The Future of Photonic Interconnects is 3D Printed Freeform Optics
- "It is time to (Wafer) Level-Up"

Thorsten Mayer (CEO) | thorsten.mayer@mycronic.com

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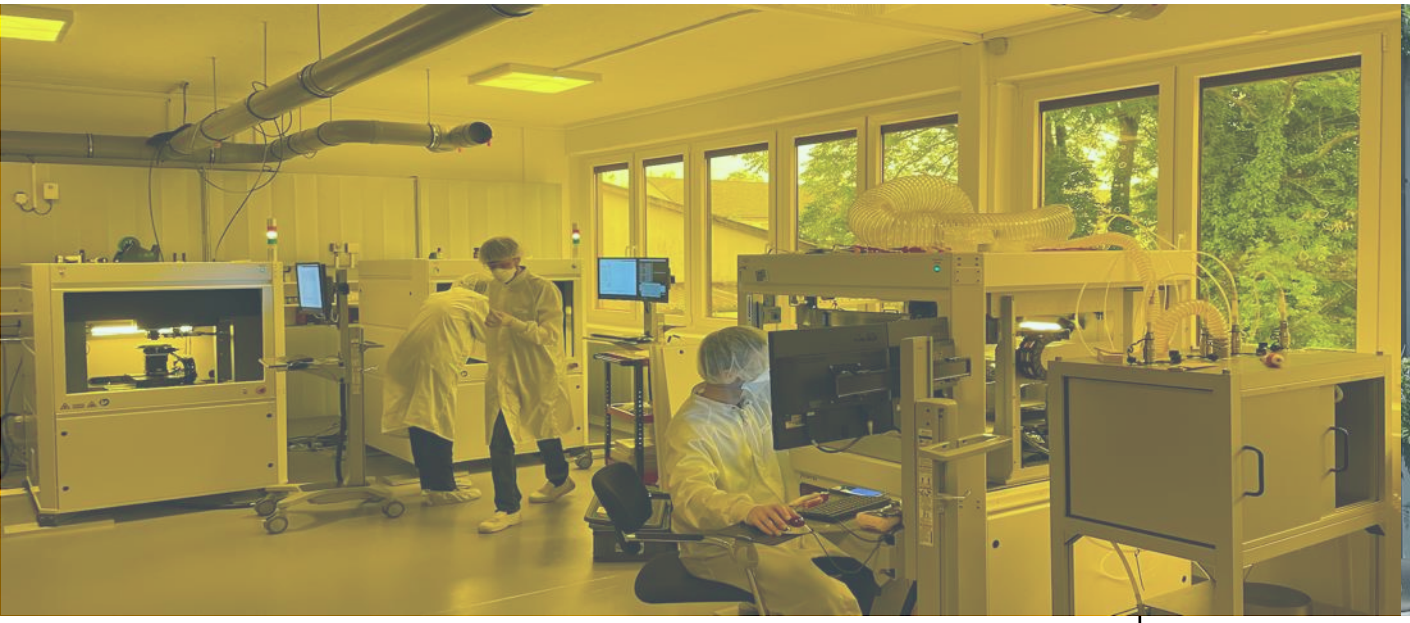
Vanguard Automation on a Page

Unique IP and Fully Automated Tool Chain for Photonic Interconnects



2018
Joint Venture between KIT Spin-Off and ELAS Technologies GmbH – headquartered in Karlsruhe, Germany

2024
Joint Mycronic AB (publ) Swedish high-tech group

MYCRONIC

Unique IP
Growing pantent families in the field of 3D lithography and photonic packaging

Products
Process technology incl. Systems, Software, Consumables, related Support and Services

40+
Employees (13 nationalities)

Photonic Integrated Circuits are Growing Rapidly

Telecom/ Datacom

AI/Optical Computing

Sensing

Quantum Technologies

Space & Defense

Empowering engineers and researchers to design and manufacture next-generation optical devices through automated solutions that overcome design, and scalability challenges.

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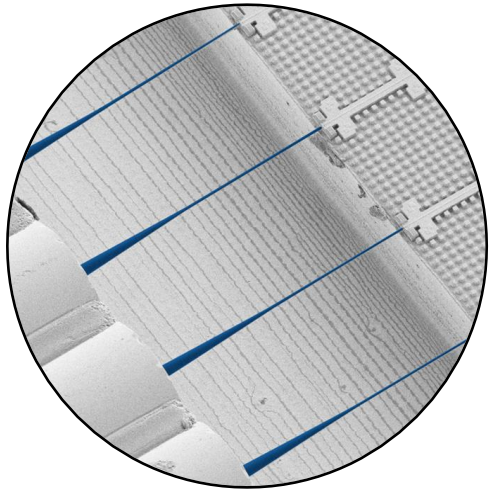
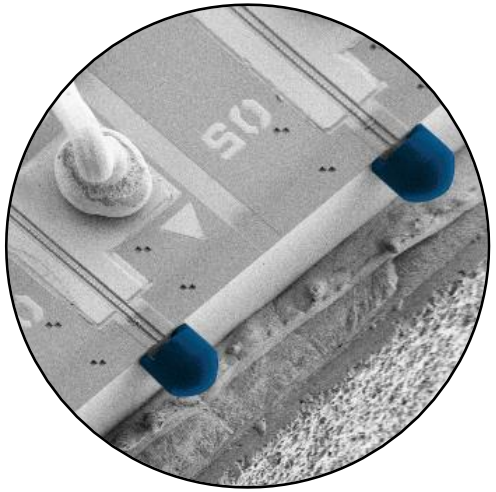
Enabling Next Generation **Photonic Integration and Packaging** Solutions with **3D Laser Lithography Solutions**

