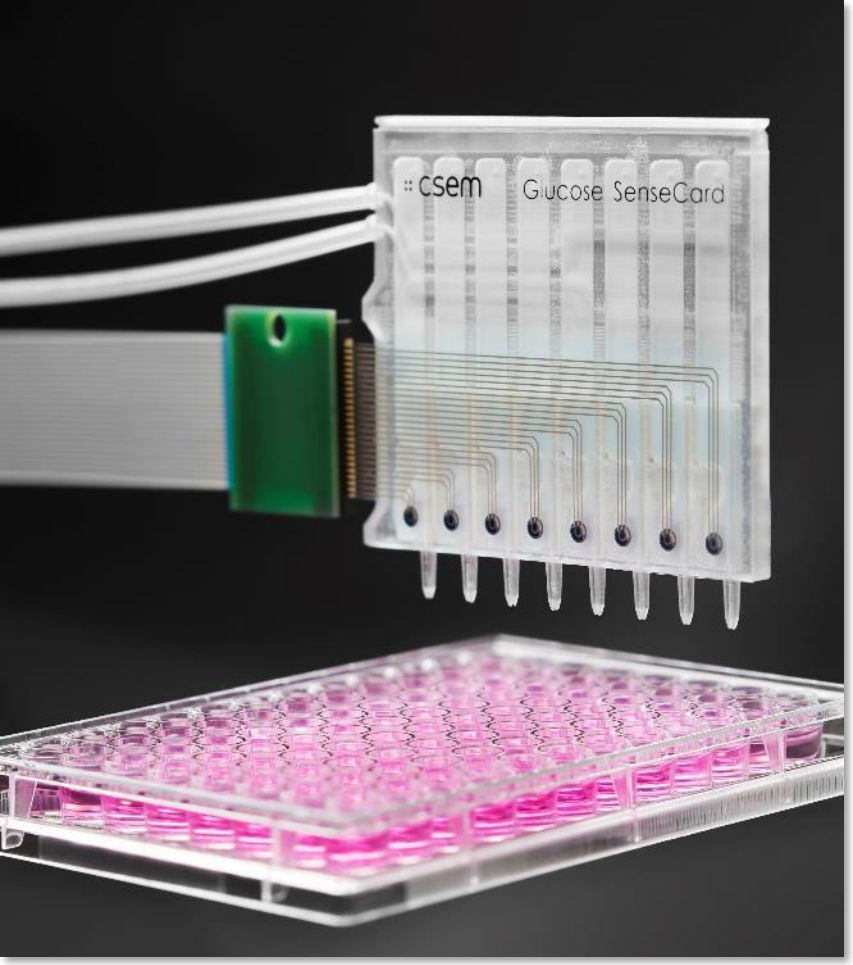

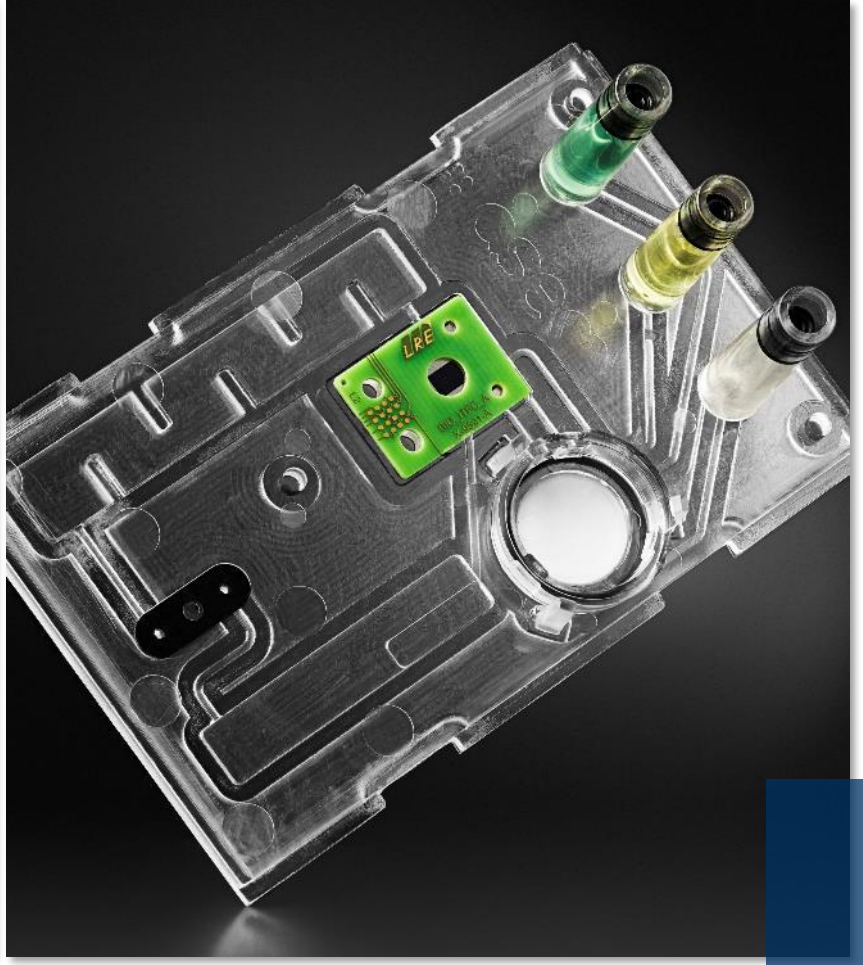

Mark Fretz
Senior R&D Engineer
Automated Sample Handling

21.03.2024

PHOTONIC CHIP INTEGRATION STRATEGIES FOR MICRO-FLUIDIC CARTRIDGES

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CSEM – Swiss Technology Innovation Center

