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Advances in Hybrid Low-loss PICs: the Best of Both Worlds

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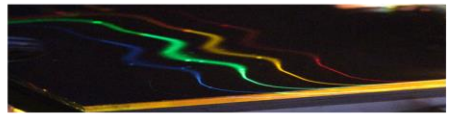
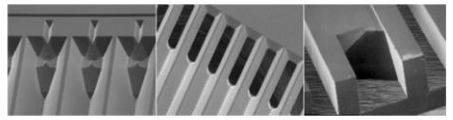
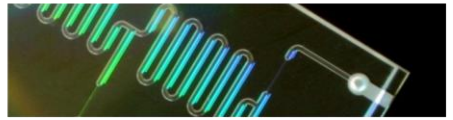
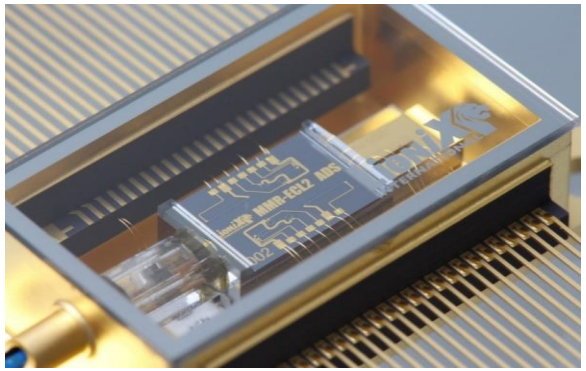
Photonic IC Modules

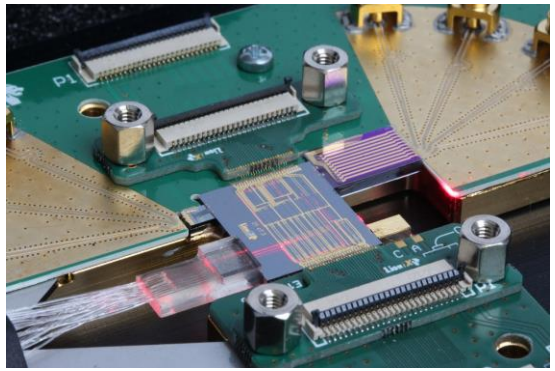
- Providing **customized solutions** for OEM's and System Integrators
- From design to device by **vertical integration** in **scalable production volumes**
- Maintaining technology leadership secured by **strong IP position**

