photonixFAB

Enabling photonics product innovation with a path to high-volume manufacturing

EPIC Technology Meeting on Microelectronics & Photonics – Two sides of One Coin,
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Joni Mellin, X-FAB, 13.11.2023

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Key Facts

- Industry driven initiative with 12 partners from 9 countries
- € 47.6 m public + private funding
  - co-funded by the EU under grant agreement no. 101111896
  - top-up funding by Belgium, Germany, France, Israel, Italy, The Netherlands and Switzerland
- Start: May 2023
- Duration: 3.5 years

Consortium partners:

Technology & Manufacturing

Research & Technology

Applications

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What do we want to achieve

- To establish a European photonics device value chain and initial industrial manufacturing capabilities, providing a path to scalable high-volume manufacturing for innovative product developers.

  - Strengthen the European silicon photonics industrial supply chain on EDA, packaging and testing, essential elements to offer production-ready technology.
  - Develop an internationally competitive offering accessible to SME's and other customers

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What are we going to do

- Extend the industrial manufacturing capability in X-FAB for SiN photonics building on LIGENTEC's SiN platform.
- Establish an industrial manufacturing capability in X-FAB for SOI photonics building on IMEC's SOI platform.
- Increase maturity of heterogeneous integration of active devices (μTP ready InP platform from SMART) on both SOI and SiN platforms to be low-volume production ready and with a path to high-volume fabrication.
- Enable hybrid photonics packaging and assembly solutions (PHIX)
- Providing EDA & PDK solutions (Luceda)
- Demonstrate platform capability through application partners

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Photonics Industrial Value Chain

Photonic design/EDA
LUCEDA PHOTONICS

PIC foundry and testing
xfab
LIGENTEC

Heterogeneous integration
xfab

Active material III-V chiplets
SMART PHOTONICS

Packaging & testing
phix

Systems and applications
NOKIA
NVIDIA.
aryballe
PHOTONFIRST

R&D support
cea leti
imec

- Demonstrate platform capability through application partners

→ telecom

→ datacom/data-center

→ sensing (olfaction sensor)

→ fiber-interrogator

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Technologies

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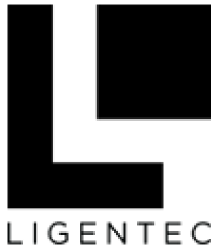
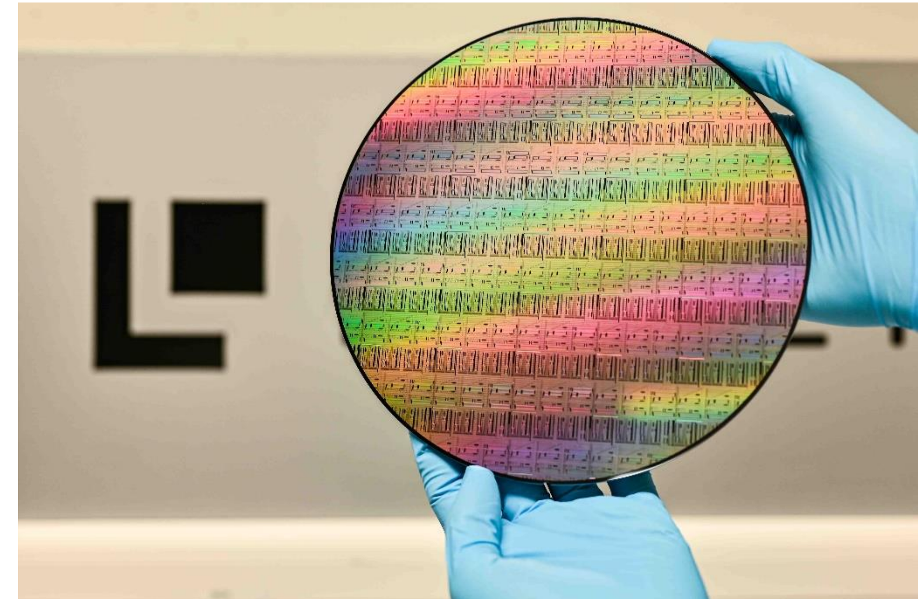
Low-loss Silicon nitride (SiN) platforms



