Hahn Schickard

Visions to Products

innBW INNOVATIONSALLIANZ BADEN-WÜRTTEMBERG

Hahn-Schickard-Gesellschaft für angewandte Forschung e.V.

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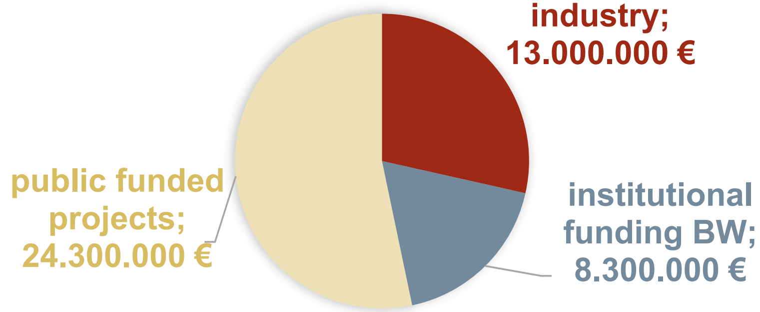
45,6 M€ revenue (2022)



270 employees (2022)

Member of the Innovation Alliance Baden-Württemberg

innBW INNOVATIONSALLIANZ BADEN-WÜRTTEMBERG

AiF Mitglied innBW INNOVATIONSALLIANZ BADEN-WÜRTTEMBERG

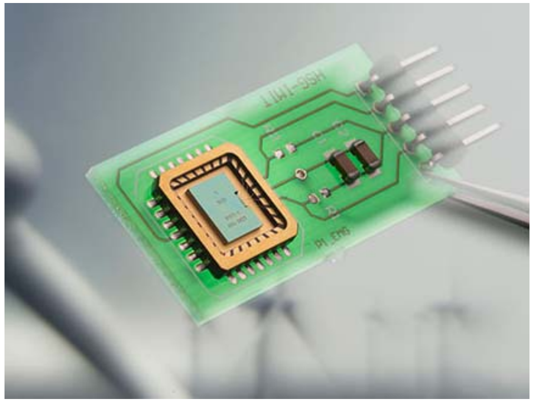
Business sectors

Researching

Exploring
the future

Engineering

Developing
tailored products



Manufacturing

Making
it happen

Venturing

Creating
future value

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Visions to Products

Business sector Venturing

Creating future value

Hahn-Schickard spin-offs:
> 200 high tech jobs in the region

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CYTENA
A BICO COMPANY
77

CYTENA BPS
A BICO COMPANY
13

Spindiag
0

BioFluidiX
a HAMILTON Company
24

DERMAGNOSTIX
21

actome
16

ionysis
14

Endress+Hauser
People for Process Automation
Biosense
15

Hahn-Schickard International
5 + 4

DETAGTO
INVISIBLE TRACING
4

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Visions to Products

Business sector Manufacturing

Making it happen

Examples of Point-of-care platforms from our spinoffs (centrifugal microfluidics)

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Spindiag

DERMAGNOSTIX

Endress+Hauser

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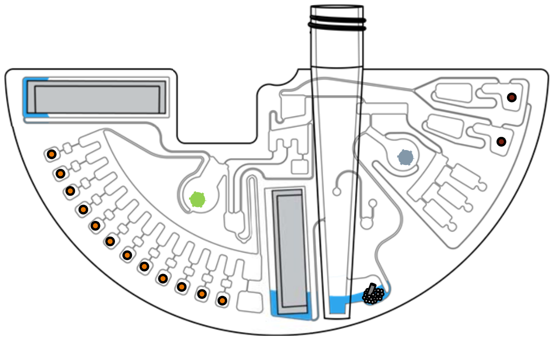
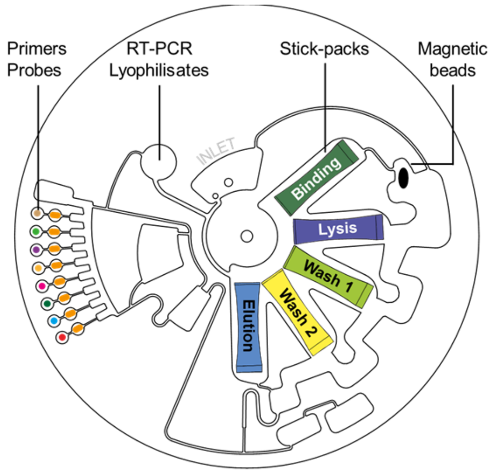
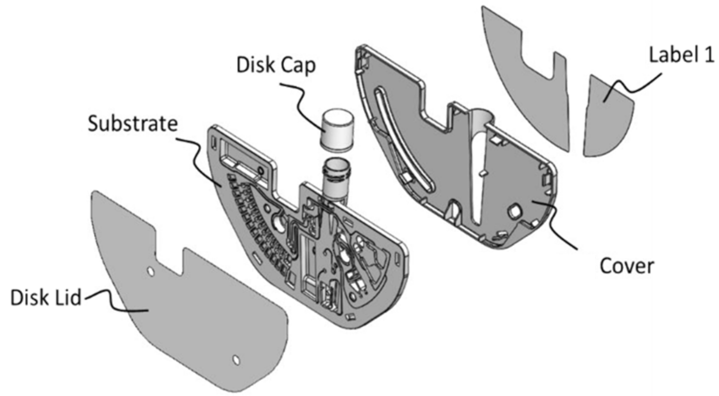
In house production according to ISO 13485: Assemble of cartridges

