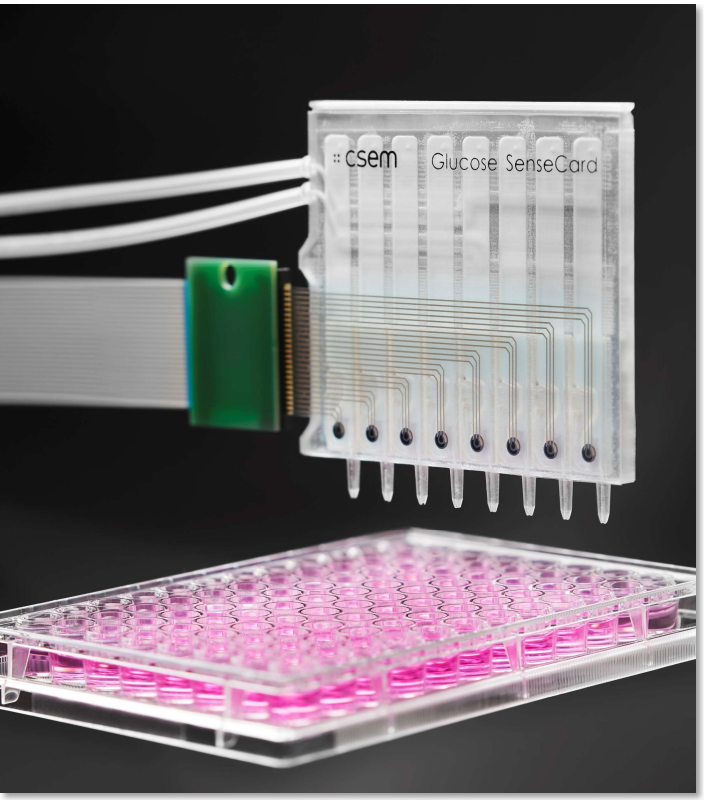

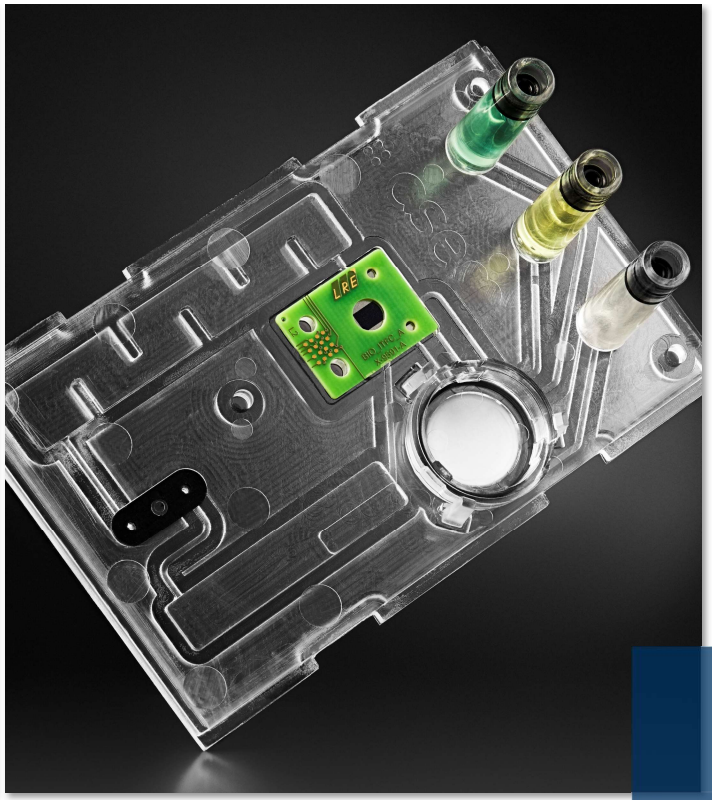

Mark Fretz
Senior R&D Engineer
Automated Sample Handling

06.03.2024

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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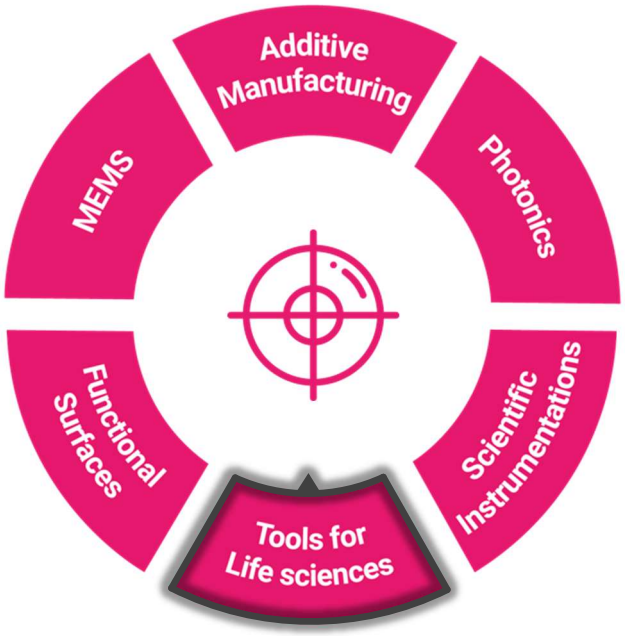
TECHNOLOGIES IN FOCUS AT CSEM