Ideal for quantum computing, sensing and other applications from visual to SWIR wavelengths



Key activities

- Installation of AN350 and AN150 platforms in X-FAB's 200mm high-volume fab
- Enhancing AN800 platform with new process modules
- Enabling early technology access and offering prototyping readiness (MPW runs)
- Industrialization of the installed SiN platforms
- SiN platform enablement for heterogenous integration (micro-transfer printing)
- Extension of photonics wafer and die level testing capabilities

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220 nm SOI platform optimized for µTP

photonixFAB

imec

xfab

Ideal for datacom, telecom, sensing and more applications

Key activities

- Installation of the imec SOI platform in X-FAB's 200mm high-volume fab
- Enabling early technology access and offering prototyping readiness (MPW runs)
- SOI platform enablement for heterogenous integration (micro transfer printing) of high-performance materials like InP and other

Au
InP
Au
Cu
Poly-Si
SiN
SiO_2
Si
Fiber Edge Coupler
air gap (undercut)
Fiber Grating Coupler
Si Substrate

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µTP ready InP chiplets

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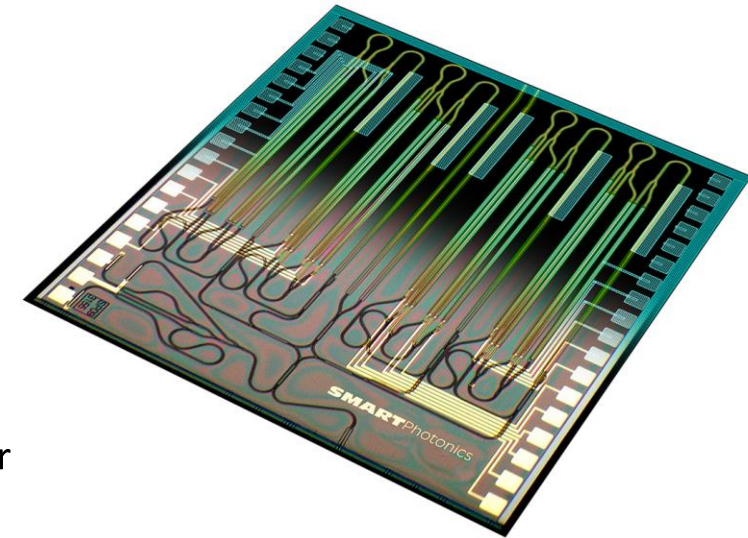
Combining the best of Indium Phosphide (InP) and Silicon (Si) photonics worlds



Key activities

- InP required for light-generating components, e.g. lasers and amplifiers
- InP photodiodes and MZIs may also be evaluated
- All InP components will be manufactured by SMART and tested by wafer-level probing prior to transfer
- Enabling micro transfer print ready InP chiplet source wafers
- A micro-transfer printing approach will be used to integrate the InP die into the SiN and SOI platforms

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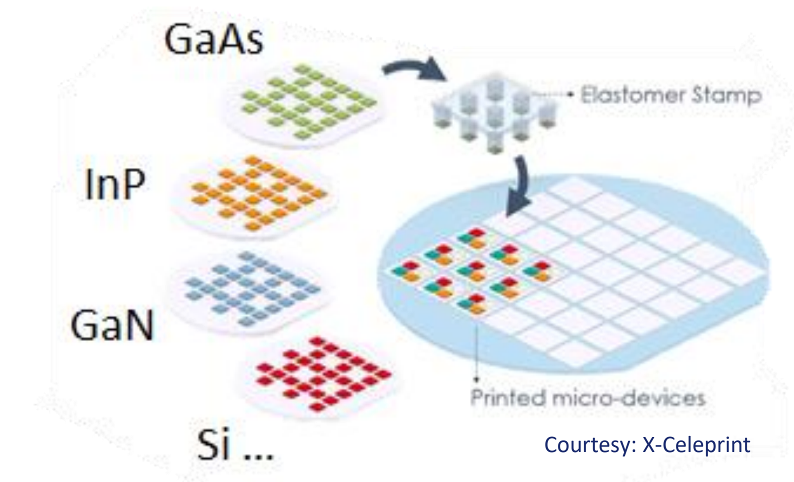
µTP of InP and other chiplets