Photonic Wire Bonding (PWB)



Facet-Attached Micro-Lenses (FAML)



Low loss connections to arbitrary mode fields

Automated, **reproducible** and **fast**

Reliable connections under various conditions

High interconnect density (compact modules)

High degree of **design flexibility** for hybrid multi-chip integration

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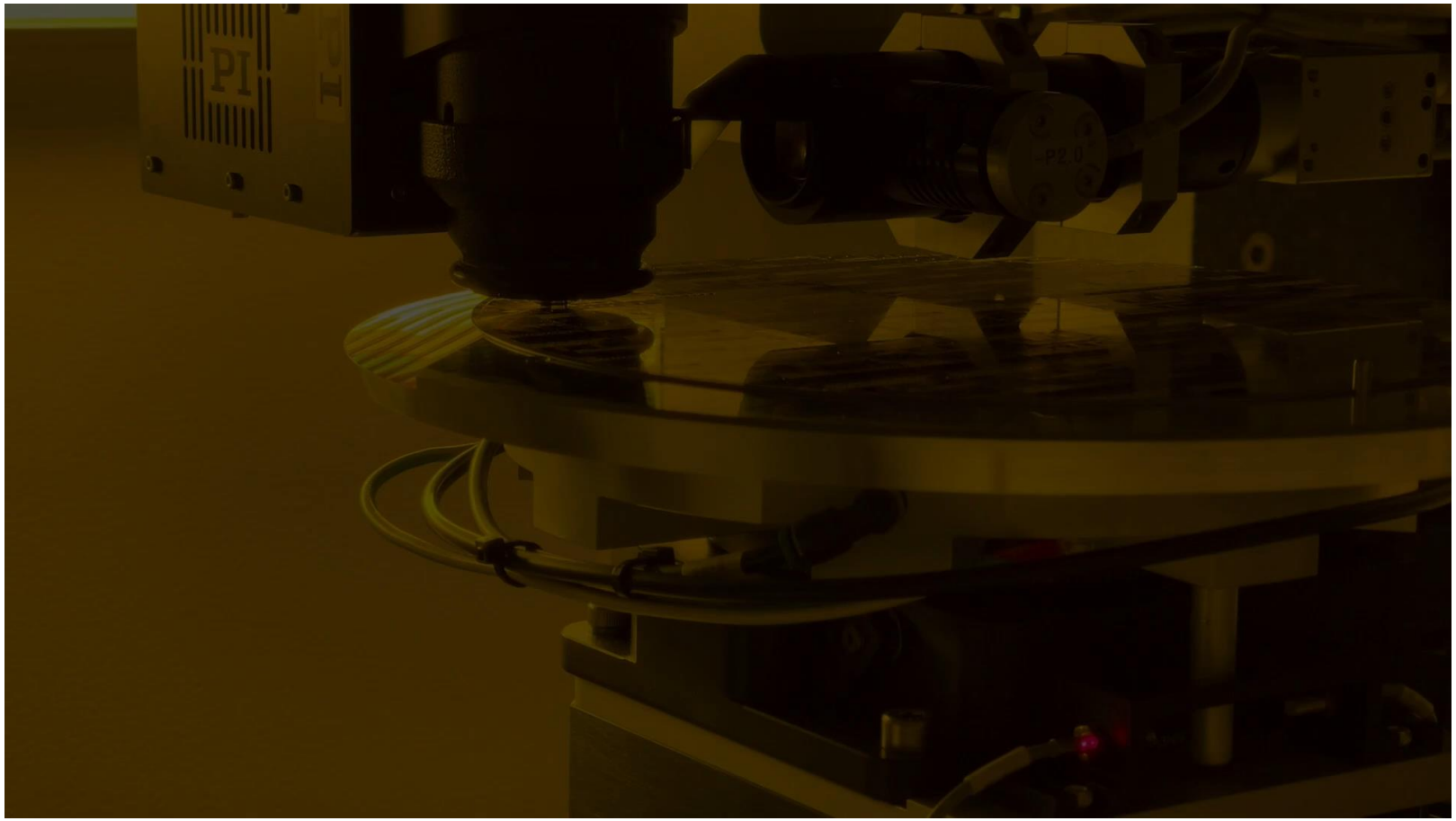
Industry Proven **Photonic Integration and Packaging**

"It is time to (Wafer) Level-Up"



