

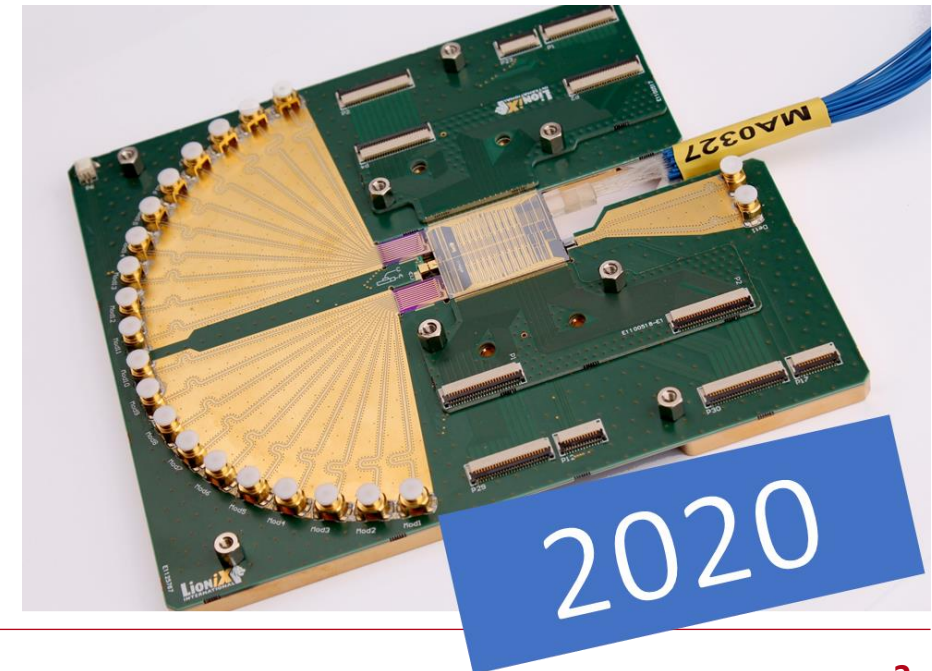
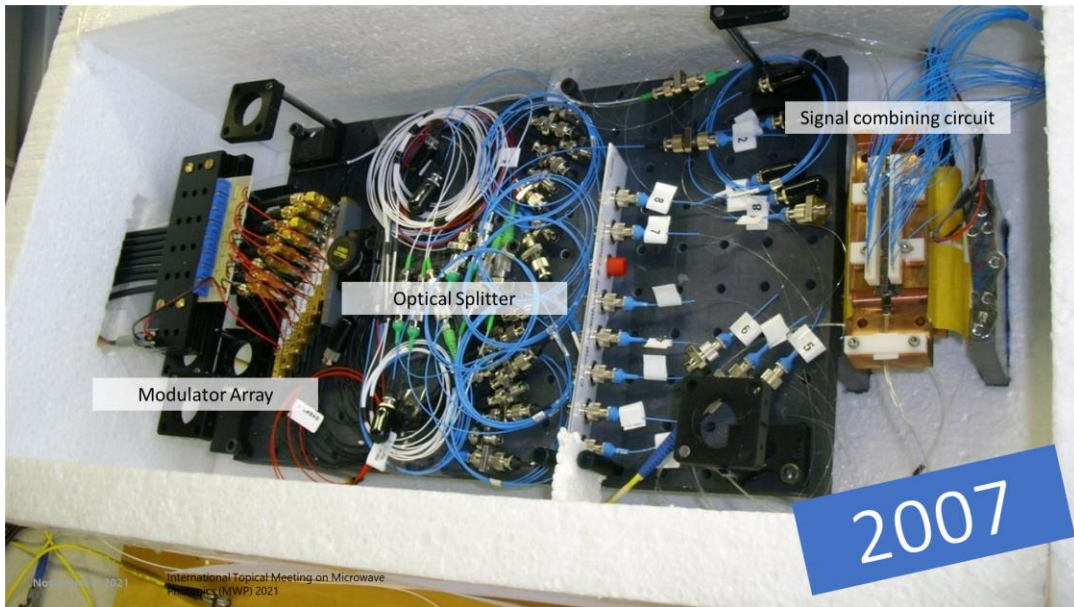


Our chips drive your business

www.lionix-international.com

Integrated Microwave Photonics PIC Platform

Chris Roeloffzen - Chief Scientific Officer



LioniX International is a leading global provider of customized microsystem solutions, in particular integrated photonics-based, in scalable production volumes.