Technology Transfer to Industry

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APPLIED RESEARCH

Development of deep technology bricks through public funding

Valorization through direct industry mandates following a full cost model (time and material)

TECH TRANSFER

CSEM AT A GLANCE

We are a public-private, non-profit Swiss **technology innovation center**

We enable competitiveness by **developing and transferring world-class technologies to the industrial sector**

1984
FOUNDED

600
SPECIALISTS in 2023

100.4
MIO TURNOVER in 2022

> 50
VENTURES since 1984

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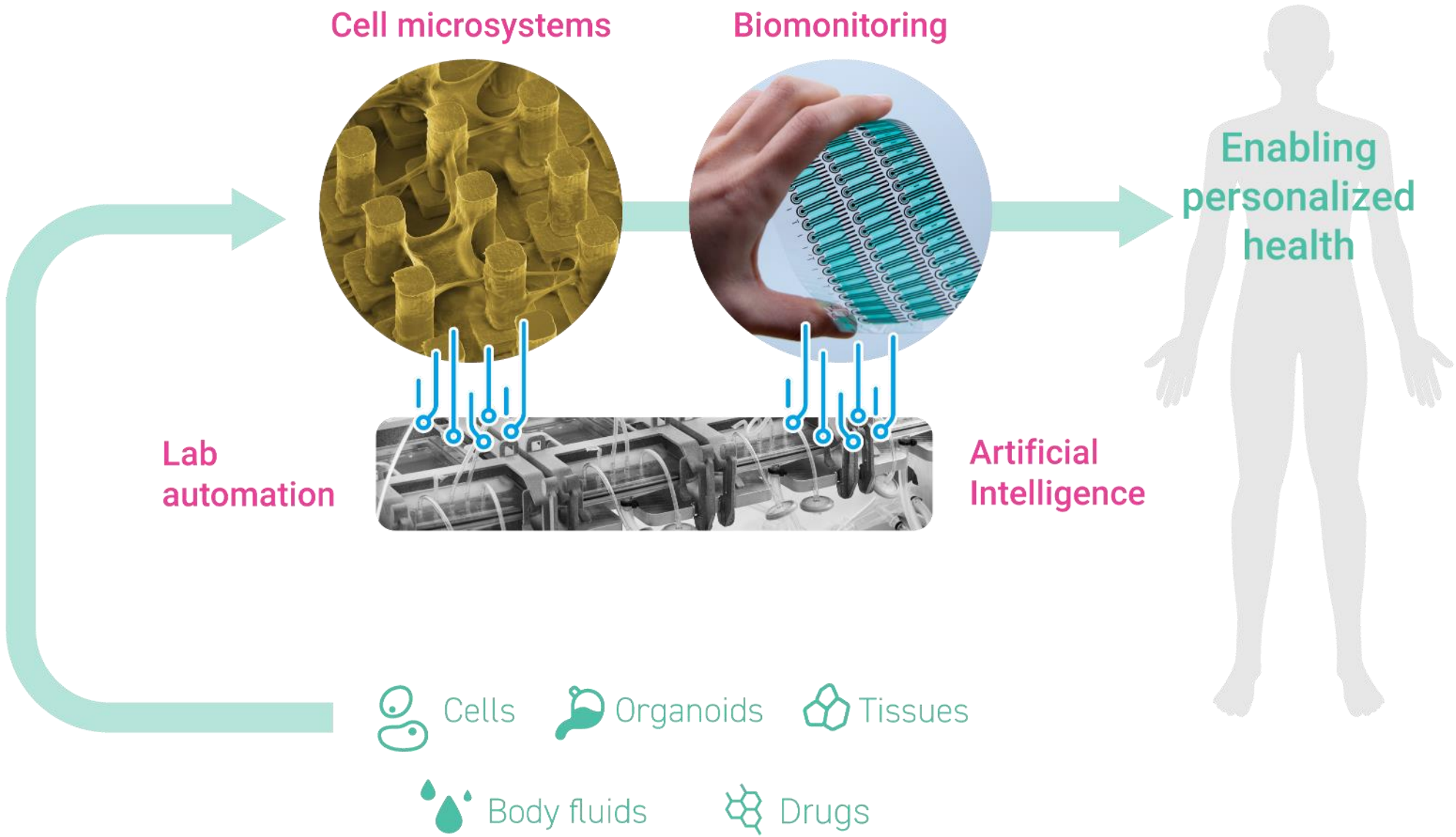
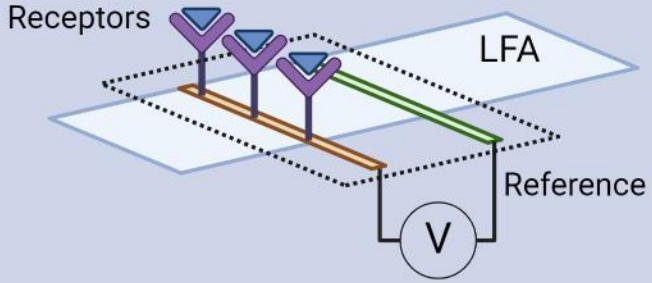
TOOLS FOR LIFE SCIENCES

