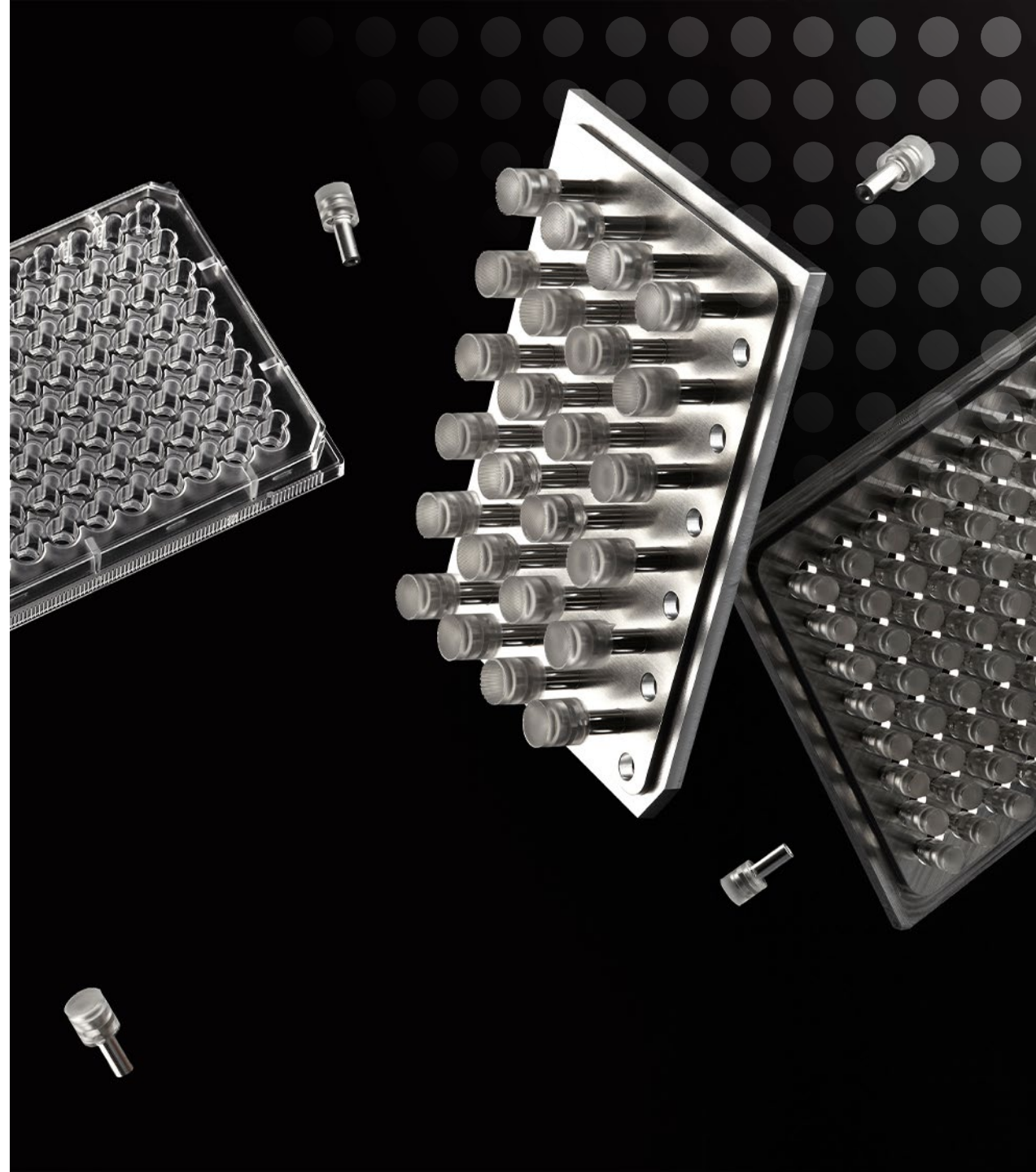


David Di Stadio  
R&D Engineer

## IMPRESSION 3D DE DISPOSITIFS FLUIDIQUES BIOCOMPATIBLES POUR DES APPLICATIONS EN SCIENCES DE LA VIE

# AGENDA

- CSEM
- 3D Printing
- Biocompatibility
- Applications
- Outlook



# 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 2024



**100.4**  
MIO TURNOVER  
in 2022

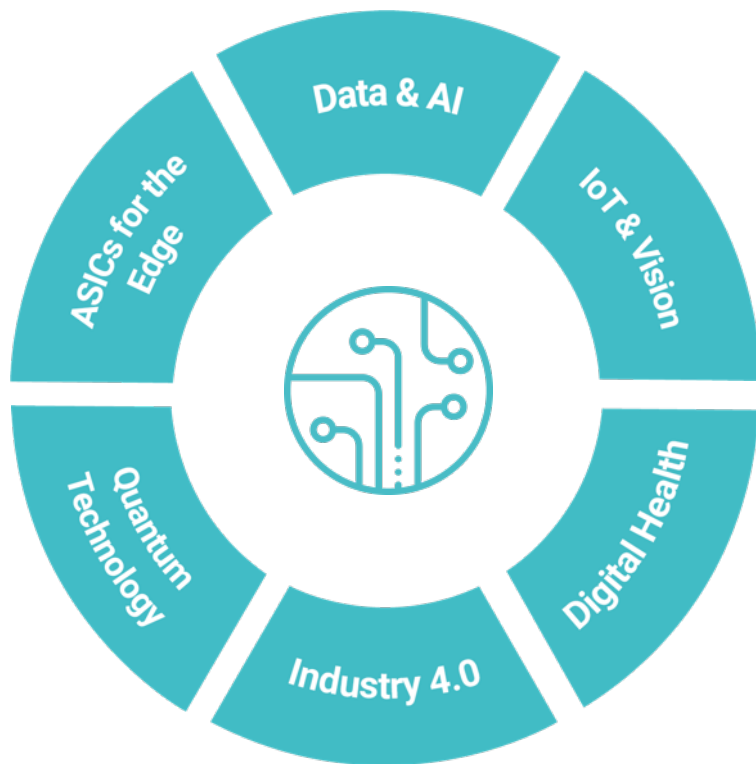