Digital Technologies

Precision Manufacturing



Sustainable Energies

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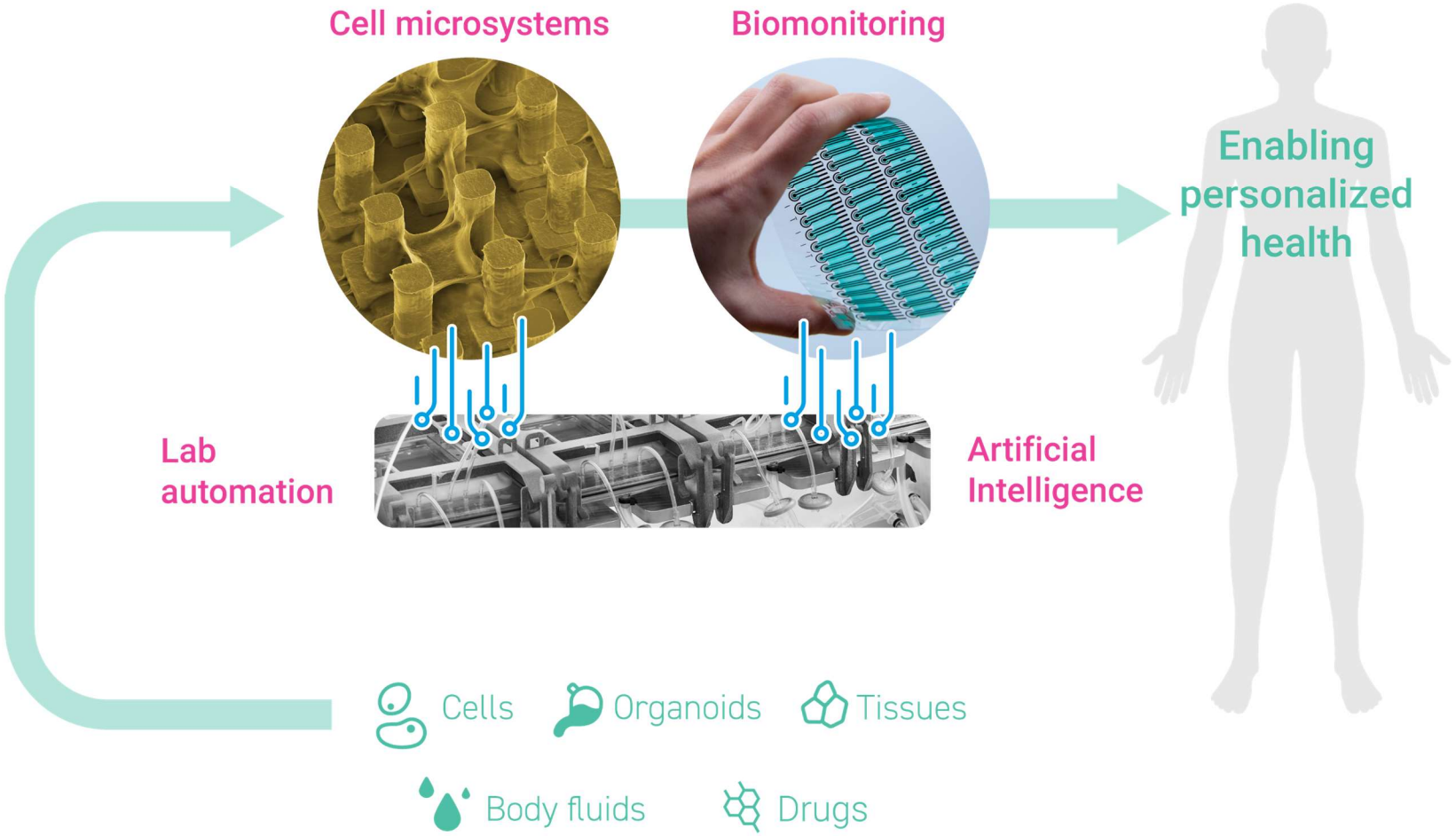
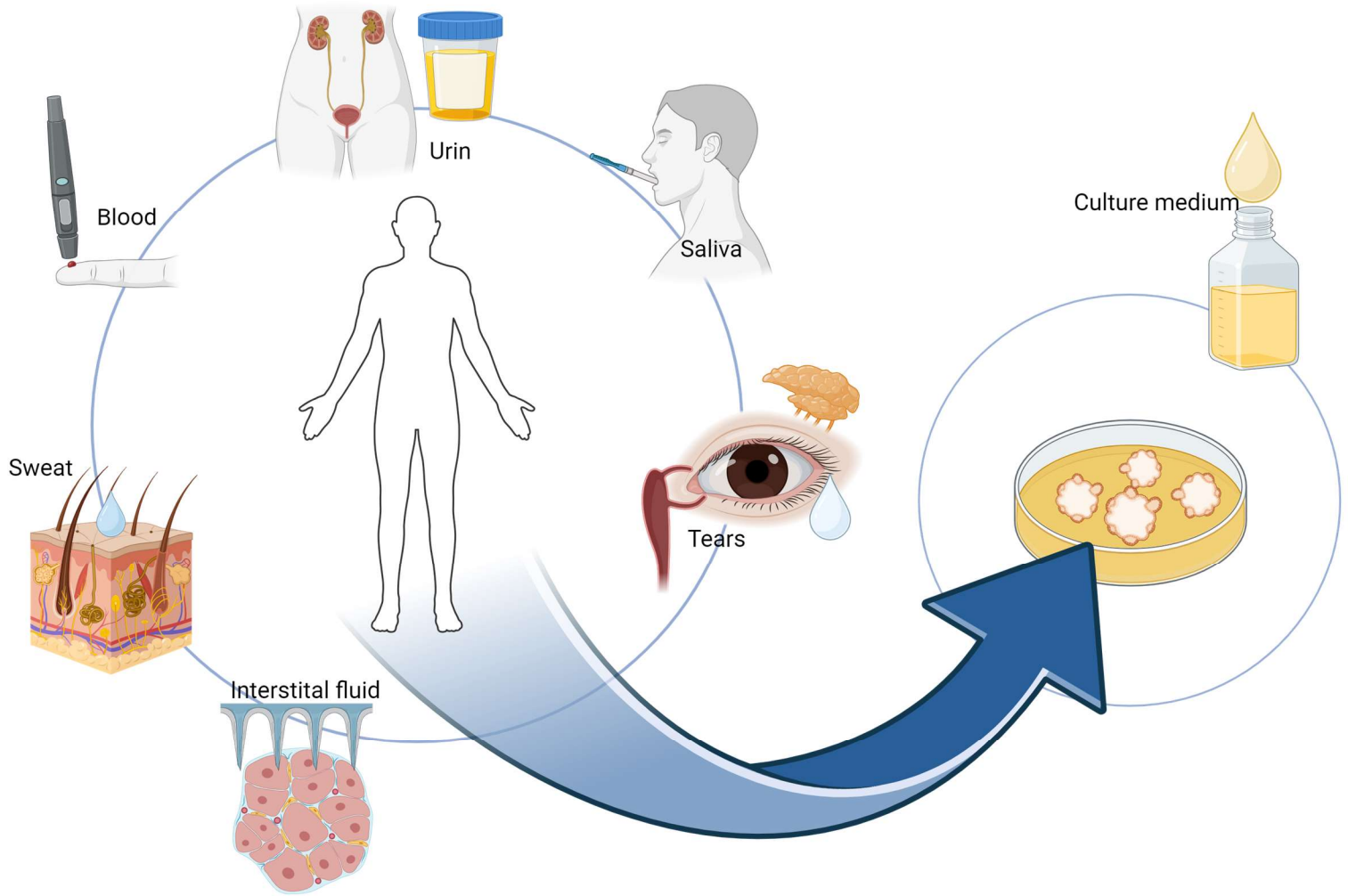
TOOLS FOR LIFE SCIENCES



