WIR! sind

DIANA

HERSTELLUNG VON DISPOSABLES

Dr.-Ing. Jörg Nestler

bi.FLOW

10. September 2024

We cost-effectively integrate all functionalities in a cartridge
→ minimizing instrument size towards true “mobile” diagnostics

Integrated Pumping

Our microfluidic cartridges feature built-in electrochemical micropumps, enabling fluid transport via electrical control.

Integrated Heating

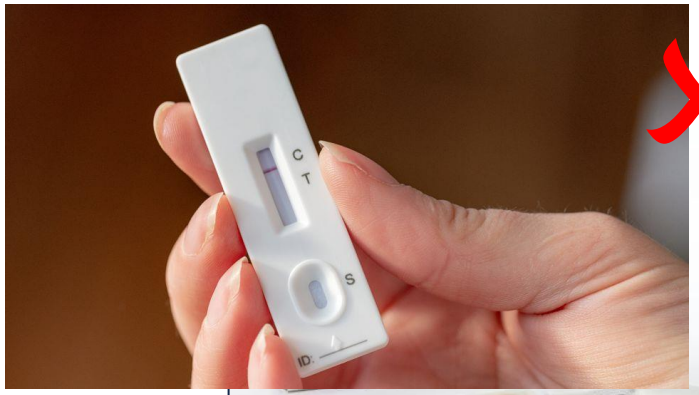
If heating is required for certain assay steps, tiny heating elements can be integrated into specific areas of the cartridge, using the same substrate as for the micropumps.

Integrated Reagents

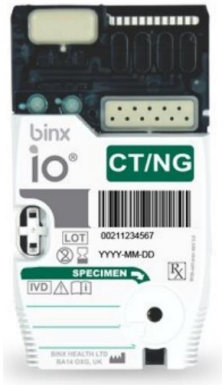
Our technology platform is capable of storing liquid and dry reagents.

TRUE “MOBILE” DIAGNOSTICS: The unique level of integration allows to perform even complex tests with a smartphone.

„DISPOSABLES“ – AND FOCUS of the TALK



Lateral Flow Strips



„Microfluidics“

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COMPLEXITY

	Low level of integration (Functions performed by instrument)	**High level of integration** (Functions performed by „disposable“)
Advantages	- Cheaper disposable	- Simple control of disposable - Simpler instrument (or even just a mobile phone), as no mechanical / pneumatic interface needed in instrument - Less maintanance of instrument - Operation by lay persons even for **complex tests**
Disadvantages	- More complex instrument	- Disposable more costly

IT DEPENDS
ON THE APPLICATION & USE CASE

COMPLEXITY vs. QUALITY

$$(98\ \%)^{20} = 67\ \%$$
$$(98\ \%)^{50} = 36\ \%$$
$$(95\ \%)^{20} = 36\ \%$$

→ Very often: Quality issue NOT detectable in a FQC!

→ Importance of 100% in-process QCs

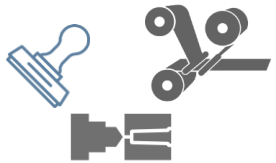
Good estimation: 50 % of production cost = QC

VALUE CHAIN – and WHAT IS INSIDE?

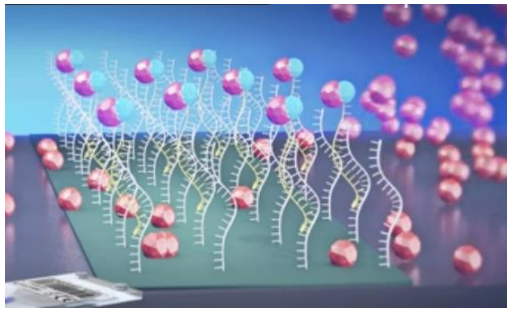
Primary Components

Assay → Design → Patterning → Surface functionalisation → Electrodes Sensors → Backend Services → Read Out Device System Integration → QM

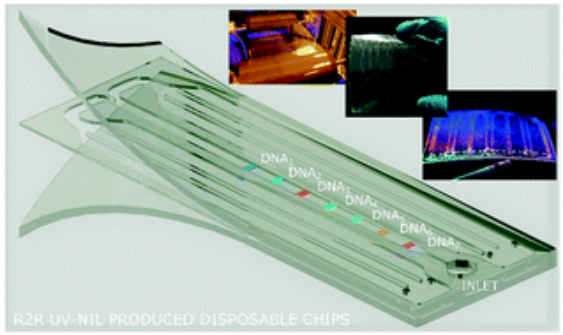








- IVD - ELISA, LAMP, PCR
- ENZYME Detection
- CELL analysis
- Water, Food analysis