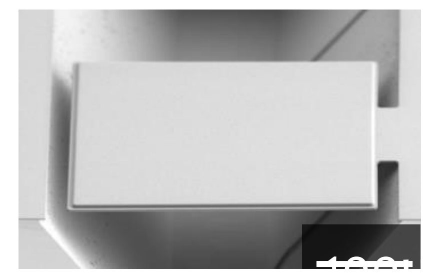
Ideal for high throughput multi-technology chiplet heterogenous integration

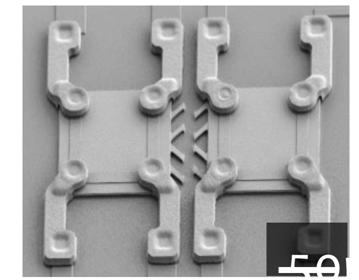


Courtesy: X-Celeprint

Key activities

- Enabling photonics print precision (3σ <500nm) TRL6 level industrial pilot line at X-FAB
- Transfer printing of InP and other chiplets on SiN and SOI platforms
- Preparation of design rules and guidelines for chiplet transfer printing on SiN and SOI platforms
- Provide early technology access to the Industrial pilot line





Courtesy: X-FAB

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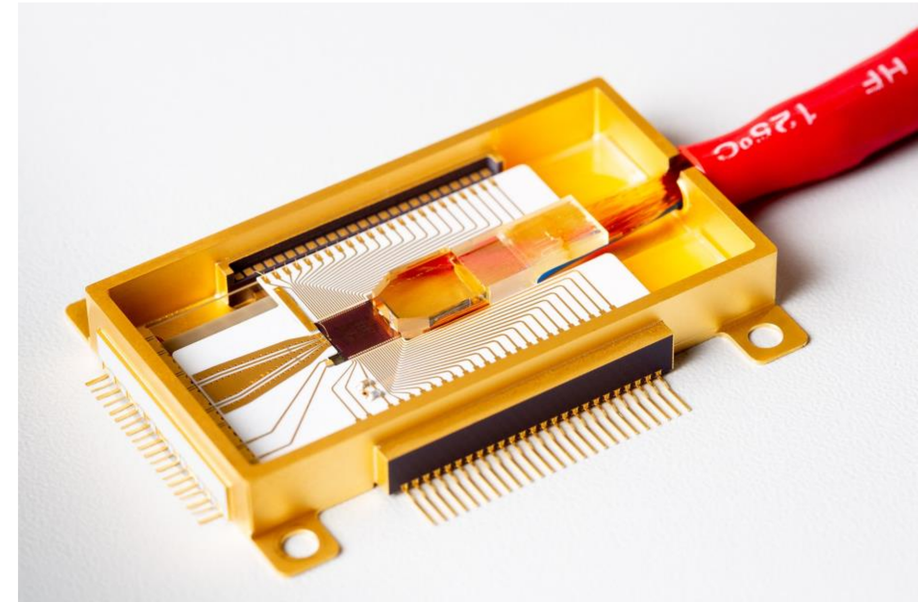
Advanced hybrid photonics packaging & testing