LIVING???


Urin
Blood
Saliva
Culture medium
Sweat
Tears
Interstital fluid

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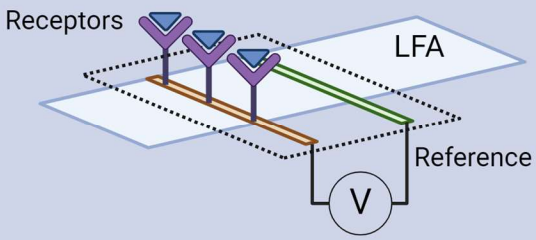
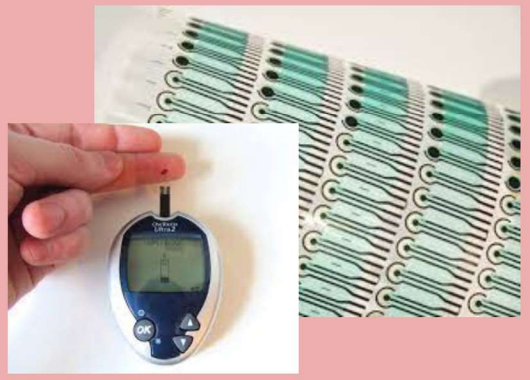
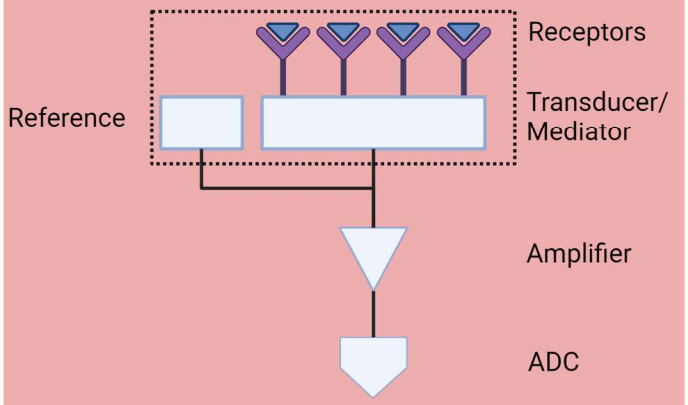
SENSING???

