



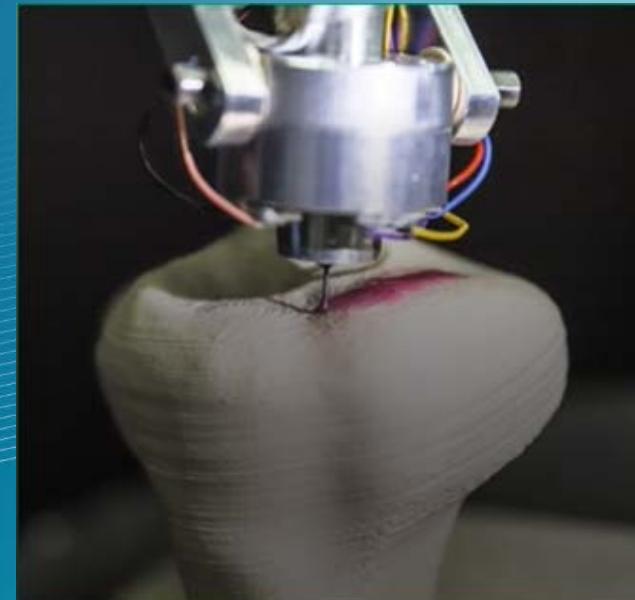
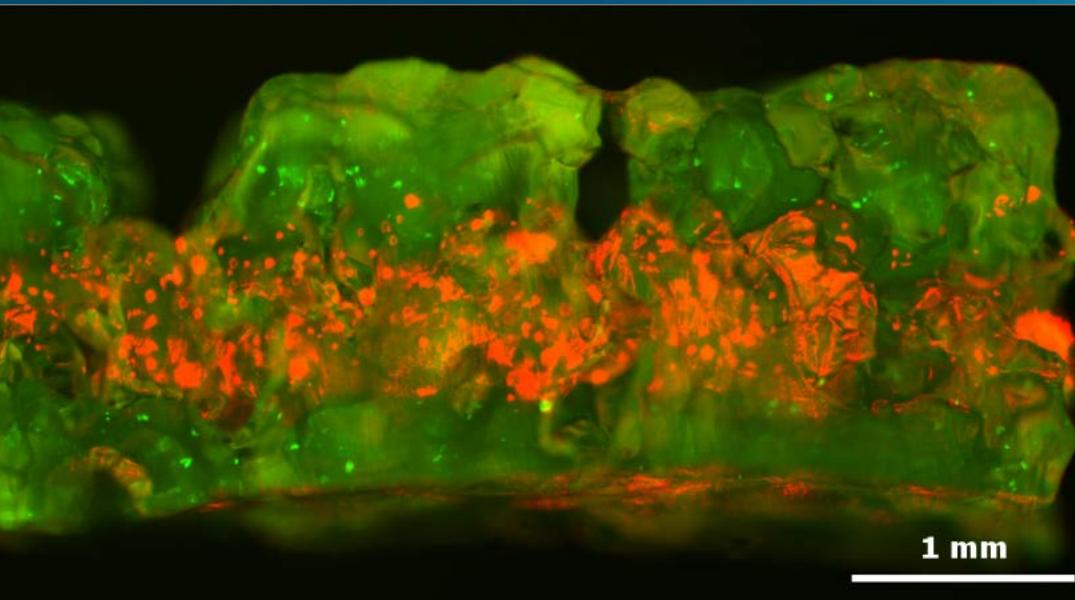
## Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB

We combine biology and  
engineering



 **Fraunhofer**  
IGB

Fraunhofer Institute for Interfacial  
Engineering and Biotechnology IGB



 **Fraunhofer**  
IGB

Fraunhofer-Institut für Grenzflächen-  
und Bioverfahrenstechnik IGB

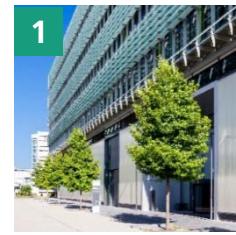
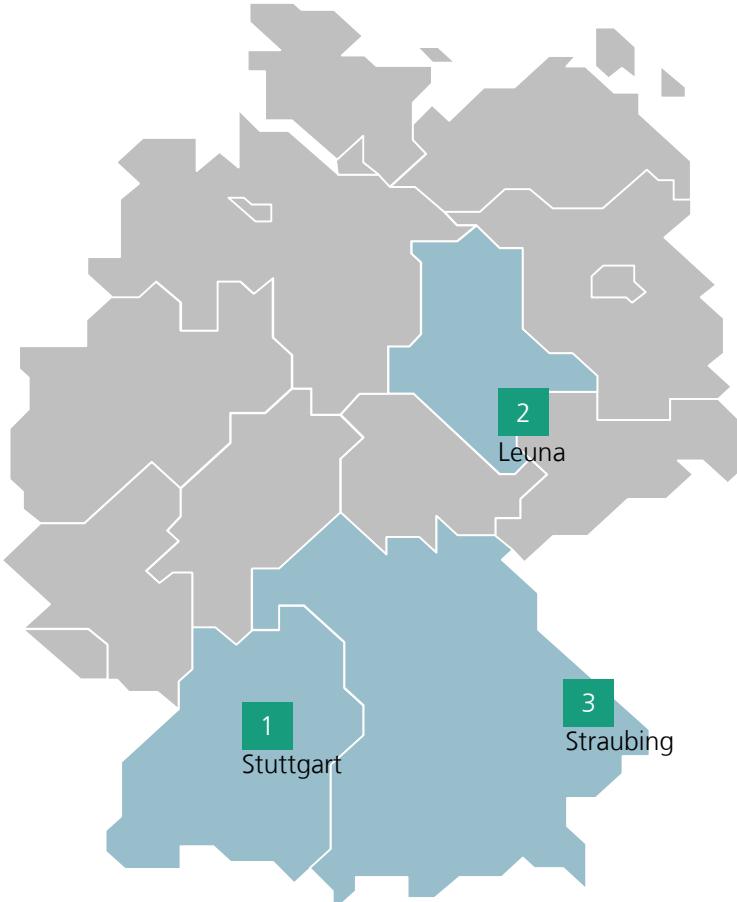
Dr. Achim Weber, 04.05.2023