Why

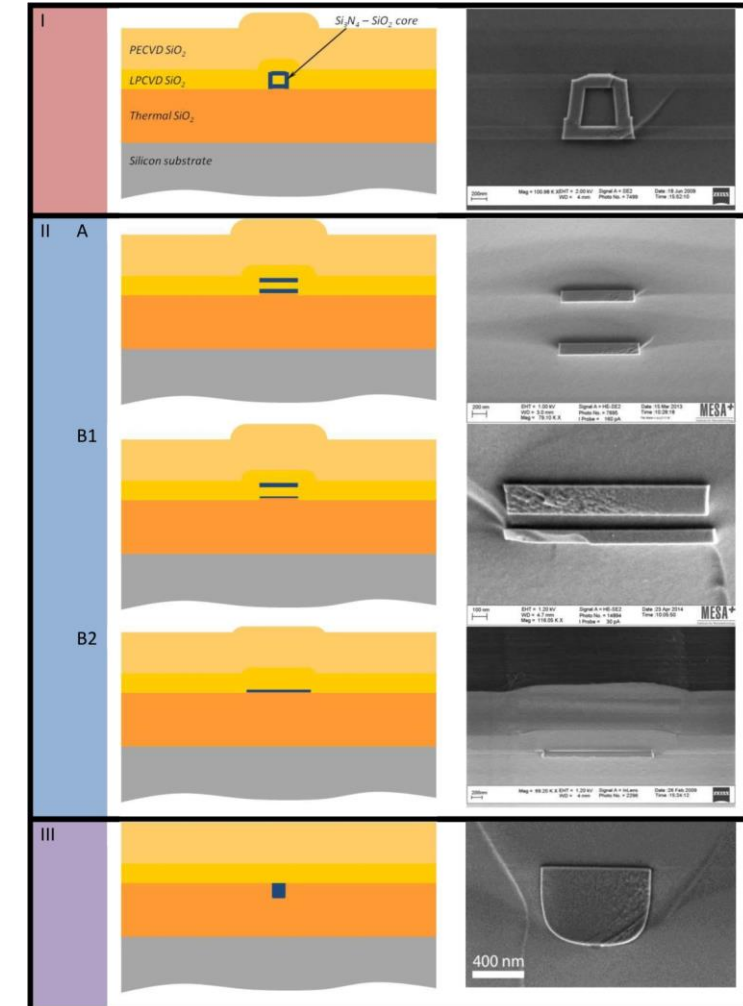
Applying disruptive technologies to solve major societal challenges. **Integrated Photonics** is one of the key enablers for this.



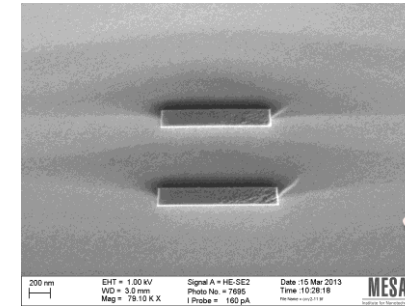
- Located in the Netherlands
- Established in 2001 (LioniX)
- > 50 employees
- > 50% PhD
- Production location in
 - Enschede, Netherlands
 - LioniX International Labs
 - Nanolab cleanroom
 - Assembly facilities
 - Seoul, South Korea
 - PIC production facilities



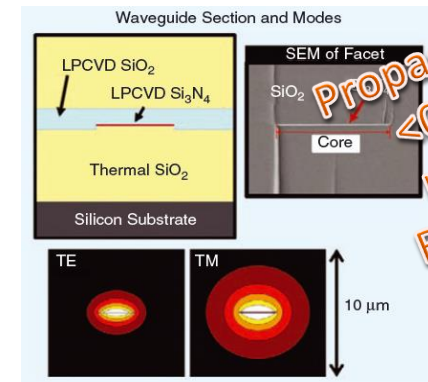
- TriPleX™: a low loss waveguide technology for single mode laser light in 405-2350 nm wavelength range
- Control of signal combination/splitting, intensity, phase, mode size, polarization and input-output geometries
- Library of passive and active building blocks: wavelength combiners, power splitters, switches, filters, attenuators, modulators
- First-time-right design process
- Stable over wide temperature range
- Optimized interface to fiber or free space configurations