Wafer Level & Batch Processing for Photonic Integration

Active Device Integration | High Reliability & Yield | Mode-field-matching

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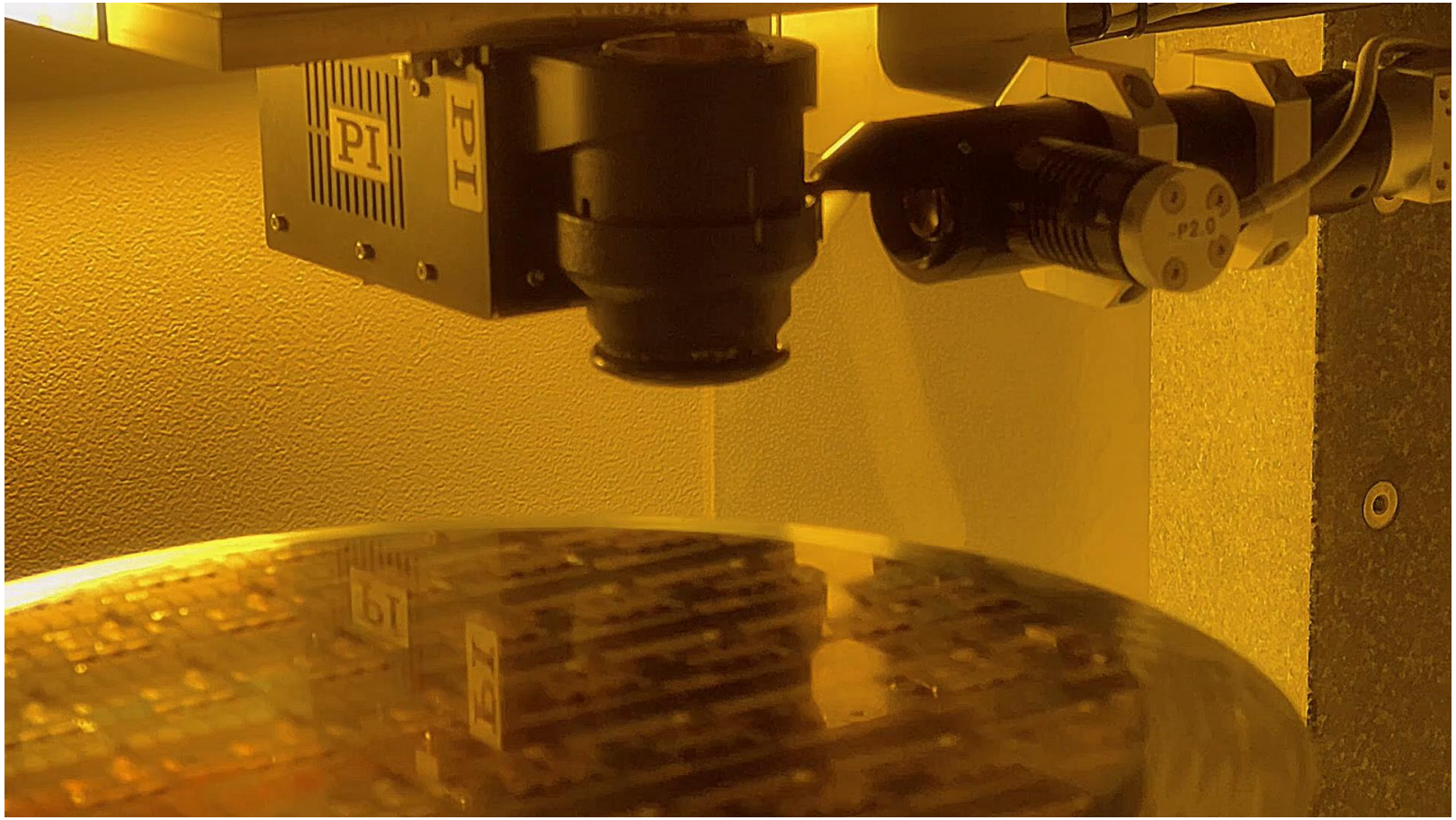
Industry Proven **Photonic Integration and Packaging**

"It is time to (Wafer) Level-Up"



Wafer Level & Batch Processing for Photonic Integration

Active Device Integration | High Reliability & Yield | Mode-field-matching

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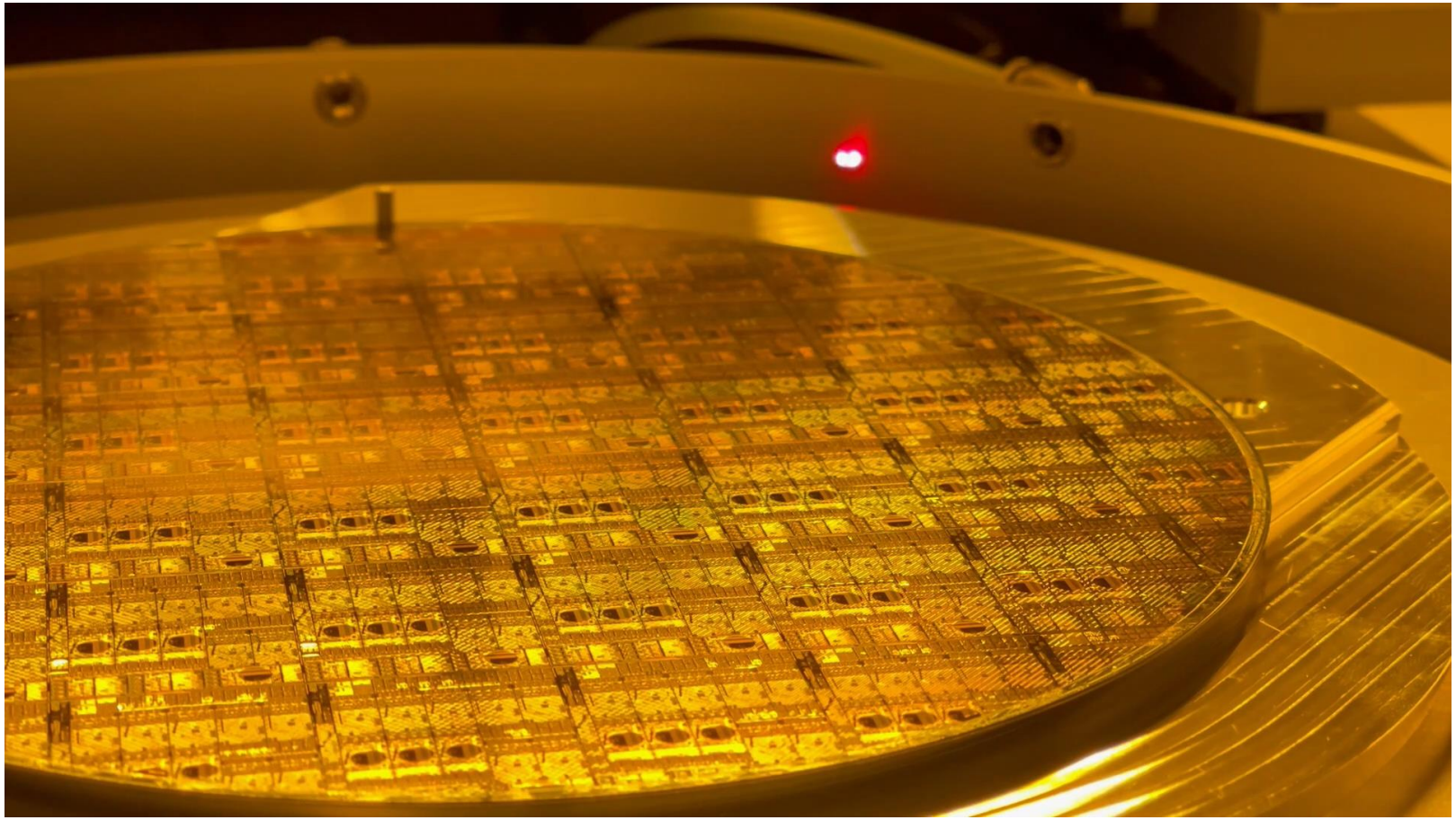

