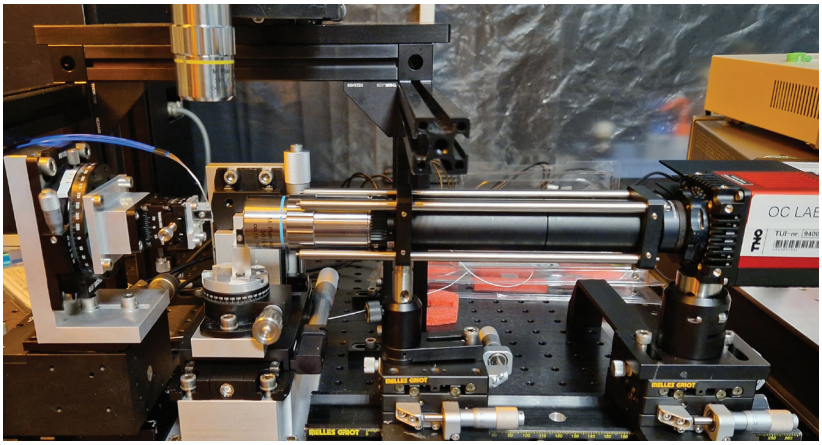
Such PIC technology is relatively new and applications are emerging fast. TNO expects that the demand for volume production will soon take off, which makes the availability of industrial mass production equipment an urgent point of attention. Simply put, MEKOPP is expected to bring PIC technology out of the lab and into the fab. The role of TNO in the project has therefore been focused on the coupling

of light into PICs to enable inspections of their functionality. This requires deep knowledge of optics but also systems engineering in order to cast optical coupling devices into prototype PIC inspection equipment platforms.

The right fit

To probe a PIC and inspect its proper functioning, light has to be coupled in. This can be done in various ways, one of which is trench coupling. The added value that TNO brings to the project is the analysis of different options for trench coupling via modelling and simulations but also experimentally on optical test set-ups. The results have been ranked against relevant higher-level requirements for PIC inspection equipment and help MEKOPP to make choices regarding which specific trench coupling concept is best suited to which type of PIC device.

As the probe is only one element in the inspection tool as a whole, part of TNO's activities have also been the interfacing and alignment of probe heads relative to the PICs to be inspected. A calibration strategy has been proposed to the system engineering team that takes care of proper positioning of the probe such that the light coming out of the probe for inspection is coupled into the PIC optical channels. Finally, reporting of the probe simulations and experiments has been carried out, including an analysis of the results against the most relevant requirements for PIC inspection equipment.



The pioneers

These results were achieved with a strong degree of internal and external collaboration. Two systems engineers were involved at TNO's end: Gregor van Baars, working closely with the consortium and IMS in particular on the system architecture, and Leon van Dooren, who is highly knowledgeable in the area of optics and optics designs. Leon succeeded Peter Toet, who played an important role in the development of the system. In addition, several optics designers, scientists and engineers were part of the project: Mercedes Alcon Camas, Dave van der Vuurst, Sebastian Falckenheiner, Robert Altmann and Peter Kerkhof. Finally, Patrique Boerboom served as the business developer and Marcel van der Kraan as the project manager for TNO on the project.

The fact that this team was able to work so effectively both together and with a consortium scattered around the Netherlands is a testimony to the MEKOPP project, which has played a vital role in pushing integrated photonics to a new level. In the longer term, this will be a foundation for sustainable economic growth as the metrology equipment market will be ready for the efficient and sustainable production of PICs that support digitalisation and the energy transition. Although the Netherlands is already a leader in this field, the work of TNO and the entire MEKOPP consortium will help to secure this position and drive the domain forward on a global scale.

MEKOPP project partners

IMS
Development of equipment for high-precision positioning of Photonic Integrated Circuits (PICs), enabling the optimisation of back-end processes and cost reduction.

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

Nobleo Technology
Realisation of software for the automatic inspection of photonic chips (PICs).

Photonic Integration Technology Center (PITC)
Shortening the path to the commercial application of integrated photonics through application-driven technology programs and by offering access to shared infrastructure.

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

Settels Savenije
Total solution supplier for high-tech equipment, systems, modules and critical components, including engineering and prototyping.

Technolution
Advanced electronics and embedded systems for complex instruments: specialist in the (combined) development of software, programmable logic and electronics for embedded and technical information systems.

TNO
One of the focus areas in the TNO expertise centre for semicon and quantum is optical metrology. TNO 's goal is to bridge low TRL developments and businesses.

Workfloor
Development of software modules that interact with manufacturing execution systems.

High Tech NL Semiconductors
Fully focused on the vast and strong semicon industry and operates as a 'single point of contact' in all steps of the value chain. Drives and stimulates (international) cooperation and initiates and facilitates (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.