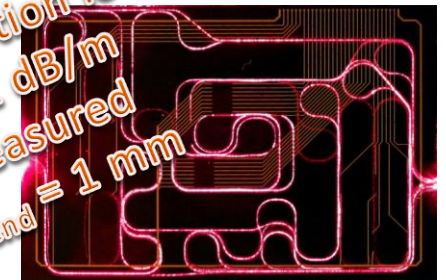
- Silicon Nitride PICs: TriPleX
 - Wavelength range 1500 – 1600nm
 - Low loss propagation
 - On chip optimization of contrast (taper)
 - Low coupling loss to SMF (<0.5 dB)
 - Low chip-to-chip coupling loss (<1.5 dB)
 - Low power actuator



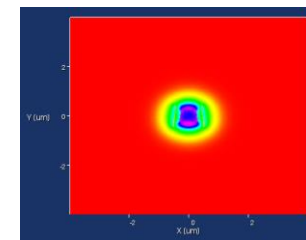
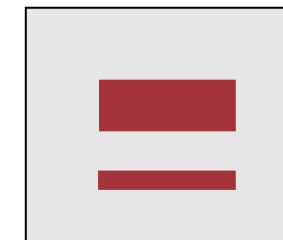
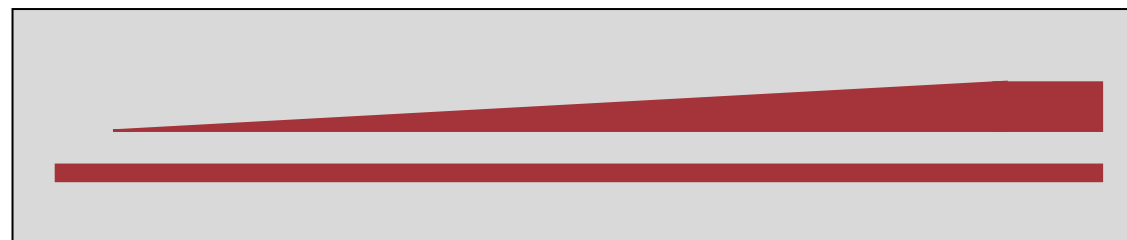
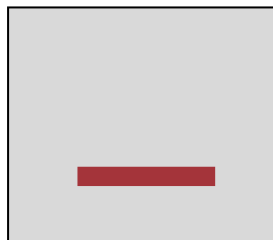
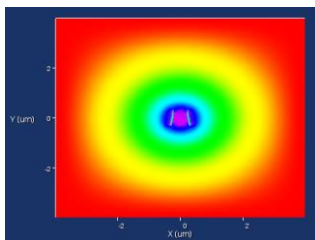
Propagation loss
 ≤ 0.1 dB/cm measured
 $R_{\text{bend}} = 80 \mu\text{m}$