- **Station 0:** Input control
- **Station 1:** Coating
- **Station 2:** Glue Dispensing
- **Station 3:** Stick pack-Insert
- **Station 4:** Exposure
- **Station 5:** Dispensing
- **Station 6:** Quality control
- **Station 7:** Drying
- **Station 8:** Lyophilized-Insert
- **Station 9:** Sealing
- **Station 10:** Laser cutting
- **Station 11:** Labelling
- **Station 12:** Cover Montage
- **Station 13:** CE Marking
- **Station 14:** Quality-control
- **Station 15:** Packaging





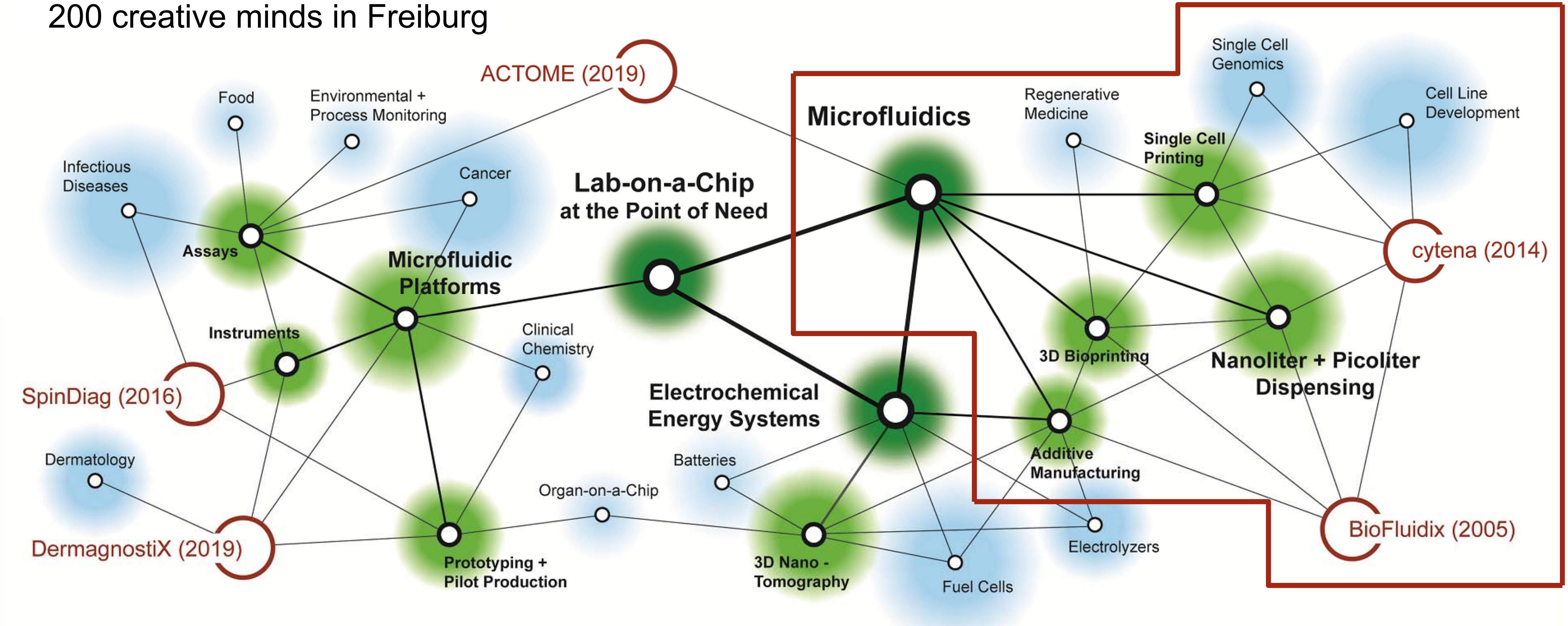


Automatisierung (1/2)

Kernkompetenzen und Anwendungsfelder

Hahn-Schickard FR im Verbund mit IMTEK-Anwendungsentwicklung & Spin-Offs

200 creative minds in Freiburg



Laboratory Automation

Sabrina Kartmann

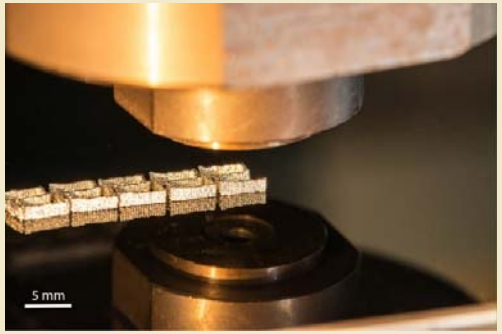
Hahn-Schickard, Freiburg

Laboratory Automation– overview of the groups

Printing processes and systems

- Development of hybrid printing systems (polymer + metal)
- Process development

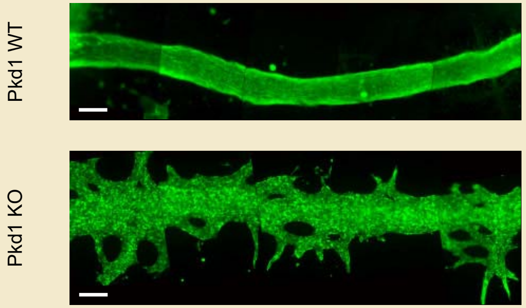
Dr. Zhe Shu



3D BioPrinting

- Single micro tumor deposition for personalized medicine
- Biofabrication of vascularized bone tissue and perfusable nephron tubules