Wafer Level & Batch Processing for Photonic Integration

Active Device Integration | High Reliability & Yield | Mode-field-matching

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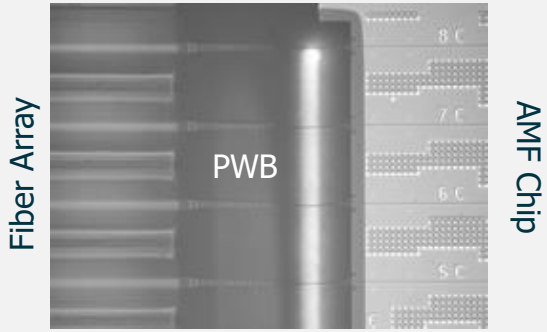
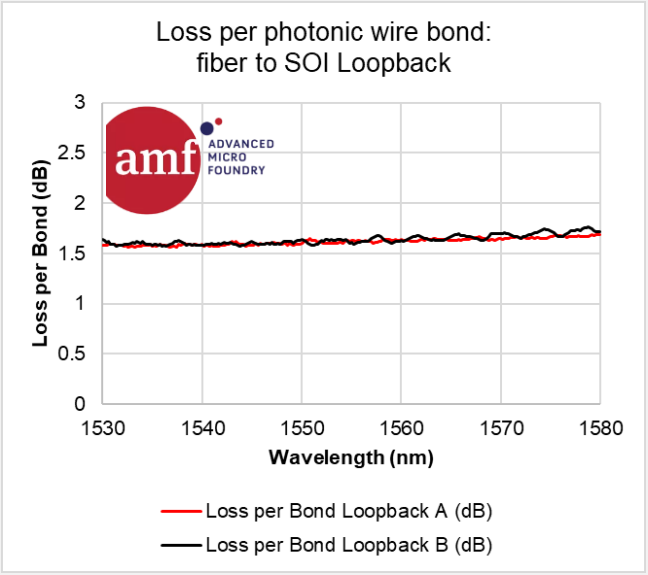
Compatibility with Any Material Platforms/Foundries

Silicon (**AMF**, Singapore)

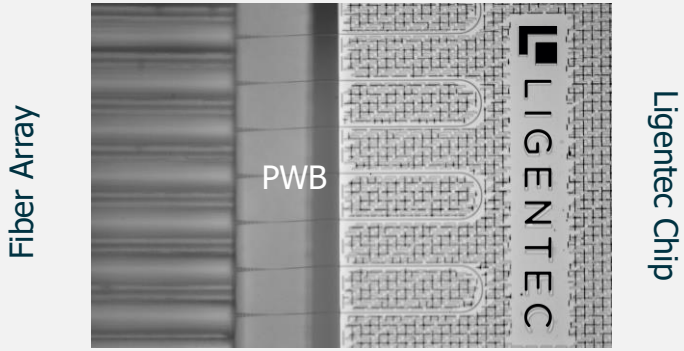
- **~1.5dB loss**

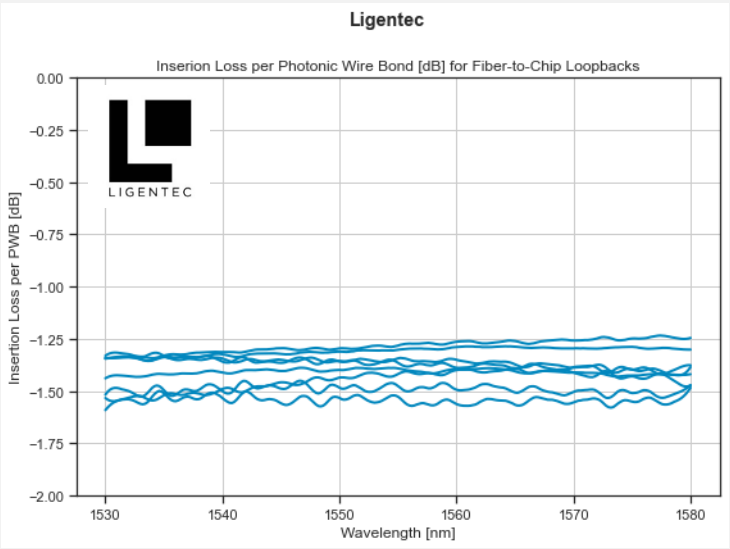




Silicon Nitride (**Ligentec**, Switzerland)