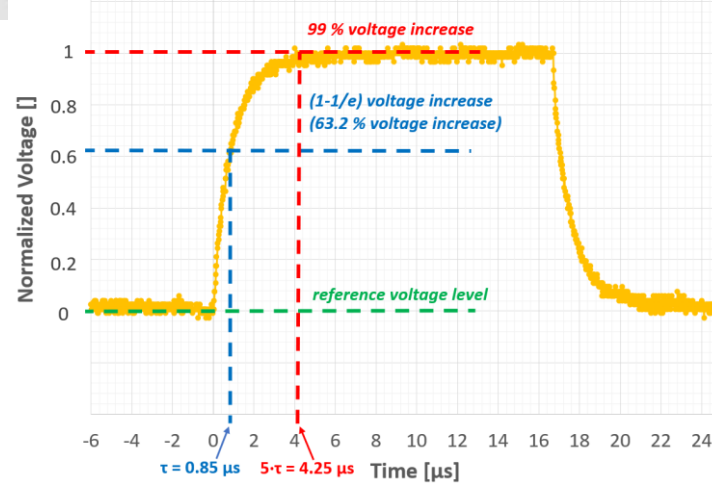
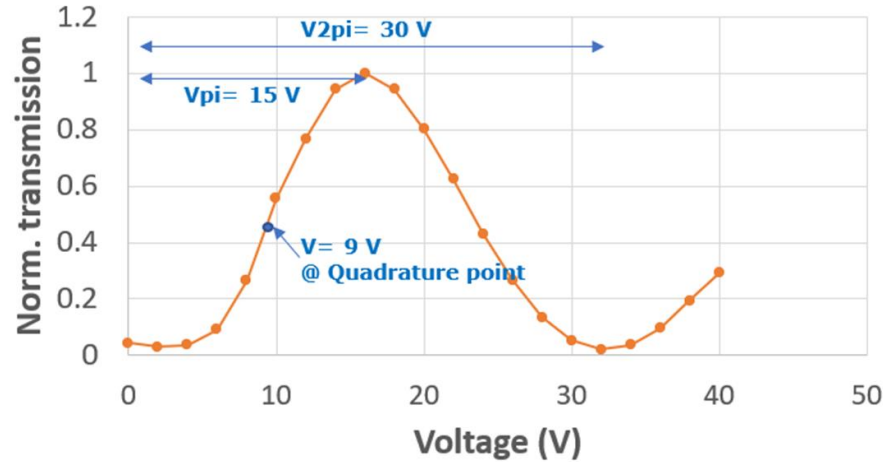


Propagation loss
 < 0.1 dB/m measured
 $R_{\text{bend}} = 1 \text{ mm}$



C. Taddei et al., *IEEE MWP* 2014, Sapporo, Japan

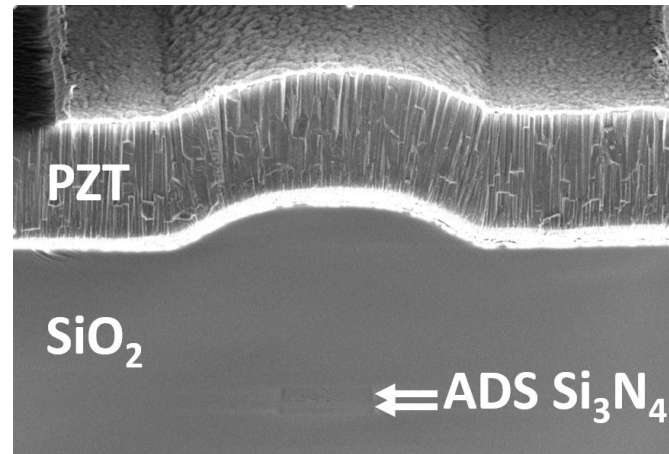




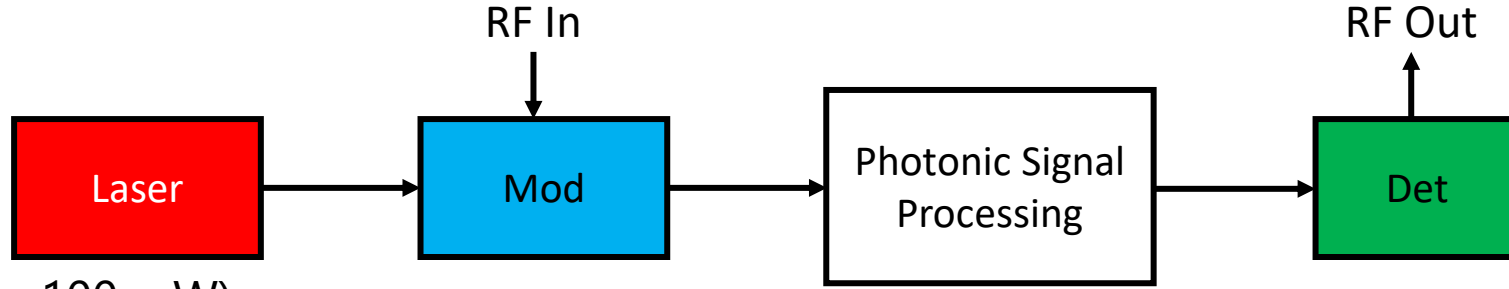
- Performance of the stress-optic actuator
- ✓ Half-wave voltage-length product $V\pi \cdot L = 24 \text{ V} \cdot \text{cm}$
 - ✓ Loss $\alpha = 0.1 \text{ dB/cm}$
 - ✓ $V\pi \cdot L \cdot \alpha = 2.4 \text{ V} \cdot \text{dB}$
 - ✓ 3-dB cut off frequency at MHz scale
 - ✓ Switching time at μs scale

Why stress-optic actuation?