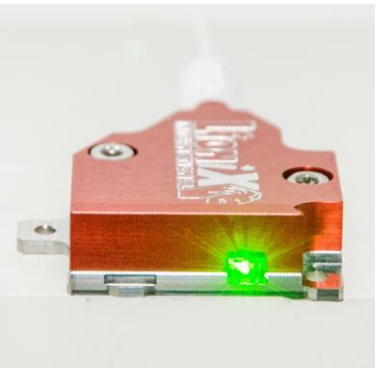
Customized Microsystem Solutions

Integrated Photonic	
Customized MEMS	
(Opto) Fluidics	

Photonic IC Modules

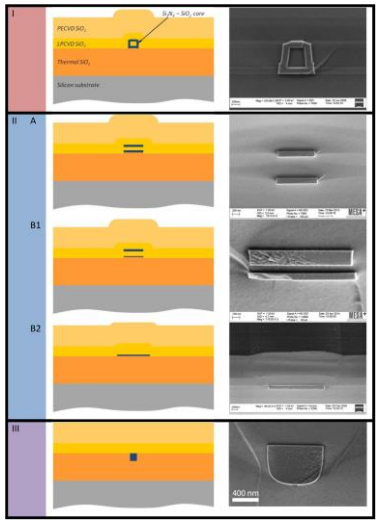




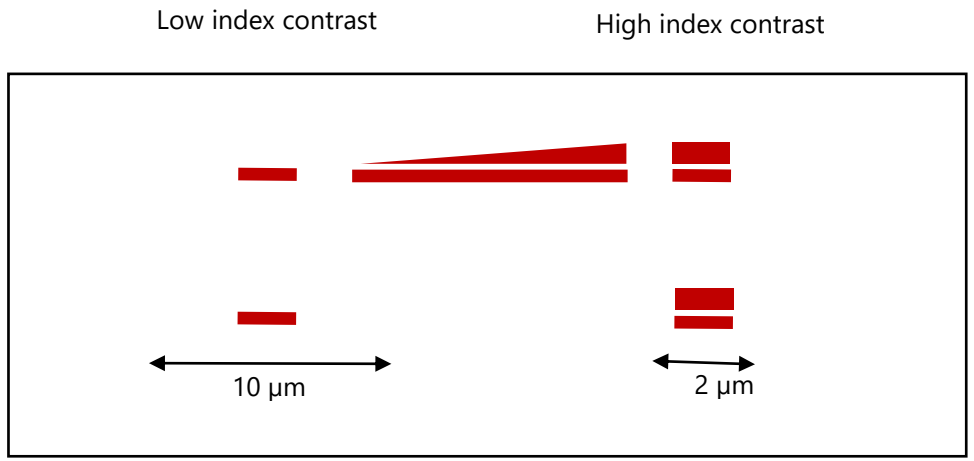


Core technology

- Silicon-Nitride waveguide platform: TriPleX®
  - Low loss operation from 400-2350nm



- Waveguide tapering for mode optimization

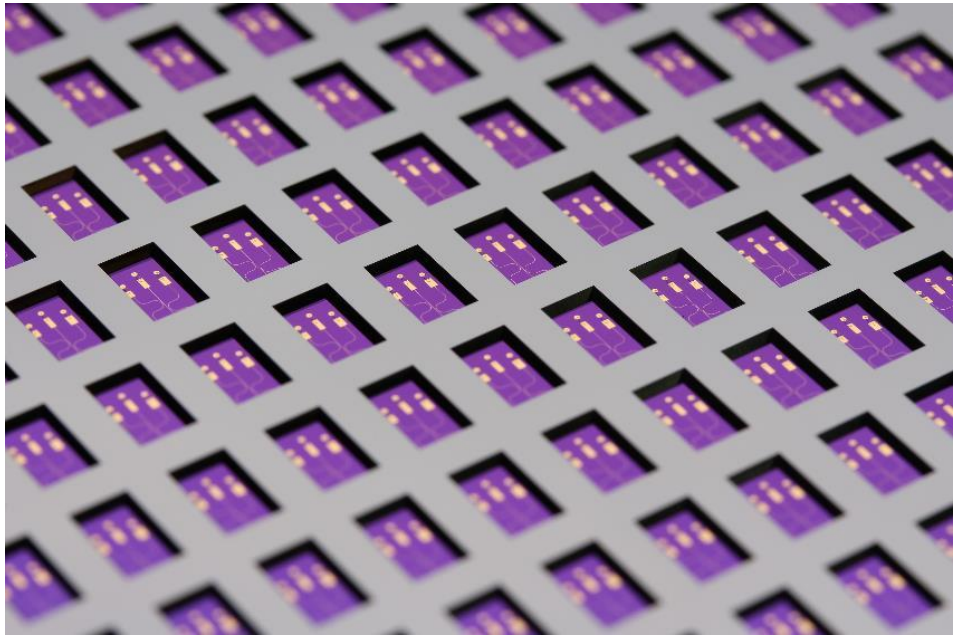


Waveguide tapering for different cross-section, index contrast and modefield size