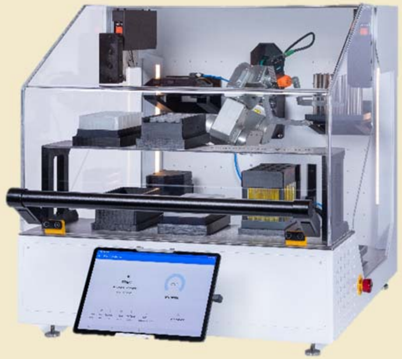
Dr. Stefan Zimmermann



Robotics & Instrumentation

- Sensors, measurement & novel non-contact dosage technologies
- Laboratory Automation

Dr. Sabrina Kartmann



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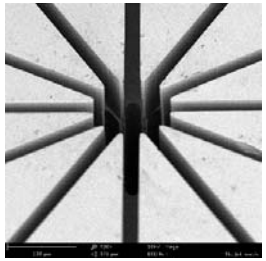
Visions to Products

Printing processes and systems

StarJet Technology

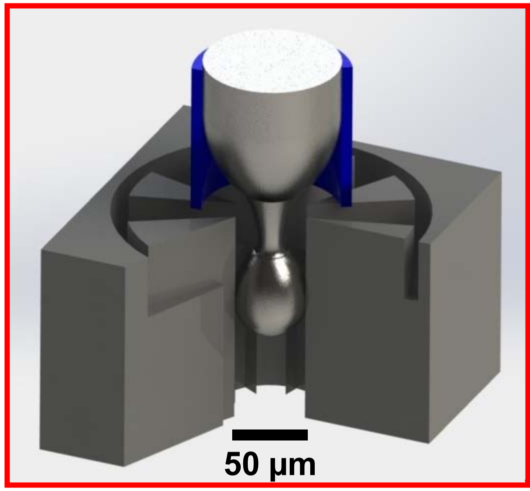
For direct, non-contact printing of molten metals

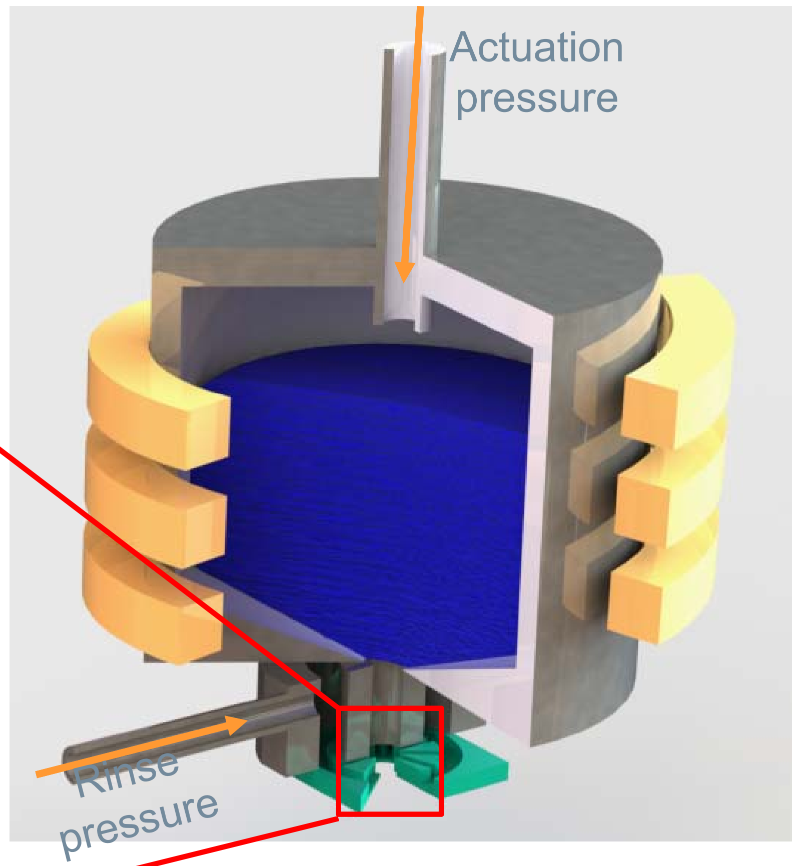
- Molten metal is ejected from nozzle in liquid state
- Metal solidifies upon impact on target