---

EFDS - Sitzung des FA-Biomedizintechnik

# Fraunhofer IGB

## Facts, figures and locations



**Fraunhofer Institute for  
Interfacial Engineering and  
Biotechnology IGB,  
Stuttgart**

**Fraunhofer Center for  
Chemical-Biotechnological  
Processes CBP,  
Leuna branch**

**Bio, Electro and  
Chemocatalysis BioCat,  
Straubing branch**

# Business areas

Innovative solutions for our clients in industry and society



Molecular **precision diagnostics**

Screening- and **test systems** for precision therapeutics

Manufacturing processes for **cell- and virus therapeutics**

Surfaces, materials and bio-inks for **medical engineering**



Fine and **specialty chemicals**

**Biopolymers** and biobased polymers

Ingredients for **food** and **feed**

Technologies for the **material use of CO<sub>2</sub>**

Customized **coatings**



**Smart infrastructure** – water, energy, food and waste

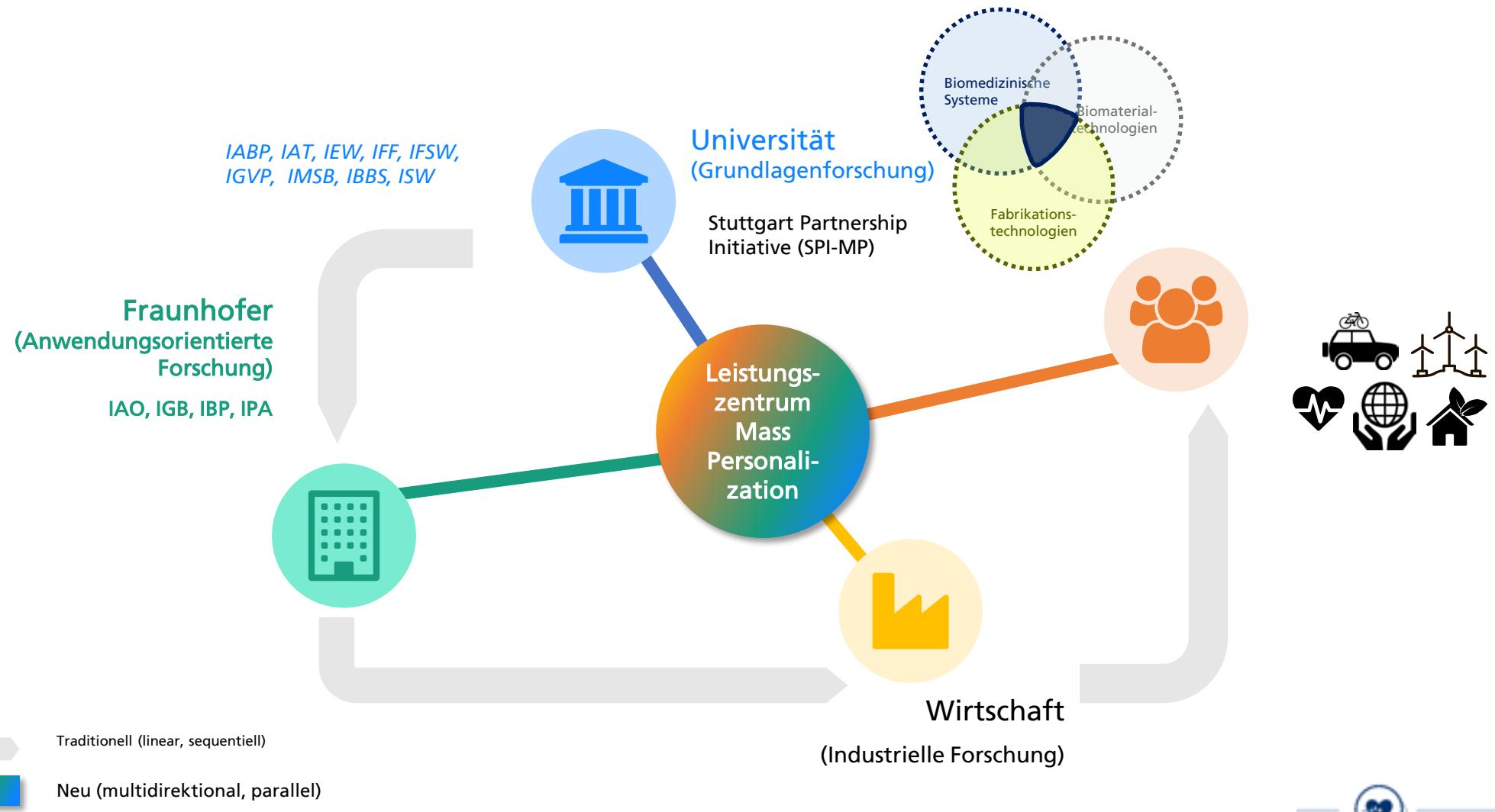
New **water treatment concepts**

**Recovery** and recycling of nutrients and metals

Novel processes for **reduction of greenhouse gases**

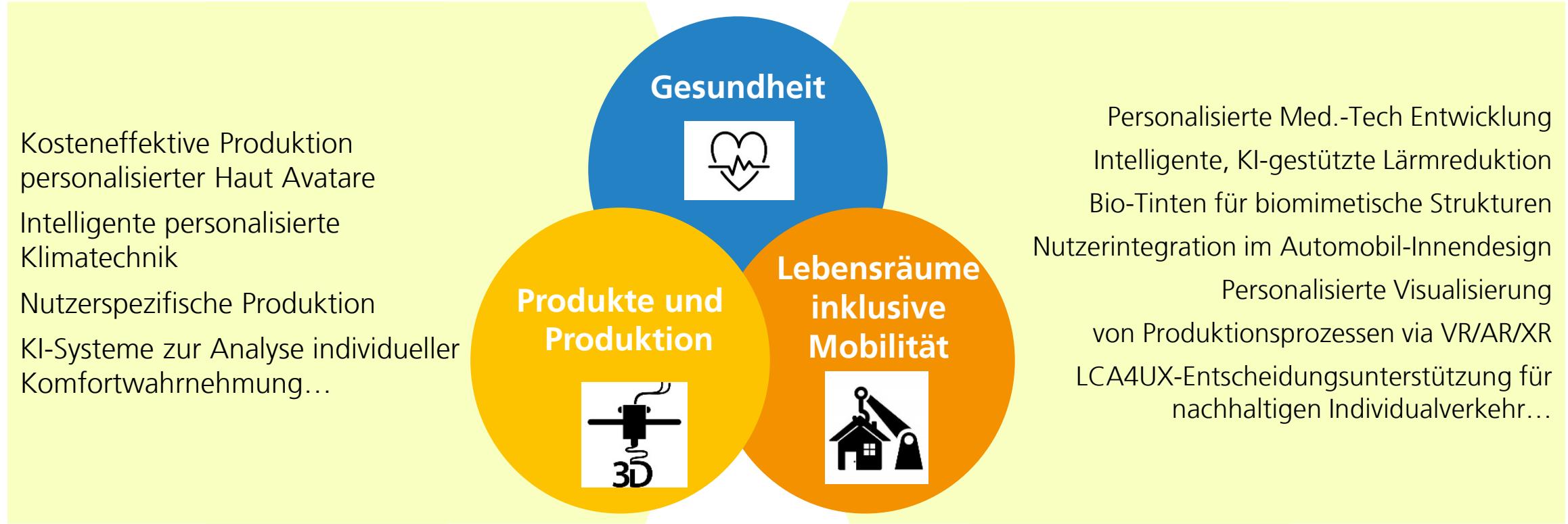
# Das Leistungszentrum Mass Personalization

Intelligent und personalisiert



# Das Leistungszentrum Mass Personalization

## Themenlinien



# Das Leistungszentrum Mass Personalization

Themenlinie Gesundheit



❖ Personalisierung des  
Gesundheitswesens z.B. smarte  
Assistenzlösungen zu  
Patientendaten



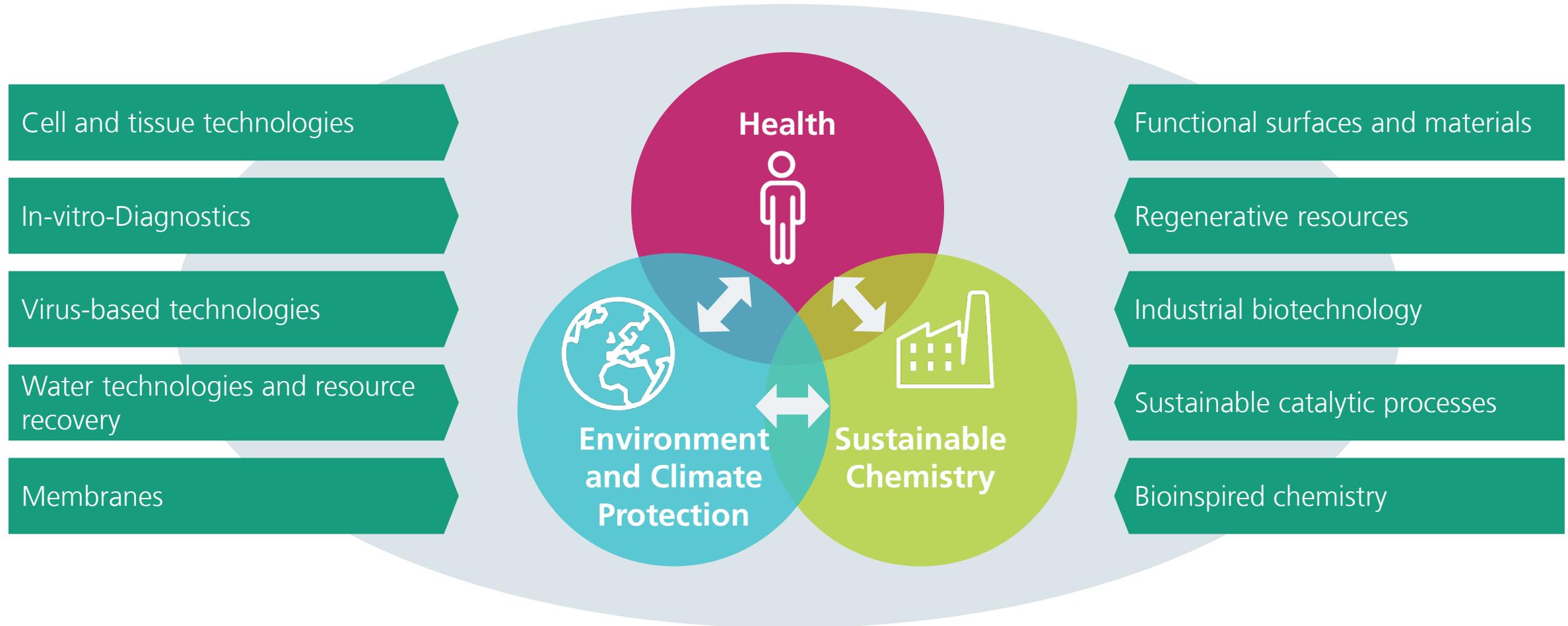
Kosten- und Leistungsbewertung  
von personalisierten Produkten  
in Medizintechnik /  
Pharmaproduktion