**> 50**  
VENTURES  
since 1984

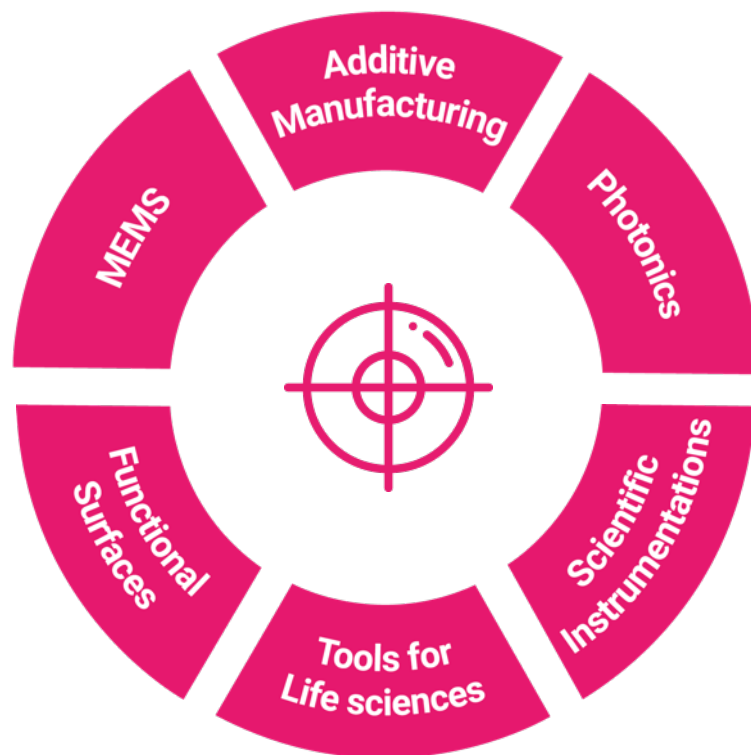


# TECHNOLOGIES IN FOCUS TO FOSTER INNOVATION

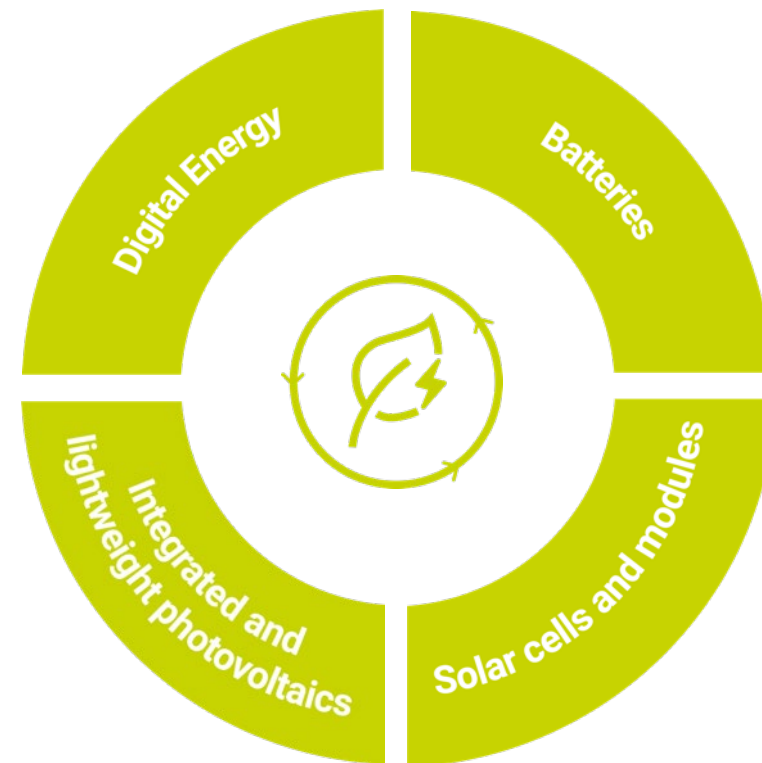
## Digital Technologies



## Precision Manufacturing



## Sustainable Energy

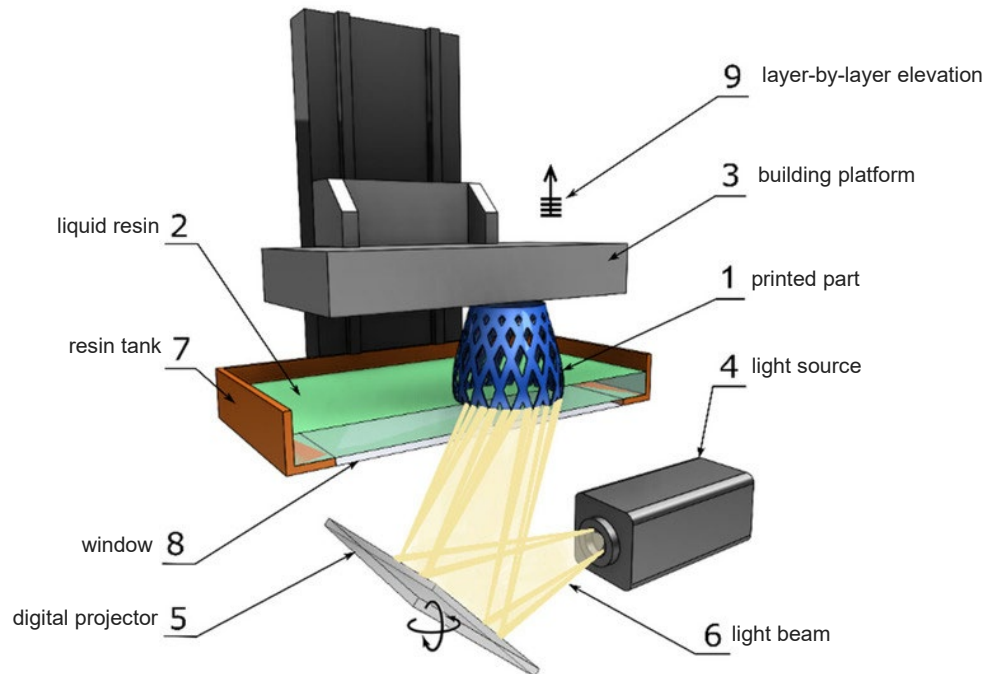


# 3D PRINTING

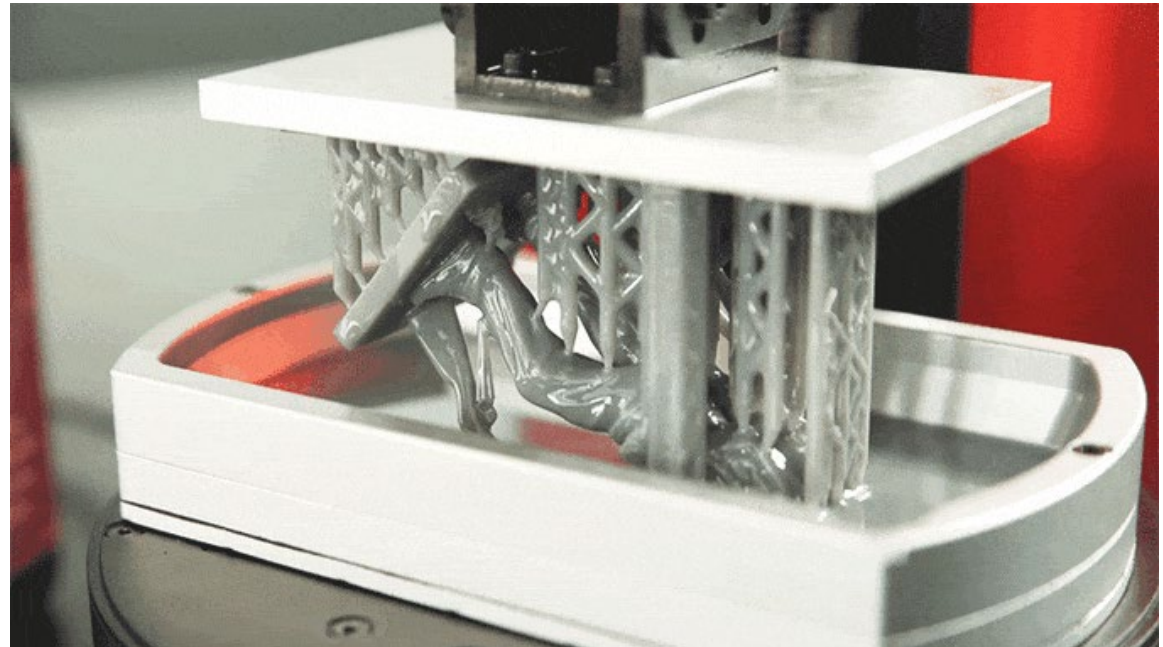
# STEREOLITHOGRAPHY - SLA

Photopolymerization resin sensitive to UV.