Pneumatically driven printhead

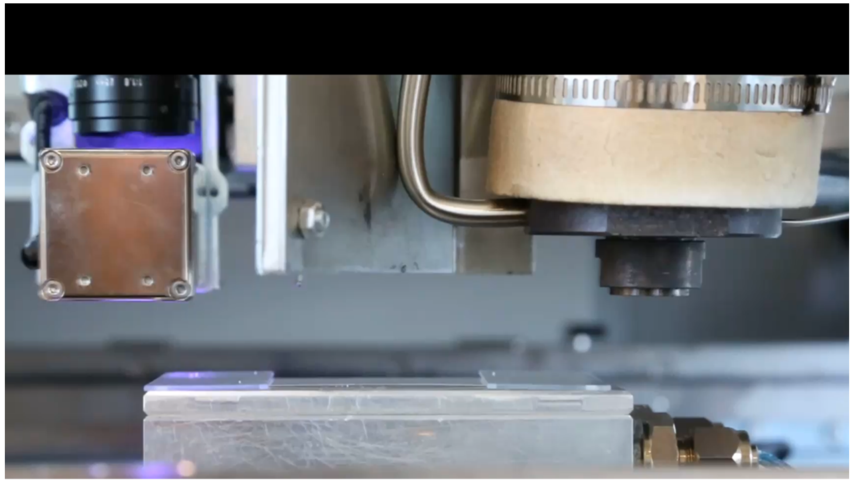
- Star-shaped nozzle chip
  - ➢ High directional stability
  - ➢ Oxidation reduced by sheath flow
- No temperature limitation for material
  - ➢ Bulk tin alloy (Solder) > 150 °C
  - ➢ Bulk Zink alloy (ZAMAK) > 400 °C
  - ➢ Bulk Aluminium alloy > 660 °C
- No chemical / post-treatment needed (no inks / pastes / particles)

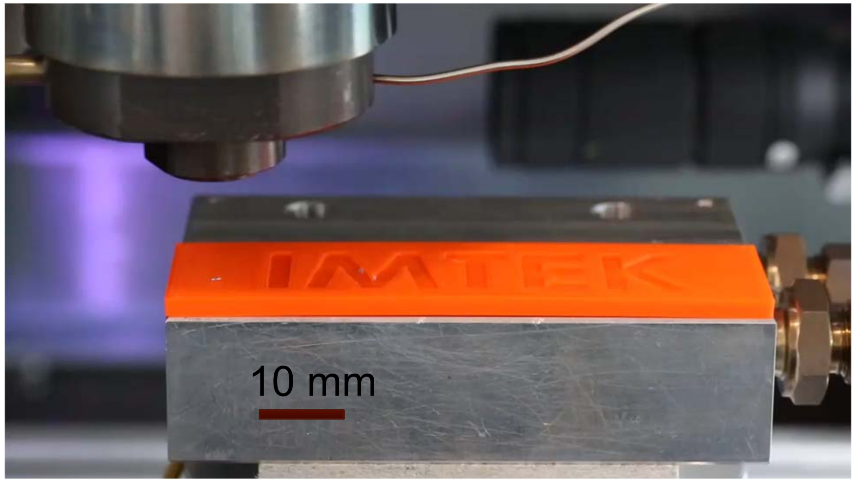




Molten metal interacting with polymer

- StarJet can operated at Drop-on-demand or Jet mode
- High temperature of StarJet is still compatible with temperature sensitive polymers





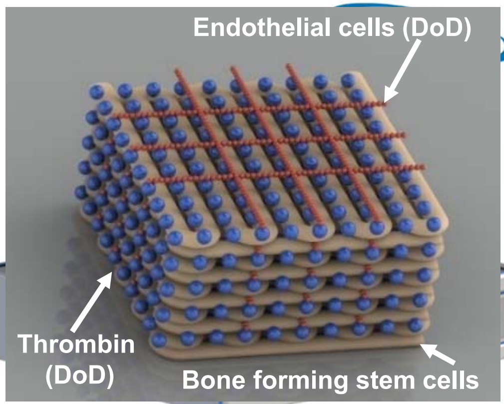
Printhead Temperature @ 400 °C

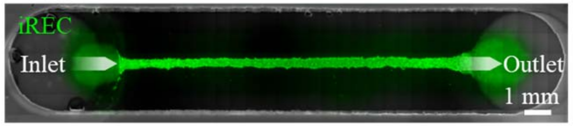
Substrate: 3D printed PETG with T_g of 60 °C

3D BioPrinting

3D bioprinting for medicine and drug discovery

- Drop-on-demand and extrusion-based printing technologies on a single platform
- Biofabrication of vascularized bone tissue and perfusable nephron tubules
- Hybrid 3D bioprinting processes supporting cellular self-assembly for regenerative medicine and organ-on-a-chip applications
- Single micro tumor deposition for personalized medicine
- Standartization in 3D Bioprinting
  - Bioprinting Fidelity Imager





