

CSEM AT A GLANCE

We are a public-private, non-profit Swiss **technology innovation center**, a transmission belt between academia and industry

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

APPLIED RESEARCH

Development of deep technology bricks through public funding

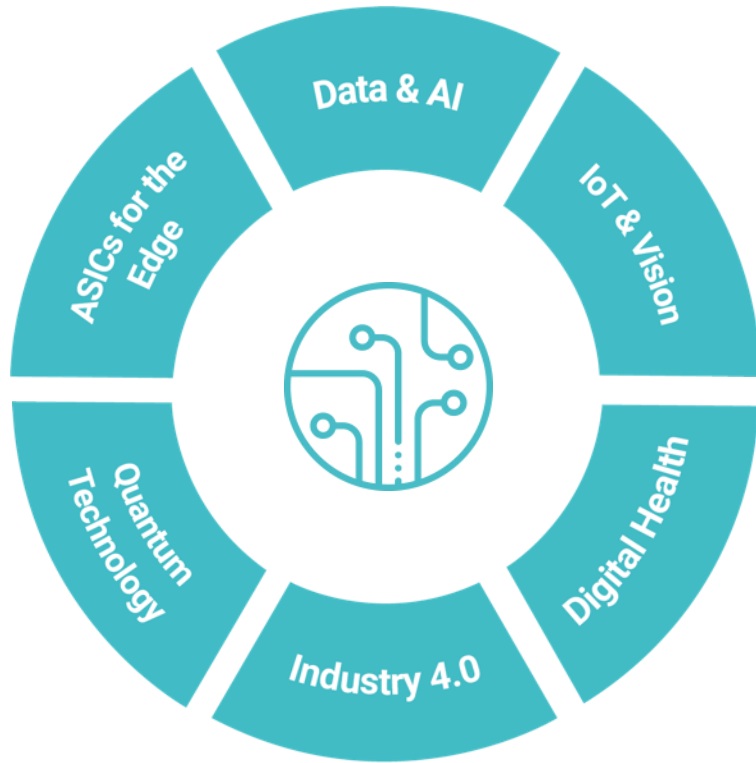


Valorization through direct industry mandates following a full cost model (time and material)