Ideal for scaling up production, from prototypes to large series

Key activities

- Hybrid assembly and packaging of SOI and SiN-based chips, in scalable volumes
- Interfacing between photonics and DC/RF electronics
- Providing photonics packaging solutions to optimise performance, minimise costs and accelerate the adoption of new technology
- Managing thermal effects, and providing environmental protection to packaged devices
- Standardisation and co-development of an Assembly Design Kit (ADK)



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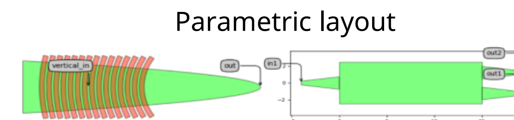
Photonic design and PDK enablement

Ideal EDA solution for PIC and optical component designs

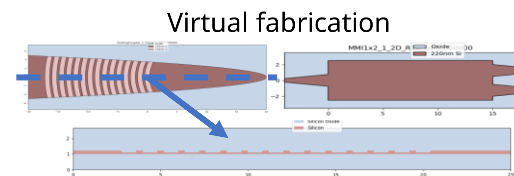
Key activities

- Photonic component layout and simulation
- Circuit implementation
- Optical and electrical routing
- Schematic capture
- Layout and tape-out
- Circuit simulation – transient and frequency domain
- Data-driven compact models
- Functional verification
- Design IP Management and Design Kit Quality Assurance