Hybrid bioprinting of vascularized bone tissue

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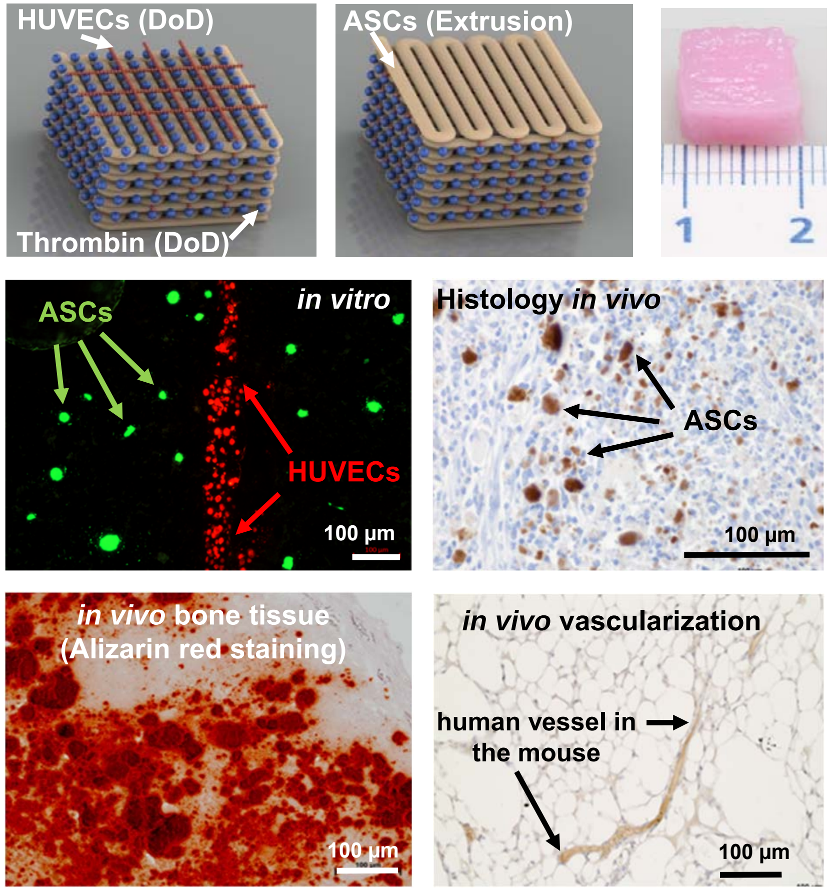
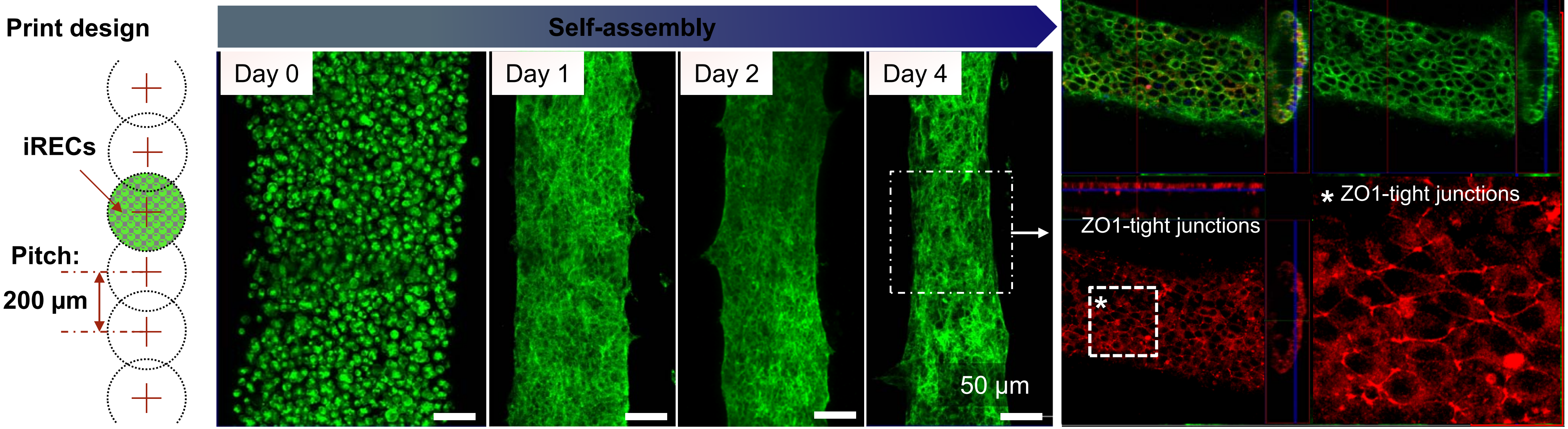
- Relevant cell types
  - Osteogenic differentiation of human adipose-derived mesenchymal stem cells (ASCs)
  - Human umbilical cord vascular endothelial cells (HUVECs)
- Hybrid bioprinting process
  - Extrusion of ASCs into complex osteohydrogels
  - Linear drop-on-demand printing of HUVECs
  - FDM printed polycaprolactone to increase mechanical stability during printing
- Formation of mineralized bone tissue and human blood vessels *in vivo*