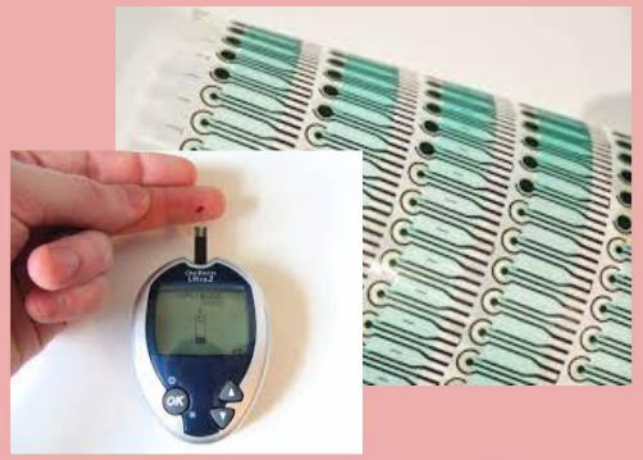


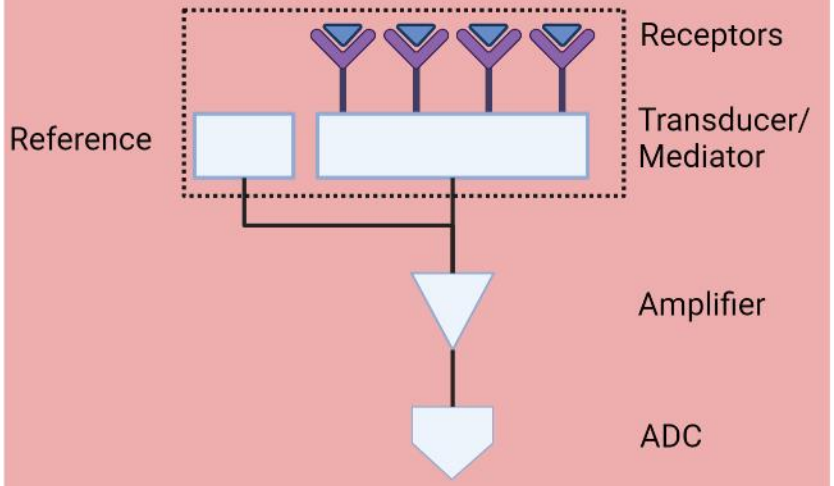
SENSING???

(e)Lateral flow assay (LFA)

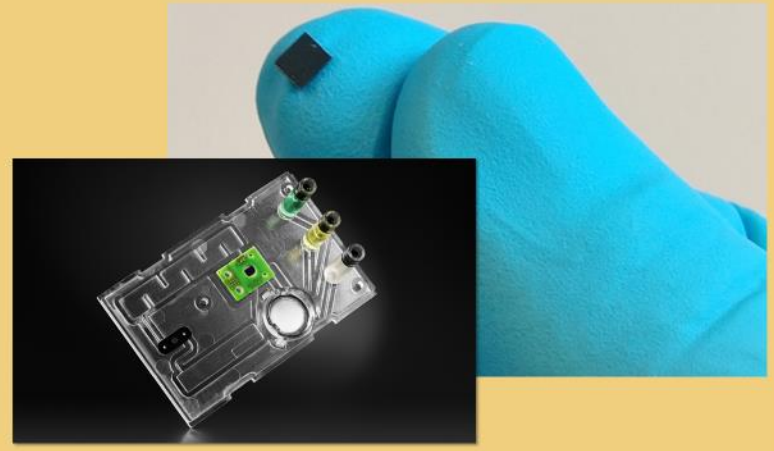


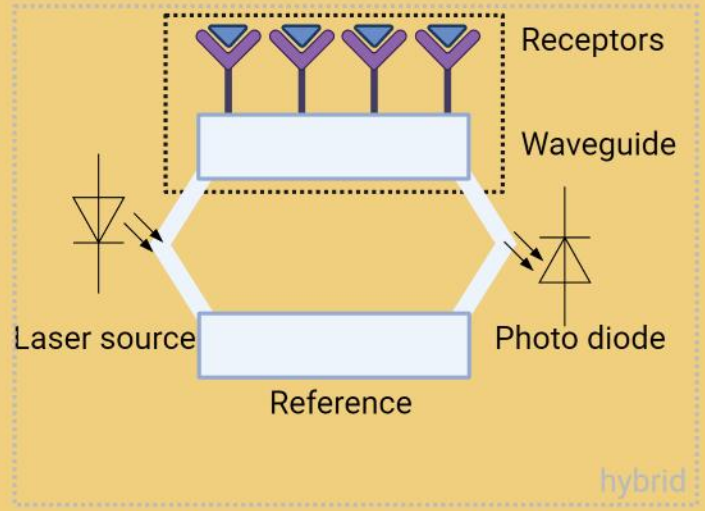
Electro chemical sensors





Photonic integrated circuit (PIC)