standard SLA machine

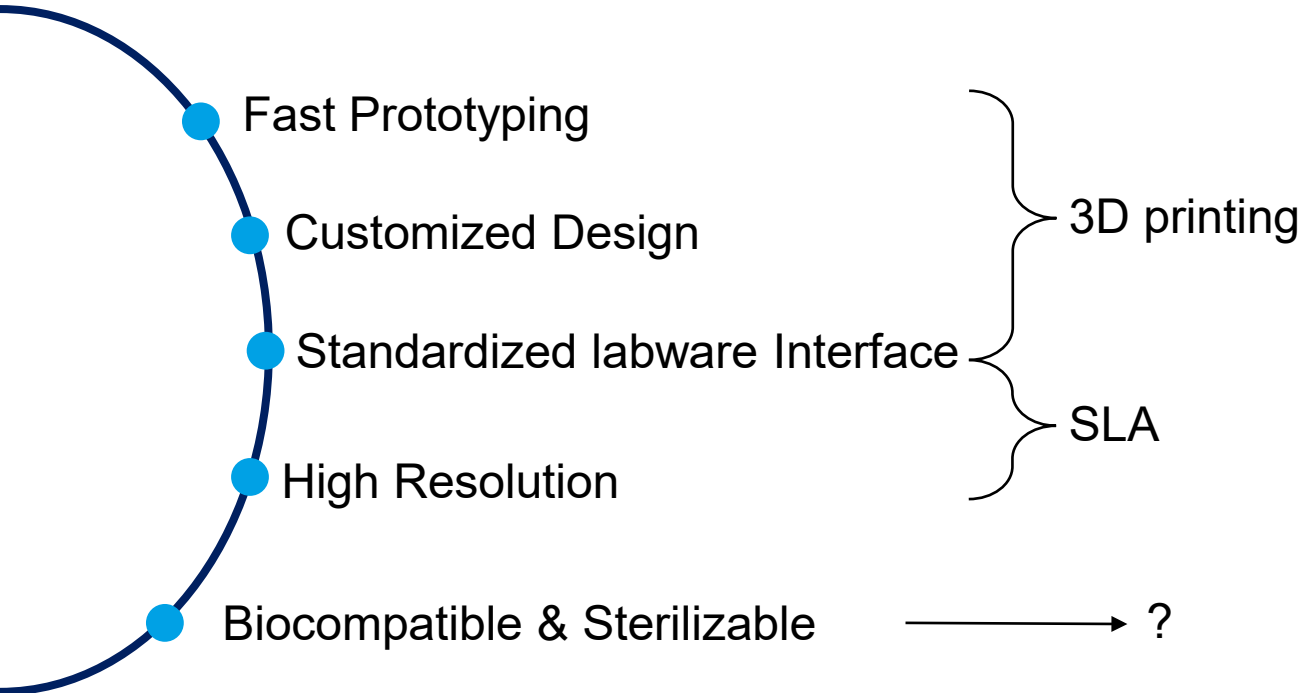


Pagac, M and al. Review of Vat Photopolymerization Technology: Materials, Applications, Challenges, and Future Trends of 3D Printing



# POLYMER 3D PRINTING FOR LIFE SCIENCE

R&D in pharma and personalized medicine need complex experimental labware to handle biofluids, cells, organoids