Personalisierte Diagnostik und  
Therapie Ansätze z.B.  
Virentherapeutika

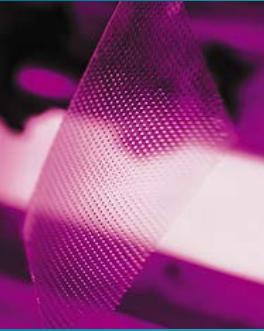
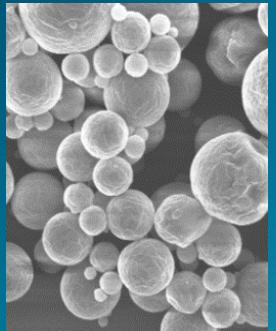
# Research for healthy people in a healthy environment

## Business areas and innovation fields



# Innovation Field Functional Surfaces and Materials

## Core technologies and applications



- Process development
- Material development
- Process scaling
- Analytics



- Up-scaling of plasma coatings
- Biobased coatings and particles



- Decontamination of surfaces with UV
- Plasma process for water treatment



- Materials for bioprinting
- Encapsulation of biopharmaceuticals



# Grenzflächen in Kontakt mit biologischen Materialien

## Grenzfläche von Nanomaterialien, Membranen, Textilien, Medical Devices

### Verstärkte Wechselwirkung

Spezifische Anbindung von Biomolekülen, z. B. für Diagnostik, heterogene Biokatalyse, spezifische Adsorber

Immobilisierte Mikroorganismen, z. B. für biologische Filter

Wachstum, Proliferation und Differenzierung von Zellen; Gewebemodelle, In-vitro-Testkits

### Verringerte Wechselwirkung

Verringerte Protein-adsorption, z.B. für Diagnostik, Anti-fouling- Ausrüstung

Bakteriophage, bakteriostatische, bakterizide Oberflächen

Minimierung von Problemen bei temporären Implantaten, Minimierung von Restenose etc.

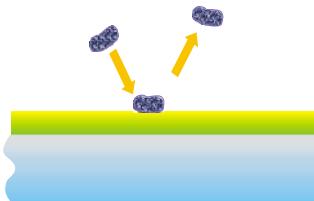


# Concepts: Prevention and removal of biological contamination on surfaces

## Prevention

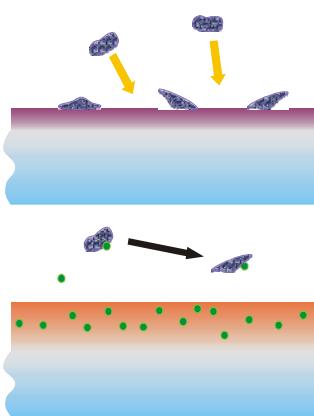
### Passive protection

- Material selection, smooth surfaces, easy-to-clean surfaces, antiadhesive coatings, ...
- Environmental conditions
- Construction



### Active protection

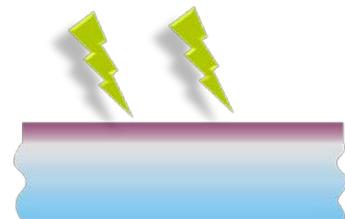
- Antimicrobial surfaces (release and non-release strategies)
- Biological countermeasures



## Removal

### Physical measures

- Mechanical cleaning
- Heat
- Radiation



### Chemical measures

- Cleaning with chemicals, biozides

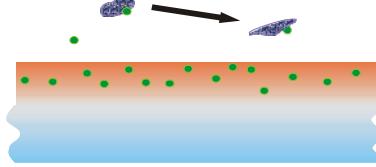
### Biological measures

- colonization with desired, harmless microorganisms
- Removal by higher organisms