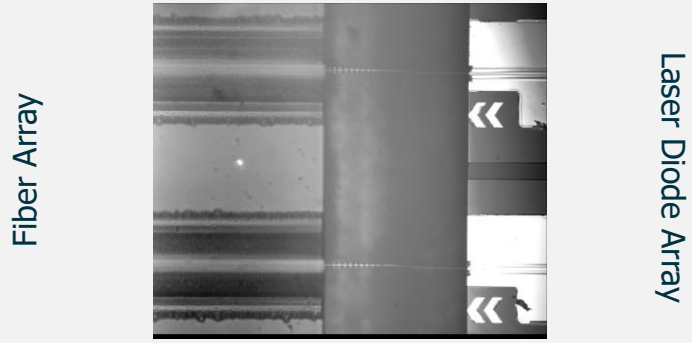
- **~1.5dB loss**

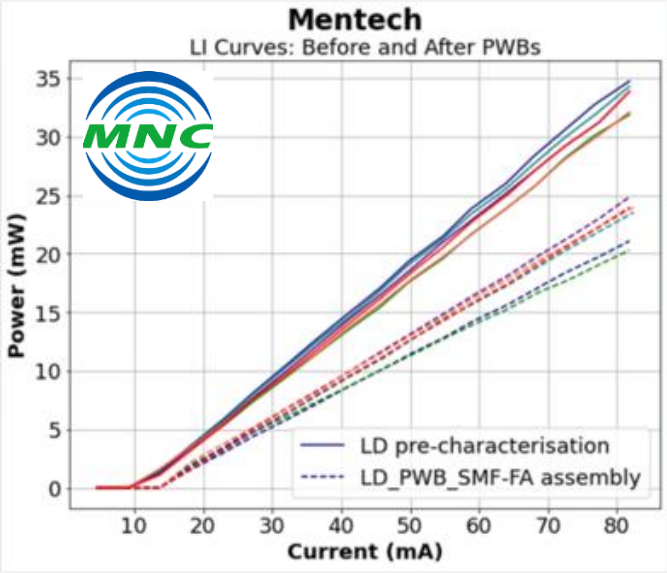




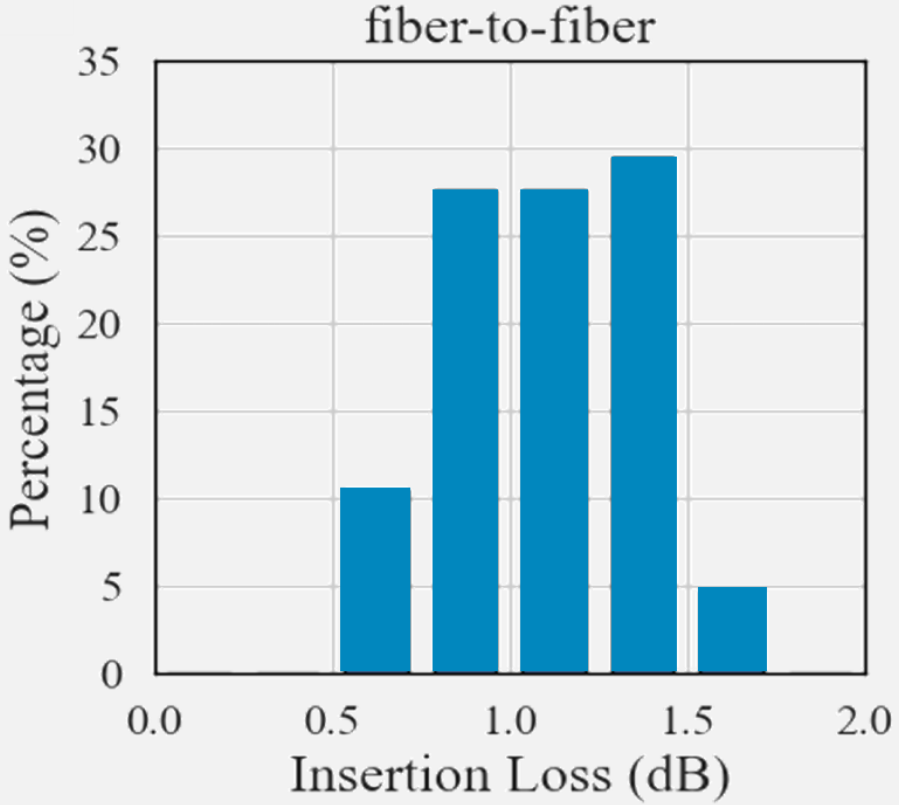
Indium Phosphite (**Mentech**, China)