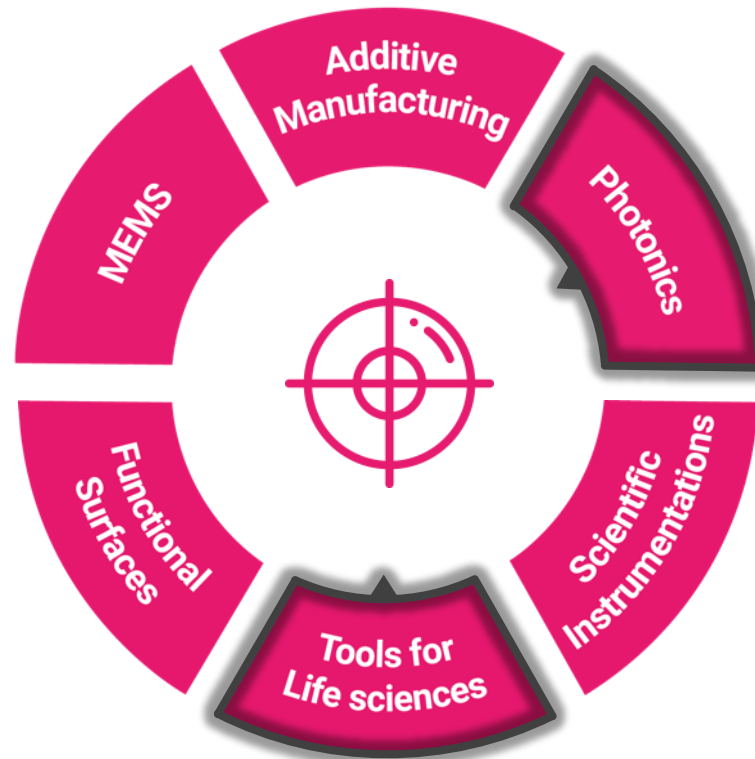
TECH TRANSFER

THREE CLEAR RESEARCH PRIORITIES

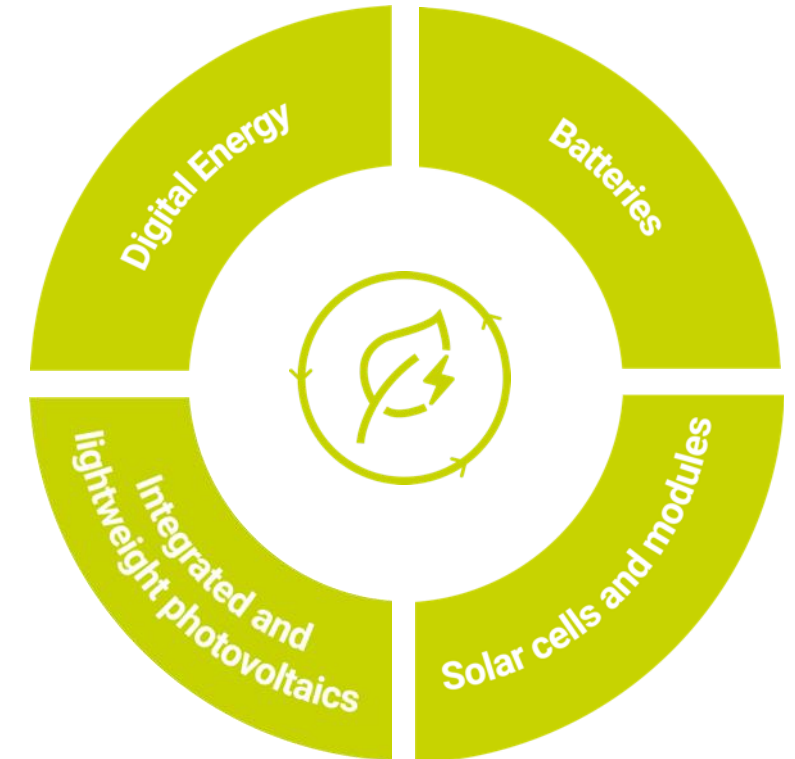
Digital Technologies



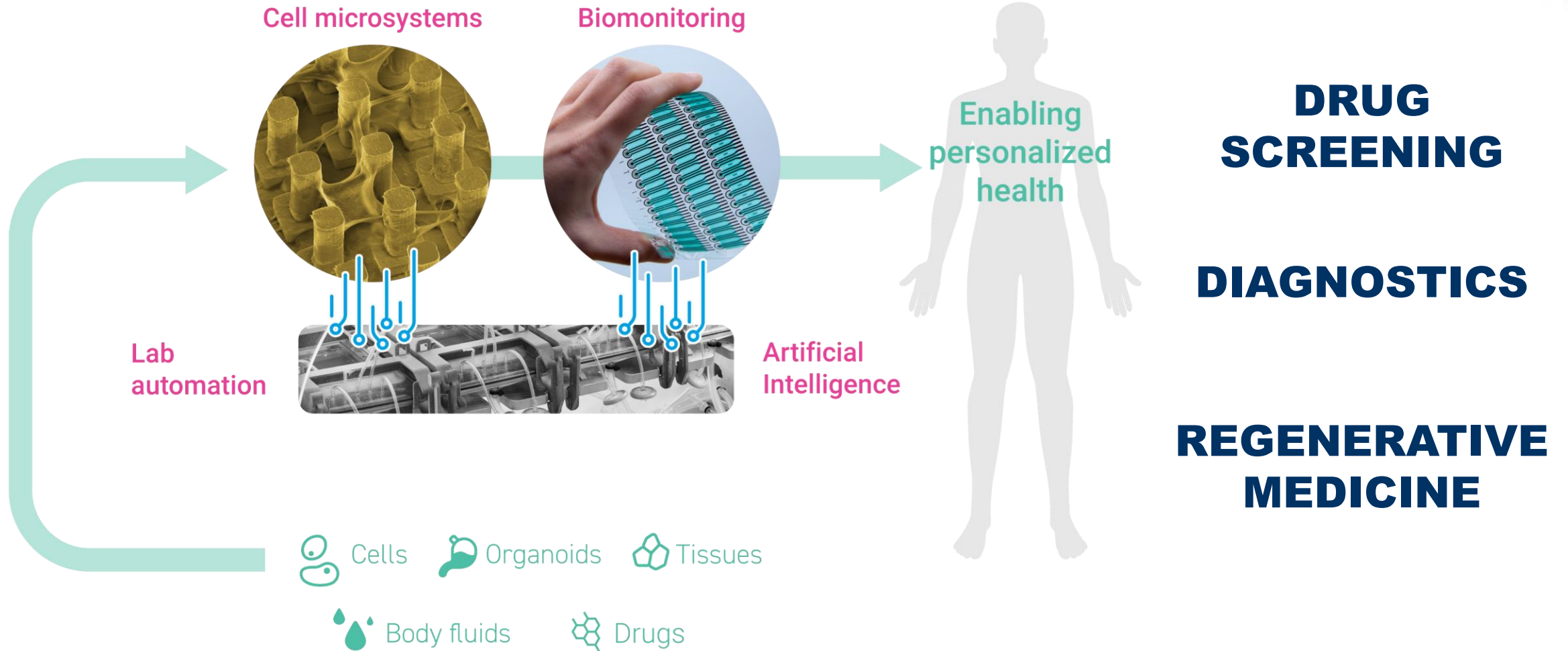
Precision Manufacturing



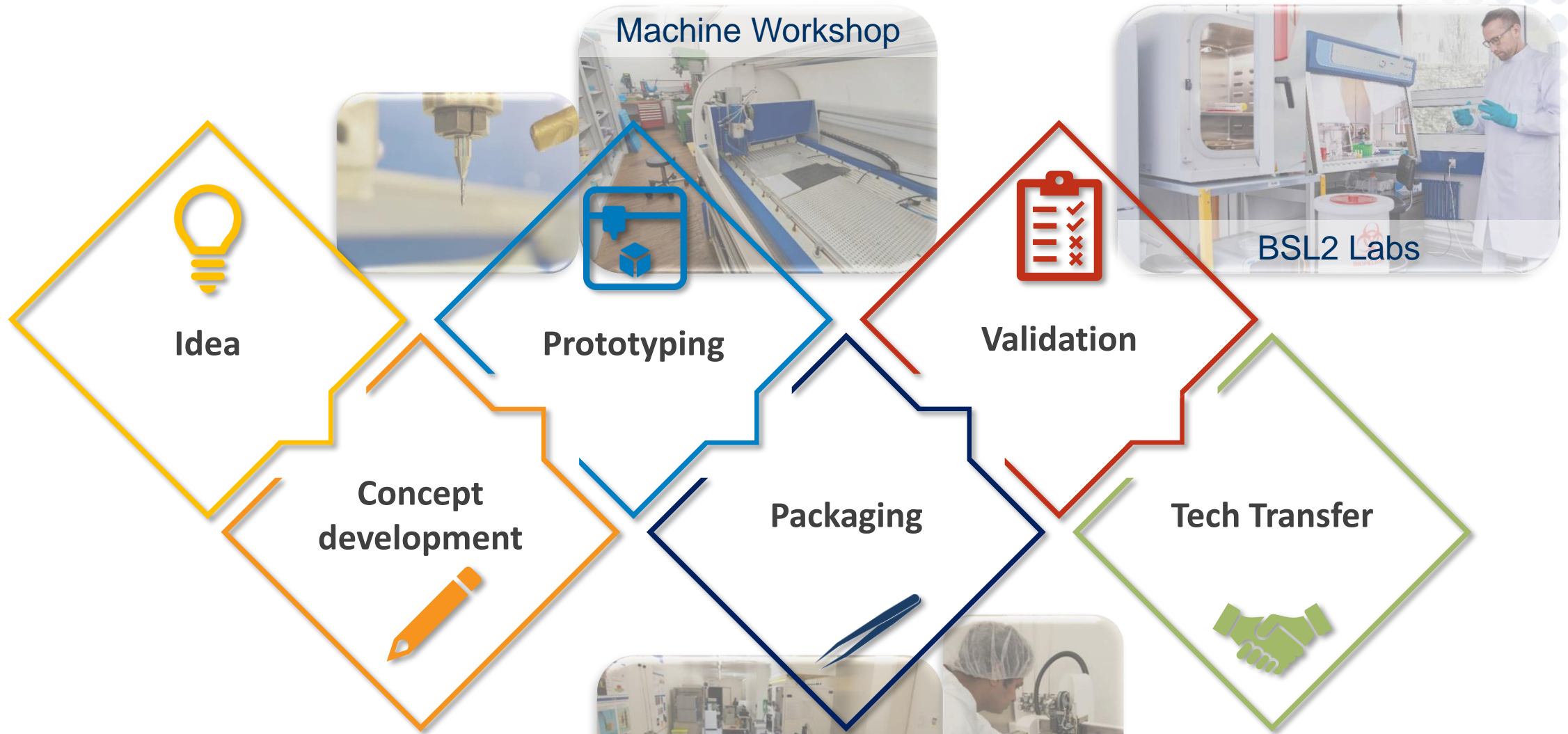
Sustainable Energies



TOOLS FOR LIFE SCIENCES



CSEM = ONE STOP SHOP



CHALLENGES FOR PHOTONIC CHIP INTEGRATION

CHALLENGES

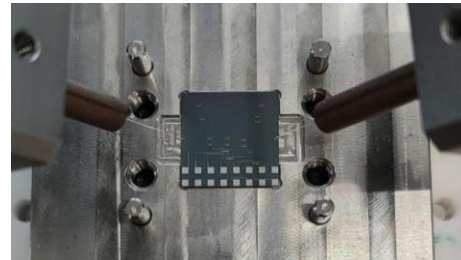
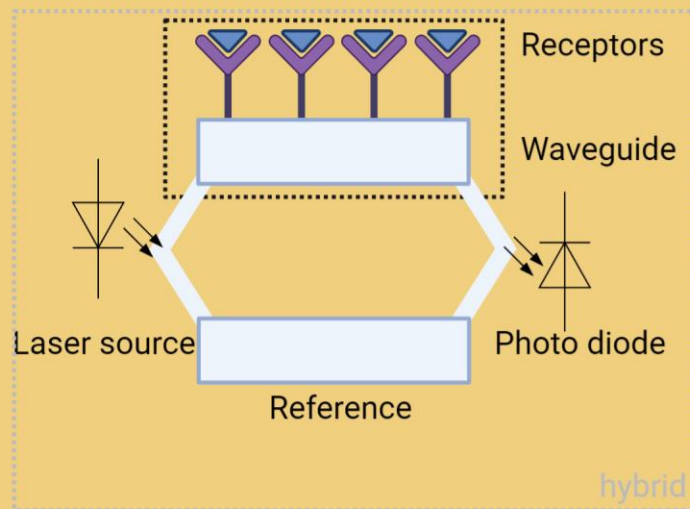
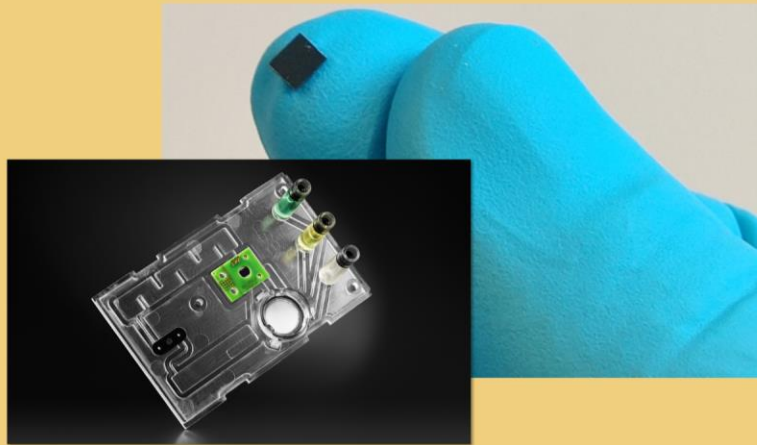
- PIC variations
- Reusable vs low-cost fluidics
- High sensitivity by preventing antifouling
- High sensitivity by local bio-functionalization
- Limited binding reaction on PIC in fluidic channel
- >RT during measurement (ideally 37 - 90 °C)
- No air bubbles on sensor allowed
- Continuous and non-pulsating flow
- Preloaded liquids
- Low quantities for contract manufacturers