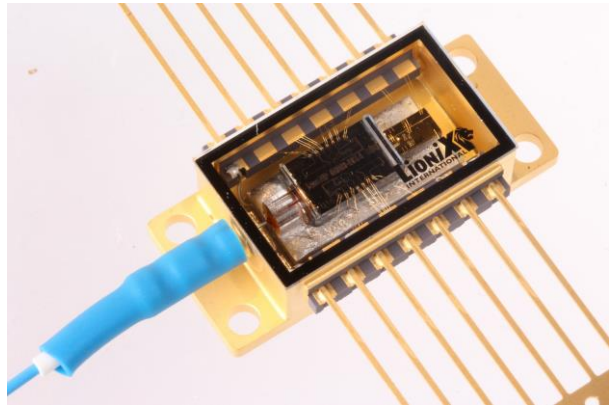
- Hybrid assembly – Best of both worlds

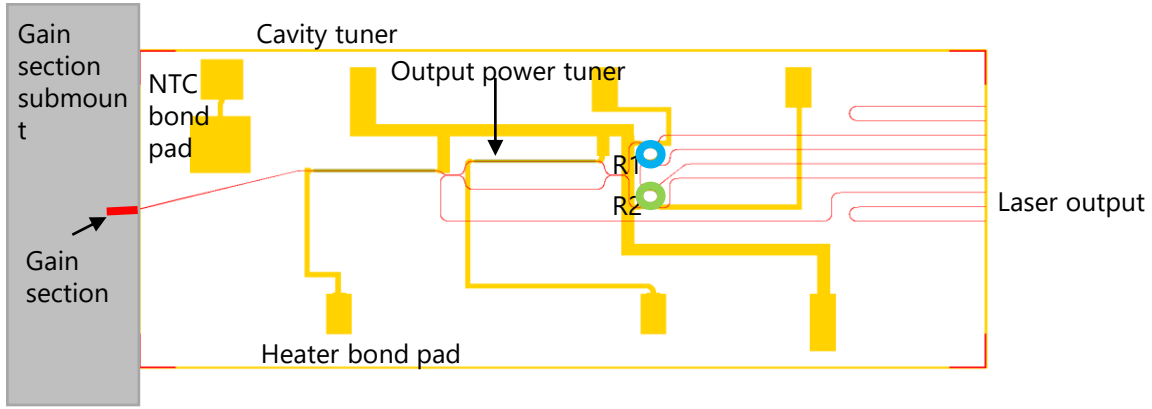
Hybrid integration

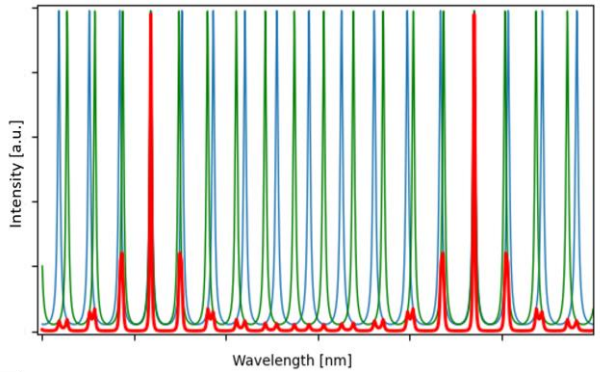
- Ability to create spot size converters enables low loss coupling to other active platforms combining best of both worlds
- Integration of different PIC platforms requires co-design from system level to final package
- Advances in:
  - Laser wavelength range
  - Aerospace applications
  - Consumer applications