# Antimicrobial surfaces: drug release strategies against

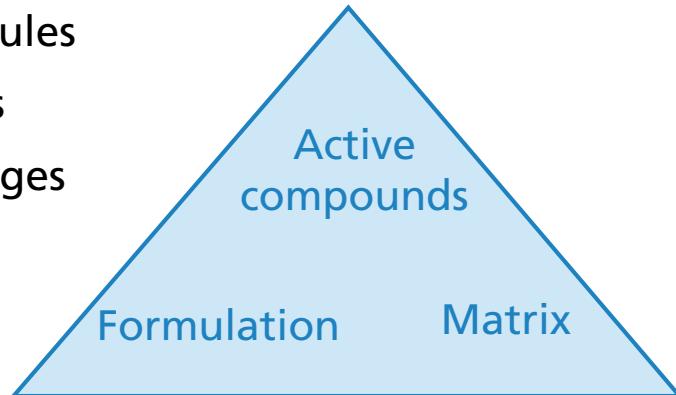
Bacterial adhesion

Biofilm formation



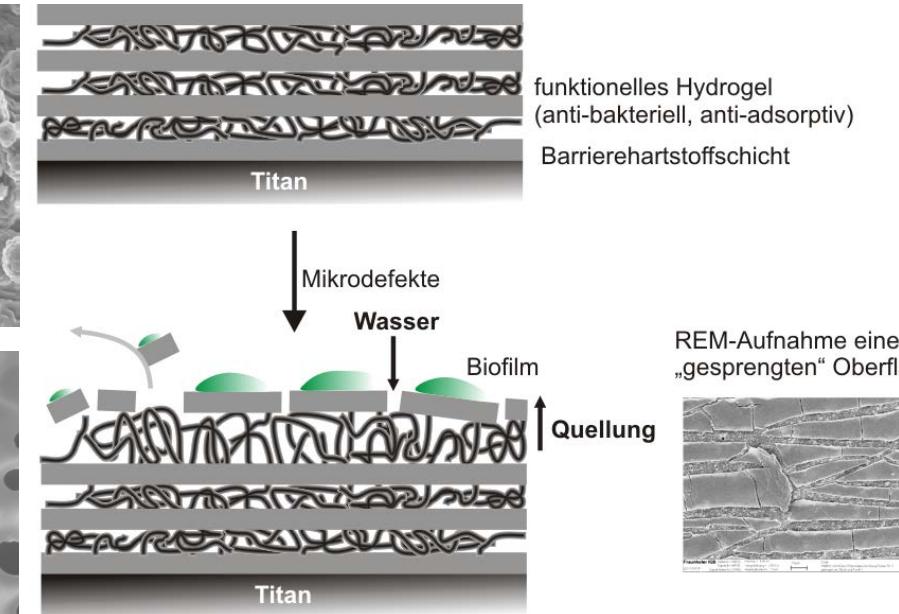
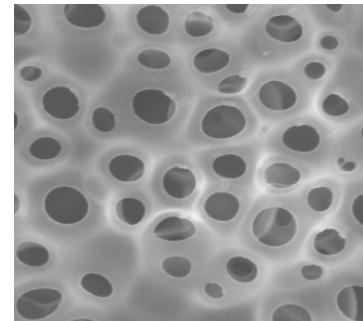
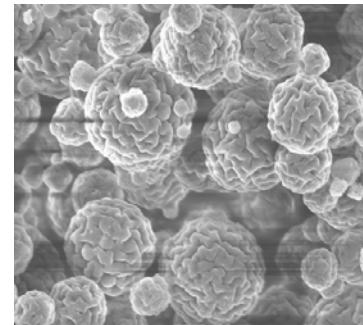
## Depot layers with releasing active agents

- Metal ions
- Antibiotics, antiseptics
- Antimicrobial peptides, enzymes
- Metal organic compounds
- Small molecules
- Nitric oxides
- Bacteriophages
- ...



## Formulation of active agents

- Particles (core shell, NP in MP, ...)
- Films (porous, degradable, non-degradable, ...)
- Multilayers



# Functional coatings for implants – Product examples

## Contact lenses

reduction of debris and friction



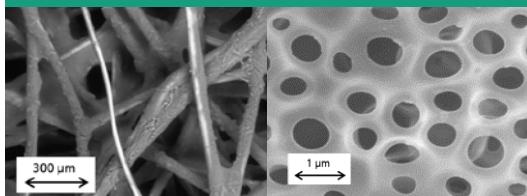
## Dental implants

improved tissue integration



## Wound dressings

improved wound healing  
(improved cell adhesion and drug release)



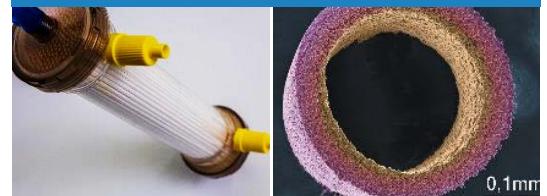
## Catheters

antimicrobial and reduced friction



## Hemodialysis modules

modified hollow fibre membranes to remove sepsis inducing molecules



## General Properties

- Biocompatible, hemocompatible
- Anti-microbial, anti-inflammatory
- Improved or reduced cell adhesion