Rukavina, et al. Biotechnology and Bioengineering. 2020

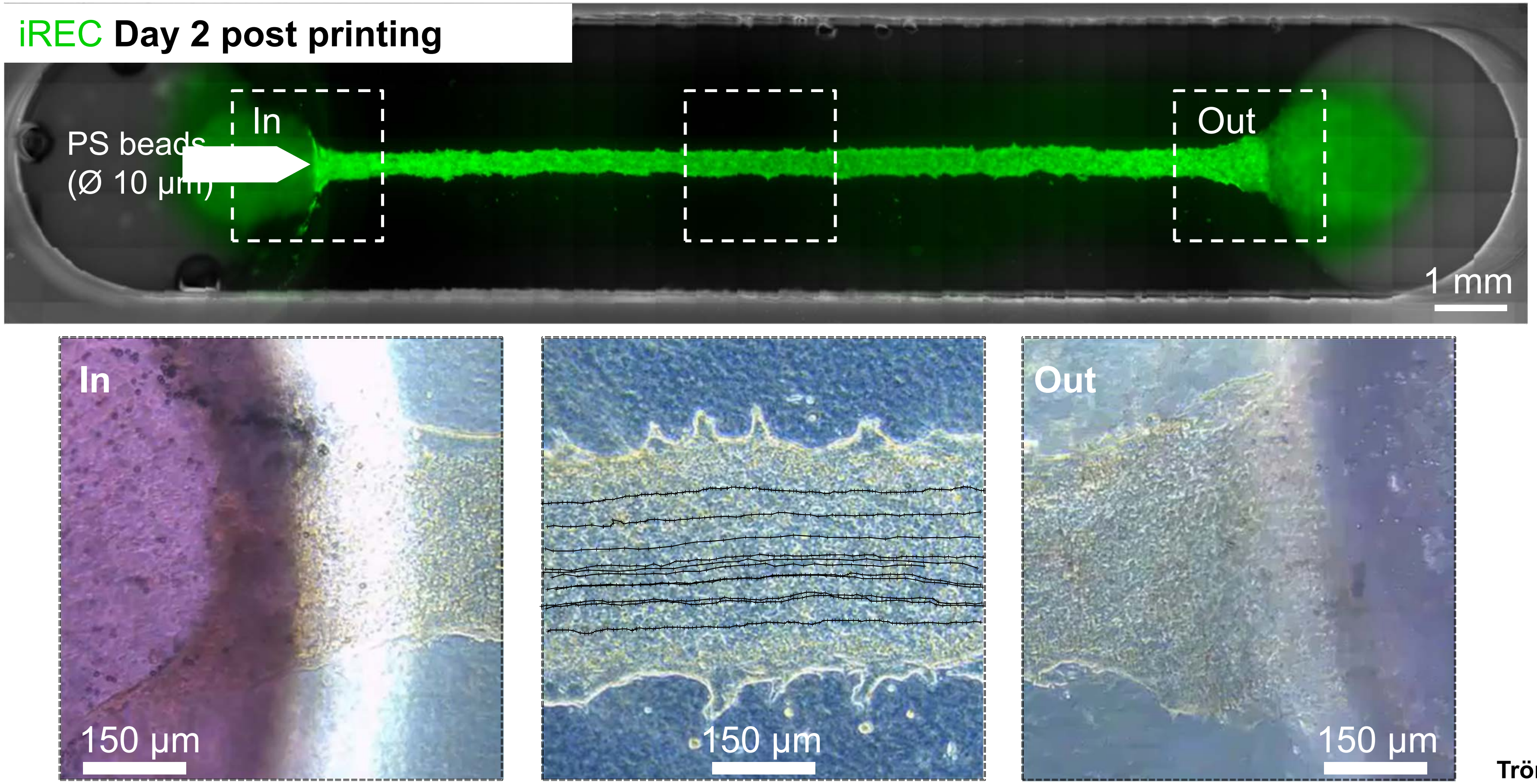
Physiological bioprinted kidney cell model

- Self-assembly of inducible renal epithelial cells (iRECs) results in tubular structures within a natural hydrogel matrix
- More physiological structure and dimension than previous models



Tröndle et al. 2021

Perfusion of nephron-like tubuli



Tröndle et al. 2021

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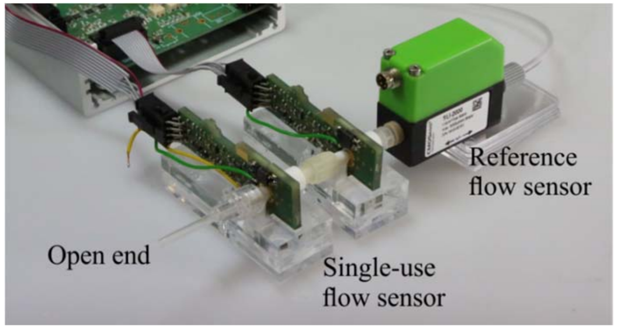
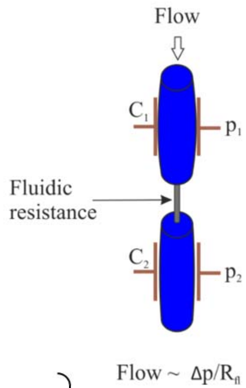
Robotics & Instrumentation

Different flow sensing techniques

Capacitive flow sensor

- Capacitive measurement principle
- Contaminated parts can be exchanged after use
- Flow range: 60 to 6000 µl/min
- High speed: < 2 ms