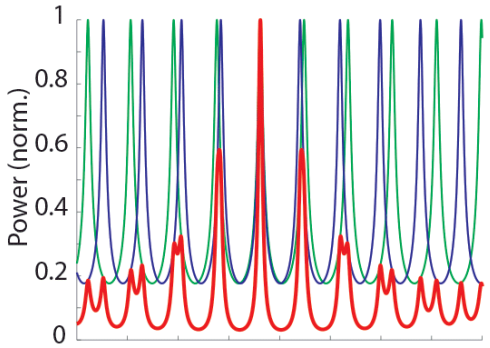


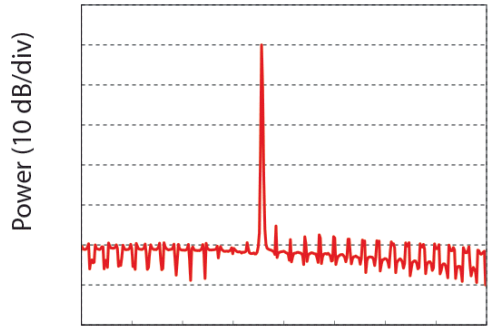
Narrow linewidth tunable laser







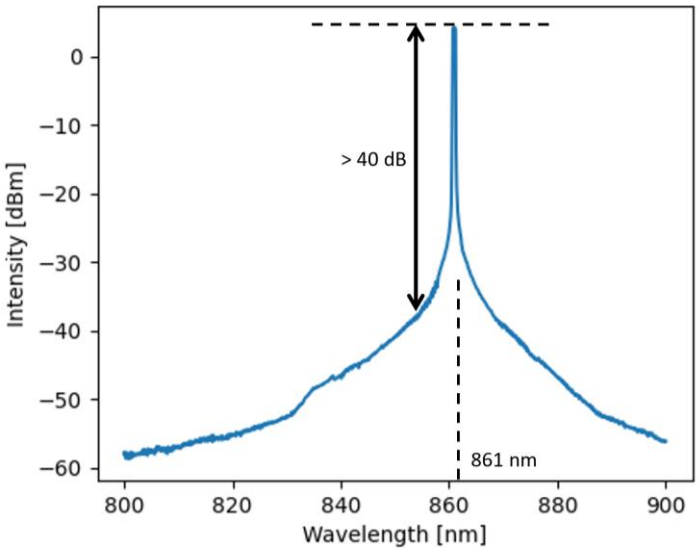


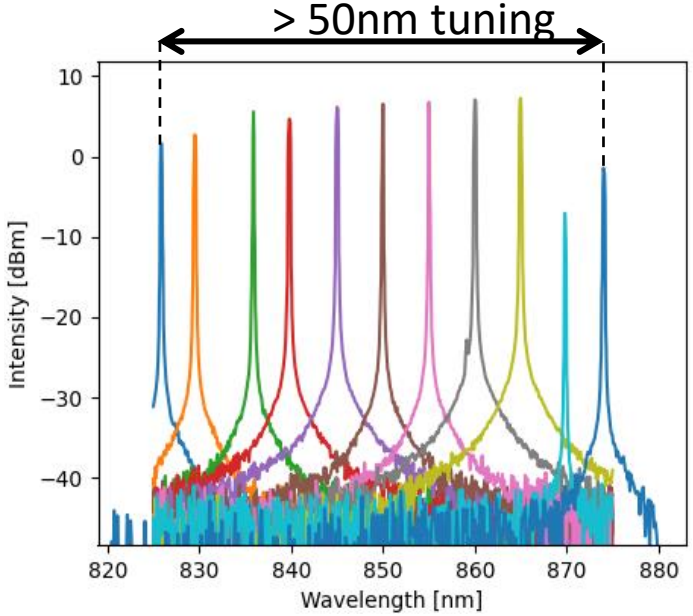


Laser wavelength range

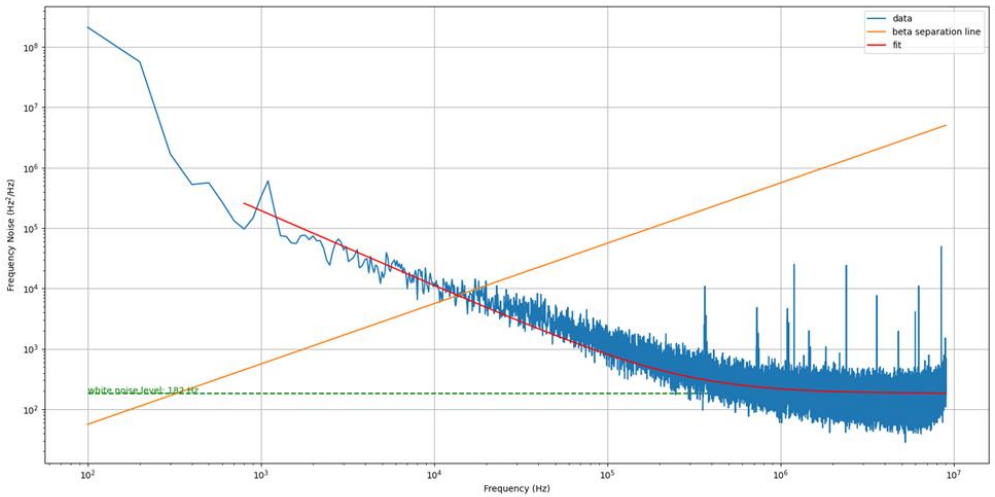
Tunable narrow linewidth laser at 850nm laser test results

- 825 nm - 875 nm → 50 nm tuning range
- >40 dB Side mode suppression ratio (SMSR)
- 7.5 dBm output power