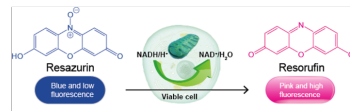
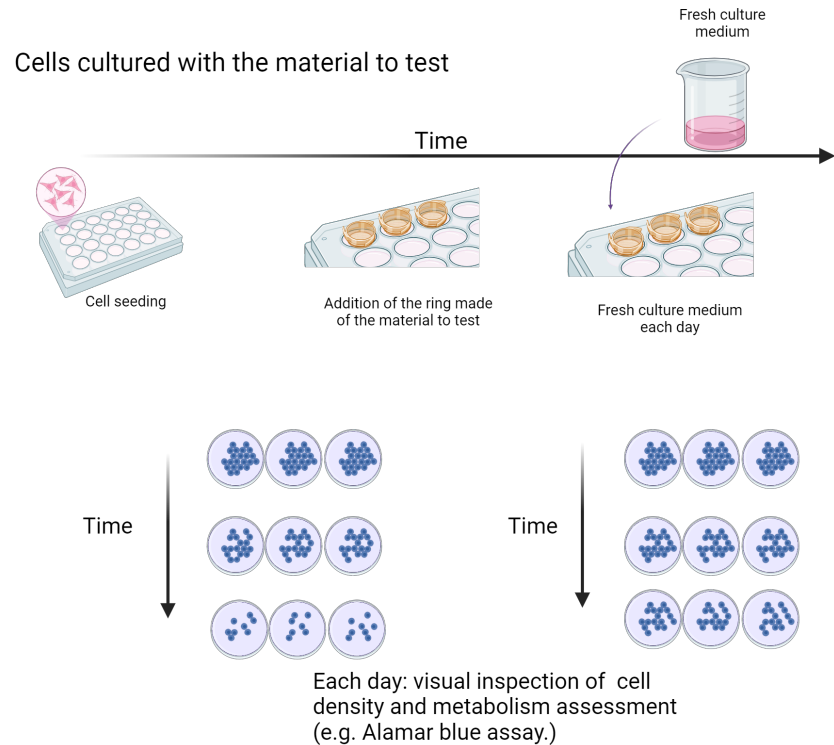
**BIOCOMPATIBILITY**



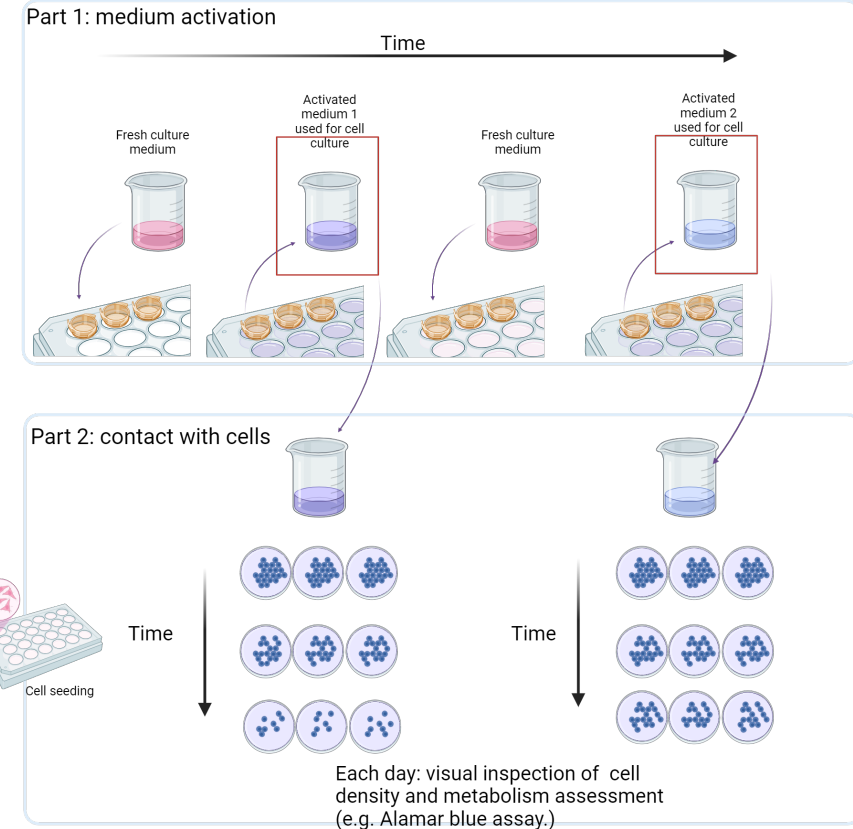
# Biocompatibility evaluation: Alamar blue assay

**Direct contact** : the cells will be in contact with the material to test

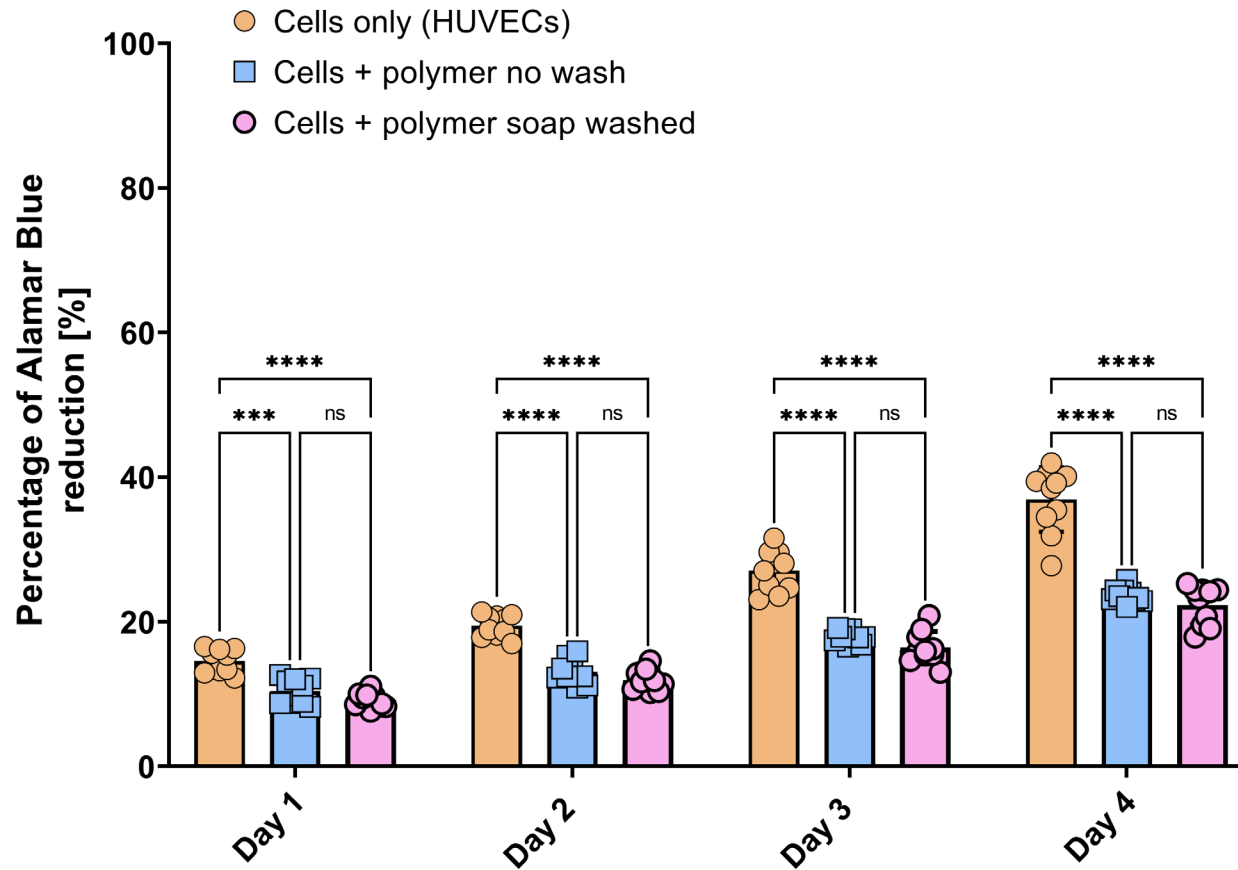
**Indirect contact** : the cells will be in contact with the medium that was in contact with the material to test