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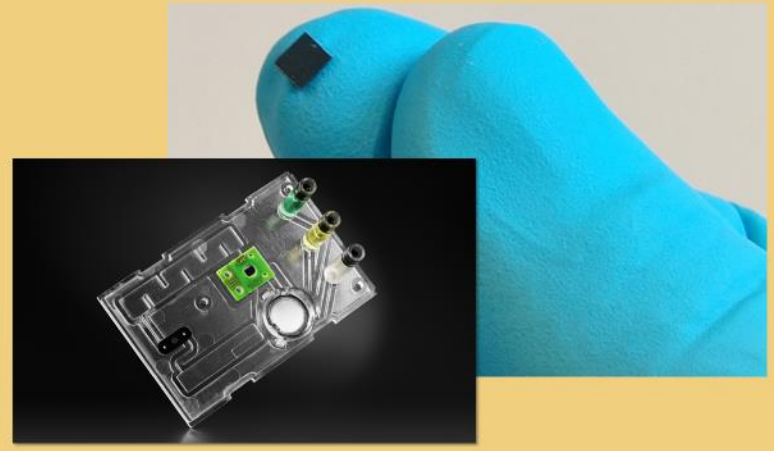
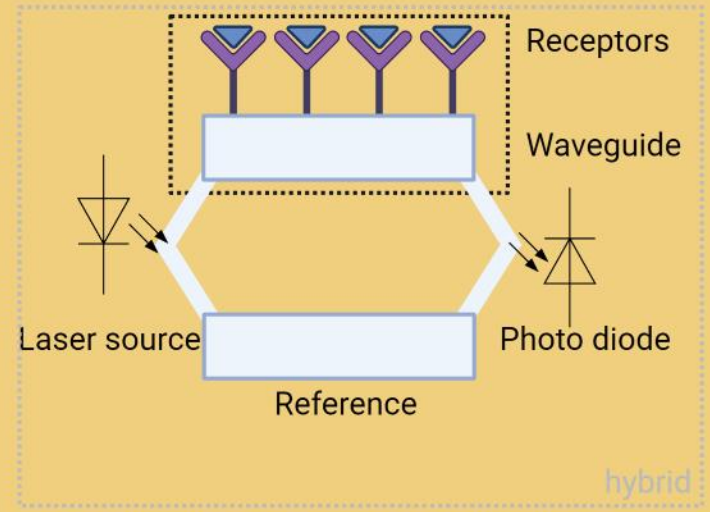
PIC INTEGRATION

(e)Lateral flow assay (LFA)

Electro chemical sensors

Photonic integrated circuit (PIC)





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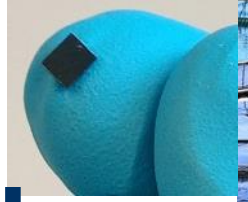
COMPLEMENTARY DIAGNOSTICS PHOTONICS PLATFORM

- Protein signature detection
- Use case: Breast and prostate cancer

- Functionalized PIC integrated in microfluidic sample preparation cartridge
- Integrated sample preparation
- Liquid stored on cartridge
- On cartridge valving