CHALLENGES

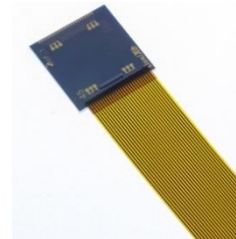
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PIC VARIATIONS

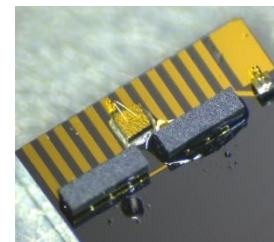
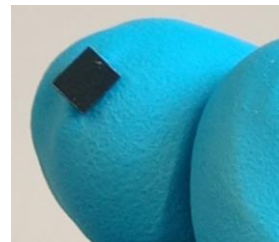
Photonic integrated circuit (PIC)



Passive
Ext light in- and out-coupling
□ 20 mm



Hybrid
□ 10 mm



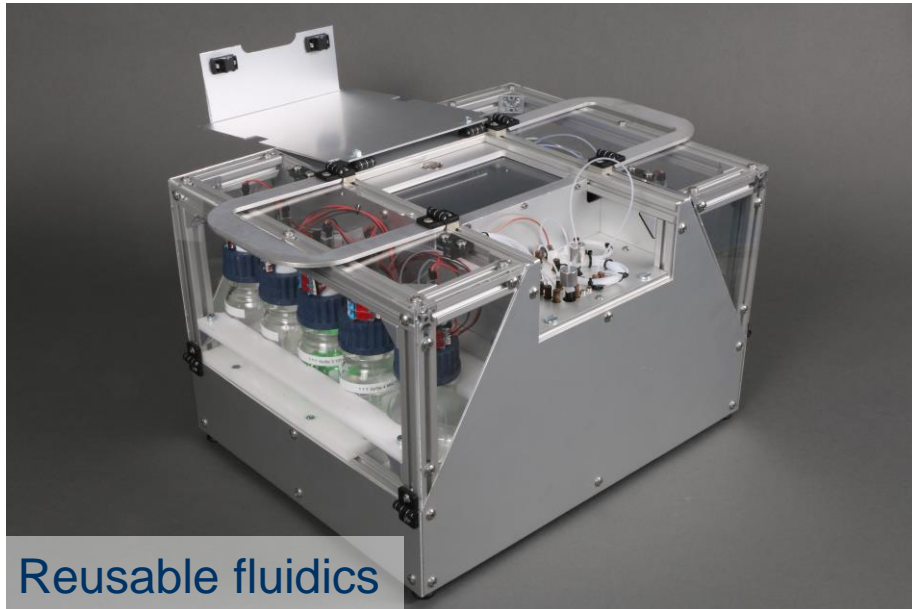
Hybrid*
3mm x 5 mm

* Wafer scale assembly by **phix** PHOTONICS ASSEMBLY
Talk by Z. Tegegne, 13012-18 1630-1700

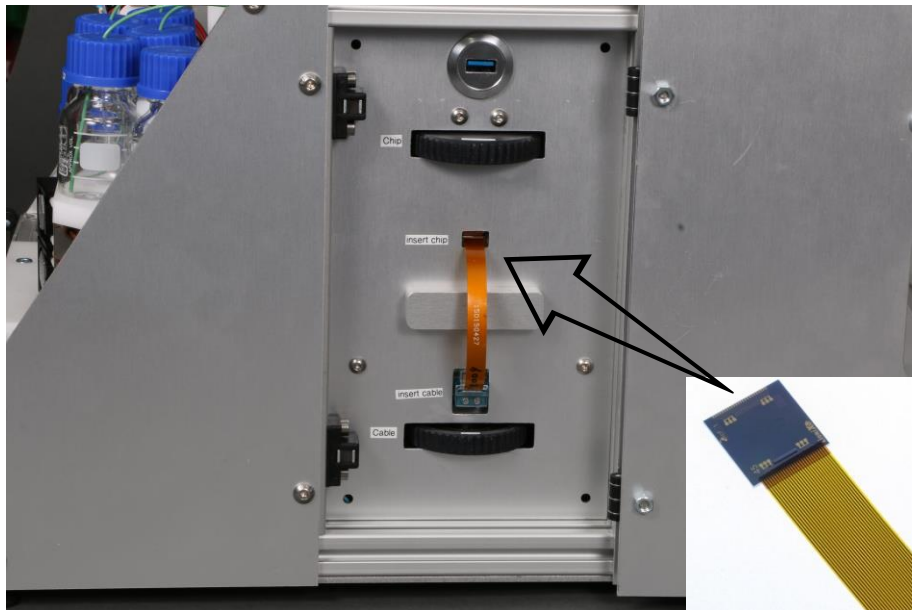
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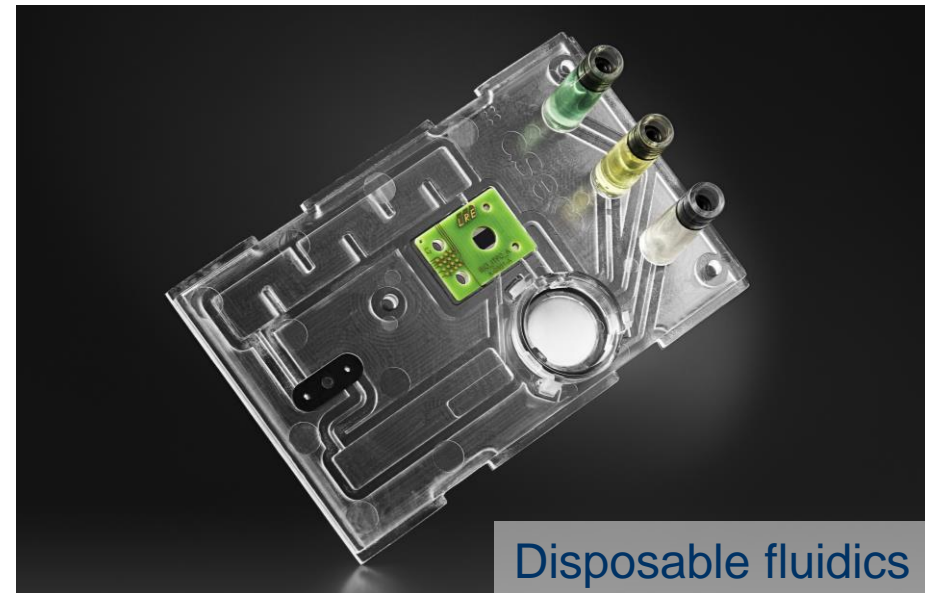