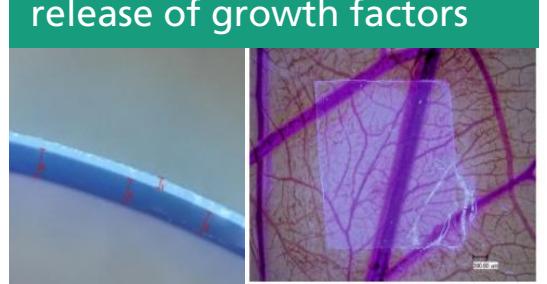
## Bone implants

accelerated cell adhesion



## Retinal-Implant

depot layer for controlled release of growth factors



# Additive Biomanufacturing

Bioprinting and Bioplotting with Living Cells, Bacteria, Biomolecules, Drugs

## Drop-On-Demand Inkjet Printing Process

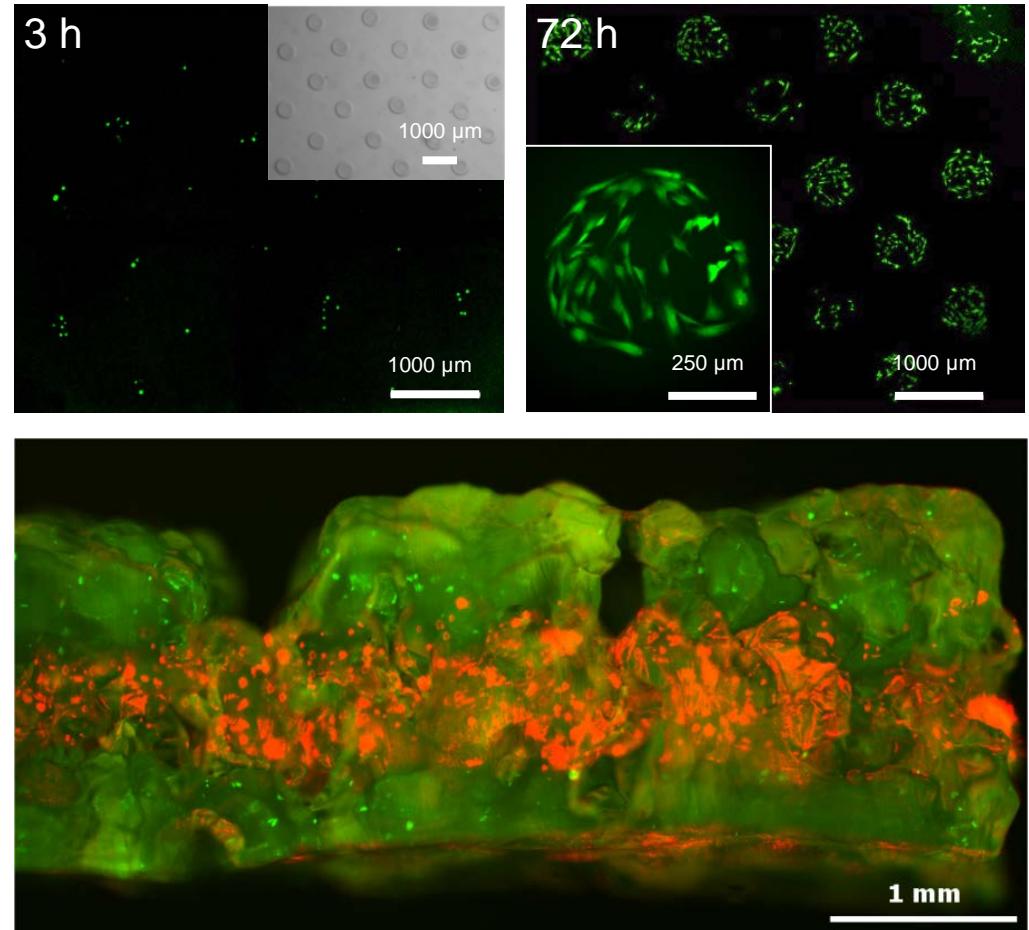
- Spot-Arrays for functional in vitro testing procedures
- Micro reaction spots, diagnostic
- 2,5 D cross linking

## Extrusion/Dispension Processes

- Multilayer hybrid system constructs for generation of biomimetic tissues (gradients, perfusable tissue testing systems, coating of bioreactors, personalised implants)
- Drug/additve loaded (growth factor, enzyme, small molecule)
- 3D cross linking