	Stress-optic	Thermo-optic
Static Power consumption:	< 1 μW	300 <u>mW</u>
Switching time:	1 to few μsec	a few 100s of μsec
3-dB EO cut-off frequency:	100s of <u>KHz</u> to 1 MHz	10s of <u>KHz</u>



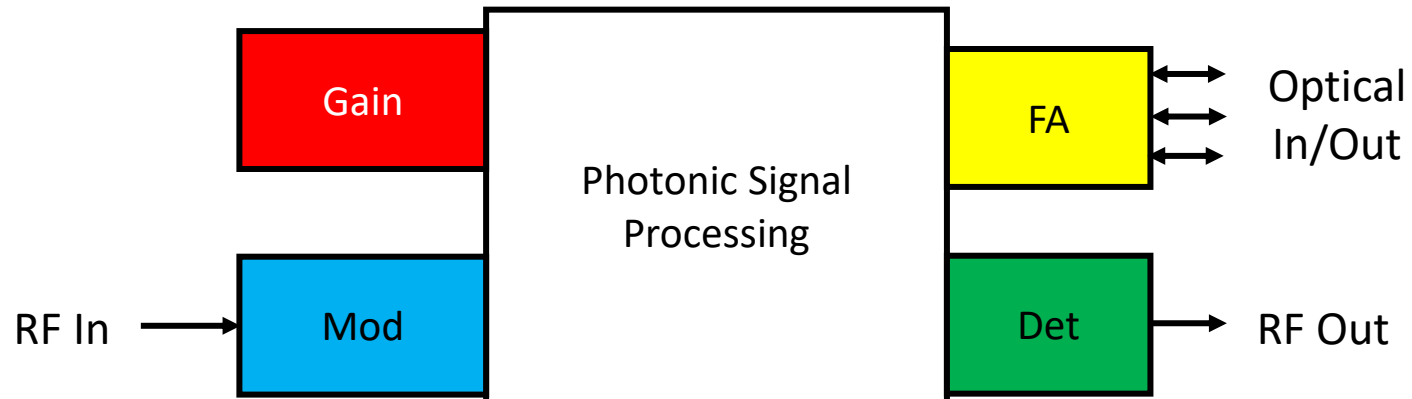
What we do: From MPL to iMWP PIC platform