Reusable fluidics



BIOFOS - FP7-ICT-2013-10 Grant No 611528

VS

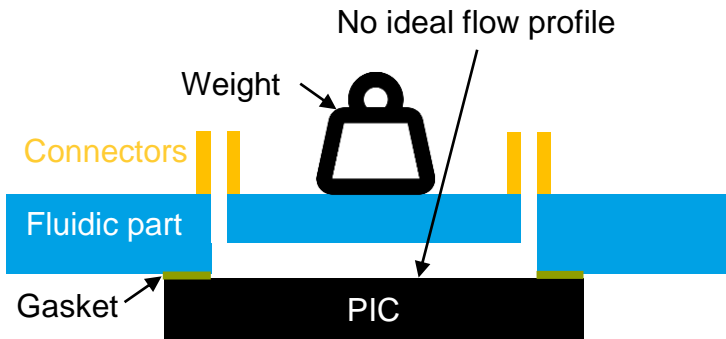


Disposable fluidics

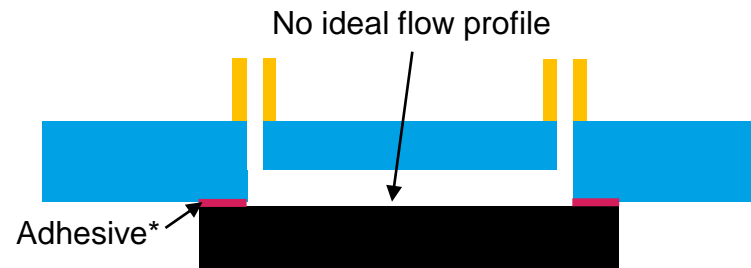
BIOCDx – H2020 Grant No 732309

PIC INTEGRATION METHODS

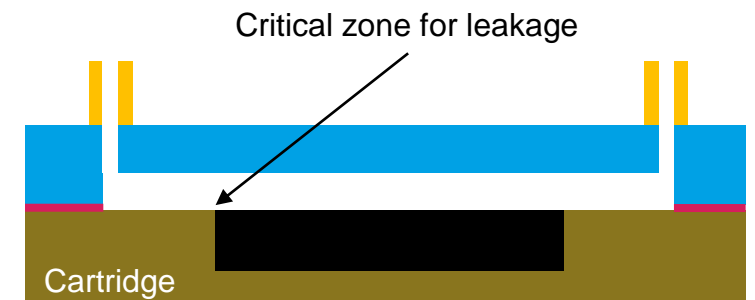
Re-usable



On-channel



In-cartridge



Standardization and integration offerings in **MedPhab** H2020 Grant No. 871345 & Pilotline
Photonic Medical Devices

CHALLENGES

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HIGH SENSITIVITY BY PREVENTING ANTIFOULING

- Antifouling coatings during fabrication
 - + standardized process
 - + batch process
 - + quality control
 - + no delay during assay
 - increased disposable costs
- Antifouling coatings during assay
 - + low cost solution
 - + easily available
 - additional liquid required
 - increased assay time