(e)Lateral flow assay (LFA)

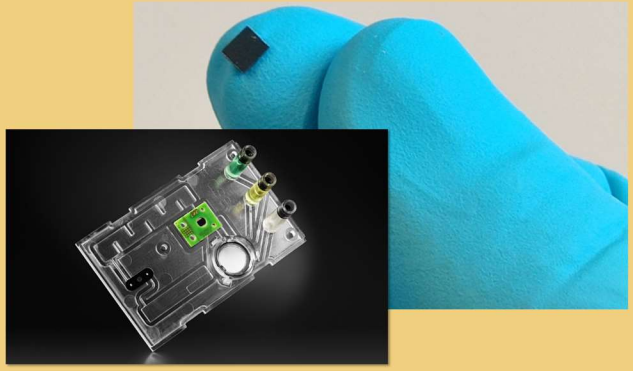


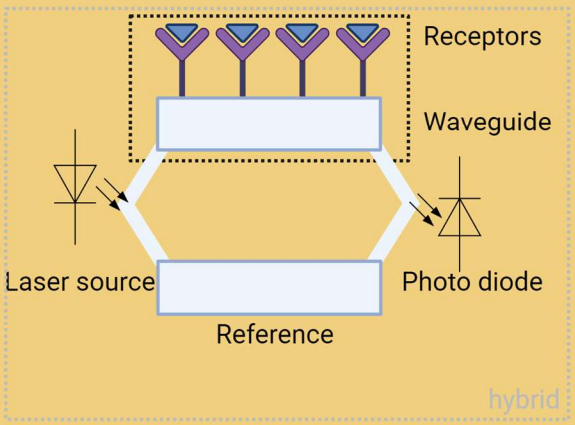
Electro chemical sensors





Photonic integrated circuit (PIC)





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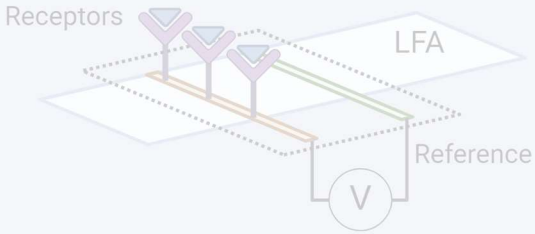
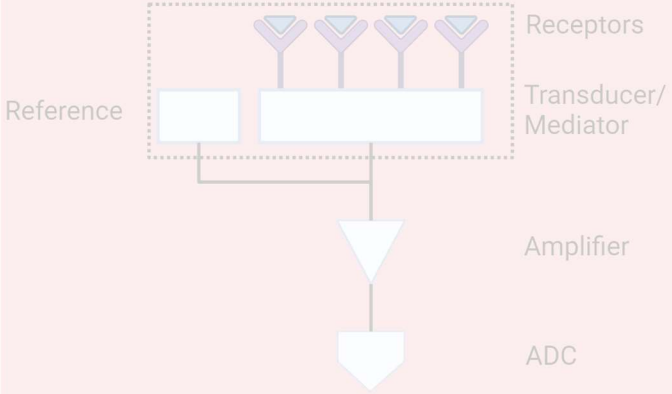
PIC INTEGRATION

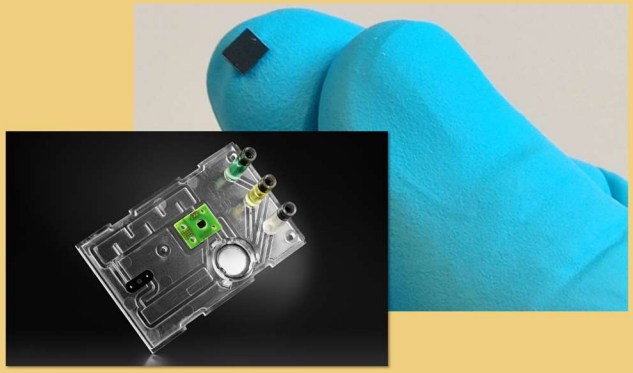
(e)Lateral flow assay (LFA)

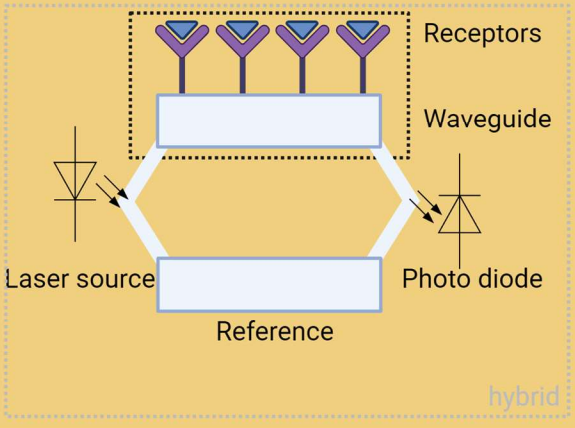


Electro chemical sensors



Photonic integrated circuit (PIC)