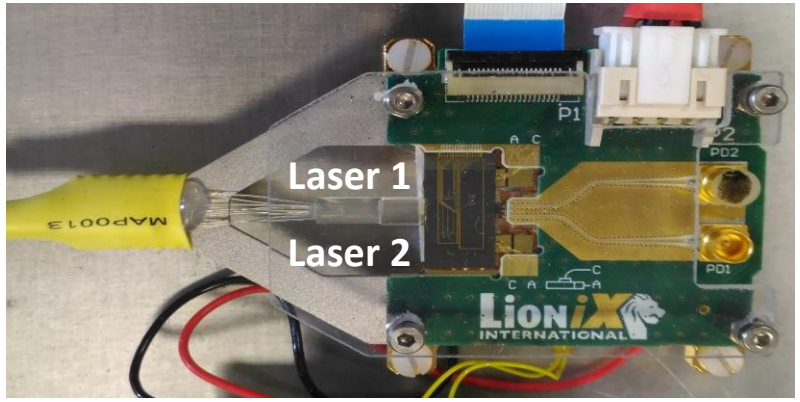


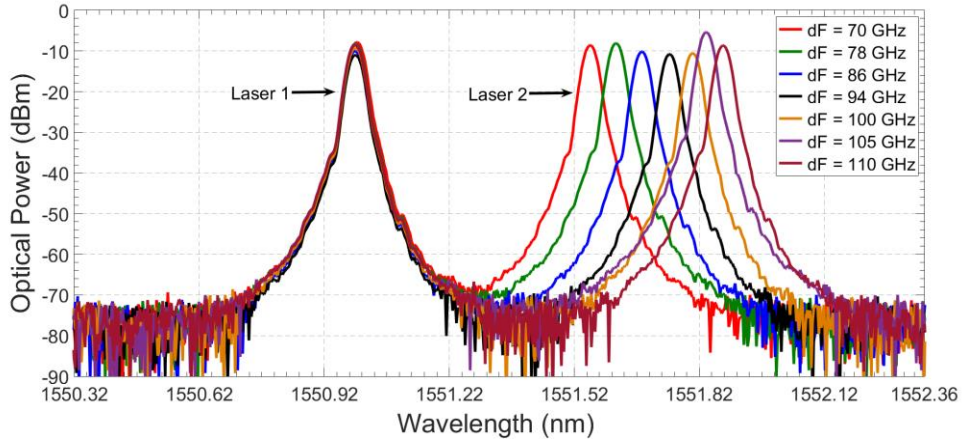
Intrinsic linewidth < 600 Hz



New Applications

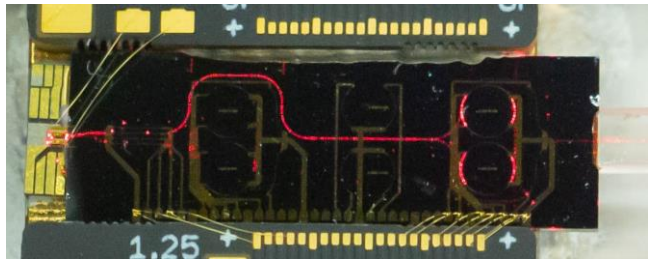
Dual on-chip laser using the same building blocks at 1550nm

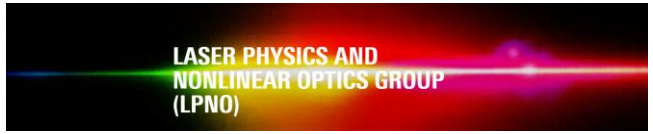


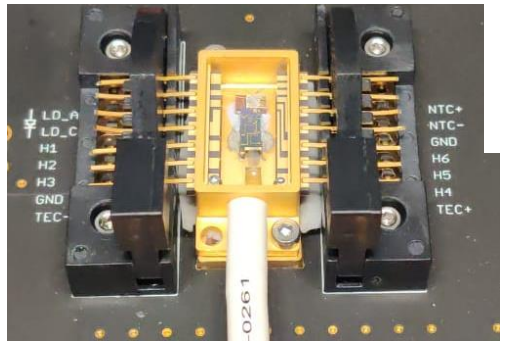


L. Gonzalez-Guerrero et al., **"InP-Si_3N_4 Hybrid Integrated Optical Source for High-purity Mm-wave Communications"**, OFC 2022 conference submission

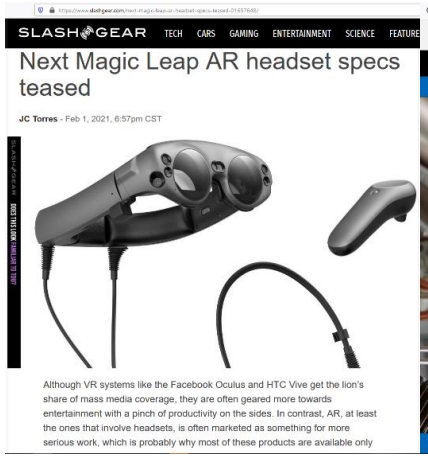
Tunable narrow linewidth lasers at visible and 780nm