SURFIX
diagnostics

Coat & Close

Blocking with BSA

∴ **csem**

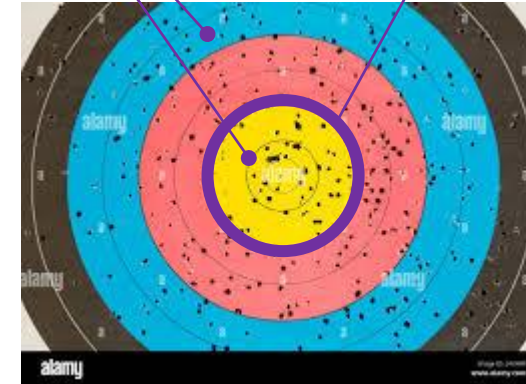
OptoDex

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Area with receptors

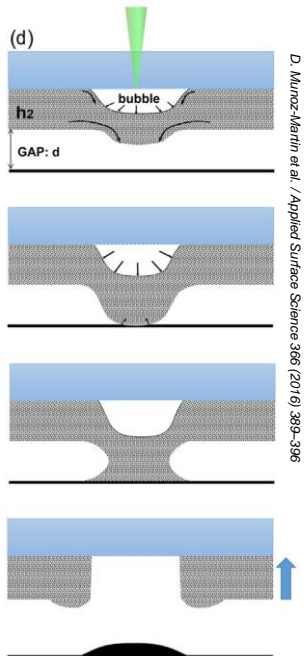
Sensitive area



LOCAL BIO-FUNCTIONALIZATION

PhosPrint
Advanced Technologies

Laser Induced Forward Transfer



SURFIX
diagnostics

Material specific coating
for e.g. Si_3N_4 and SiO_2



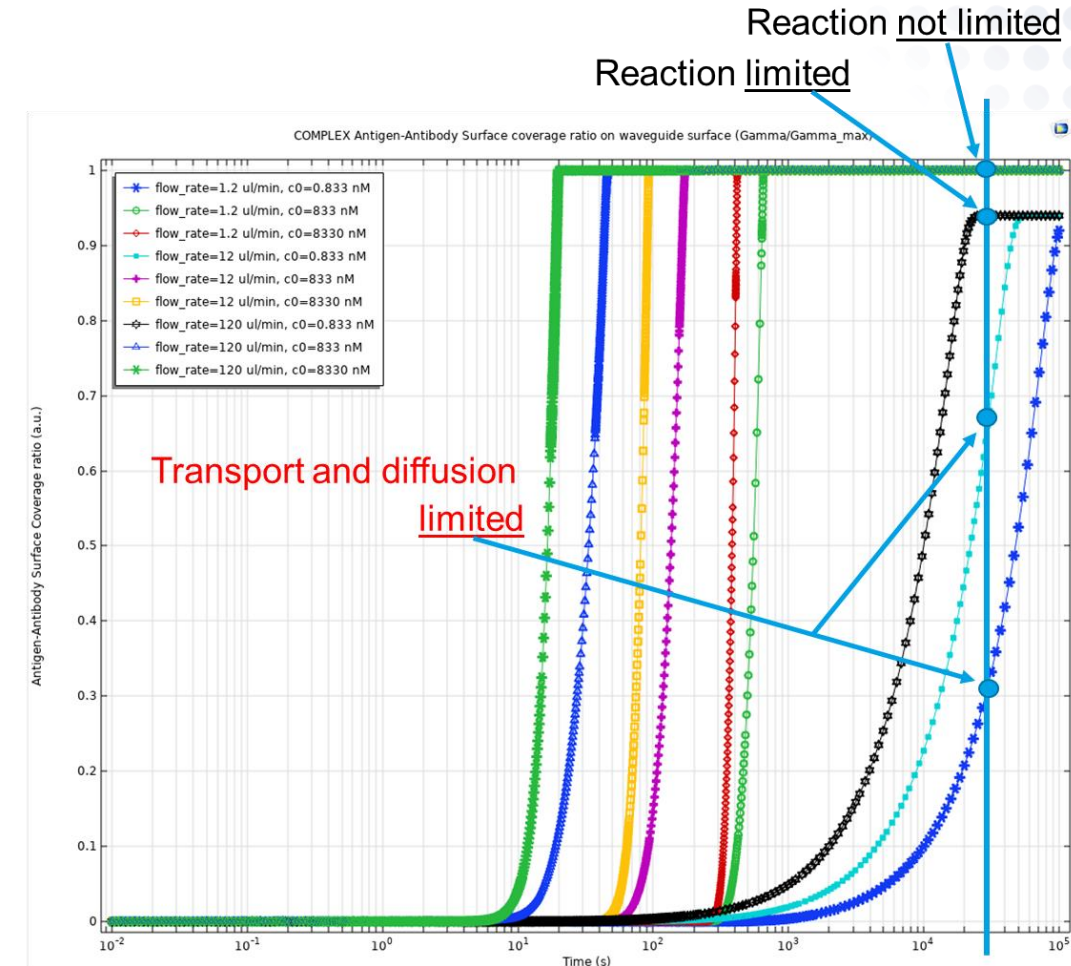
Droplet dispensing

Automated or manual



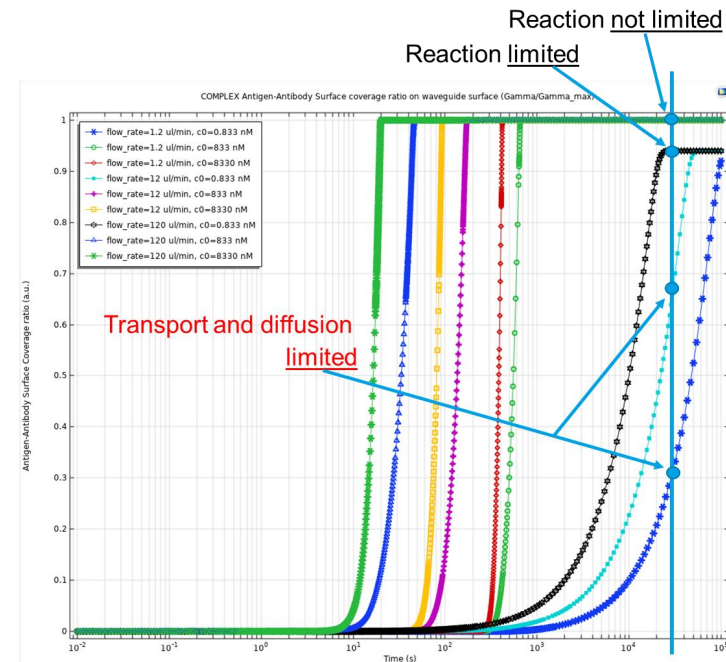
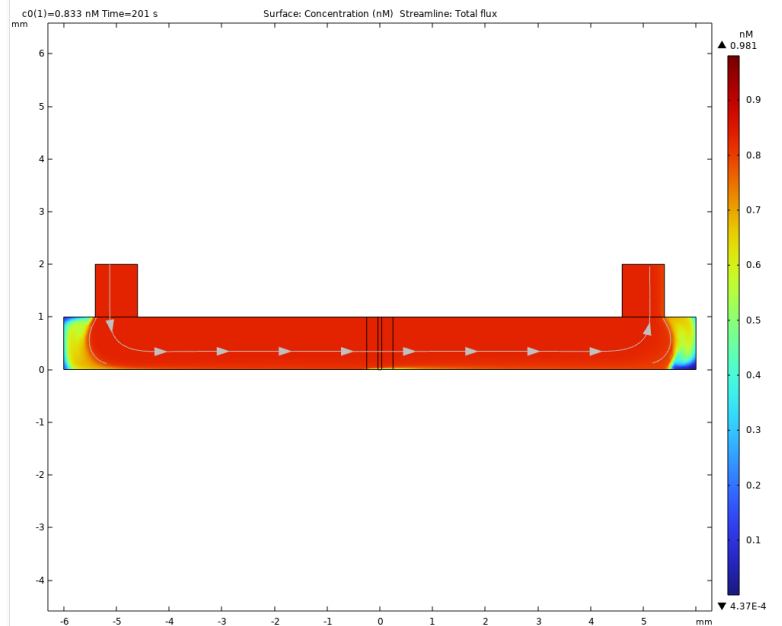
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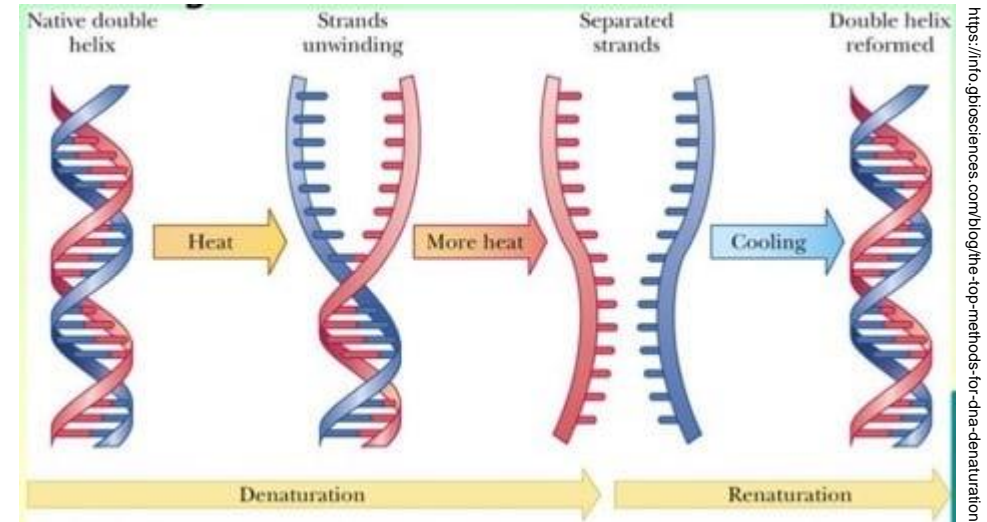
COMPUTATIONAL TOOLS TO OPTIMIZE PARAMETERS

- Sensitivity (coverage ratio)
- Flow speed
- Channel geometry
- Kon/Koff



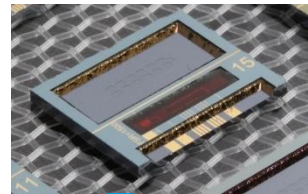
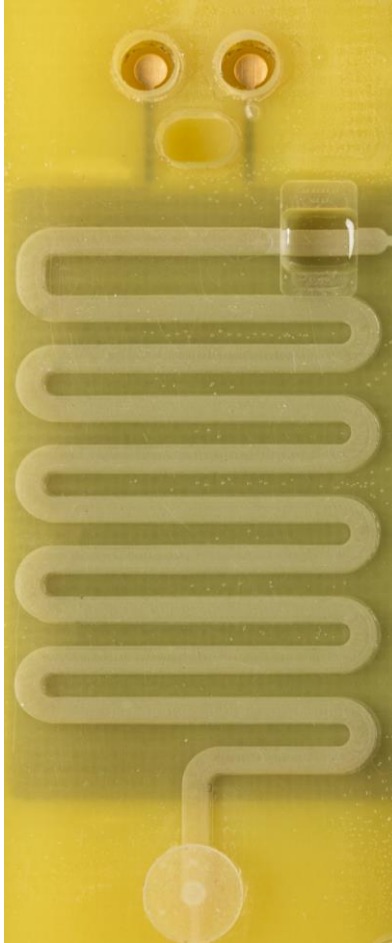
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SOLUTIONS TO CONTROL TEMPERATURE ON-BOARD