- **~1.5dB loss**

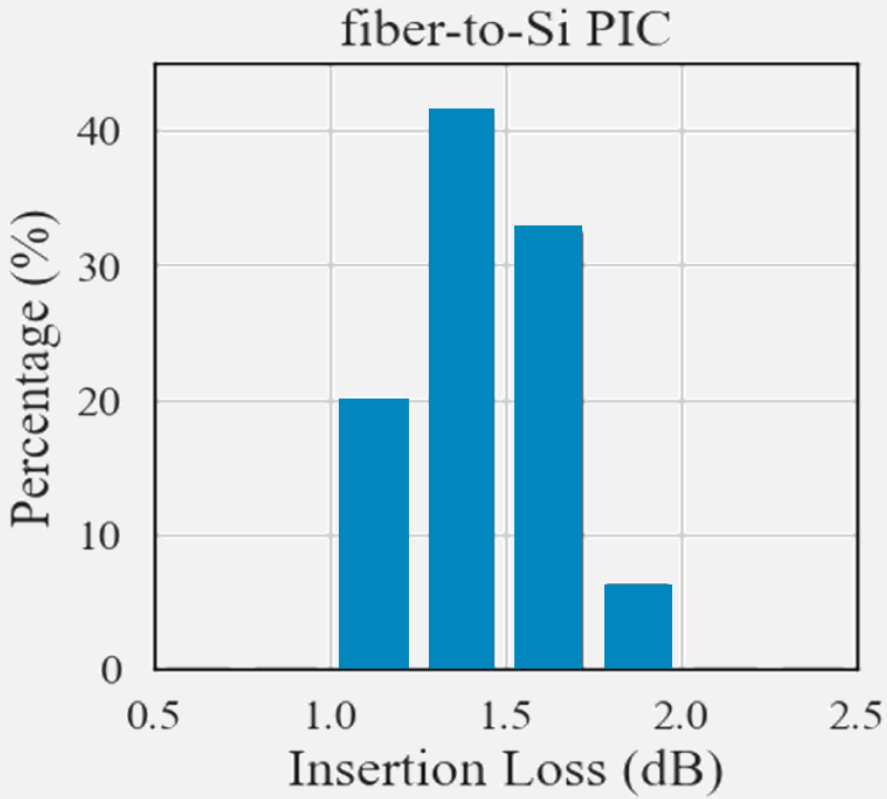




Yield - Statistics on Insertion Loss using Photonic Wire Bonds



105 connections, average IL 1.1 dB



160 connections, average IL 1.44 dB

M. Lu et al., "**Using Industry Ready Photonic Wire Bonds & Facet Attached Micro-Lenses**,"
in IEEE Transactions on Components, Packaging and Manufacturing Technology, doi: 10.1109/TCPMT.2025.3531206.

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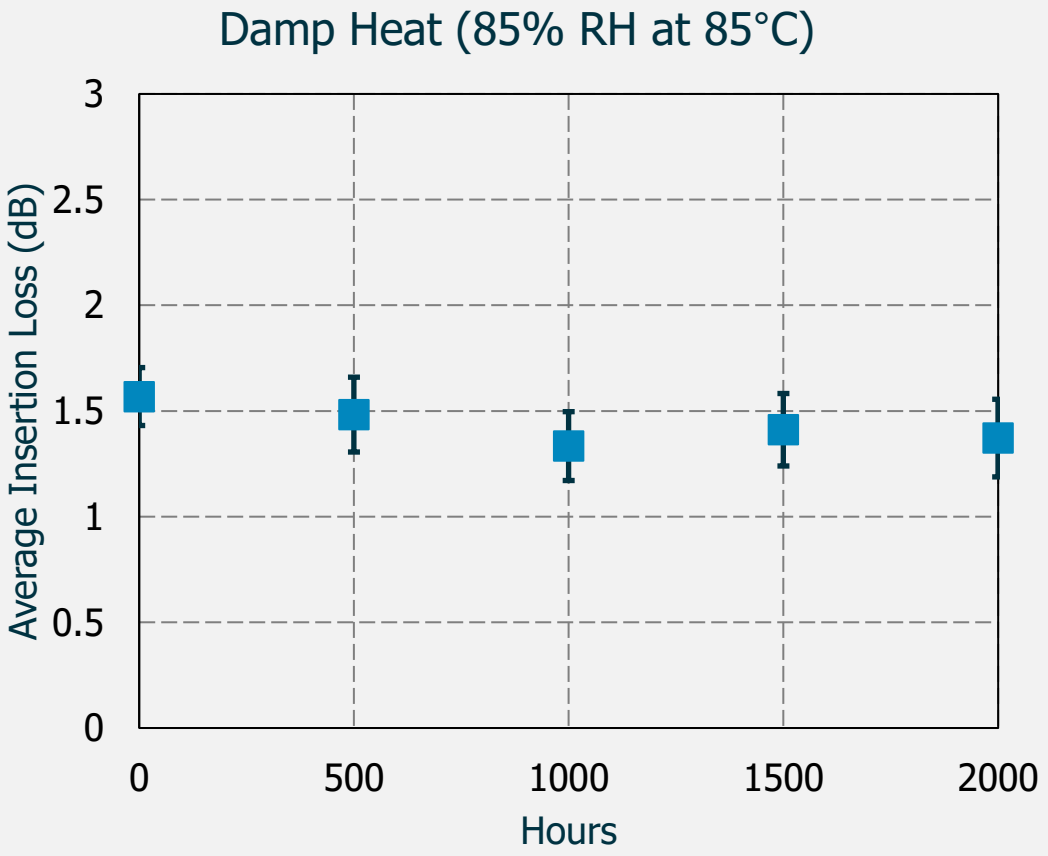
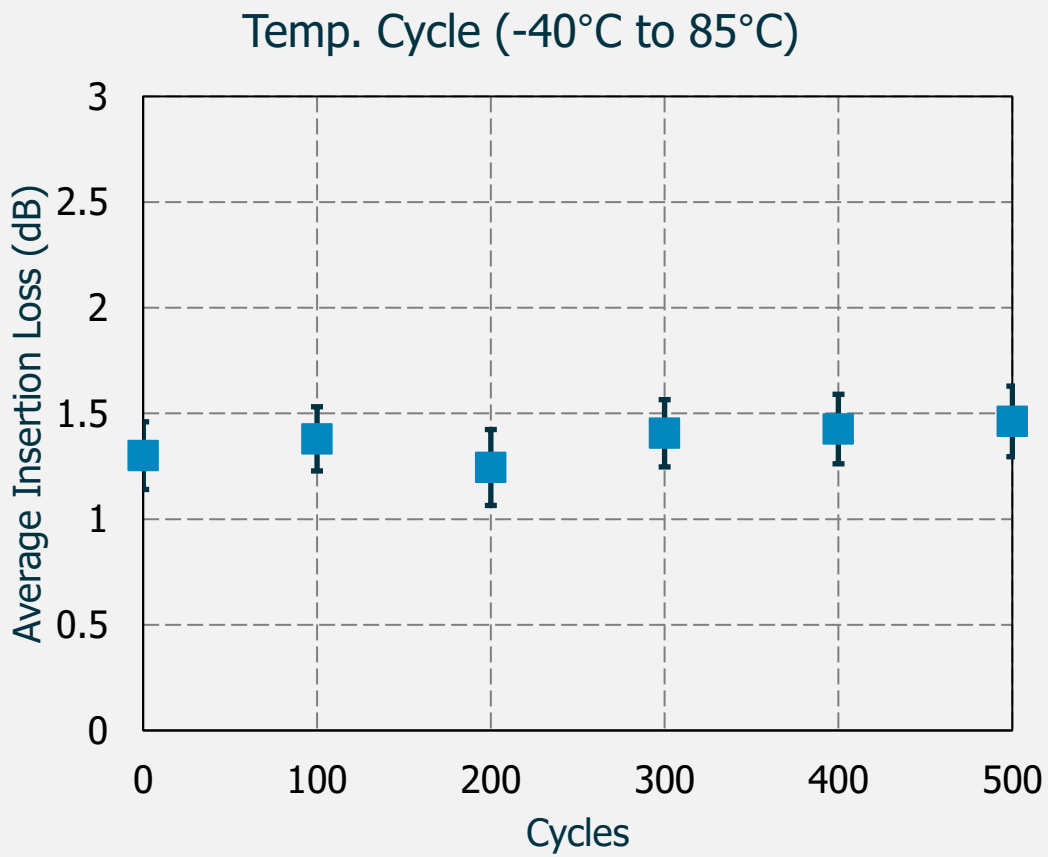
Reliability - Insertion Loss in Damp Heat and Temperature Cycling