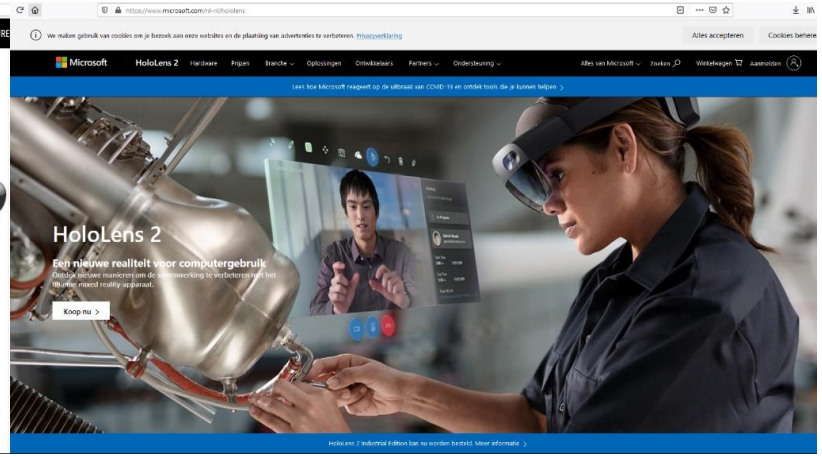






Lightengine AR/VR Glasses

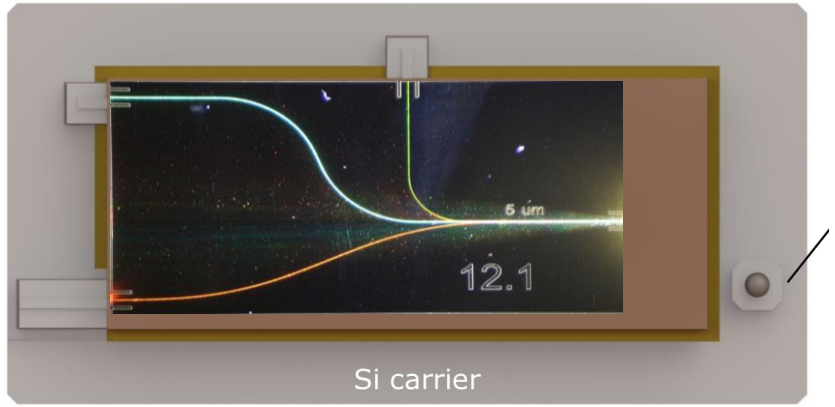


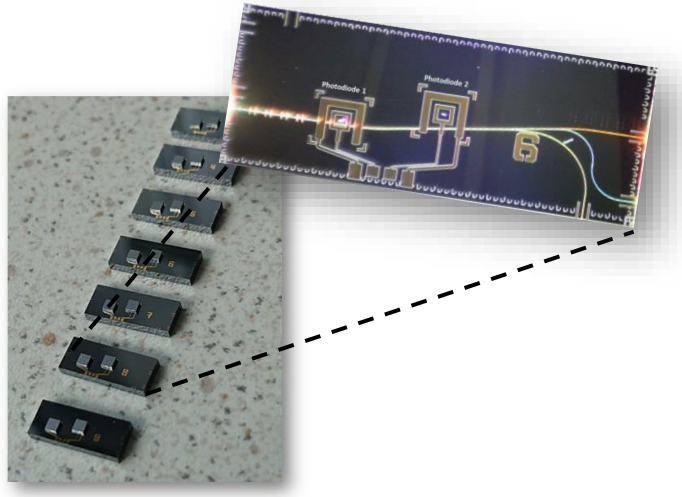


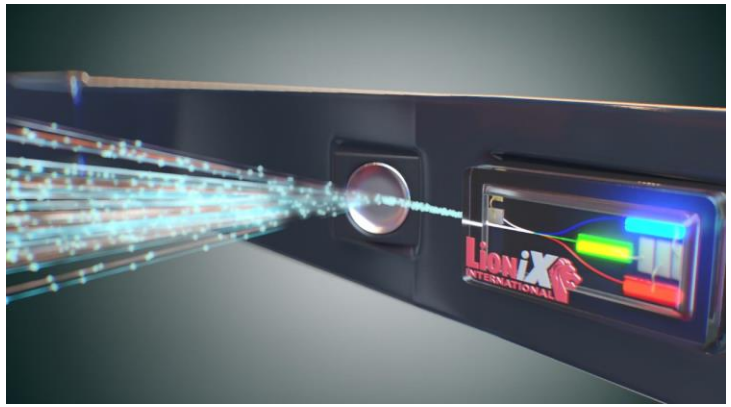
- Size and style determine market acceptance
- Miniaturization of lightsources/displays essential, requiring co-design with product designers

