Opto-fluidics, a fruitful marriage between Integrated Optics and Microfluidics

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Our mission

LioniX is a leading provider in co-development of products and manufacturing of components based on cutting-edge micro/nano technology for its (OEM) customers.

- Located in Enschede, the Netherlands
- Founded in 2001
- 30 employees, > 50% PhD
- Member of the Panthera Group
What we do?

- LioniX provides ‘design to manufacturing’ and ‘horizontal integration’ by partnering with foundries, suppliers of complementary technologies and R&D institutes.
Opto-fluidics: combination of Integrated Optics and Microfluidics

Opto-fluidics: evanescent field sensing in micro-fluidics
**Photonic Integrated Circuits**

Means:

→ Full manipulation of light on chip for:
  - colour combination
  - optical signal processing (datacom, telecom)
  - beam shaping
  - sensing (biophotonics), etc.

→ Connection of chip to outside world through Fiber Arrays (FA’s)

→ Hybrid connection of external components (lightsources (lasers)), fast modulators) in standardized packages containing electronics
Photonic Integrated Circuits

3 mature standardized platforms commercially available through MPW services:

Indium Phosphide (InP) - TriPleX (Si$_3$N$_4$) - Silicon Photonics (SOI)

- Ultra low loss
- Applicable in almost all interesting wavelength regions
- Reliable modulators (heaters, stress modulators)

- But, not electro-optical, so no direct laser generation possible

Therefore:

Combine TriPleX with InP gain section yielding:

Very high quality, widely tuneable lasers

Also high level hybrid integration with other gain materials (AlGaAs, GaN, etc.) is available
TriPleX™ platform

Direct flip-chip connection of Low cost lasers (VCSELs) on TriPleX chip

- Adjustable polarization properties (sensors ⇔ telecom)
- Low optical attenuation
- Small bend radii (small footprint!)
- Design by geometry
- Silicon and glass compatible
- Spot size converters for low loss fiber chip coupling

Applications of TriPleX PICs

Visible Light Photonics: beam shaper (DNA seq.)
Microwave Photonics: OBFN (5G)
Laser Photonics: Tuneable laser (ICT)

Opto-fluidics: Point-of-care (iNDx)
Biophotonics: Medical imaging (OCT)
Opto-fluidics: Disposable sensor chips
Refractive index based sensing platform
Refractive index based sensing platform

- size of single sensor element < 200 $\mu$m
- on 1 mm × 1 mm multiple elements can be placed
- sensor array up to 20 sensors easily possible
Refractive index based sensing platform

Sensitivity: 110 nm/RIU

Experimental resolution: 0.1 - 0.01 pm
⇒ Δn = 1 \cdot 10^{-6} \text{ to } 1 \cdot 10^{-7} \text{ RIU}
⇒ surface sensitivity:
⇒ \sim 0.1 - 1 \text{ pm layer protein!}

Biosensors and Bioelectronics, May 2016 (invited)
JePPIX: jeppix.eu
- Multi-Project Wafer service for Photonic ICs
- Open access to InP and TriPleX technology platforms

PICs4All: pics4all.jeppix.eu
- EU Innovation Support action
- Free advice on the applicability of PIC technology
- Enable access to PIC technologies, lower barriers for applying PICs
- Create European network of Application Support Centers
- Contact: k.lawniczuk@tue.nl

JePPIX and PICs4All EU Innovation support

www.jeppix.eu