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Fully Automated Tool Chain and Services vanguard SYMPHONY 1000

Machines

SONATA 1000

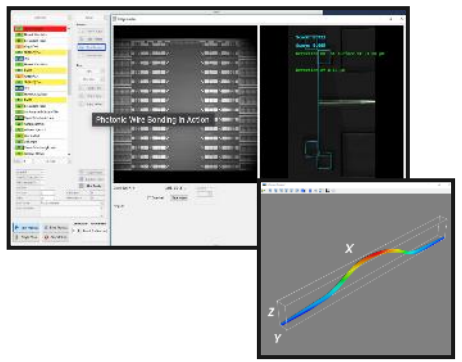
Automated 3D Lithography-based Nano Printing

REPRISE 1000

Automated Pre- and Post-Processing: Development and Encapsulation

Software

Composer and BrightWire3D



Software for Machine Control, Process Development and Management

Additional Products and Services

VanCore, VanClad, ...

Materials for the Production of PWBs and Micro Optical Lenses

Professional Services

- Training
- Process Development
- Feasibility Studies
- Development Support
- Maintenance Services

The Full Suite: SYMPHONY 1000

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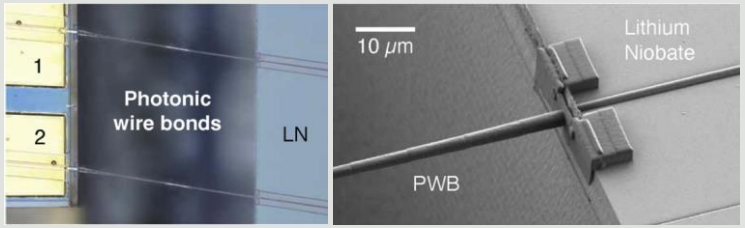
Use Cases – Photonic Wire Bonding

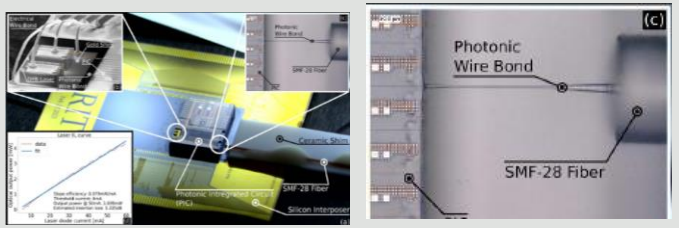
Active Device Integration

Multi-Chip Hybrid Integration | Passive alignment process | Mode-field-matching | Relaxed pick and place tolerances of ± 30 µm

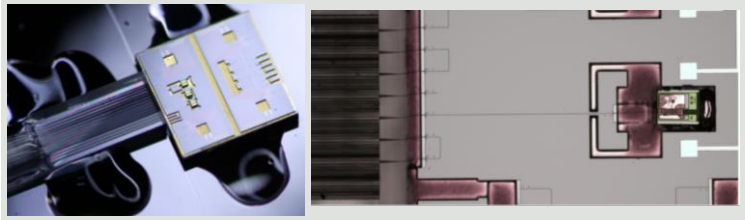
"High-power and narrow-linewidth laser on thin-film lithium niobate enabled by photonic wire bonding", Franken et. al. APL Photonics 1 February 2025; 10 (2): 026107