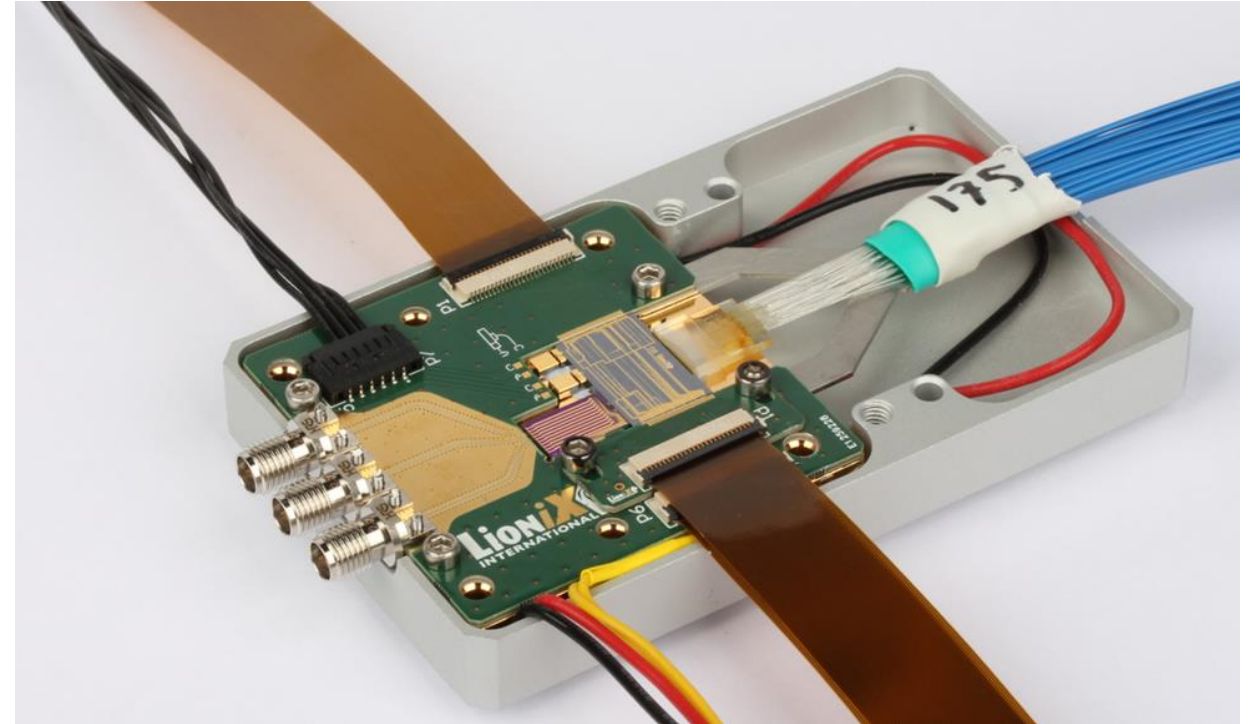
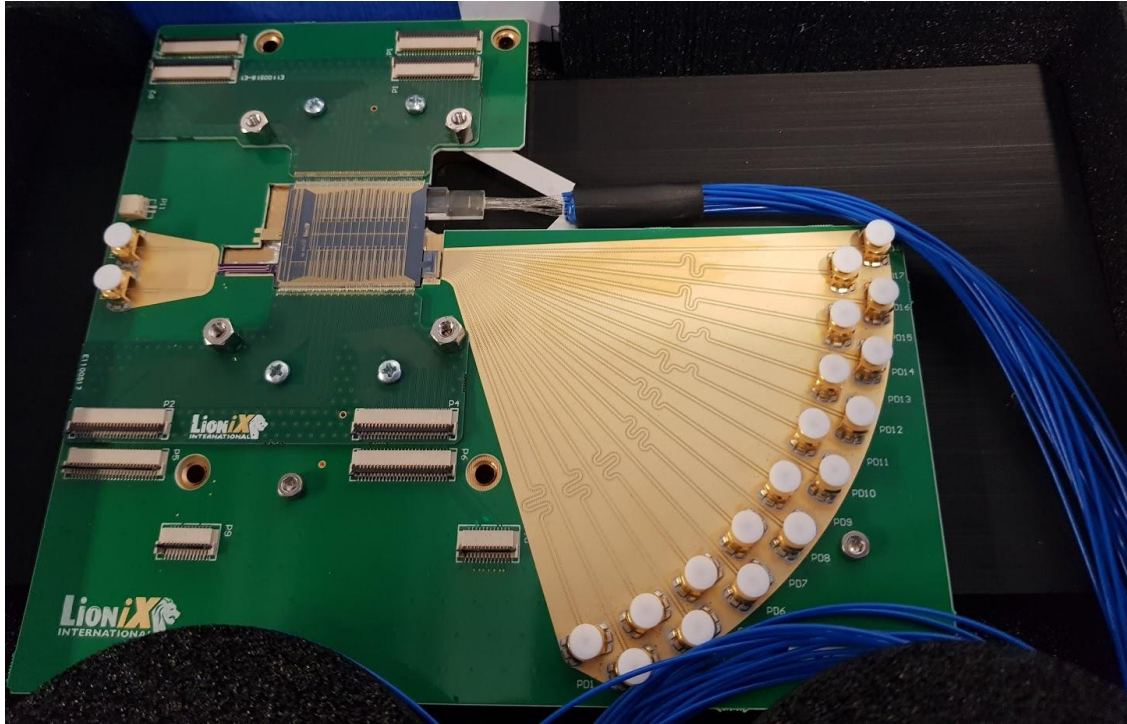


- High power (> 100 mW)
- Small linewidth (< 10 kHz)
- Low RIN (-170 dBc / Hz)

- High speed (> 40 GHz)
- Sensitive ($V_{\pi} < 3$ V)

- High speed (> 40 GHz)
- Responsivity (> 0.6 A/W)





- TriPlex chip design and Fabrication
- InP chips (gain, modulators and detectors) available
- Hybrid integration
- Packaging
- Control electronics for testing in laboratory

Design your own

Briefings

LIONIX INTERNATIONAL

Multi Project Wafer Runs

Introduction

To enable you a low cost and easy access to our photonic integrated circuit technology, we offer regular scheduled Multi Project Wafer (MPW) runs in the TriPleX™ technology. This Photonic Integration platform is suitable for components for telecom/datacom in the infrared (1550nm) region, as well as in life science applications in the visible range.