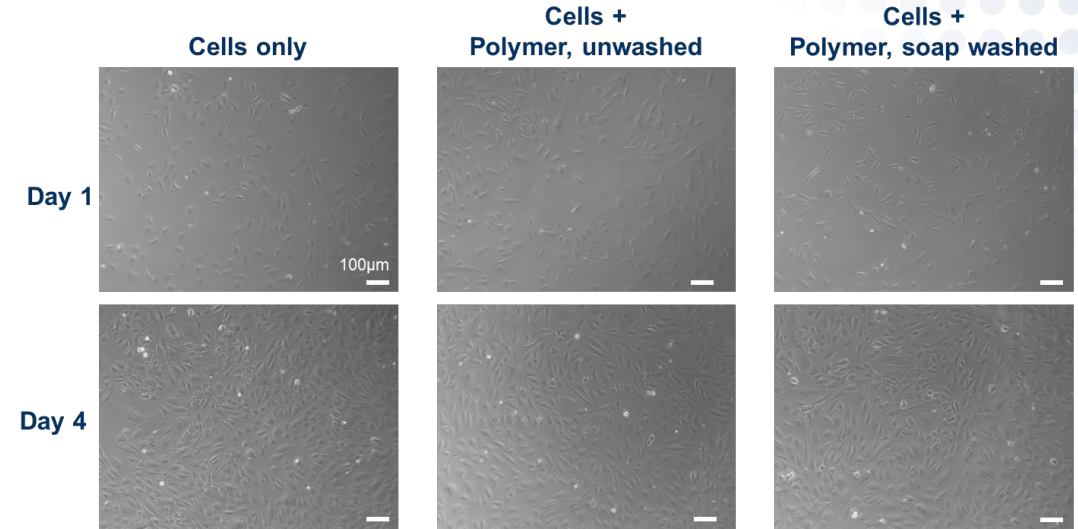
**Cell metabolism measurement:** reduction of the Resazurin by viable cells into fluorescent component Resorufin



# Biovalidation – typical results

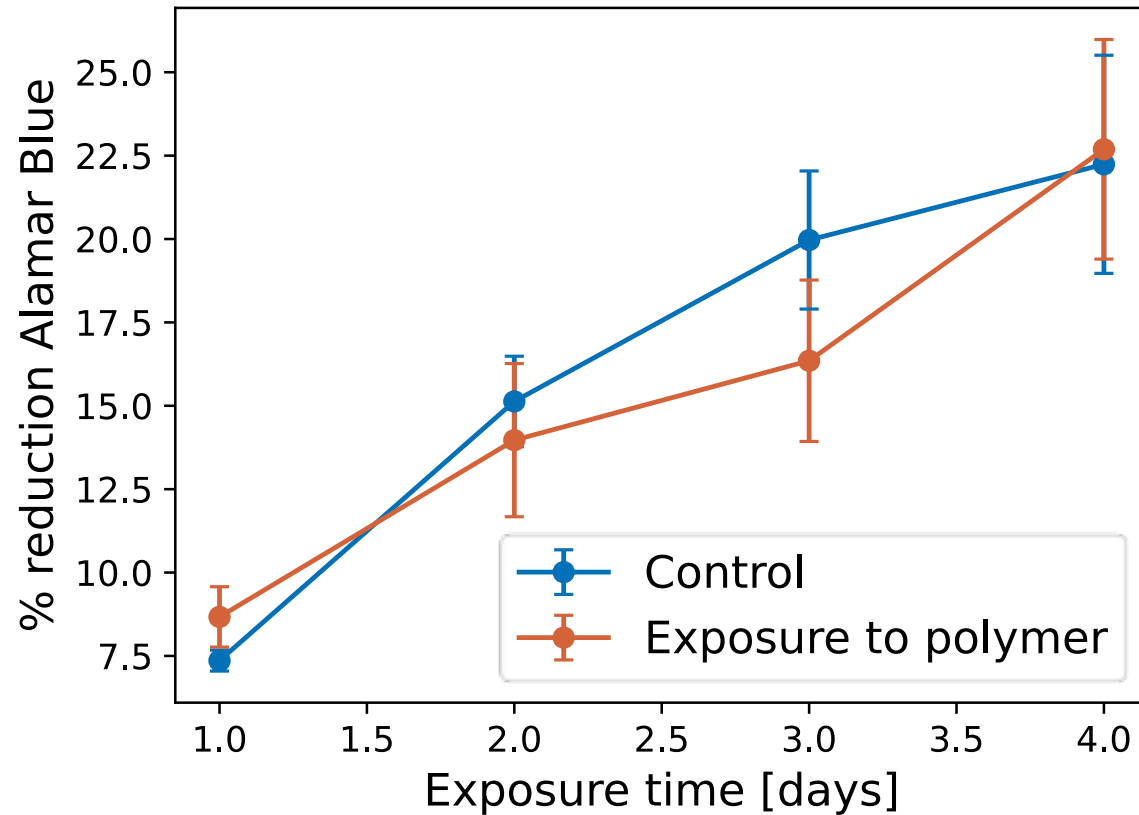


- The polymer significantly impact the HUVECs metabolism
- The impact is increasing overtime
- The washing step does not influence the material biocompatibility