- Active & Passive Microfluidics
- From Milling over Inj. Mold to Roll-to-Roll
- From several 100 to Millions of Units

Microfluidic Chip

- Device Development
- Technology Platforms
- Complete System Integration

Microfluidic Solution

Microfluidics InnovationHub

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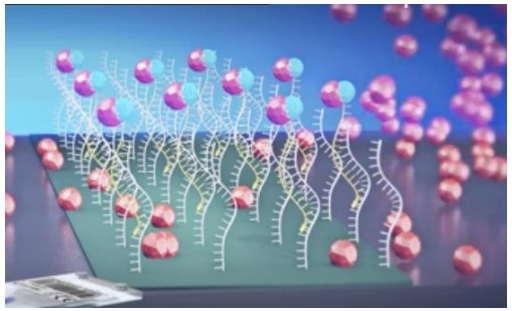
VALUE CHAIN – and WHAT IS INSIDE?

Primary Components

Assay | Design | Patterning | Surface functionalisation | Electrodes Sensors | Backend Services | Read Out Device System Integration | QM



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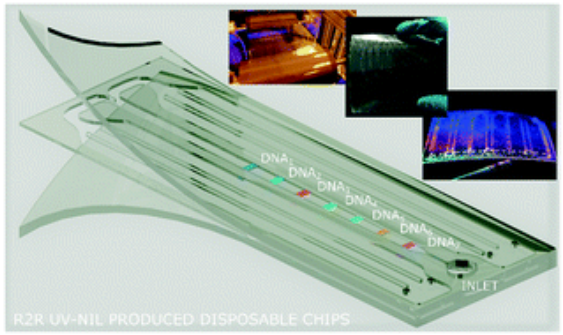

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Microfluidic Solution

Microfluidics InnovationHub

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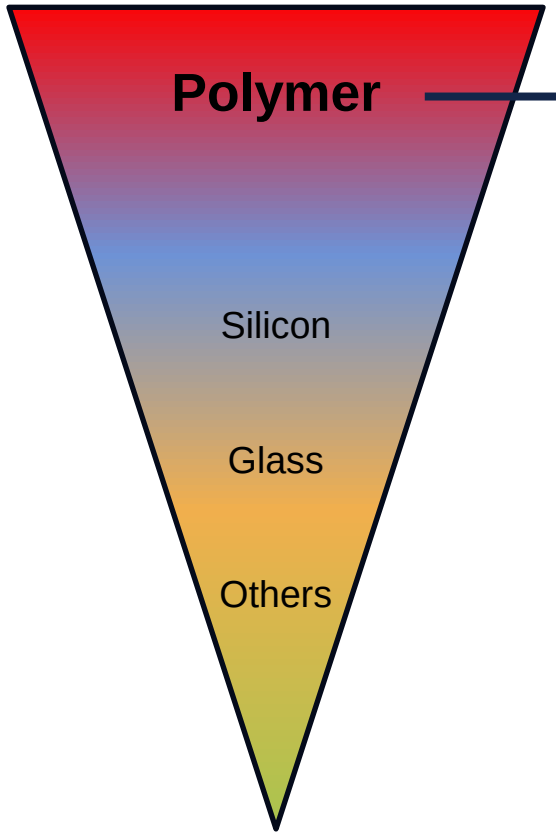
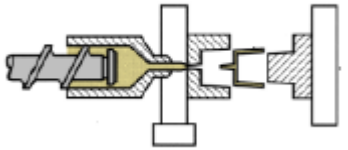
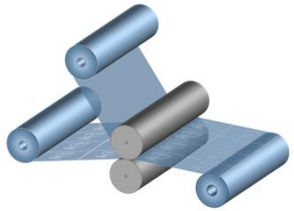
PATTERNING: MATERIALS & TECHNOLOGIES



- **Molding / Thermoforming**
- 3D printing
- **Laser cutting**
- Mechanical Micromachining
- **Laser ablation**
- …



- Injection molding
- Hot Embossing
- Roll-to-Roll



VALUE CHAIN – and WHAT IS INSIDE?