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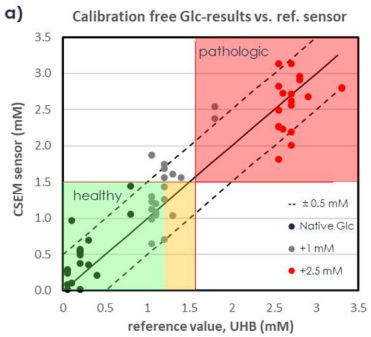
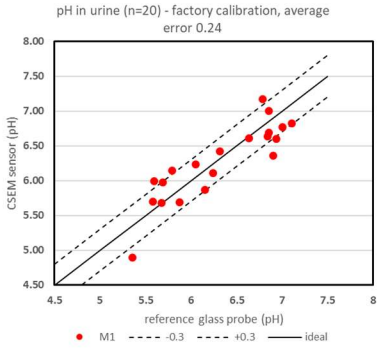
ELECTROCHEMICAL SENSING FOR QUANTITATIVE URINALYSIS

- Urine analysis at the point-of-care
- Glucose, pH and Sodium simultaneously measured
- Easily accessible body fluids: up to 0.6 to 2.6 L of urine a day
- Diagnose and/or monitor several conditions such as pregnancy, kidney disorders, or urinary tract infections

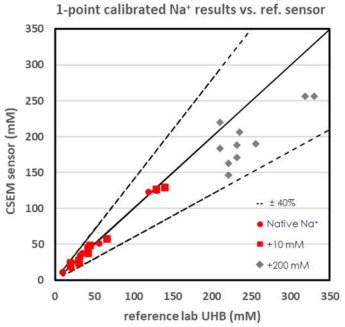
Glucose



pH



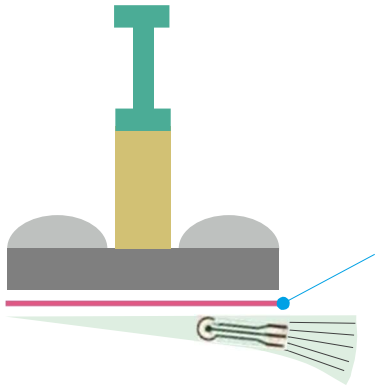
Sodium



Swiss TPH
Swiss Tropical and Public Health Institute

STANLEY THOMAS JOHNSON STIFTUNG

INTEGRATION OF ELECTRO CHEMICAL SENSORS



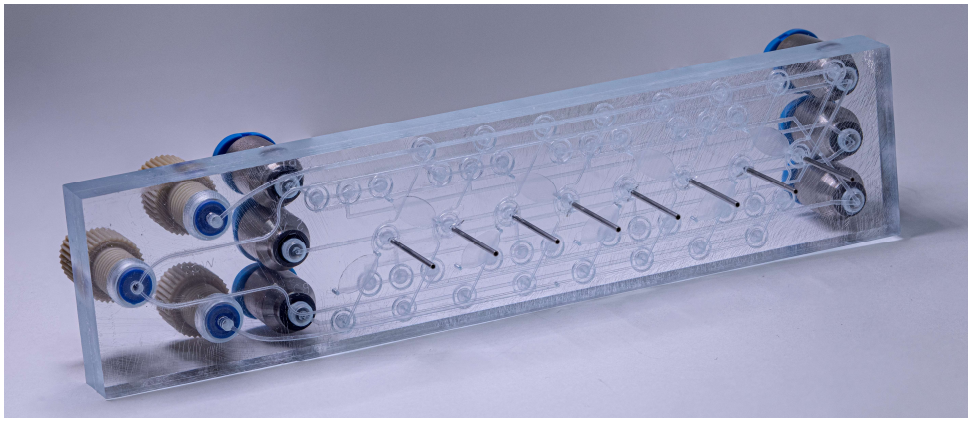
Structured adhesive (tape)

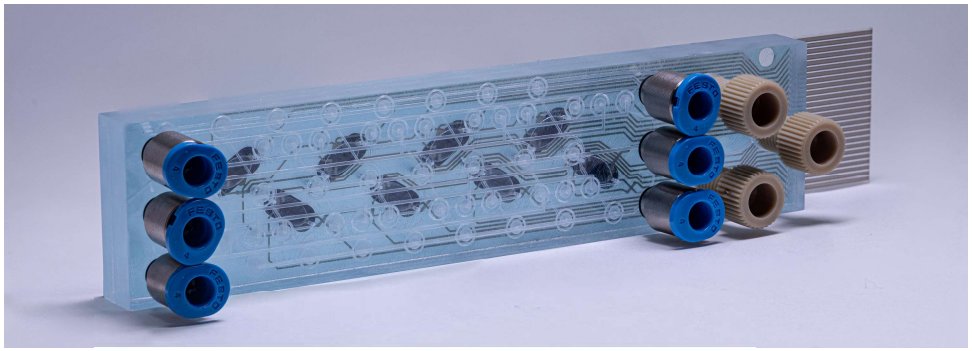
Screen printed electrode sheets
Bio-functionalized sensor spots

SENSECARD
LONG TERM METABOLISM MONITORING FOR 3D TISSUES

- Microfluidic sampling
- Small volume sampling
- Compatible with 96-SBS format
- Electrochemical sensing for glucose concentration (0 – 5mM, tunable on request)
- 8 sensor parallel measurement