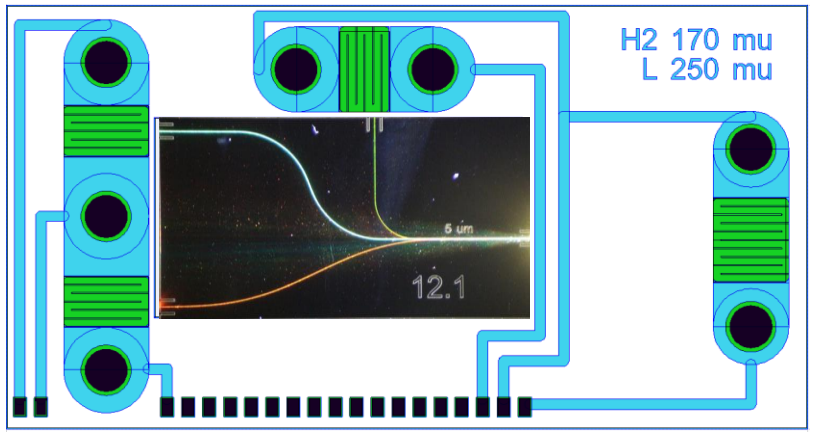
RGB Laser diode integration (butt end)

- Soldering of laserdiode submounts on silicon carrier (micro optical bench, MOB)
- Flip chip integration of detectors





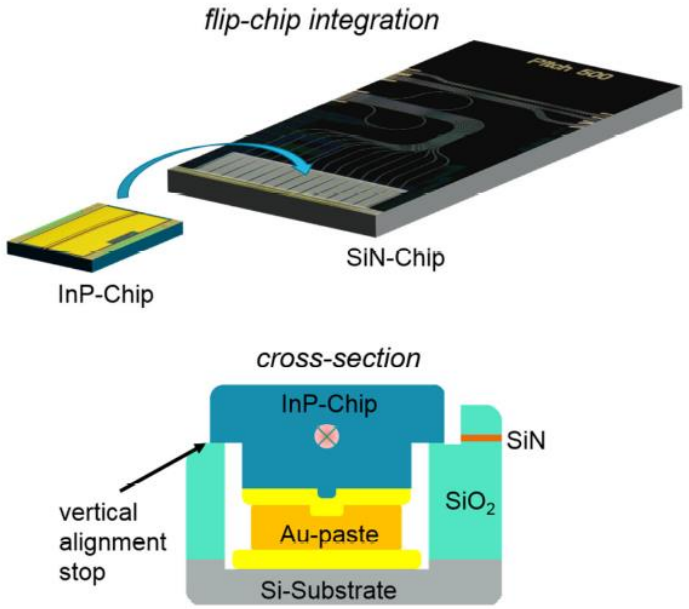


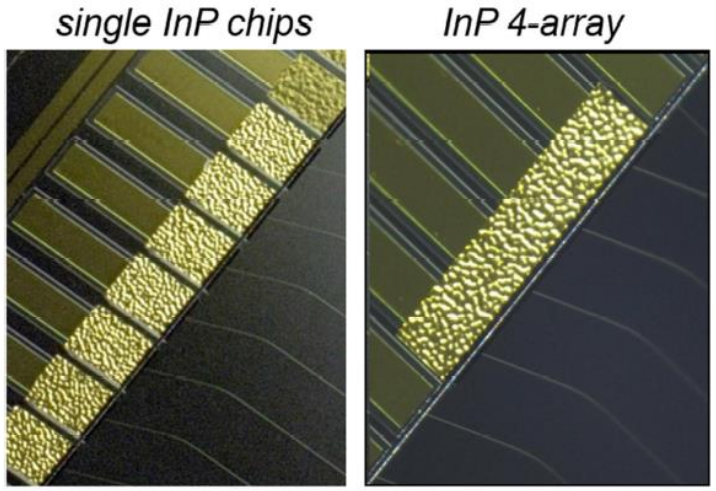


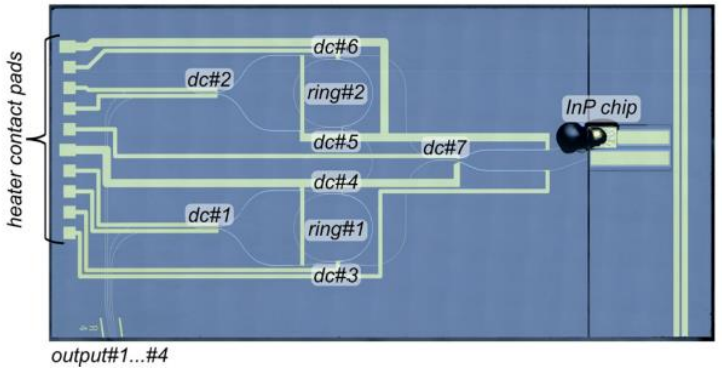
Further miniaturization and price reduction requires full flip chip integration matching both platforms in packaging process