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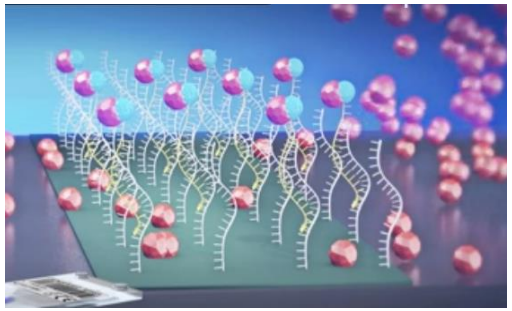

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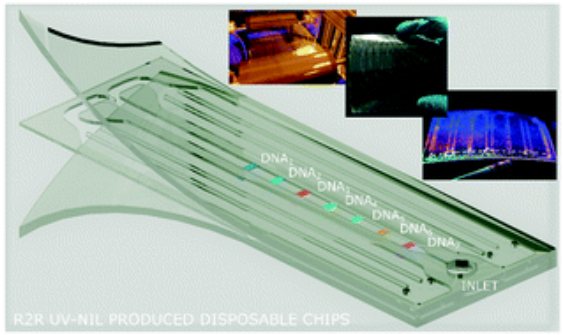

- Active & Passive Microfluidics
- From Milling over Inj. Mold to Roll-to-Roll
- From several 100 to Millions of Units

Microfluidic Chip

- Device Development
- Technology Platforms
- Complete System Integration

Microfluidic Solution

Microfluidics InnovationHub

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SURFACE FUNCTIONALIZATION

Used for, e.g.:

- Adjustment of **wettability** (sensor, microfluidics)
  → dip coating, spray coating, dispensing/spotting

- **Blocking** of surfaces (sensor, microfluidics)
  → dip coating, spray coating

- Deposition of **biomolecules**
  (recognition molecules on **sensor**)
  → spotting

Array of spots (dia: 150µm)

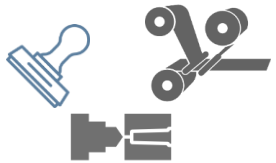
Spotting machine (Scienion)

VALUE CHAIN – and WHAT IS INSIDE?

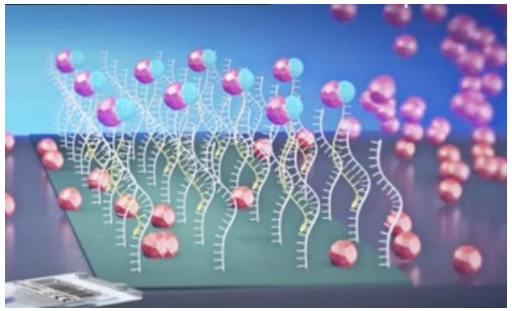
Primary Components

Assay | Design | Patterning | Surface functionalisation | Electrodes Sensors | Backend Services | Read Out Device System Integration | QM









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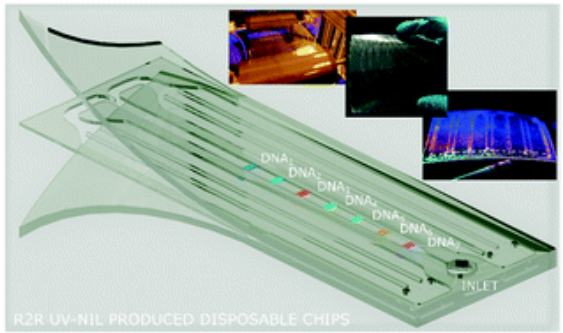

- Active & Passive Microfluidics
- From Milling over Inj. Mold to Roll-to-Roll
- From several 100 to Millions of Units