Onboard heater



Backside heater



External heater

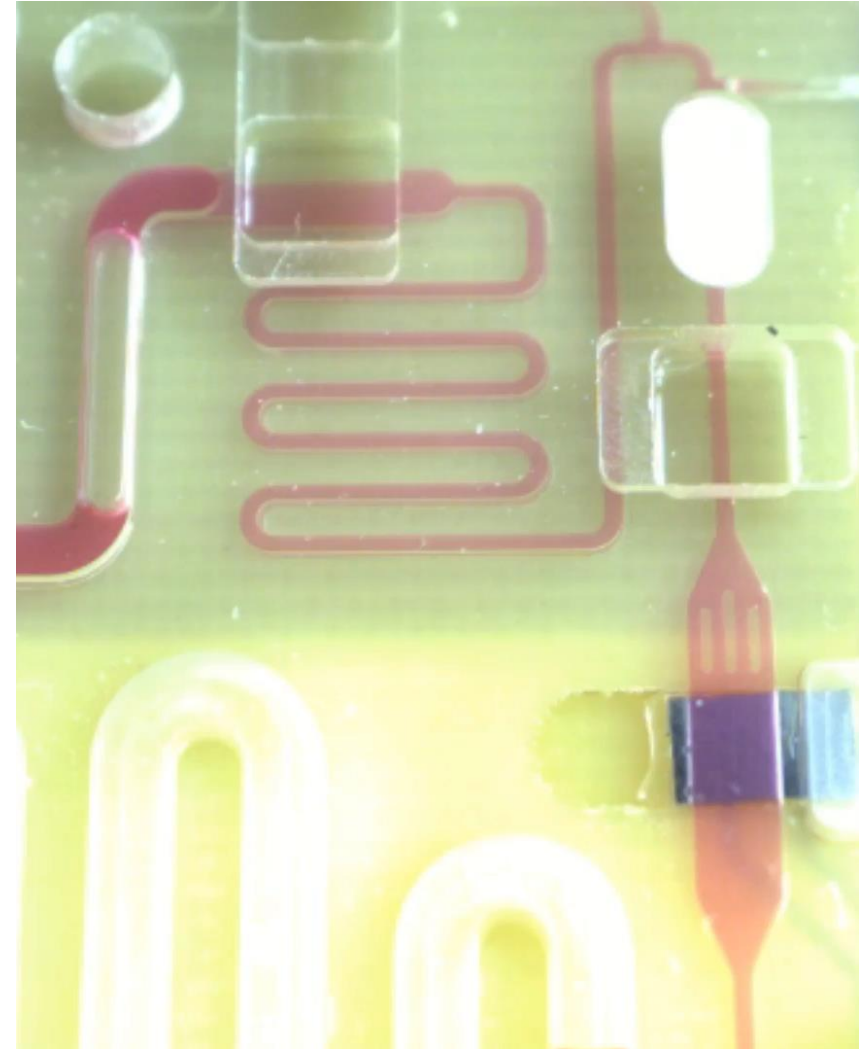
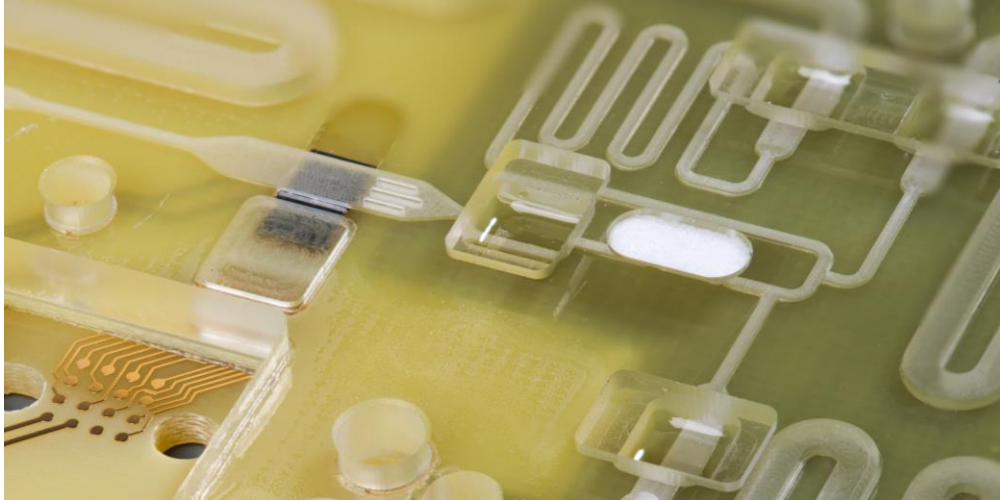


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ON-BOARD DEGASSING



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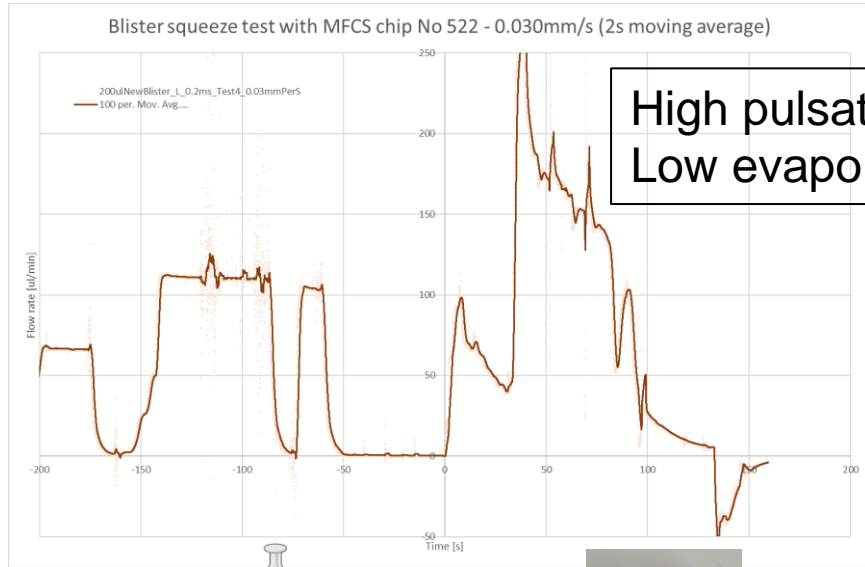