3D CELL CULTURE MONITORING USING FLEXIBLE MEMBRANE

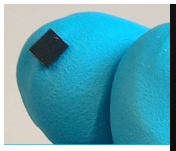




Moore4Medical

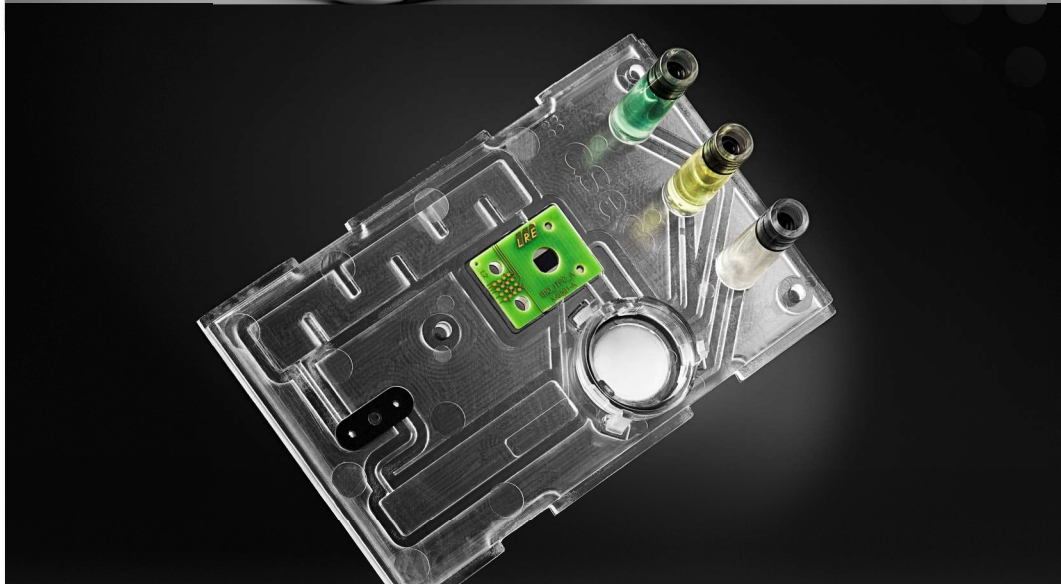
micronit

COMPLEMENTARY DIAGNOSTICS PHOTONICS PLATFORM

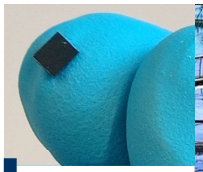


- Protein signature detection
- Use case: Breast and prostate cancer

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

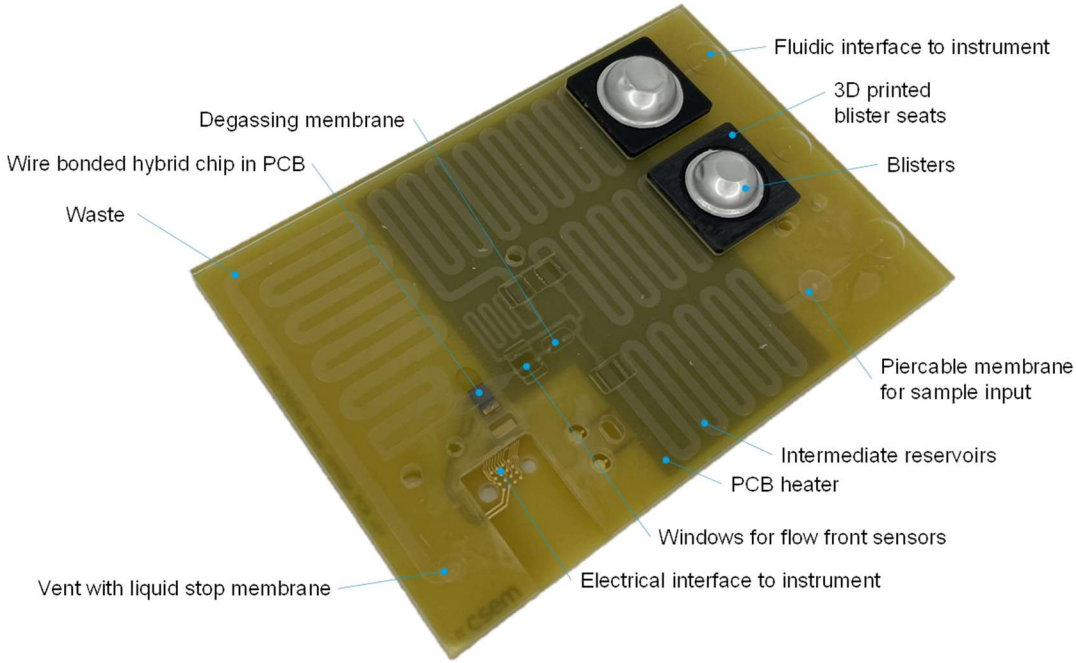


AQUA CULTURE PATHOGEN DETECTION



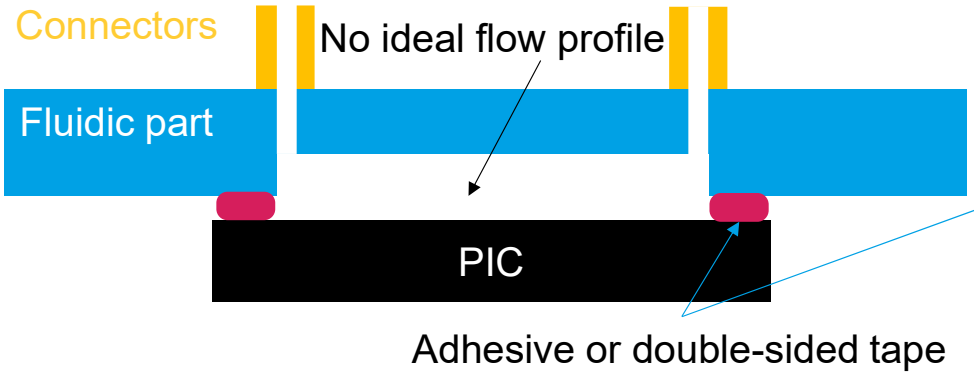
- Pathogen detection
- Reduction of antibiotics by correct treatment

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



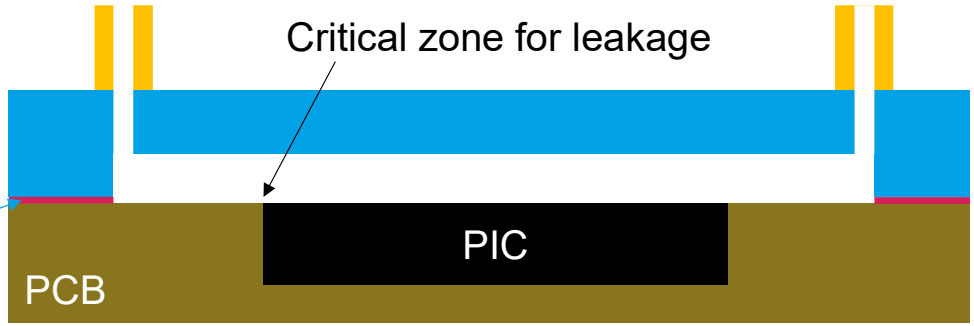
PIC INTEGRATION METHODS

On-Channel method



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

In-PCB method



- Challenging bonding
- Smallest chip possible