Microfluidic Chip

- Device Development
- Technology Platforms
- Complete System Integration

Microfluidic Solution

Microfluidics InnovationHub

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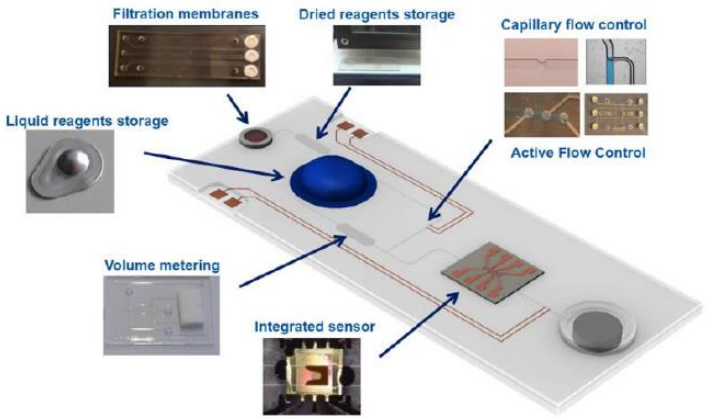
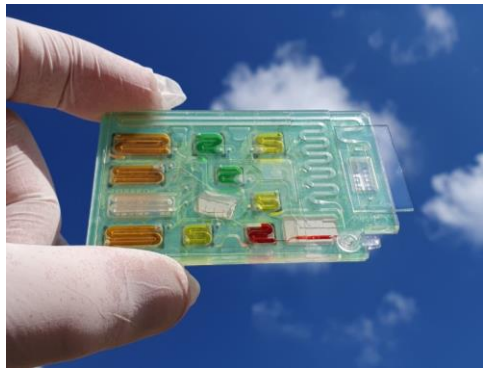
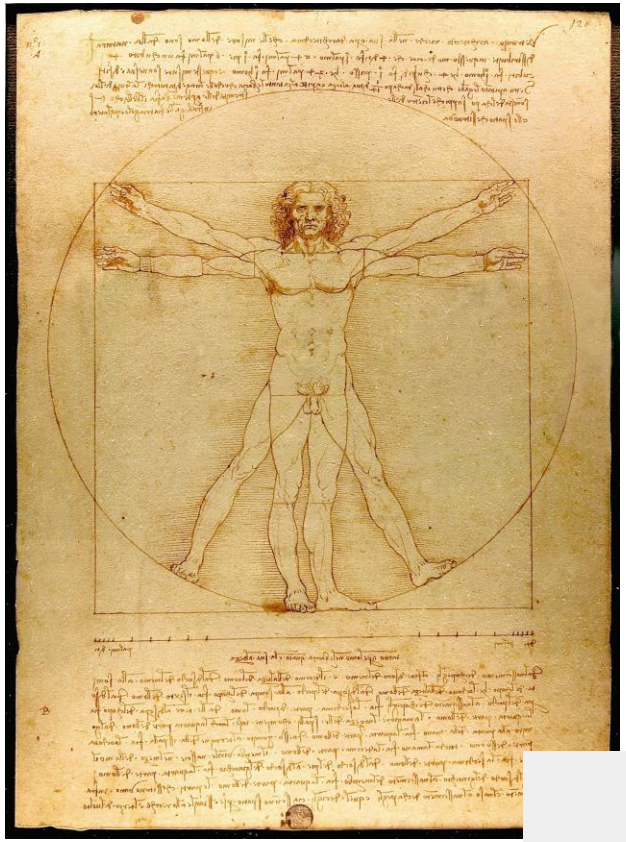
BACK-END PROCESSES

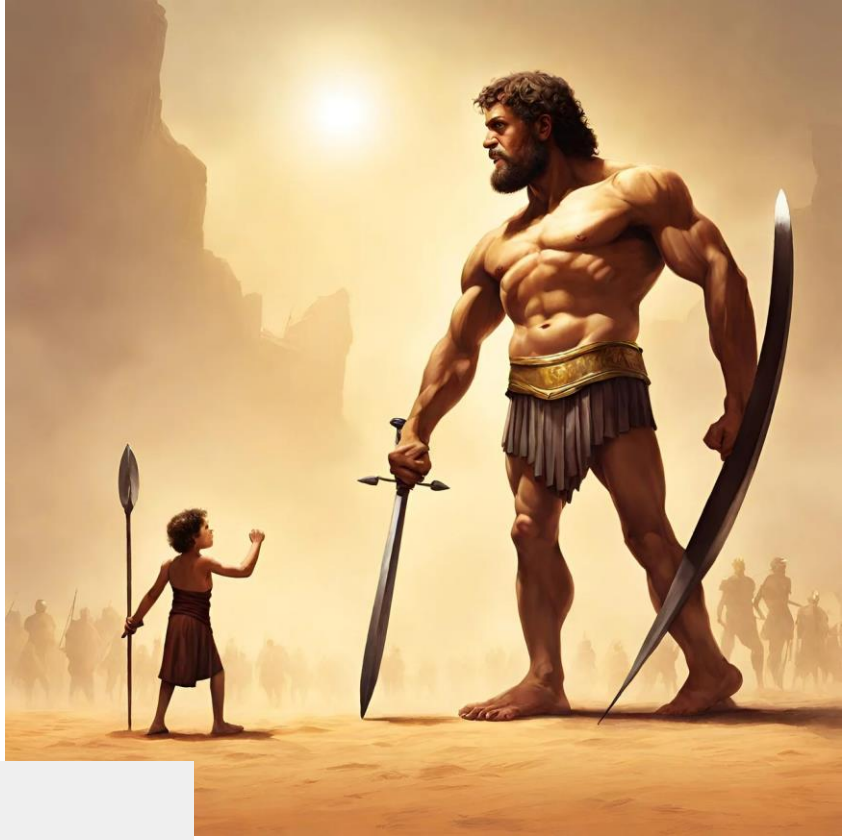




- Very often: HYBRID Integration!
- Back-end processes may include:
  - Assembly
    - Glue
    - Adhesive Tapes (structured ~)
    - Thermal bonding
    - Laser bonding
  - Cutting / Drilling
  - Dispensing



Der vitruvianische Mensch,1492
Leonardo da Vinci (Photo: Luc Viatour)



VALUE CHAIN

ONLY BIG PLAYERS WALK ALONE!