PULSATION FREE DISPENSING WITH ONBOARD SYRINGES



Low pulsation
High evaporation

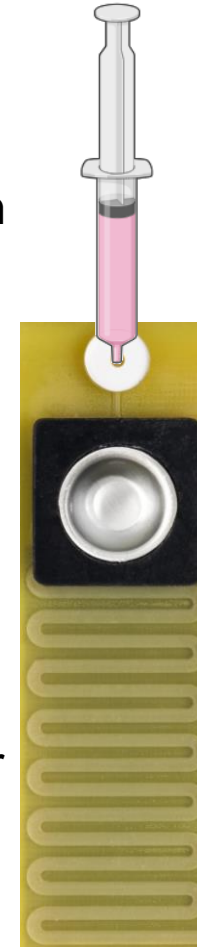
PULSATION FREE DISPENSING WITH BLISTERS



Driving medium
in syringe

Blister

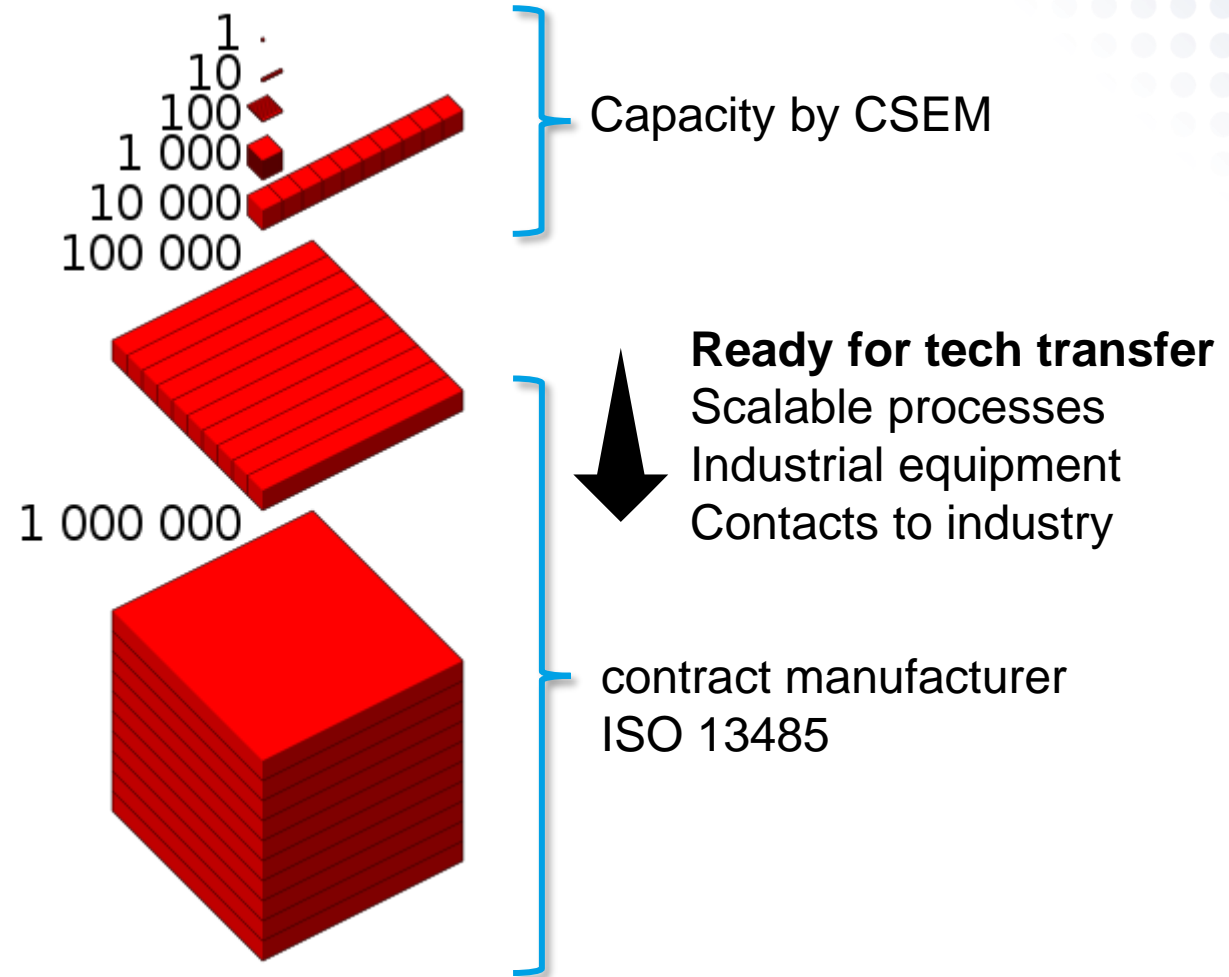
Intermediate meander



Low pulsation
Low evaporation

CHALLENGES

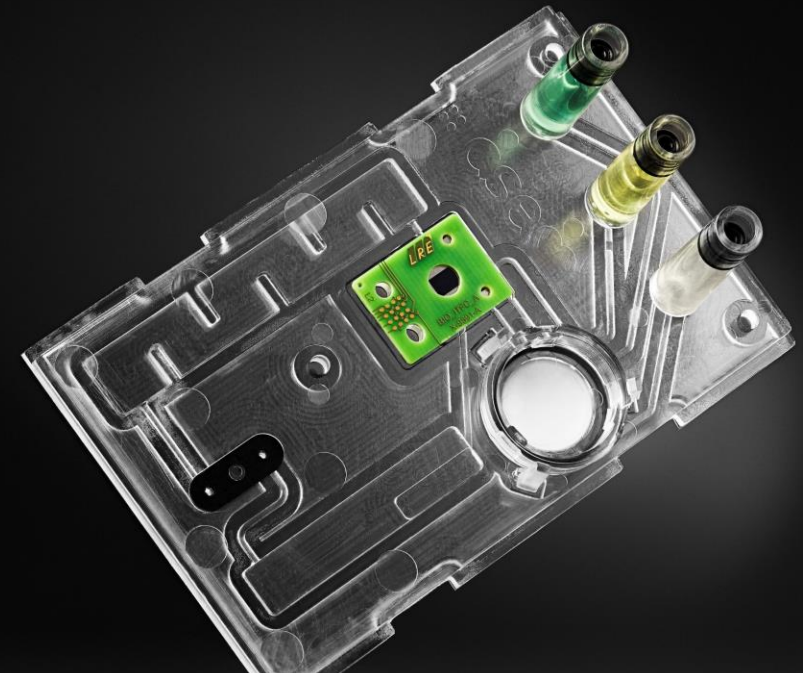
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PROJECT EXAMPLES