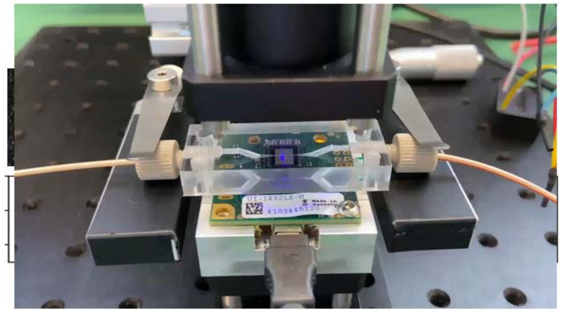


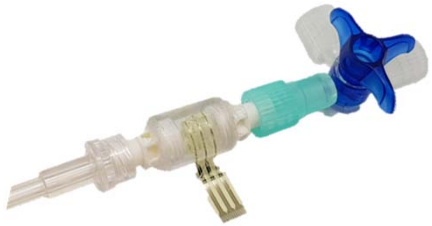


Kartmann, S., et al., Sensors and Actuators A: Physical 247 (2016): 656-662.
Patentfamilie: WO2014048911A1

Calorimetric flow sensor

- Flexible low-cost polymeric foil with embedded sensors and heaters
- Flow range: 80 – 800 µl/min





Holo µ-PIV flow sensor (MEDD II)

- Under development
- Flow range: 5 to 500 nL/min

Automated Volume Measurement

Multiple measurement methods

- Executed on the same individual droplet
- Under identical conditions
- With “arbitrary” liquids

Investigated methods

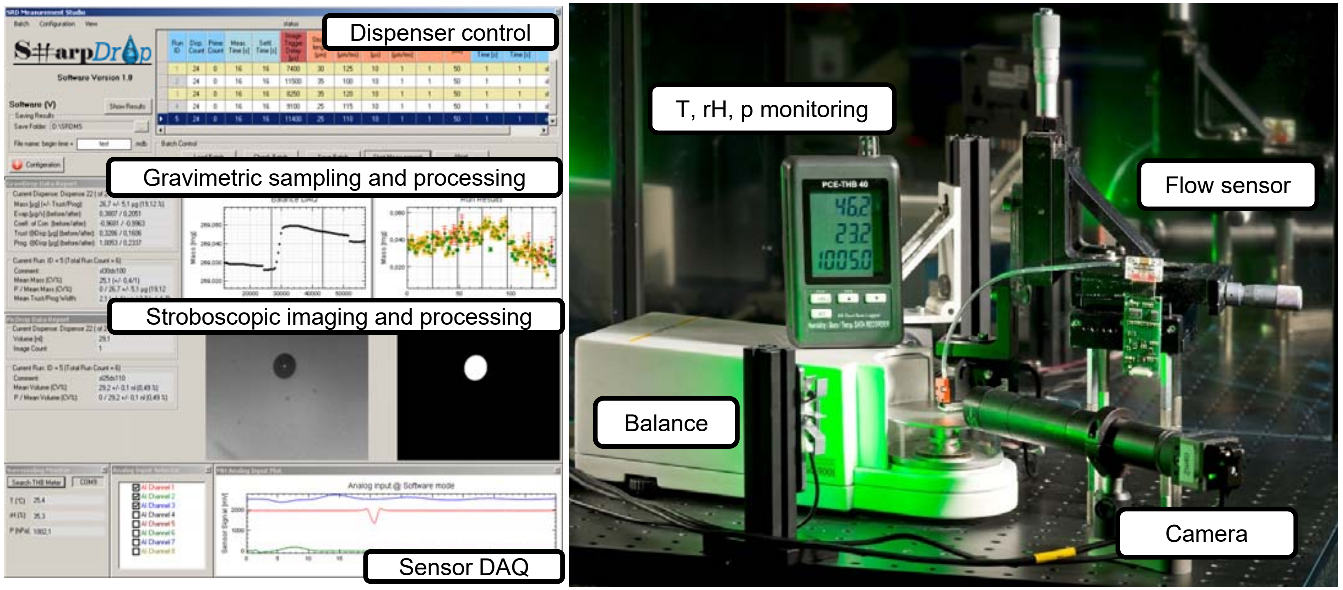
- Gravimetric (reference)
- Stroboscopic
- Droplet sensors

Off-line reference

- Fluorometric Method (Artel MVS)