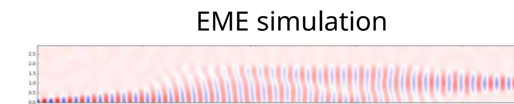
Parametric layout



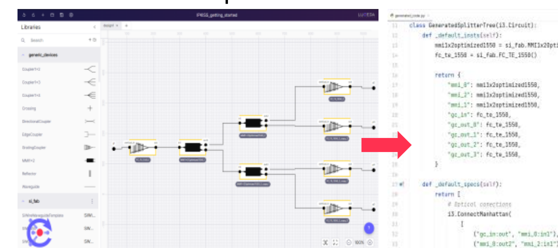
Virtual fabrication



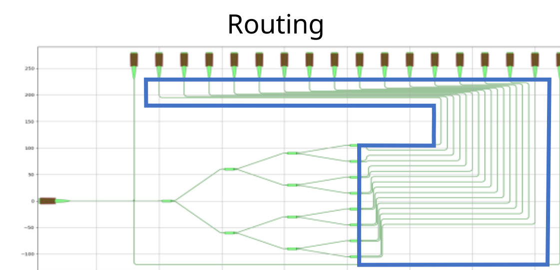
EME simulation



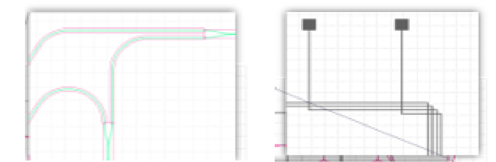
Schematic capture with code assistance



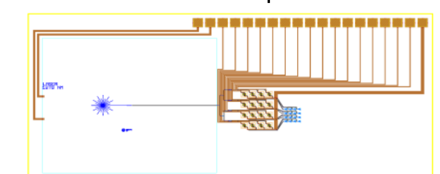
Routing



Optical & Electrical connectivity



GDS export



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Applications & Markets

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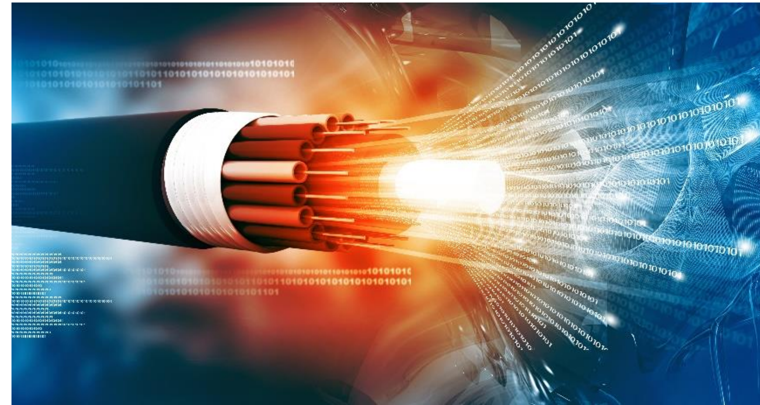
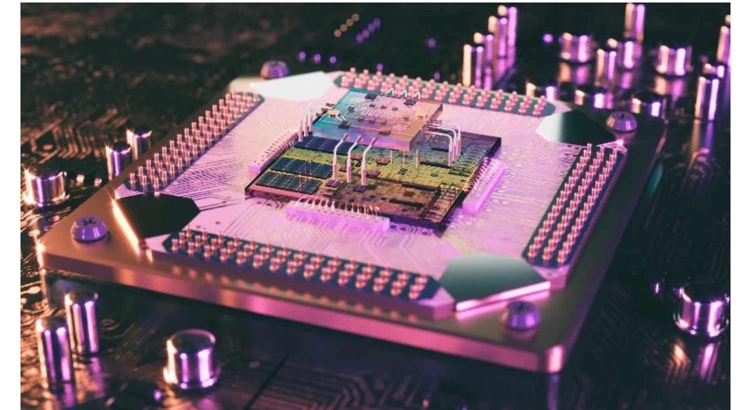
We support main Applications & Markets

Datacom, AI and computing

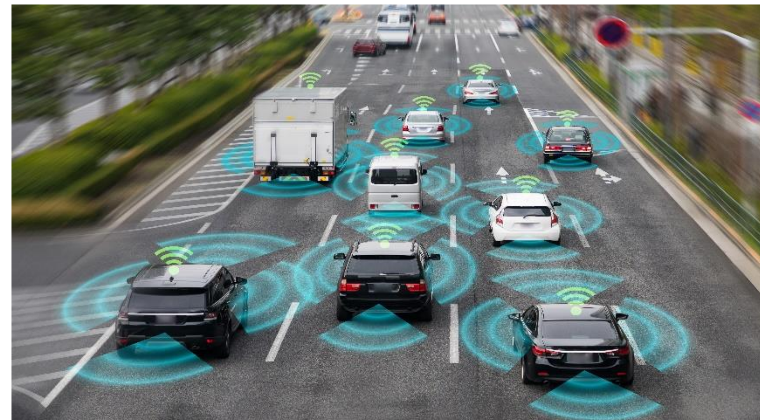


Telecom



Quantum computing & technologies

Medical, diagnostics and biosensing, consumer medical



Automotive, PIC enhanced LIDAR

AR/VR, industrial and environmental sensors

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5 Availability

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Availability in high volume industrial fab

Key technologies	Availability
Early technology access for SIN / SOI platforms	Early 2025
Commercial MPW program for SIN / SOI (TRL8+)	Late 2025
Early technology access for µTP ready InP chiplet technology (TRL6+)	Early 2025
Early technology access for InP µTP on SIN / SOI platforms (TRL6+)	Mid 2025
Packaging & testing solution Assembly PDK for the SIN / SOI platforms	End 2024

Note:

- More detailed availability will be communicated later
- ***Prototyping and small scale production is available today through partners***

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Acknowledgement

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The project is supported by the Key Digital Technologies Joint Undertaking and its members including top-up funding by Belgium, Germany, France, Israel, Italy and the Netherlands. The project is also supported by Switzerland separately.

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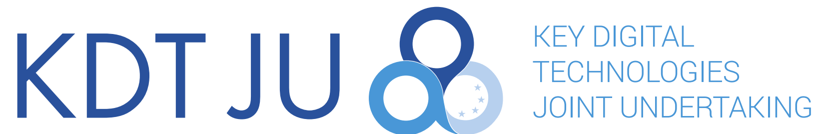

Get in touch

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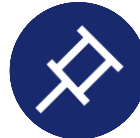

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