RGB LD integration (Flip chip)

- Flip chip integration







M. Theurer et al., "Flip-Chip Integration of InP to SiN Photonic Integrated Circuits," in Journal of Lightwave Technology, vol. 38, no. 9, pp. 2630-2636, 1 May1, 2020, doi: 10.1109/JLT.2020.2972065.

RGB light engine next generation

BRILLIANCE
The future is visible

Scaling of hybrid PIC modules

- Silicon – Nitride PIC modules
- Scaling from prototypes into volumes
- Currently scaling both PIC manufacturing as well as mass module manufacturing

https://www.phix.com/additional-investments-and-new-building/

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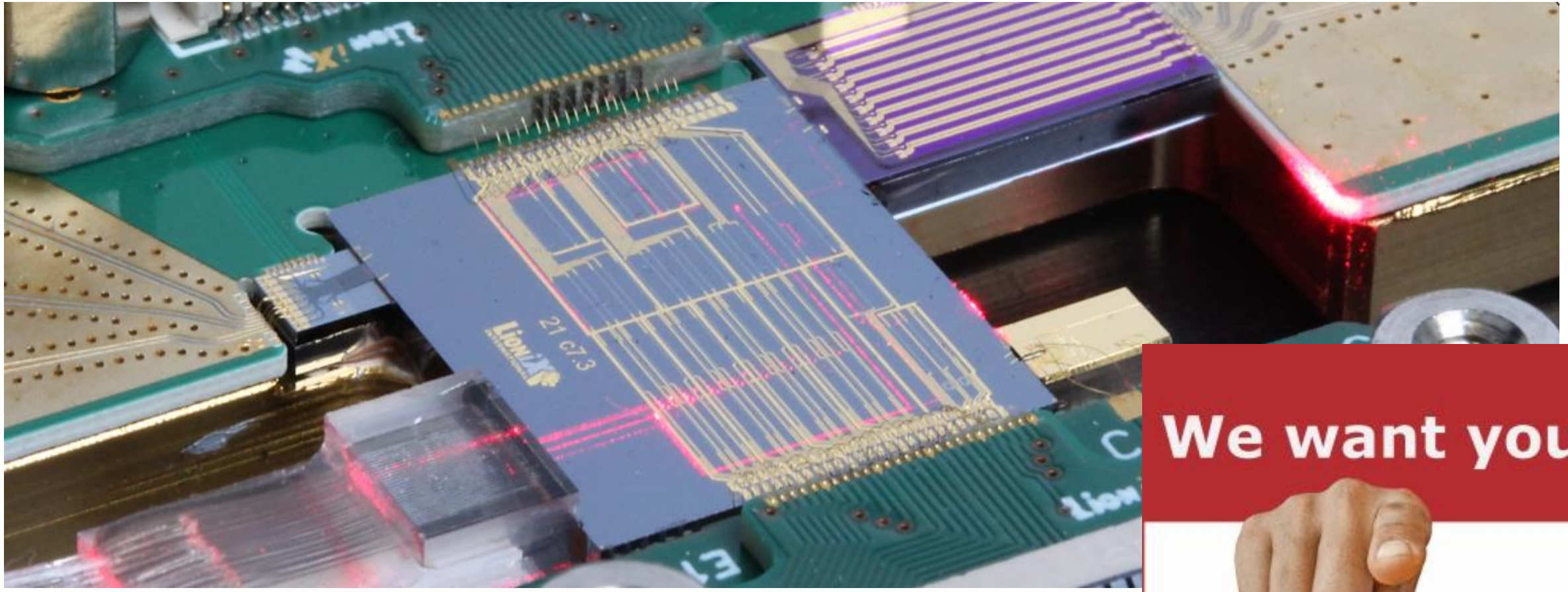
NEWS

Twente's high-tech ecosystem looking for a boost in manufacturing capacity

Artist impression of the High Tech Foundry. Credit: University of Twente

https://bits-chips.nl/artikel/twentes-high-tech-ecosystem-looking-for-a-boost-in-manufacturing-capacity/

Thank You



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