… and not even all of them

… and not even all of them succeed(ed)

Microfluidics InnovationHub

WE DEVELOP AND PRODUCE

Microfluidic Lab-on-a-Foil Systems

- Single entry point to research & development services
- Comprehensive service portfolio
- Fast prototyping and scale up
- Multiple funding opportunities
- Quality assurance

For reference cases please visit:

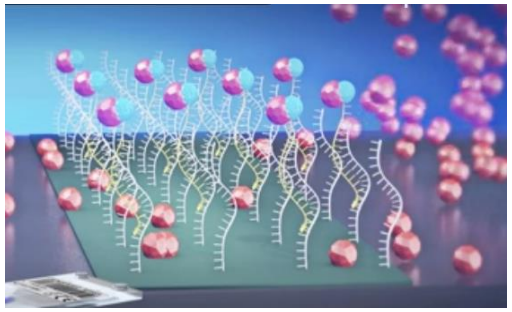
https://www.microfluidicshub.eu/projects

Microfluidics Innovation Hub is the single entry point of the European project NextGenMicrofluidcs (www.nextgenmicrofluidics.eu). NextGenMicrofluidics has received funding from the European Union's HORIZON 2020 research & innovation programme under grant agreement no. 862092.

MIH – We develop customized lab-on-a-chip systems

Primary Components

Assay | Design | Patterning | Surface functionalisation | Electrodes Sensors | Backend Services | Read Out Device System Integration | QM



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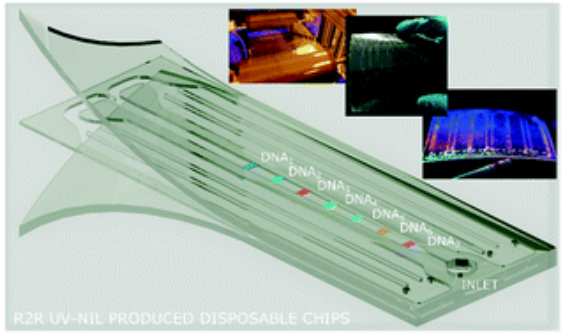


- Active & Passive Microfluidics
- From Milling over Inj. Mold to Roll-to-Roll
- From Prototypes to Millions of Units

Microfluidic Chip

- Device Development
- Technology Platforms
- Complete System Integration

Microfluidic Solution

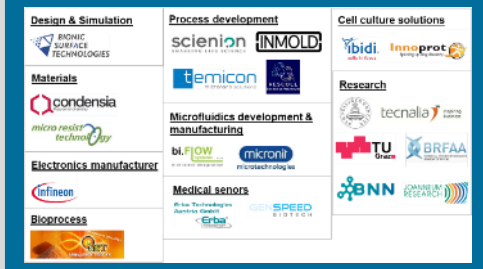
Microfluidics InnovationHub

MIH – Single Entry Point to NGM Services

H2020 Partners (e.g. PhotonHub)

MIH is a non-profit association that includes 20 NGM members

Research
Development
Production



Program Management

Partner Coordination

Business Fulfillment

MIH OPERATIONS

Commercialization of Demo Case

Lead Identification

Conferences, Trade Shows

Online Awareness Campaigns

Open Calls

Matchmaking Platforms

VC Network

MARKETS

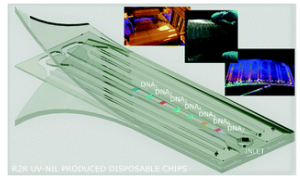
USE CASES

CUSTOMERS

EXTERNAL PARTNERS

Microfluidics InnovationHub

Service Portfolio



Microfluidic Chip

Microfluidic Solution

Primary Components

Assay | Design | Patterning | Surface functionalisation | Electrodes Sensors | Backend Services | Read Out Device System Integration | QM

Molecular & Biochemical Assay Development

We develop molecular assays for your specific requirements and adjust existing assays to optimally suit R2R processes

Material Development

We develop and modify (biobased) UV resins and thermoplastic polymers, functional inks or selective membranes for your microfluidic system

Design & Simulation

We design and simulate the optimal structures for your microfluidic chip, light guiding structure and cell culture plates

Toolmaking

We master your required (3D) structures and complex nanopatterns and make tools for large scale replication

Replication

We offer a unique portfolio of industrial high-throughput replication processes such as embossing, injection molding and most importantly various types of R2R replication.

Functionalisation

We offer chemical modification as well as deposition and immobilization of customized (bio)functional materials on a wide range of polymer substrates for your lab-on-a-chip device .