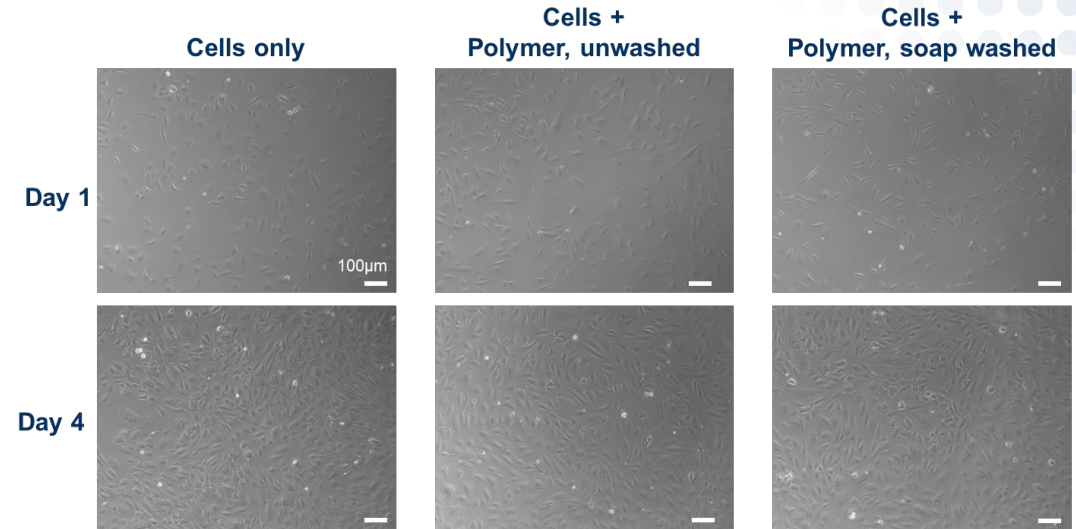


Cell density no visually affected by the polymer (not washed or washed)

# Biovalidation – typical results



- The polymer doesn't impact the HUVECs metabolism



Cell density no visually affected by the polymer (not washed or washed)

# APPLICATIONS

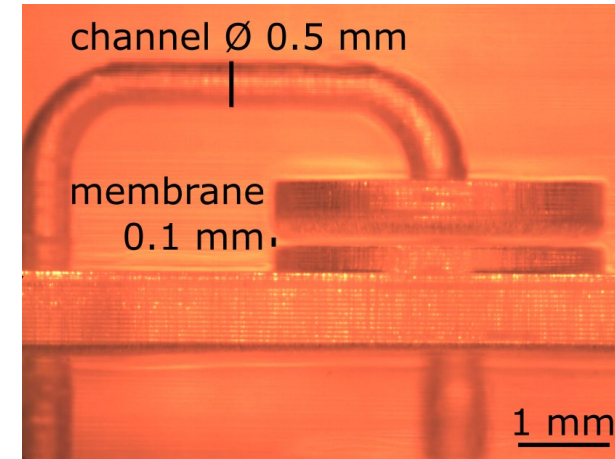
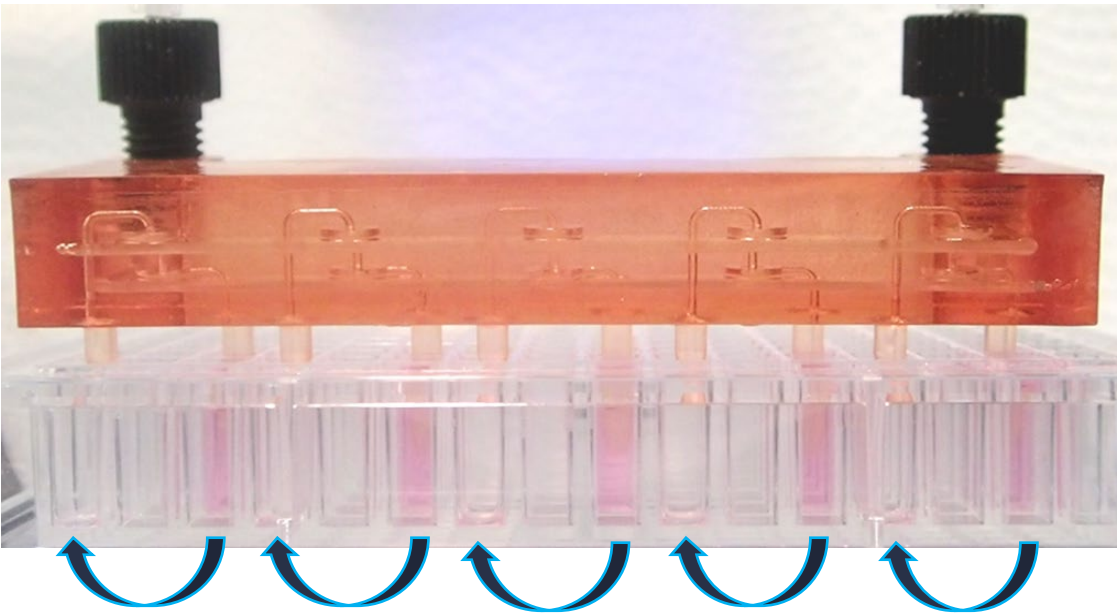
# SmartLid for automated, continuous perfusion