SharpDrop Software

- Acquisition of all sensor data
- Analysis and direct display of the results

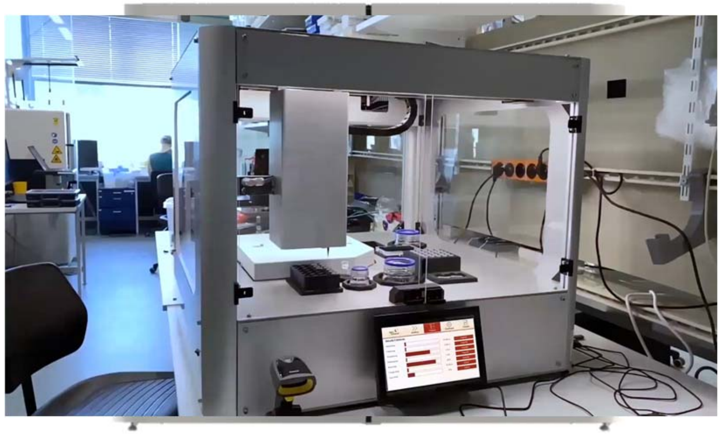


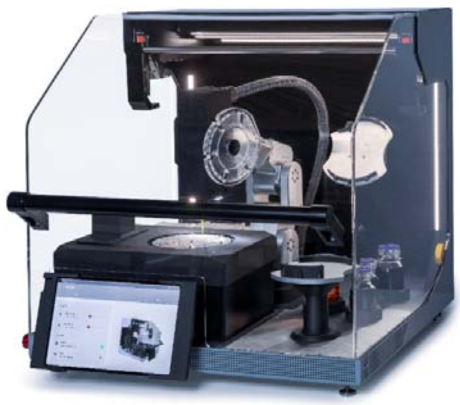
Participation in ISO/TC48 WG5 (Expert)

Automation of laboratory processes

Liquid handling workstations

- Fields of application: biotechnology, pharmaceutical and food technology
- Customized solutions
- Use of different motion technologies (SCARA, 6-axis robot arm, axis systems)



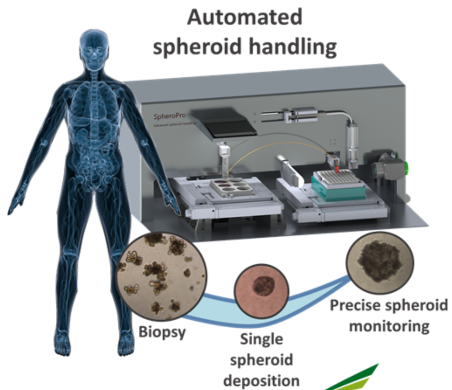


Development of new components

- Pressure & flow sensors
- Incubator, Heater, gripper

Small autonomous embedded systems

- Based on our embedded Linux platform
- Miniaturized processing systems
  - ➢ Microbioreactors (e.g. for cell line development)
  - ➢ Perfusion systems for organ-on-chip application



Computer Vision

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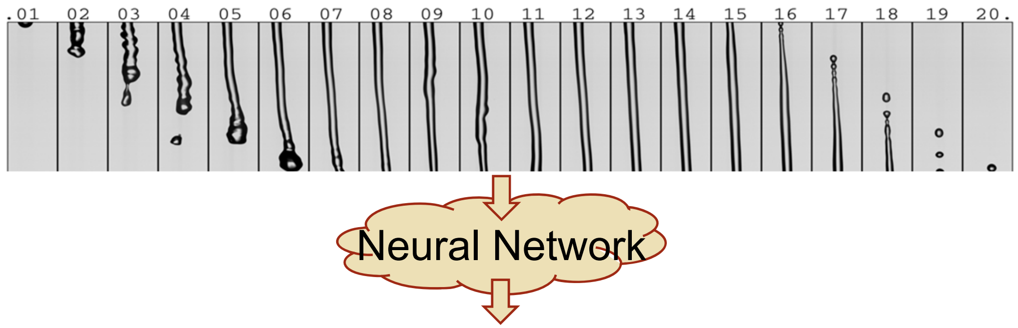
Dosing technology

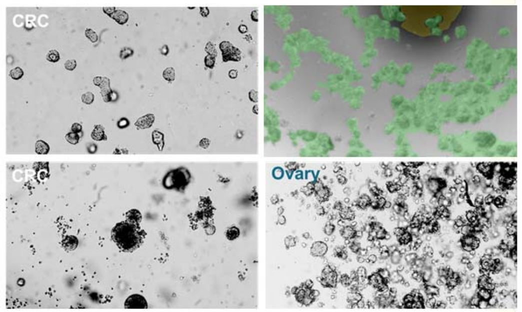
- Determination of the volume of jets with the help of deep learning
- Determination of rheological properties with the help of deep learning

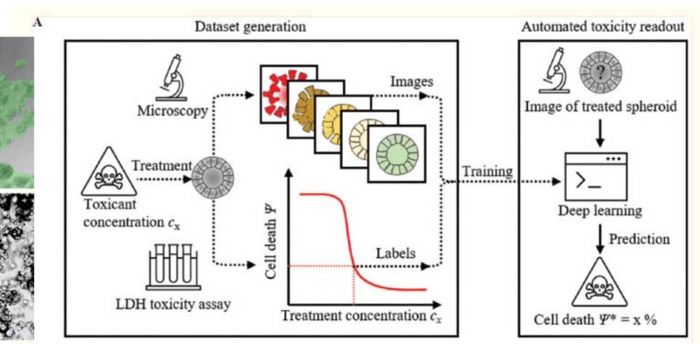


Volume (nL), viscosity etc.

3D cell culture

- Optimization of 3D cell culture workflows using computer vision
- Image recognition for printing cells/spheroids
- Deep learning-assisted nephrotoxicity testing with bioprinted renal spheroids





https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9186384/

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