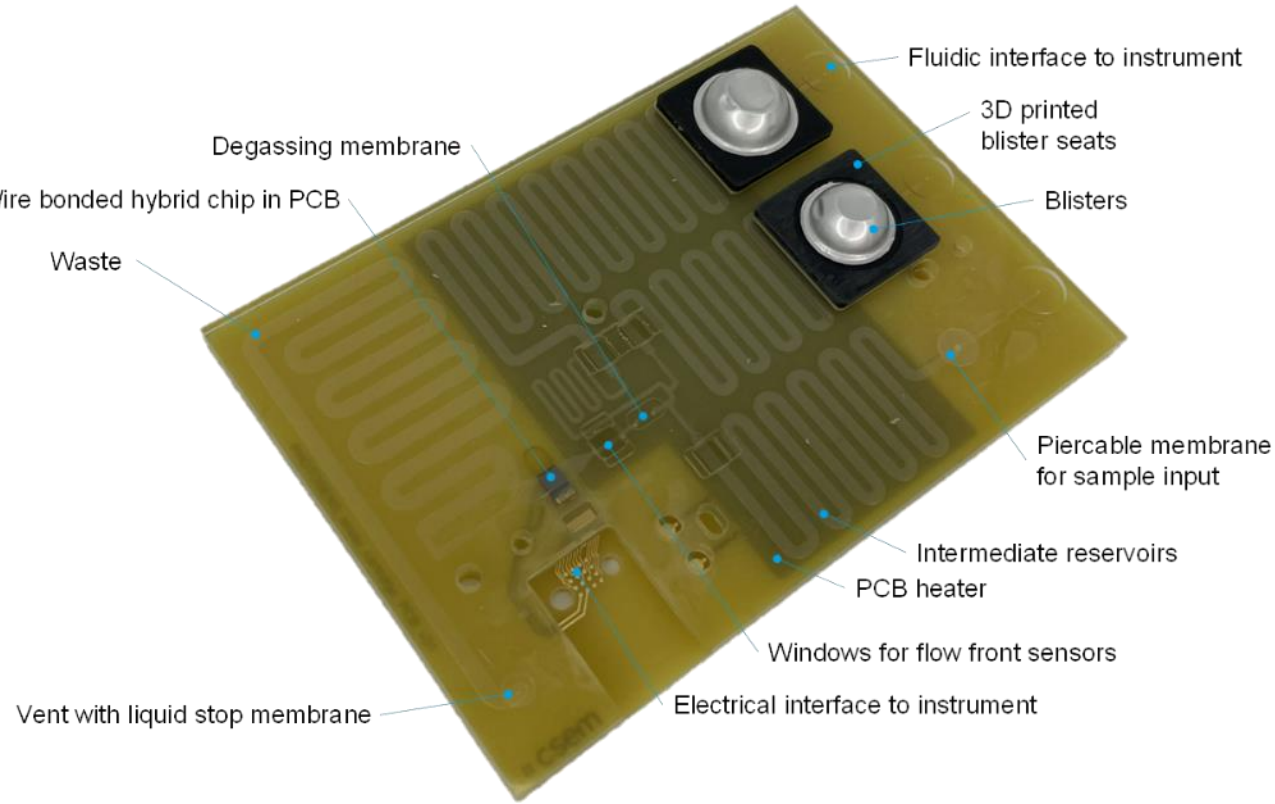
BIOCDx

AQUA CULTURE PATHOGEN DETECTION



- Pathogen detection
- Reduction of antibiotics by correct treatment

- Liquid stored on cartridge
- Hybrid PIC with only electrical interface to instrument
- On cartridge heating



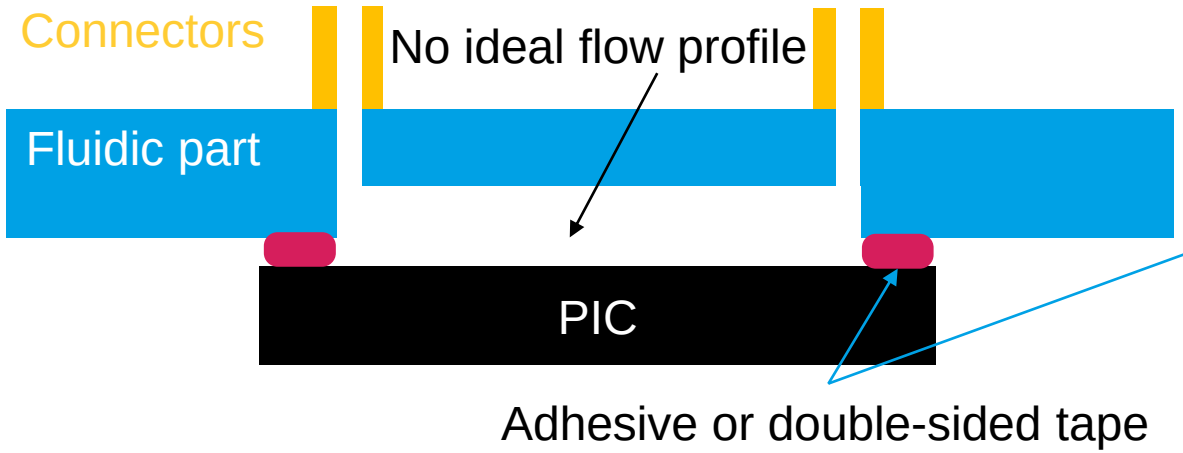
INTERFACES

- **Fluidic interface**
  - Exposure to liquids
  - Sealing

- **Photonic/Electronic interface**
  - Dry
  - Allow access to wave guides

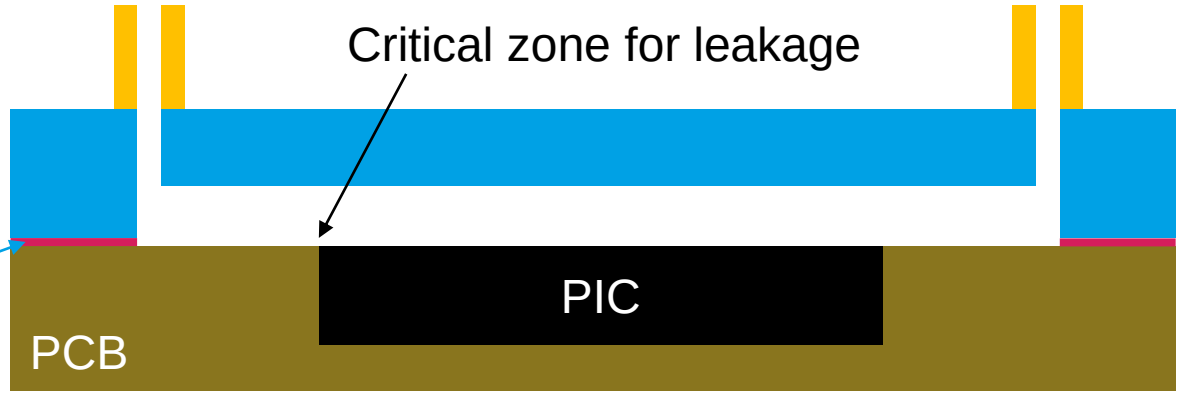
FLUIDIC INTERFACE: PIC INTEGRATION METHODS