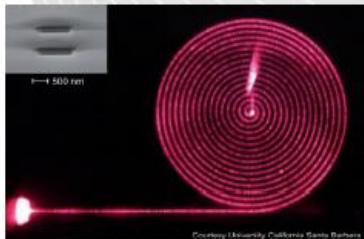
Multi Project Wafer

In addition to the PIC manufacturing we provide the following services enabling you for an easy access to the state-of-the-art photonic technology:

- Training on design tools
- Special offer for simulation tools and mask layout software
- Design kit
- Design support

In addition we offer post processing upon request:

- Etching trenches for fluidic applications
- Etching trenches next to waveguides for heat localization
- Packaging (in particular fiber chip coupling)
- Glass bonding and fluidic connection
- Polishing



MPW Technology – 1550 nm

The TriPleX™ waveguides offered within the infrared MPW are designed for single polarization (TE) applications to operate at the telecom wavelength (1.55 μm). The waveguide however is also transparent for lower wavelengths. The TriPleX™ technology has applications from 405nm to 2.35μm. In addition, these waveguides show a low propagation loss (< 0.5 dB/cm @ 1.55μm). The high contrast waveguide allows bend radii of 125 micron, which makes large scale integration (VLSI) on chip possible. The coupling to and from a fiber from this high contrast waveguide is optimized by the addition of spot size converters, which expand the mode profile to the size of a standard telecom fiber, allowing low loss fiber chip coupling.

Planning

MPW run

1550 nm

Tape out (design deadline)

Devices ready

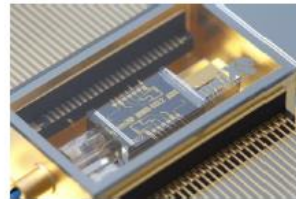
Briefings

LIONIX INTERNATIONAL

Tunable laser element added to TriPleX Multi Project Wafer

Introduction.

To enable you a low cost and easy access to our photonic integrated circuit technology, we offer regular scheduled Multi Project Wafer (MPW) runs in the TriPleX™ technology. This Photonic Integration platform is suitable for components for telecom/datacom in the infrared (1550nm) region, as well as in life science applications in the visible range.

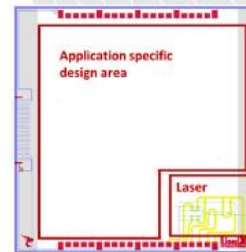


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PDK and building blocks

The MPW offering includes a process design kit (PDK) containing validated and specified building blocks. This building blocks are a good start to a design and allow the user to create many new functionalities.



Tunable laser building block

Now our MPW offering has been extended with a tunable laser building block. The building block provides the user with a narrow linewidth source with specifications given in the table below. As with all other building blocks offered in our PDK, it allows the user to easily connect the items together and create a customized or application specific design.

	Wavelength tuning range	On-chip power	Linewidth
Tunable laser	Chirped	>1 mW	< 100 kHz

Briefings

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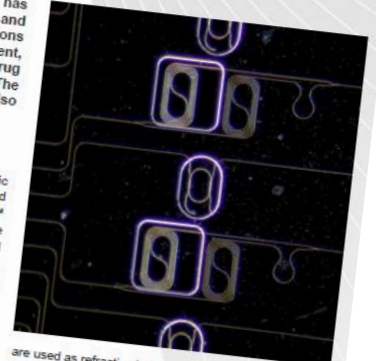
Multi-Project Wafer run 850nm for Bio-sensing

Introduction

Our bio-photonic sensor platform has unparalleled sensitivity and reproducibility and finds application in bio sensing applications like: drug discovery and development, companion diagnostics, therapeutic drug response monitoring and early diagnostics. The photonic sensor building blocks are now also offered via our multi-project wafer offering.