"Packaged Tunable Single-Mode III-V Laser Integrated on a Silicon Photonic Integrated Chip Using Photonic Wire Bonding",(2024) Deenadayalan et al., IEEE 74th (ECTC), Denver, Colorado, USA)



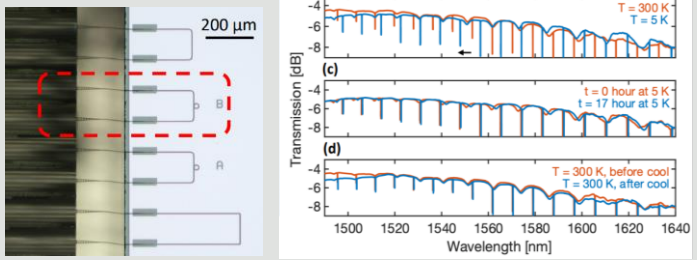
"SiEPICfab: the Canadian silicon photonics rapid-prototyping foundry for integrated optics and quantum computing",(2021)
Darcie et al. , Proc. SPIE 11691, Silicon Photonics XVI



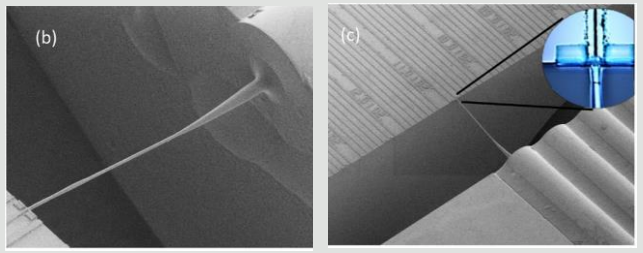
Quantum Applications

Cryogenic temperatures | (IL) < 2dB | No degradation

"Cryogenic Optical Packaging Using Photonic Wire Bonds", (2023)
arXiv:2307.07496v1 [physics.optics]



"Plug-and-Play Fiber-Coupled Quantum Dot Single-Photon Source via Photonic Wire Bonding", Adv Quantum Technol. 2023, 2300227



Use Cases – 3D-printed lenses

Relaxed Alignment Tolerances | Maximize Coupling Efficiency | Low Back reflectance

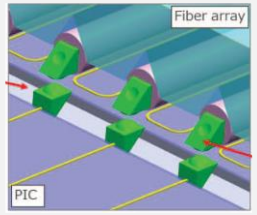
"3D-printed Beam Expanding Lens for Chip to Fiber Vertical Coupling",(2024) Y. Mizuno et al., 2024 IEEE 74th (ECTC), Denver, Colorado, USA)

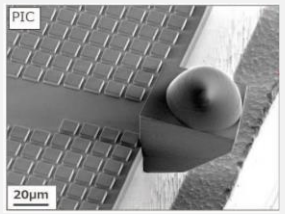
Vertical coupling

Wide bandwidth (1260 to 1575 nm)

Relaxed alignment tolerance ±10µm

1.2dB coupling efficiency





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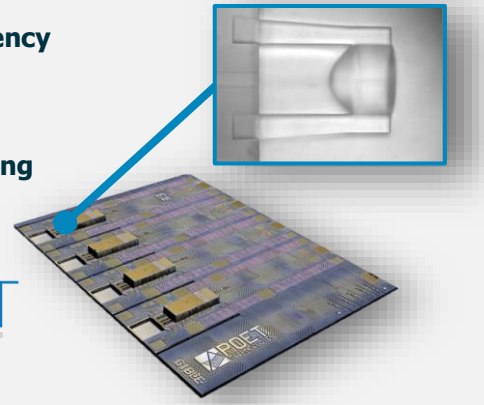
Connect with Innovation

Collaboration to incorporate 3D-lithography technology into POET's Optical Interposer™ platform.

Increased Efficiency

Cost Reduction

Wafer level scaling



POET Technologies

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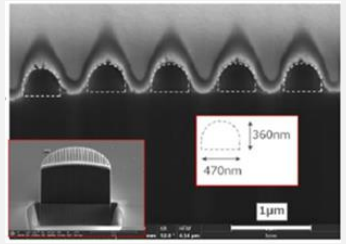
"3D-printed aspherical lens with moth-eye anti-reflection structure",(2024) Y. Mizuno et al., Proc. SPIE 12898, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XVII, 128980R

Reflectance on the lens surface was reduced to **0.005%**

Coupling efficiency to fiber is improved to **-0.33 dB**

Structure size 360 x 470 nm



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Connect with Innovation

Quantum Applications

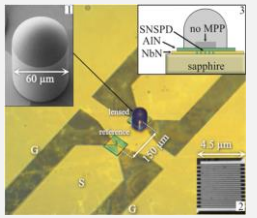
Cryogenic temperatures | No degradation | Broadband working range 530 – 2000 nm

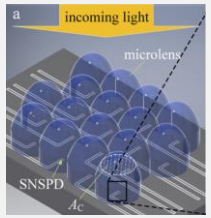
"Superconducting nanowire single-photon detector with 3D-printed free-form microlenses", Opt. Express 29, 27708-27731 (2021)

The paper demonstrates FaMLs operating at **cryogenic temperatures** down to **4.6K**

Assemblies undergo **10 cool down cycles**

KIT Karlsruhe Institute of Technology





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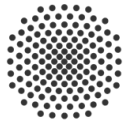
Eco System Partners, Academic and Commercial Users



University of Stuttgart

Bringing tomorrow's electronics to life

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