On-Channel method



- Simple bonding
- Waste of chip area
- Flow profile not ideal

In-Board method



- Challenging bonding
- Smallest chip possible
- Ideal flow profile
- Separate components

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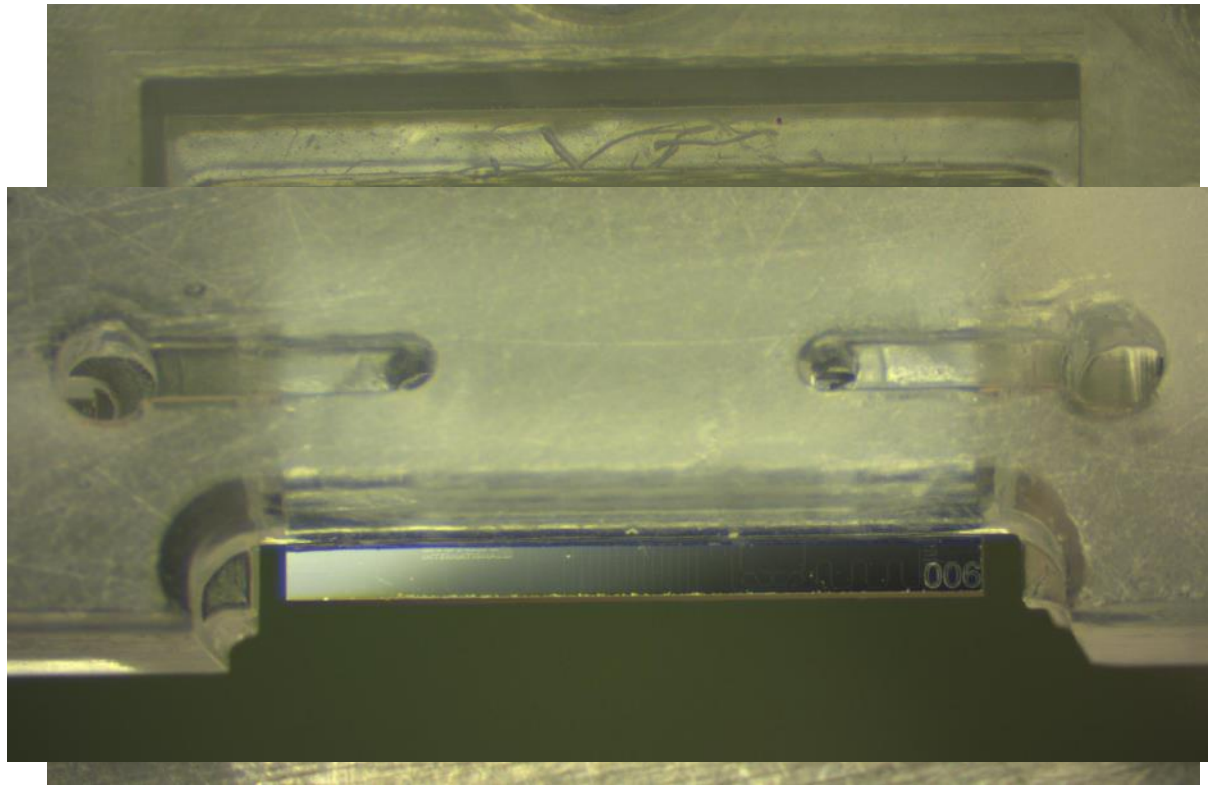
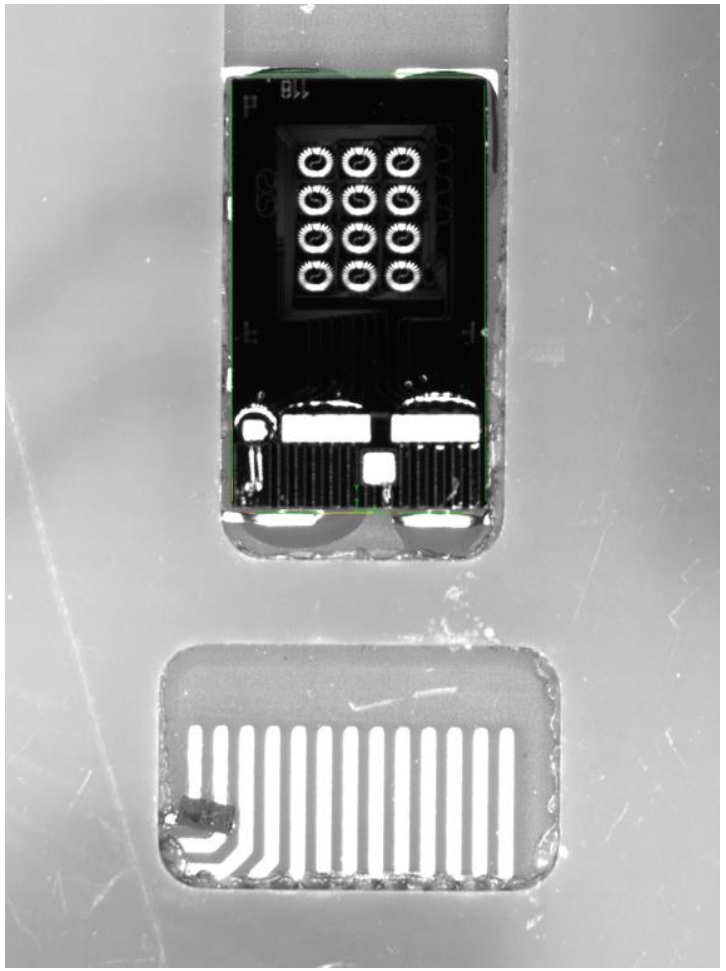
PIC INTEGRATION METHODS