MPW for bio-sensing

To enable you low cost and easy access to our photonic integrated circuit technology, we offer regular scheduled Multi Project Wafer (MPW) runs in the TriPleX™ technology. Our well-known offer for components for the telecom/datacom in the infrared (1550nm) region, as well as in life science applications in the visible range (400-700nm), is now extended with our offer in the 850nm range.



are used as refractive index or absorption sensors. Other waveguide building blocks like bends, couplers and splitters are available to connect the sensor (arrays) in any way you like. Waveguide tapers and grating couplers are available to connect fiber (arrays) to the device or to prepare the device for flip-chip of VCSELs and detectors.

Other applications

The 850nm MPW is optimized for bio-sensing applications. Also other applications are addressed in this wavelength range like for example:

- Optical Coherence Tomography
- Spectrometry
- Metrology
- And many others

Want to be on the next MPW 850nm run?

Leave you details here:
www.lionix-international.com/bio-sensing-MPW



Are you interested? Discover more on our website www.lionix-international.com/mpw

24th run

15 November 2021*

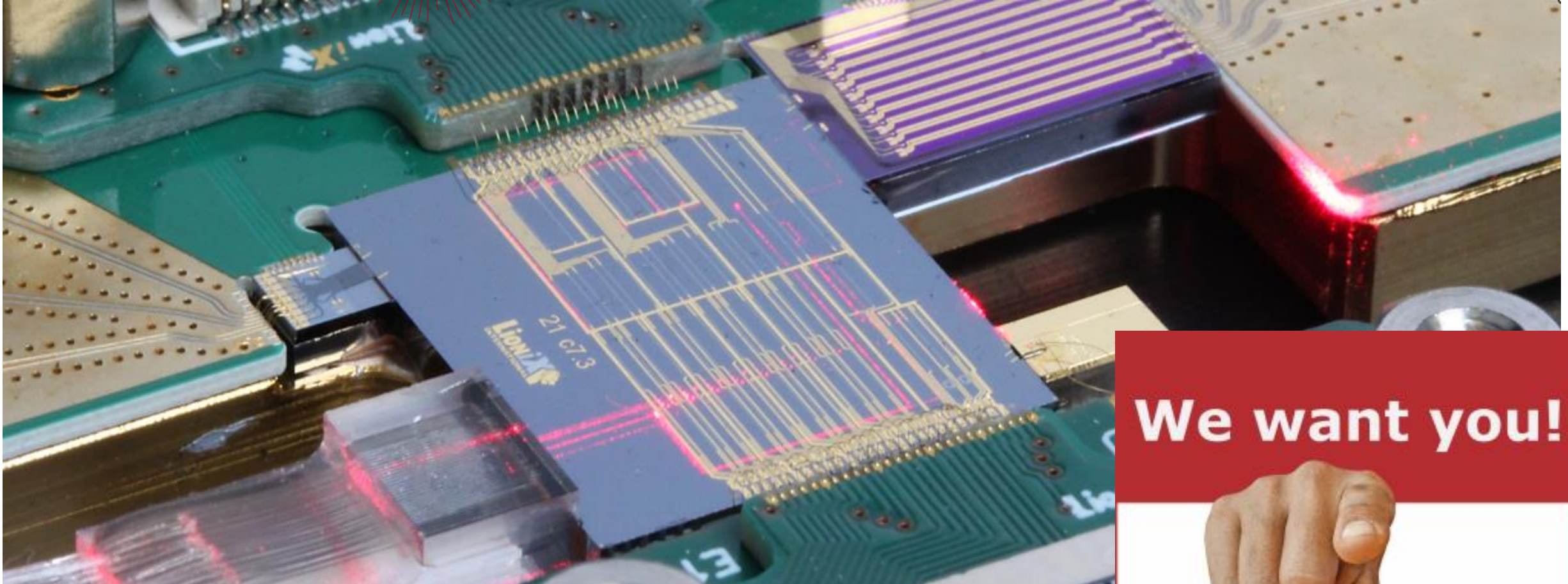
15 April 2021

25th run

31 March 2022

31 August 2022

Tell us about your challenge!
Thank You



We want you!