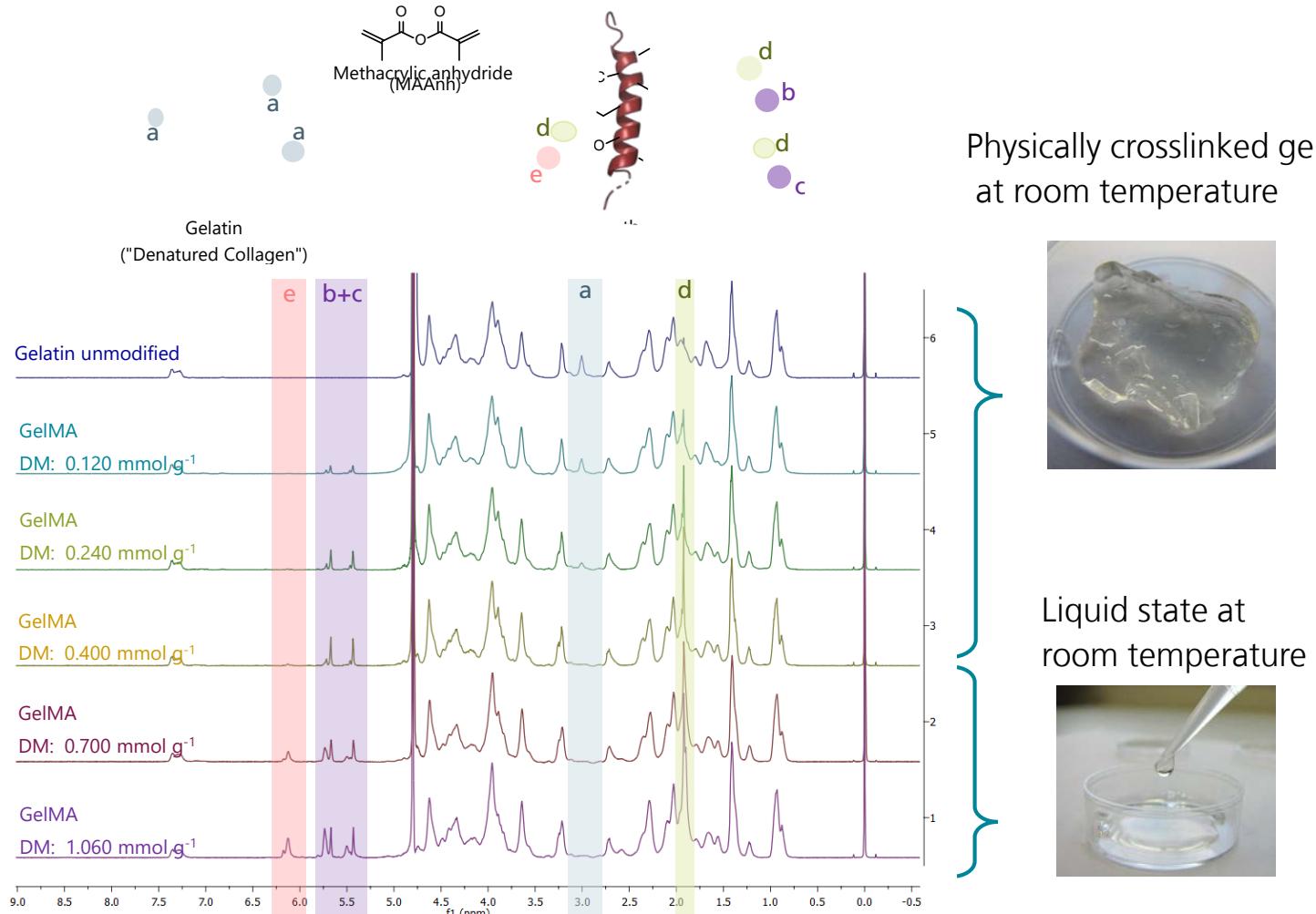
## 1/2-Photon Processes

- Combination of AM processes
- $\mu\text{m} - \text{cm}$  structuring

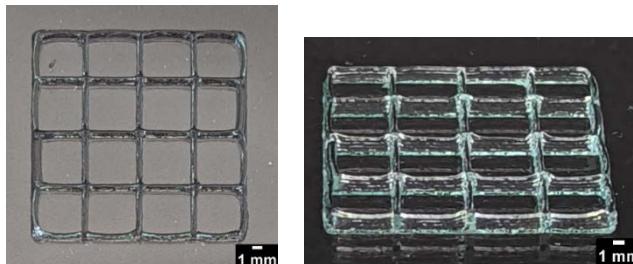


# Printability of Methacrylated biomaterials

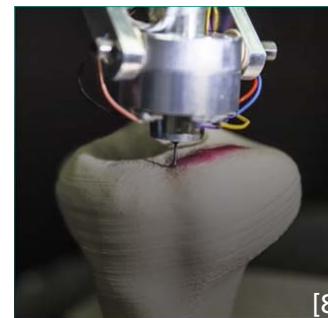
Degree of modification (DM) varies 3D Printing characteristics of GelMA bioinks



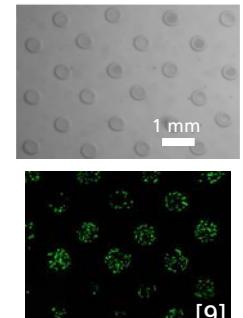
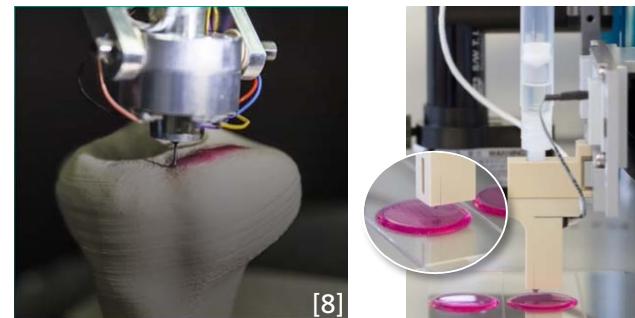
Extrusion based printing with temperature controlled printhead