Pneumatic actuation of **integrated flexible membranes** on SmartLid

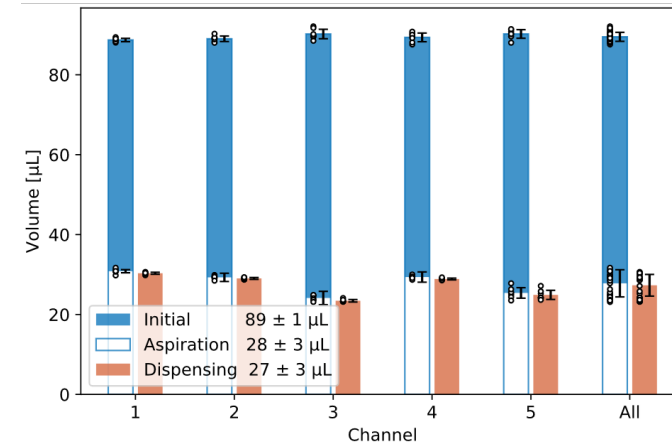
**Automated & continuous perfusion** of vascularized in-vitro tumor model

40x chips per plate = small footprint required

**Small volume** transfer achieved



After autoclave + 5'000 cycles

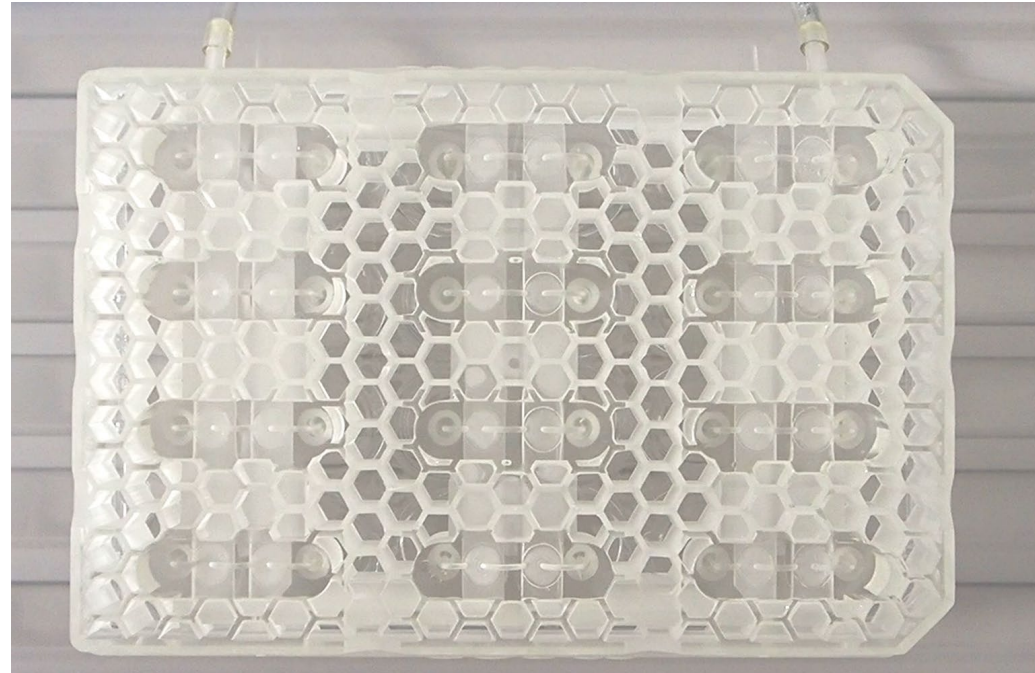




# Medium exchange in standard well-plates

Printing of **monolithic devices** with 12 integrated peristaltic membrane pumps

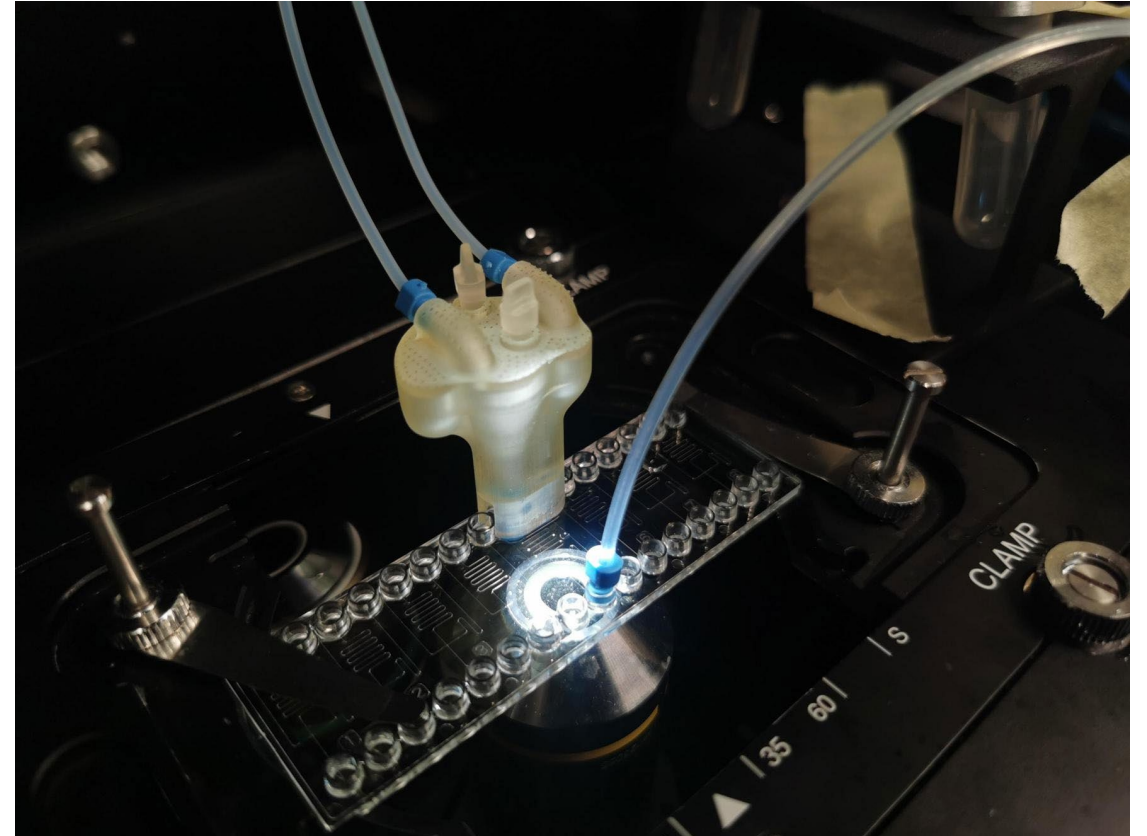
**Reliability improved** through process optimization & resins with different mechanical properties