On-Channel method



In-Board method



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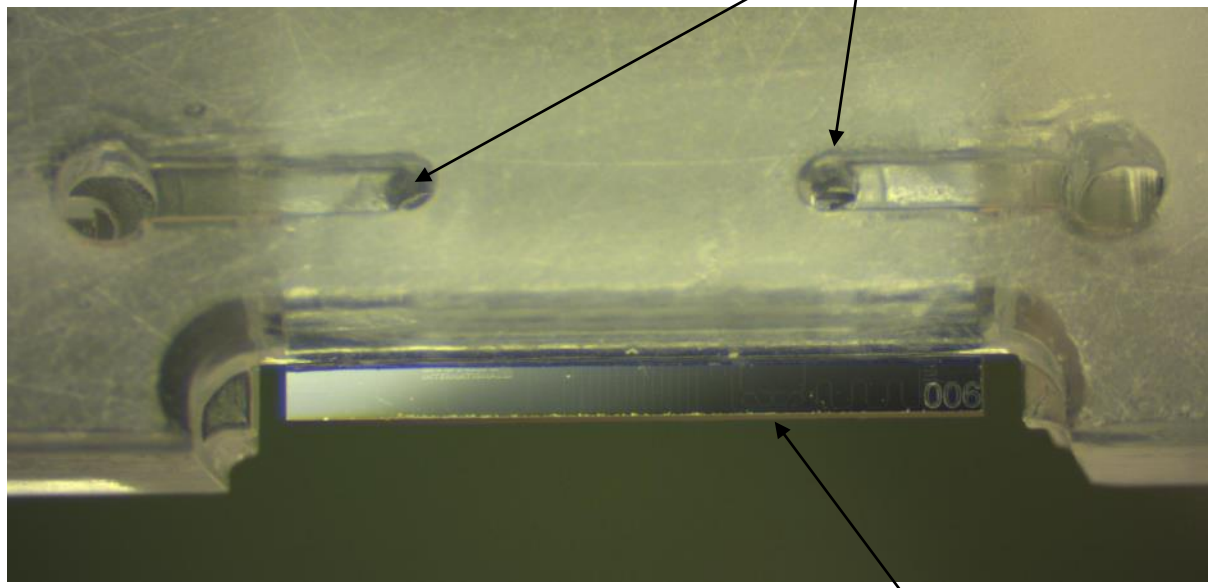
PIC INTEGRATION METHODS

On-Channel method

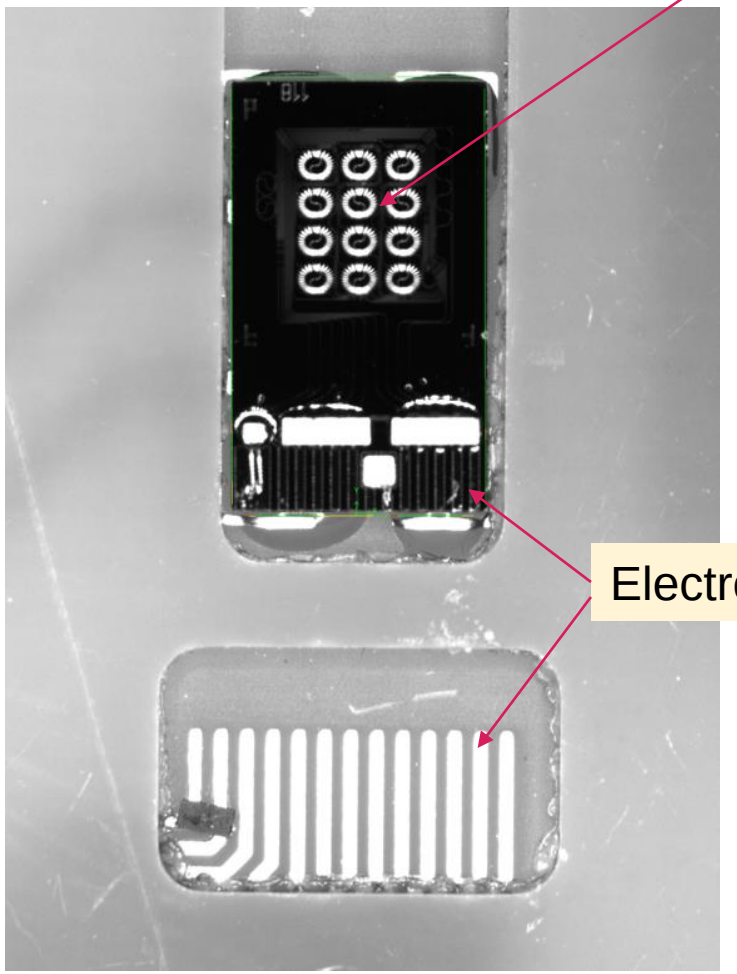
Fluidic interface
(adhesive seal)