Electrode Printing

We print customized electrode designs and (electrode) arrays on large area substrates. We offer post functionalization of printed electrodes through chemical treatment or spotting processes for sensor applications.

Backend

We offer backend services such as multi-material assembly, foil-to-foil bonding, inlet cutting and chip singulation. We assemble multi-material (hybrid) lab-on-a-chip devices containing foils, rigid parts and complex microfluidic chip cartridges.

Read-out Devices

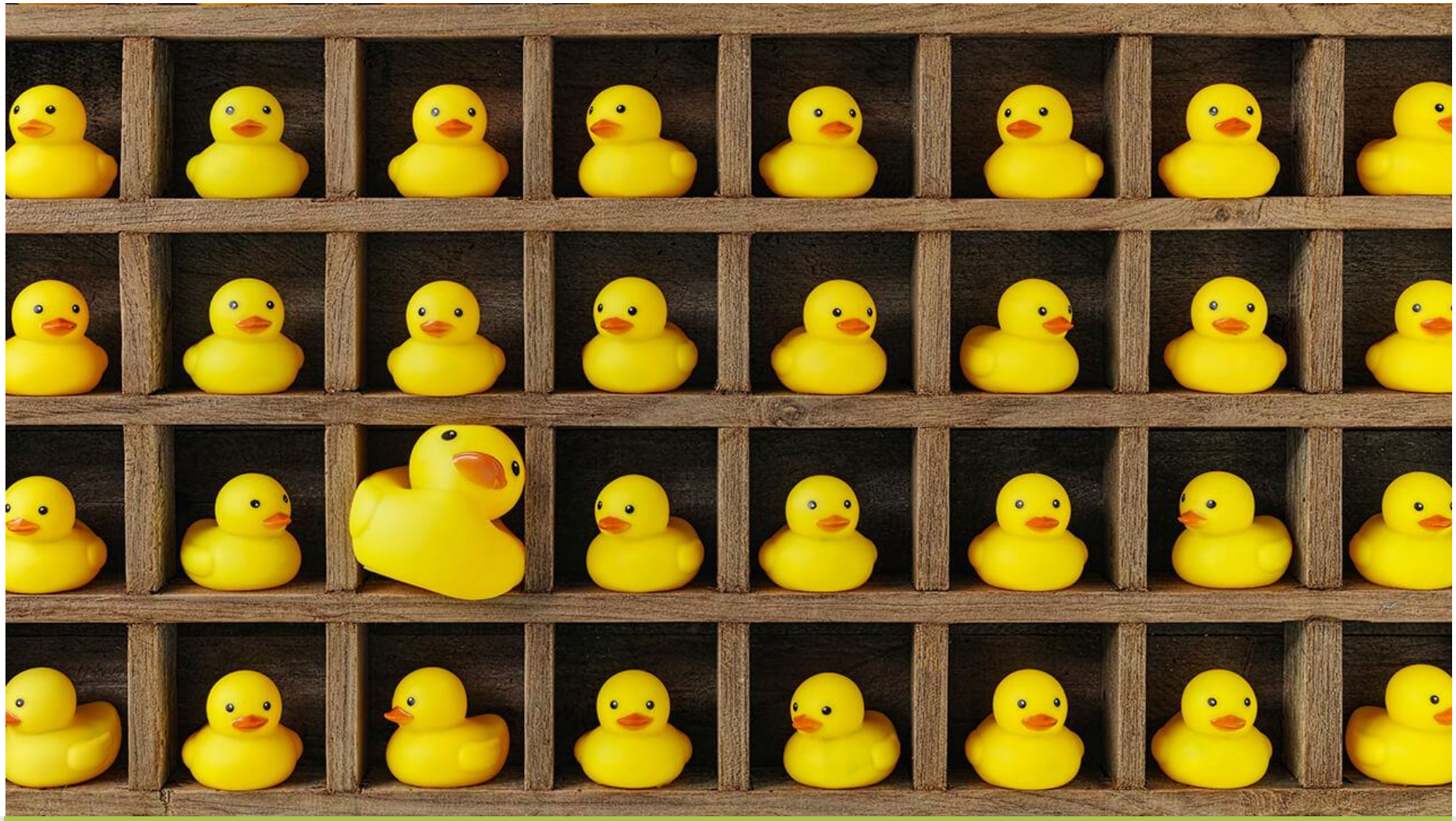
We offer detection and acquisition device development as well as complete system integration services

Quality Control

We are establishing a “MIH–Certified” service to ensure design & production according to application-specific standards.