- Ideal flow profile

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ADHESIVE BONDING APPROACHES

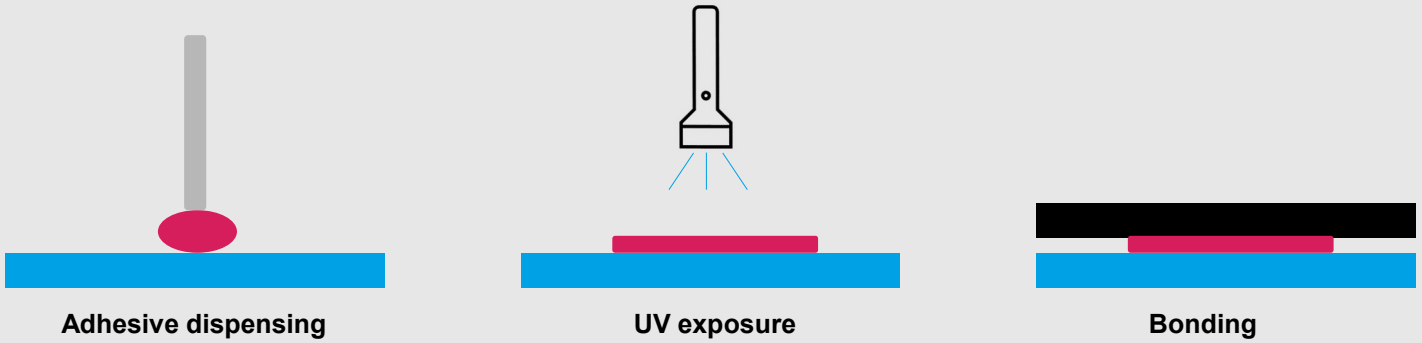
Bond material

- Epoxy
- Acrylate
- Silicone
- Cyanoacrylate

Curing mechanisms

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

UV pre-exposure



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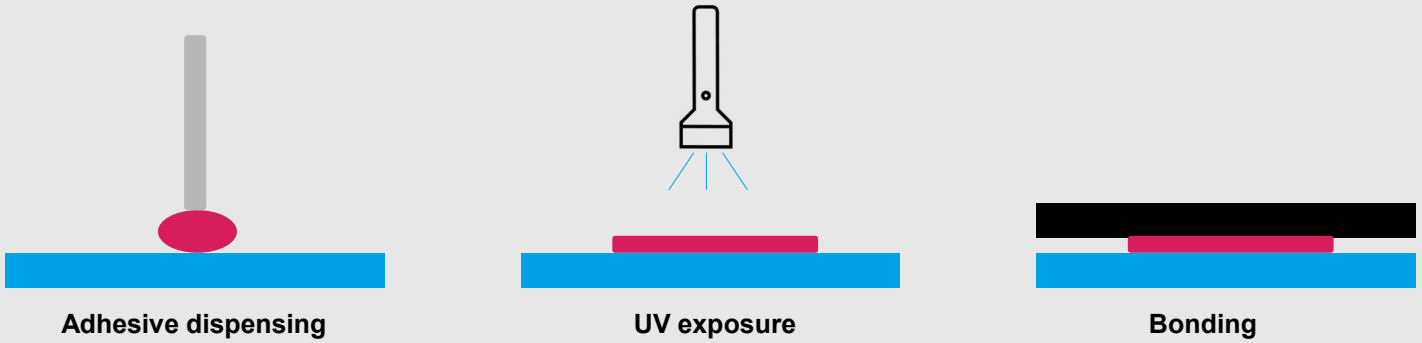
ADHESIVE BONDING APPROACHES

- 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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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

- Leak tightness, mechanical function and non-toxicity might be compromised by repeated sterilisation
- Leaks may endanger the operator, the instrument and the electronics

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.)