Photonic interface
(wave guides)

In-Board method

Fluidic seal not shown



Electronic interface

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ADHESIVE BONDING APPROACHES

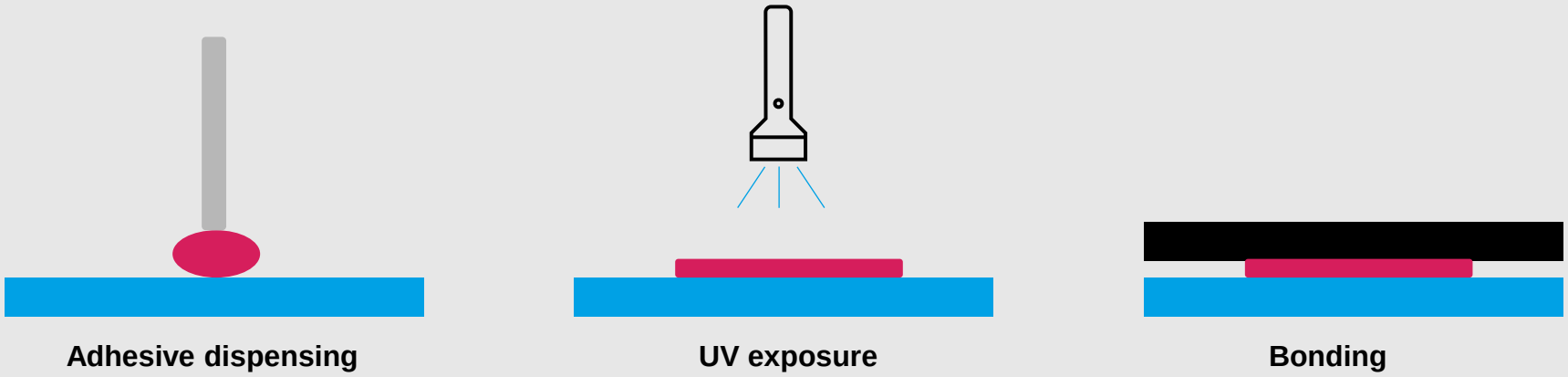
Bond material

- Epoxy
- Acrylate
- Silicone
- Cyanoacrylate

Curing mechanisms

- UV exposure
- RTV
- moisture
- UV pre-exposure for opaque components

UV pre-exposure



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MANUFACTURING

Class 10’000 clean room

Automated pick and place

+/- 20um alignment accuracy

Chip integration

Tape bonding

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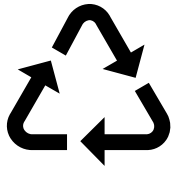
DISPOSABLE VS RE-USABLE

- **Single** sterilisation cycle
- and/or single cleaning cycle
- Short term exposure to test fluid
  - Toxicity
  - Impact on signal through leaching
- Leak tight

- **Multiple** sterilisation cycles
  - Steam!
- Multiple cleaning cycles
- Multiple exposures to test fluid
- Repeated mechanical loading
- Leak-tight or hermetic



STERILISATION / AUTOCLAVING/CLEANING

- Leak tightness, mechanical function and non-toxicity might be compromised by repeated sterilisation
- Leaks may endanger the operator, damage the instrument and the electronics
- CSEM's view:

Encapsulation	Many Autoclave cycles (>10)	Few autoclave cycles (2-5)	Many EtO	Single EtO	Corrosive environment	Alcohol cleaning	Diluted NaOH
Tape bonding	X	High risk	Low risk	Low risk	✓	Low risk	Unknown
Adhesive bonding	X	High risk	Low risk	✓	✓	✓	Unknown
Metal soldering	Low risk	✓	✓	✓	High risk	✓	✓
Diffusion bonding (Thermocompression, laser assisted diffusion)	Low risk	✓	✓	✓	✓	✓	✓
Glass soldering*	Unknown	Unknown	Unknown	Unknown	Unknown	✓	Unknown

*Used to create hermetic seals in long-term medical implants (pacemakers etc.)

CSEM = ONE STOP SHOP

Idea

Prototyping

Validation

Concept development

Packaging

Tech Transfer

partially

csem

csem toolpoint FOR LAB SCIENCE

PRECISION LIQUID HANDLING WORKSHOP

November 19 - 2024

22 OCTOBER 2024 SWISS SYMPOSIUM IN POINT-OF-CARE DIAGNOSTICS

NEXT YEAR EVENT – SAVE THE DATE

22nd October, 2024 | Zürich Technopark

csem

Discover our Life Science Brochure

https://www.csem.ch/pdf/157550

FACING THE CHALLENGES OF OUR TIME