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



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

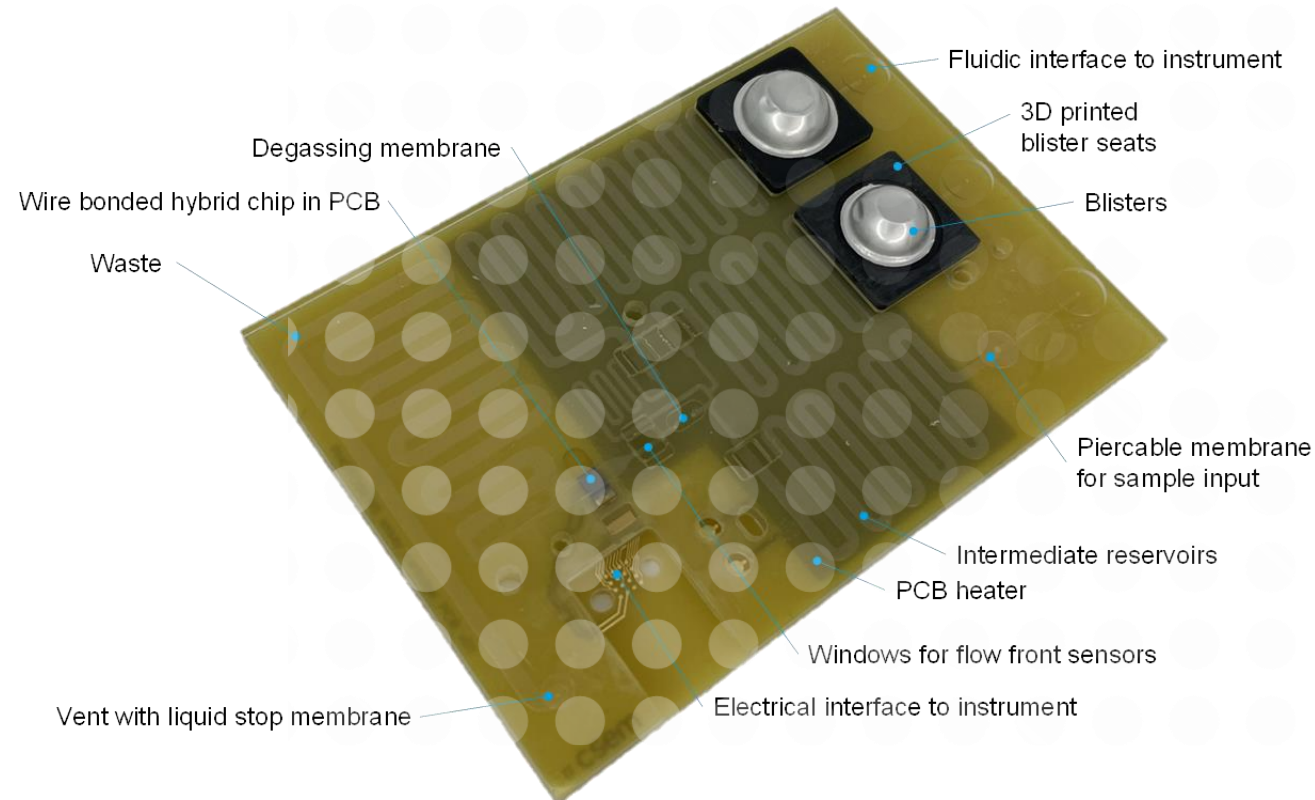


PHOTO-SENS

H2020 Grant No 965643

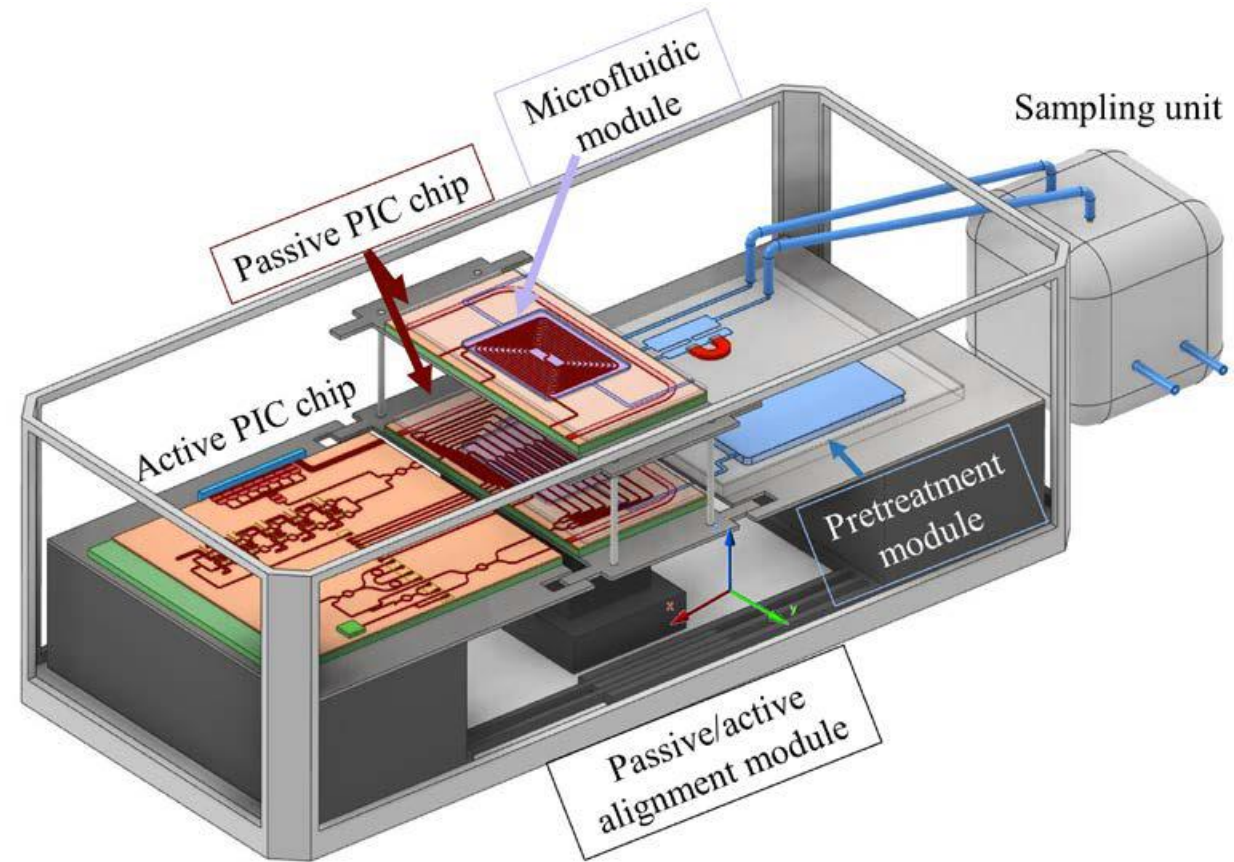
CONTAMINATION DETECTION & NUTRIENT MONITORING IN BIOREACTORS

Contamination detection using an aMZI & magnetic bead capture:

- Early, in-situ detection of contamination
- **Targets:** Bacillus cereus, Bacillus fusiformis, Pseudomonas protegens, Mycoplasma

Real-time nutrient monitoring using Raman Spectroscopy:

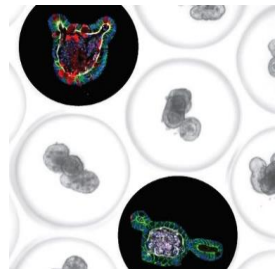
- Monitor bioreactor culture medium
- **Targets:** glucose, lactate, ammonia, glutamine, glutamate, nitrate, phosphate, sulfate, acetate



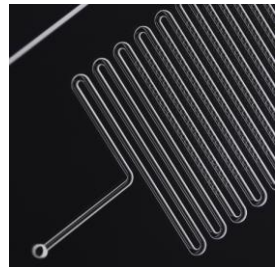
EU Grant No 101093150

SOCIETAL AND ECONOMIC IMPACT

SUNBIOSCIENCE



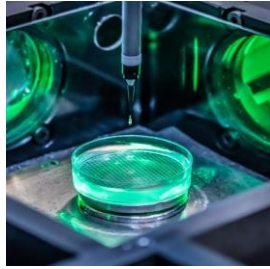
IMT



ALITHEA GENOMICS



HAMILTON



CUTISS personalized skin



HiFiBio THERAPEUTICS



REGEN+U



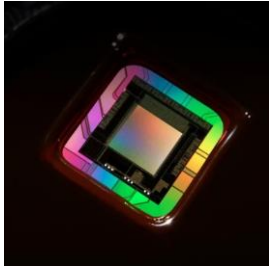
NOVARTIS



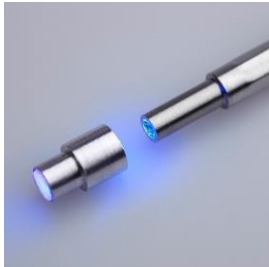
securecell



3-Brain High resolution technology



LIS_{th}



AKTi!A



TECAN



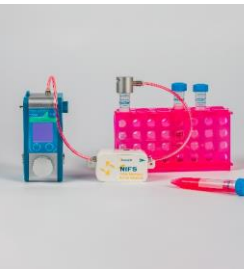
MCMM DIAGNOSTICS



STAT PEEL MATERIAL SELECTIVE DETECTION SYSTEM



FLUIGENT SMART MICROFLUIDICS



insphero



maxon



cellularhighways ATP Company



limula



SURFIX diagnostics



INVENesis



ivoclar

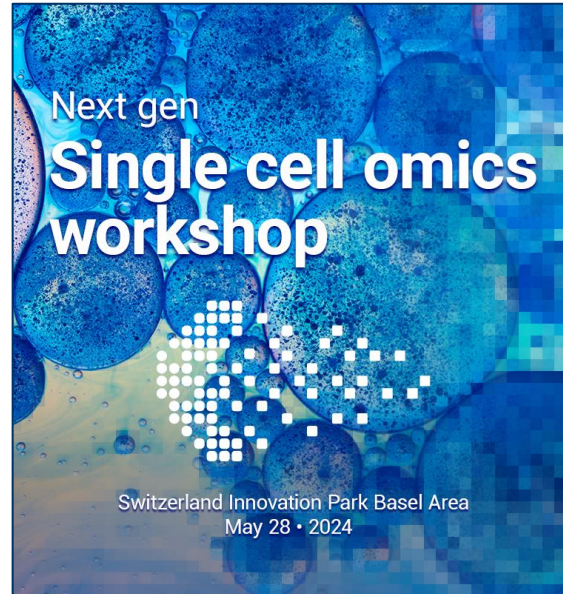


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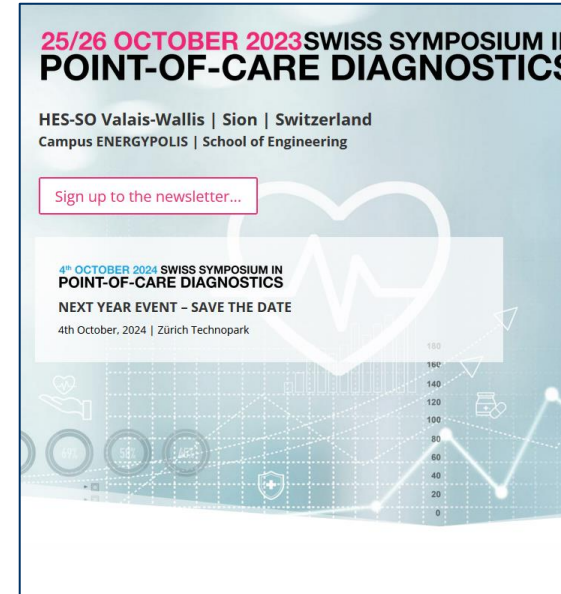
TOOLS FOR LIFE SCIENCES EVENTS



- **Next Gen OoC & Organoids Workshop**
- **February 2025**
- **Basel**



- **Next Gen Single Cell Omics Workshop**
- **May 28, 2024**
- **Basel**



- **Swiss Symposium in Point-Of-Care Diagnostics**
- **October 4, 2024**
- **Zurich**



- **Precision Liquid Handling Workshop**
- **November 19, 2024**
- **Zurich**



FACING THE CHALLENGES OF OUR TIME

Tell me your challenge: siegfried.graf@csem.ch