Welcome to our Rubber Chemical Resistance Chart

Here is the rubber compatibility chart that rates all popular rubber materials that comes into contact with various chemicals. Use this rubber chemical resistance chart to make sure that the elastomer or O-ring seal you choose will be compatible with the particular environment. The chemical compatibility of rubber is extremely important as the rubber can degrade rapidly if the rubber material is not compatible with the environment or media that it comes into contact with.

LEGEND: 1 = Satisfactory, 2 = Fair, 3 = Doubtful, 4 = Unsatisfactory, X = Insufficient Data

A-Bu Bu-Do Do-Le Le-Pa Pa-St St-Z

	Nitrile	EPDM	Neoprene	SBR	Silicone	Butyl	Polyacrylate	Hypalon	Viton	Polyurethane	Fluorosilicone	Aflas	Kalrez
Abietic Acid	X	X	X	X	X	X	X	X	X	X	X	X	1
Acetaldehyde	3	2	3	3	2	2	4	3	4	4	4	3	1
Acetamide	1	1	1	4	2	2	4	2	3	4	1	2	1
Acetanilide	3	1	1	1	2	1	4	1	3	4	1	X	1
Acetic Acid, 30%	X	1	X	X	X	X	X	X	X	X	X	X	1
Acetic Acid, 5%	2	1	1	2	1	1	4	1	1	4	2	1	1
Acetic Acid, Glacial	2	1	4	2	1	2	4	3	2	4	2	3	1
Acetic Acid, Hot, High Pressure	4	3	4	4	3	4	4	3	4	4	4	3	1
Acetic Anhydride	3	2	2	2	2	2	4	2	4	4	4	2	1
Acetoacetic Acid	3	1	1	1	2	1	4	1	3	4	1	X	1
Acetone	4	1	4	4	4	1	4	3	4	4	4	2	1
Acetone Cyanohydrin	3	1	1	1	2	1	4	1	3	4	1	X	1
Acetonitrile	3	1	X	X	X	X	X	X	1	X	X	1	1
Acetophenetidine	2	4	4	4	X	4	4	4	1	3	2	X	1

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STANDARDISATION

- Standardised methods for
  - Leak-tightness testing of assembly (mechanical integrity)
  - Cleaning
  - Measurement of leachates –> polymer trays, adhesive tapes and adhesives
  - Toxicity/cell viability
  - Test fluid

CSEM = ONE STOP SHOP

Idea

Concept development

Prototyping

Packaging

Validation

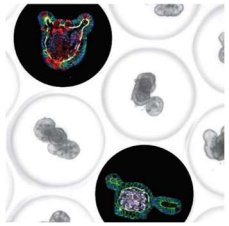
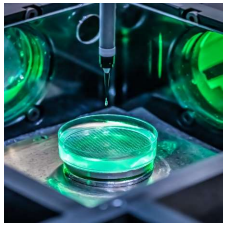
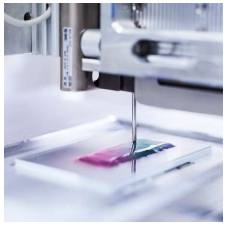
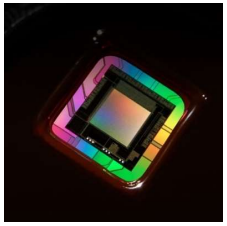
Tech Transfer

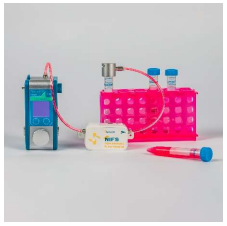
partialy

csem

SOCIETAL AND ECONOMIC IMPACT

SUNBIOSCIENCE HAMILTON REGEN+HU 3·Brain TECAN. FLUIGENT SMART MICROFLUIDICS cellularhighways A TTP Company INVENesis



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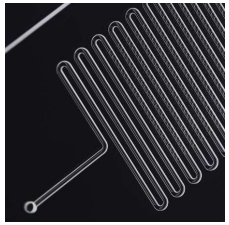
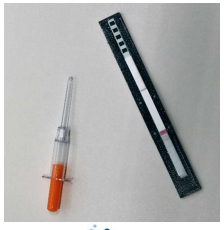
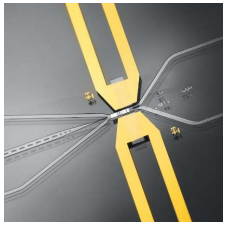







ALITHEA GENOMICS HiFiBiO THERAPEUTICS securecell AKTiA STAT PEEL maxon SURFIX diagnostics

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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

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Discover our Life Science Brochure

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


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FACING THE CHALLENGES OF OUR TIME