Extrusion based

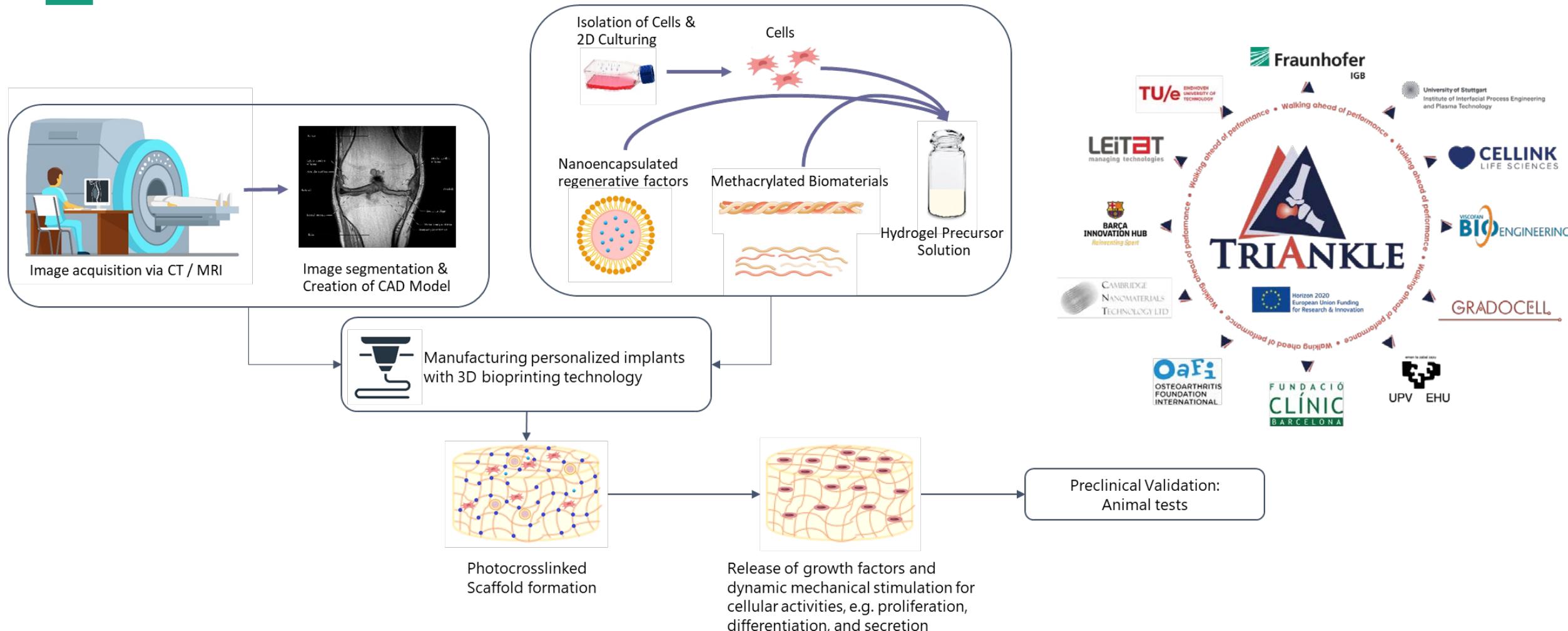


Inkjet Printing



# TriAnkle Project

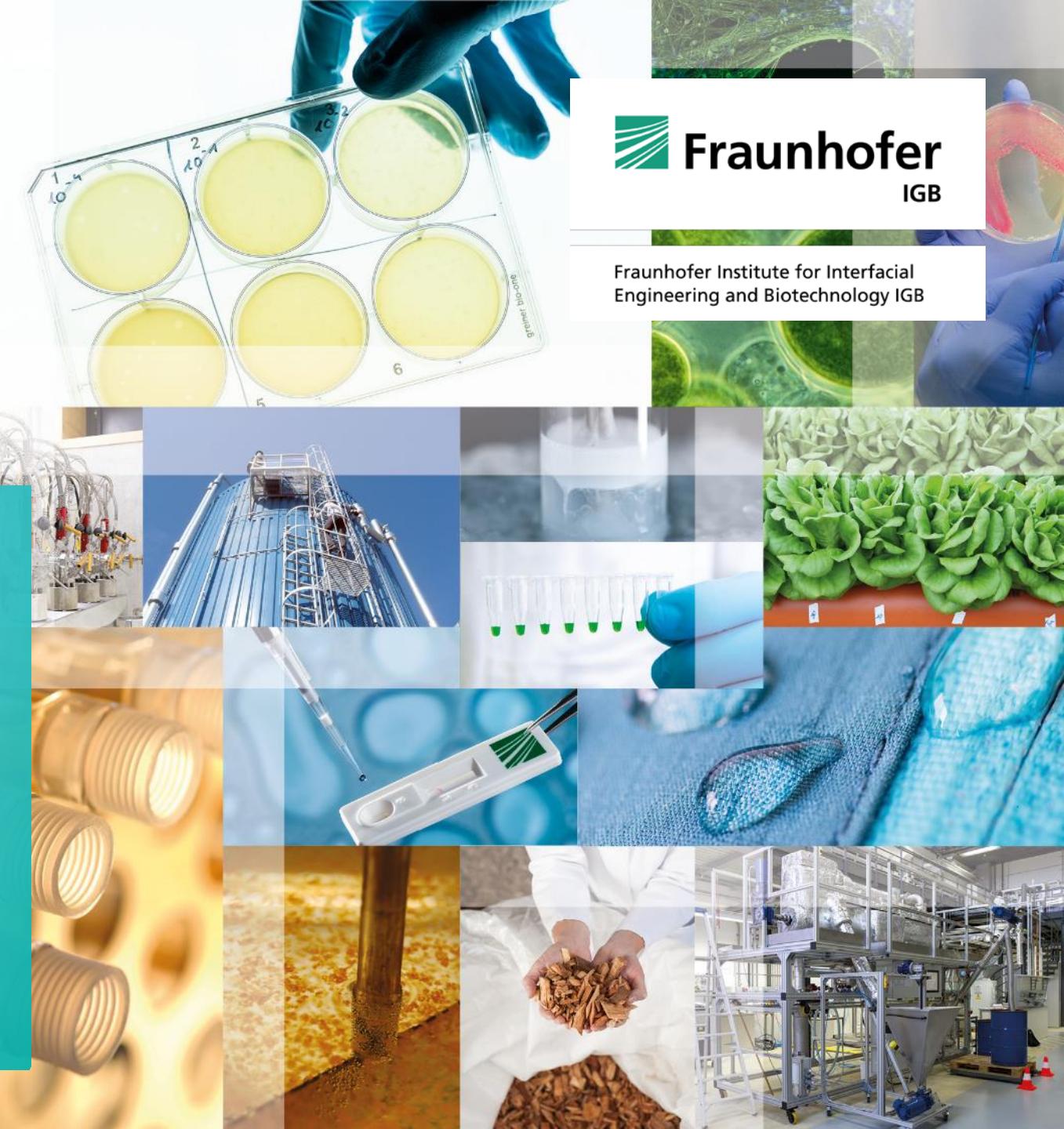
## Development of collagen- and gelatin-based bioinks for personalized scaffolds



# Contact

---

**Dr. Achim Weber**  
**Dep. Head of Innovation Field**  
**Functional Surfaces and Materials**  
**Phone +49 711 970-4022**  
**achim.weber@igb.fraunhofer.de**  
**www.igb.fraunhofer.de**



 **Fraunhofer**  
IGB

Fraunhofer Institute for Interfacial  
Engineering and Biotechnology IGB