Microfluidics InnovationHub

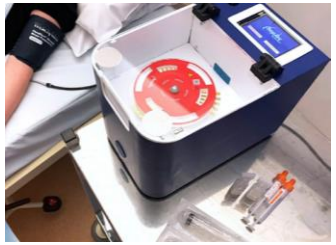
Manufacturing Services



ONE SIZE DOESN'T FIT ALL

Selected Examples from Microfluidics InnovationHub

(In total:
>15 customer projects)

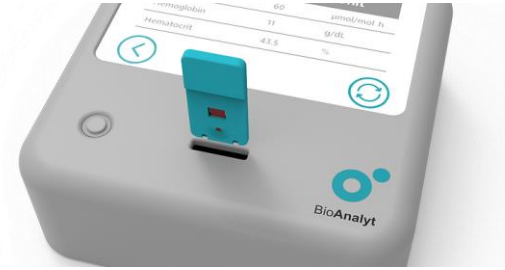


Sepsis diagnostics

Lithography | Roll-to-Roll | Surface Functionalization | Electrodes and Sensor

Iron dificiency and anemia diagnostics

Injection Molding | Surface Functionalization

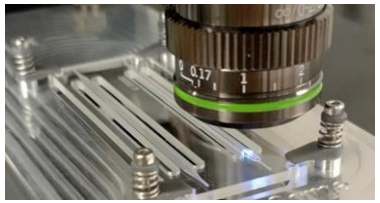


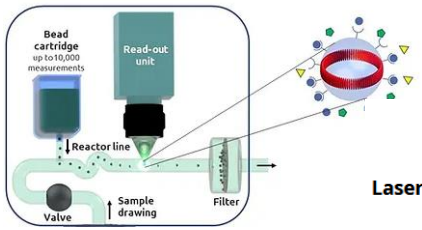
Kidney Transplants

Electrodes and Sensor | Injection Molding | Back-end Services

Acoustic separation of exosomes

Injection Molding | Material Development | Bonding | Back-end Services



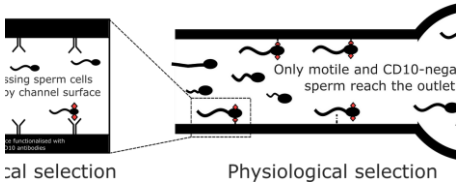


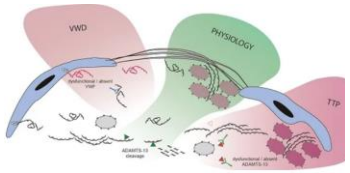
Inline sensing of microbes

Laser Ablation | Wet Etching | Back-end Services

Selection/Sorting of sperm cells

Roll-to-Roll | Material Development | Surface Functionalization | Bonding





Blood disorders

Injection Molding | Assay Development | Material Development | Surface Functionalization

Detection of multiple coagulation markers

Injection Molding | Surface Functionalization

REQUIREMENTS of MIH projects:

- Feature sizes: **1µm** .. **mm**
- Quantities in production: several **Hundreds** to **Millions** p.a.
- Acceptable manufacturing cost: **250** € .. **1** €
- Materials: **Polymers**, **Glass**
- Sensing principles: optical, electrochemical, acoustic, thermal
- Structuring methods: Injection molding, R2R-embossing, laser cutting, etching, UV-NIL