# Customized connectors for microfluidics

Multi-port, air-tight reservoir for microfluidic applications

Compatibility with **standard labware**



# ACTIVE ALIGNERS 2.0

## PRODUCT

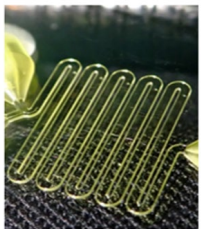
- Smart 3D printed aligners with microfluidic channels

- Beneficial fluids:

- Antibacterial
- Fluoride
- Flavor



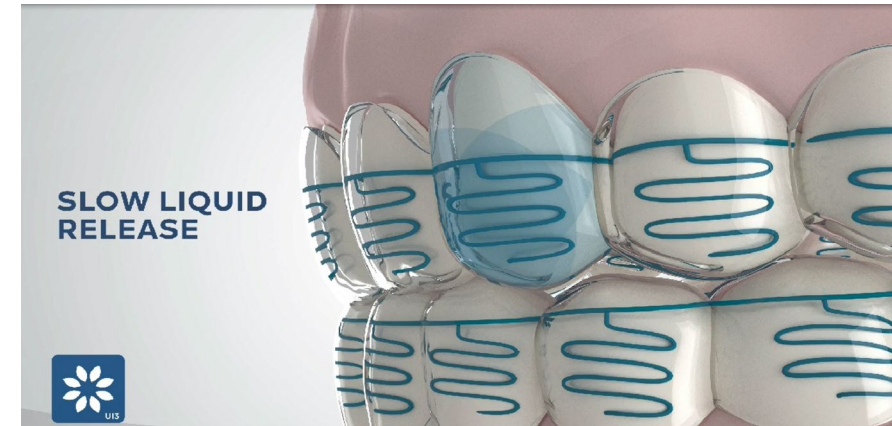
\*Aligner material is CE and FDA approved



# Aival

## BENEFIT

- Fluid is slowly released => Active aligner
  - No bacterial buildup
  - Enamel remineralization
  - Pleasant breath

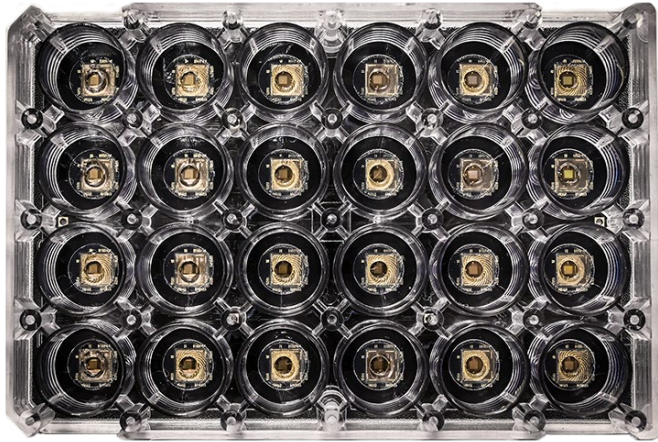


\*Fluid is transparent

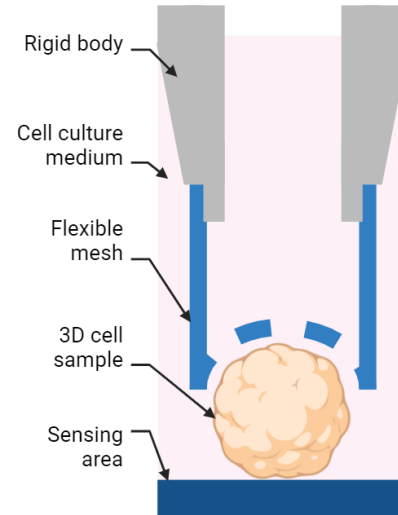


# 3D CELL SAMPLE POSITIONING INSERTS

## ELECTROPHYSIOLOGY IN MULTI-WELL PLATES



24-well CorePlate® with multi-electrode arrays

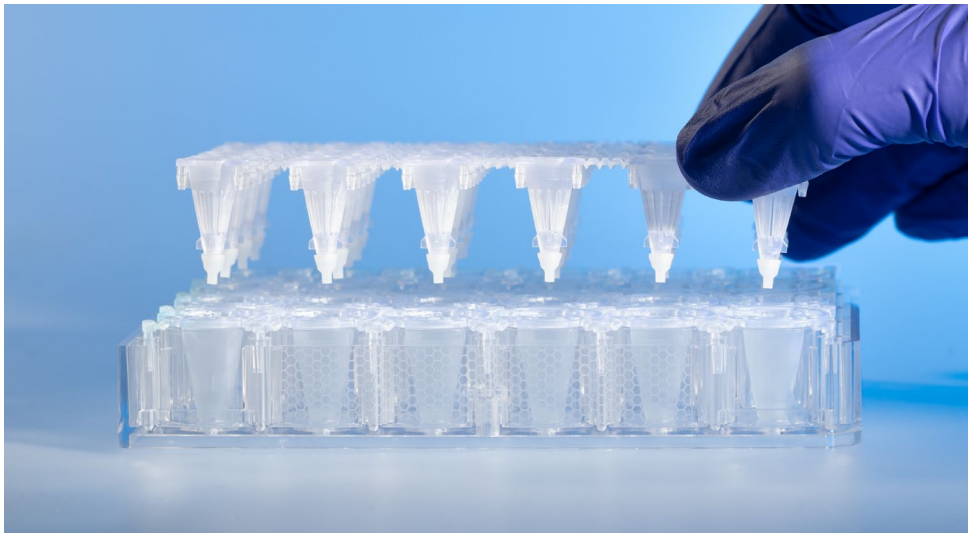


Complex in vitro 3D model from different sizes (0.2 – 2 mm)

Positioning and immobilization

Safe media exchange and perfusion

In vitro electrophysiological models



# OUTLOOK



# OUTLOOK AND CONCLUSIONS

- **3D printing is essential for life science**
  - Fast Prototyping & small production
  - Customized Design
  - High resolution
  - Biocompatible
- **Investigating different material**
  - Ceramics
  - Titanium





FACING THE CHALLENGES OF OUR TIME