Example 1

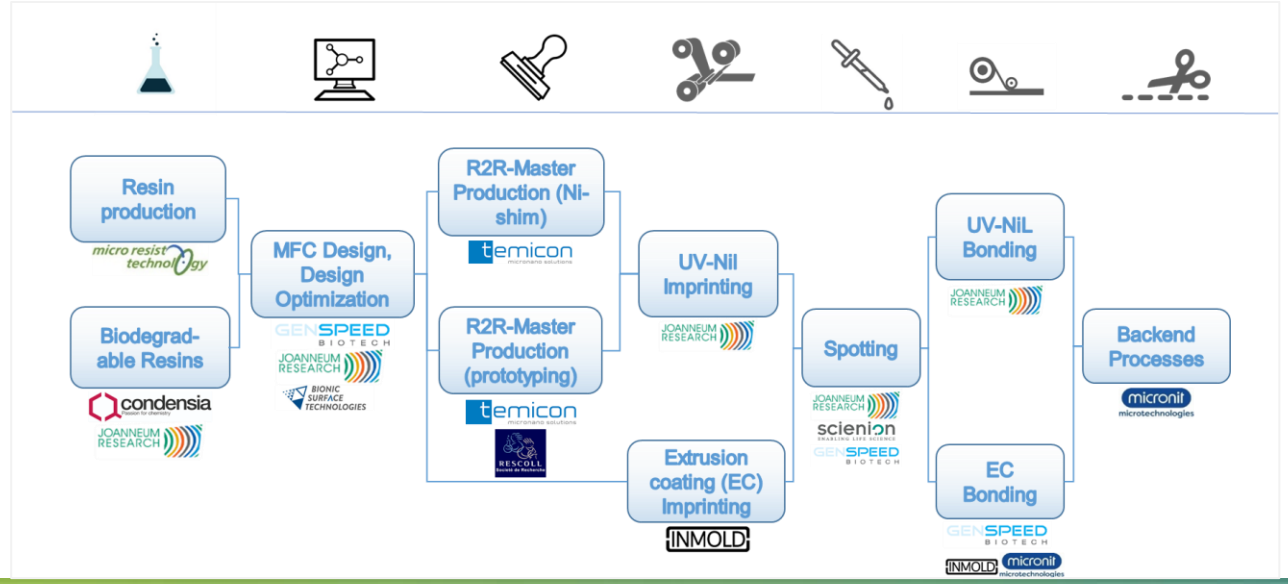
Application

- Fast Covid19 Antibody test based on blood samples

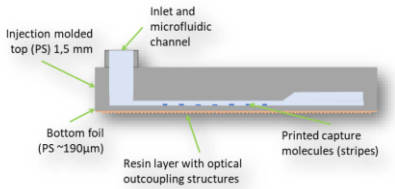
Project scope

- Transfer Injection Molded MFC to R2R MFC for high volume production

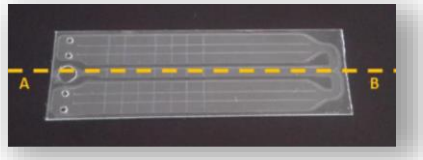
Process Flow:

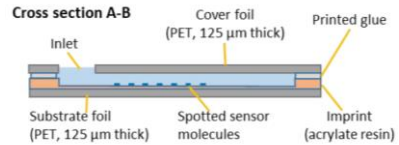


Injection Molded Microfluidic Chip (MFC)

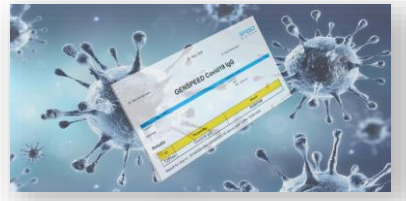


R2R Foil based Microfluidic Chip





Antigen Read Out Devices



Microfluidics InnovationHub

Competitive ELISA for high-sensitivity detection of mycotoxins Aflatoxin A1 / M1 in food products.

USP: Rapid and highly sensitive PoN testing for food safety along the logistical chain has the potential to greatly increase efficiency and reduce waste

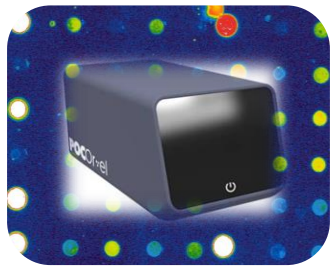
Project	Sector	Subsector	Analytical Method	Analytical Sample	Analytical Target	PoN
OREL	Agro/Food	Food Safety	Immuno - ELISA	Primary goods - grain	Aflatoxin M1 / B1	Logistical chain

Assay: Design and implementation

Sensor foil: Supply and spotting

Microfluidic cartridge: Design, manufacture & assembly

Experimental assay validation



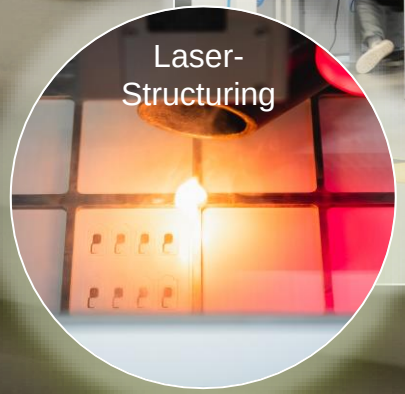
TIMELINES AND QUANTITIES

Development of a diagnostic Point-of-Care-Product:

- What the customer asks for:
  10 Mio Pieces per year after 3 years, of course for < 1 € per piece
- How reality looks like: 100 … 20,000 Pieces per year for 5 years,
  1 Mio pieces after 7 - infinite years…
  price definately > 1€

Scaling of production

Assembly and QC laboratory
for the production of our "BiFlowX"



Pilot line for automatic production
of our "BiFlowX"

bi.FLOW

WHERE REVENUE IS GENERATED...

The market value for
(microfluidic) Point-of-Need **diagnostic tests**
is **13 times larger** than
the market for their **devices**
(the „hardware“ of the test)!

Point of need **Test** market:
10 Billion USD

Microfluidic **Devices** for
point-of-need testing
780 Million USD

WIR! sind

DIANA

Fragen ?

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Germany

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+49 371 836527-10