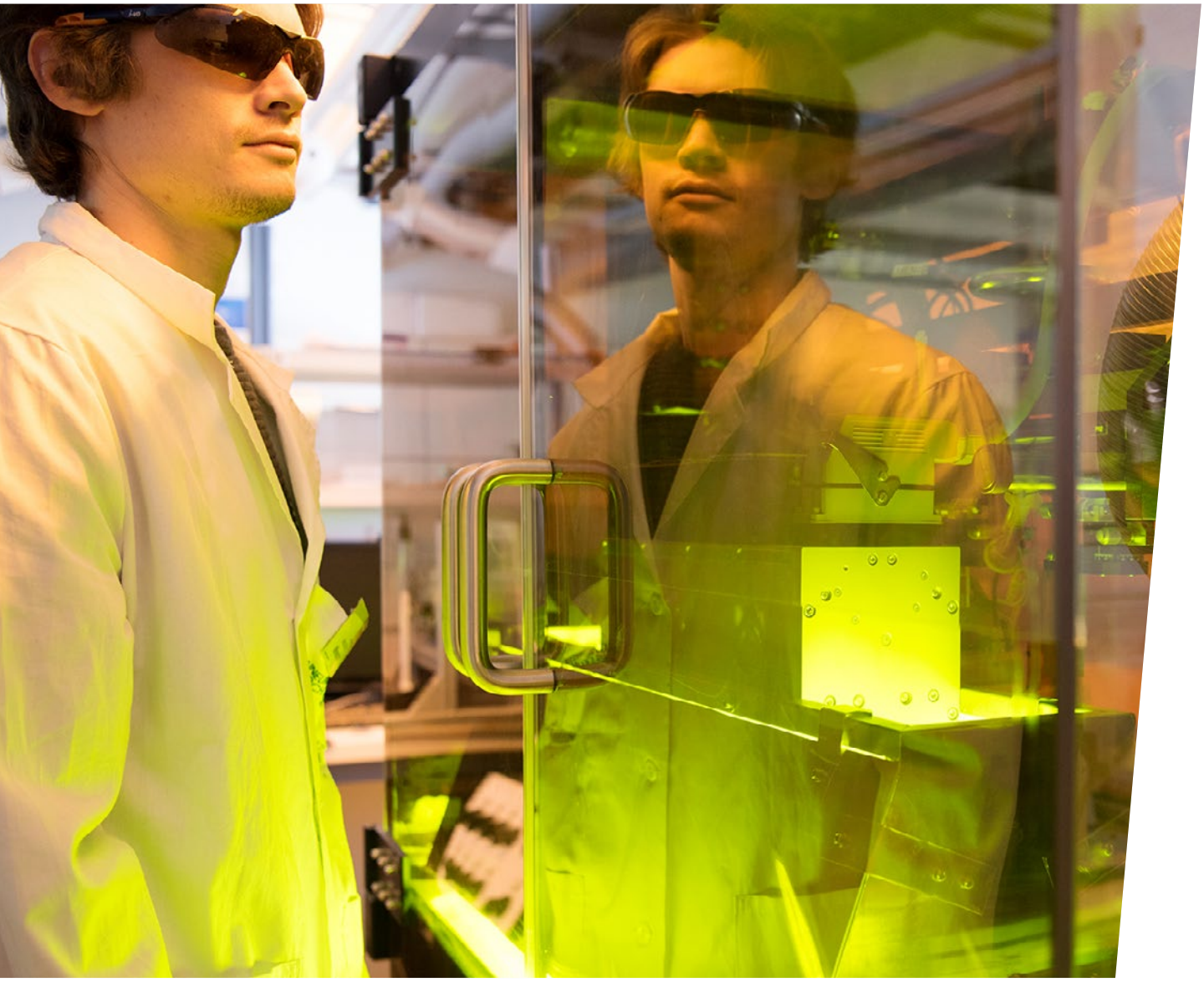
JOANNEUM RESEARCH
MATERIALS

MATERIALS

Institute for
Sensors, Photonics and Manufacturing Technologies



JOANNEUM RESEARCH Forschungsgesellschaft mbH

JOANNEUM RESEARCH develops solutions and technologies for business, industry and public authorities over a wide range of sectors and conducts applied cutting-edge research on an international level.

The company makes a significant contribution towards safeguarding the economic success of the region and assumes a key role in the transfer of technology and expertise into the economy.

Owners

80,75 %
State of Styria

14,25 %
BABEG Carinthian Agency for Investment Promotion and Public Shareholding

5 %
Wirtschaftsagentur Burgenland GmbH

Certifications

ISO 9001
Requirements for quality management systems

ISO 14001
Environmental management systems

ISO 13485
Medical devices – Quality management systems – Requirements for regulatory purposes

ISO 14644
Cleanrooms and associated controlled environments

ISO 17025
Accredited test laboratory ROBOTICS Evaluation Lab

GLP
Good Laboratory Practice

Numbers – Data – Facts

around **500** employees (from over 25 nations)

7 research units

6 locations

around **50** million Euro of research services per year

Unternehmensfilm

SENSORS.
LIGHT.
SURFACES.

»MATERIALS provides materials science solutions for manufacturing and industry.«

Prof. Dr Paul Hartmann
Director

MATERIALS

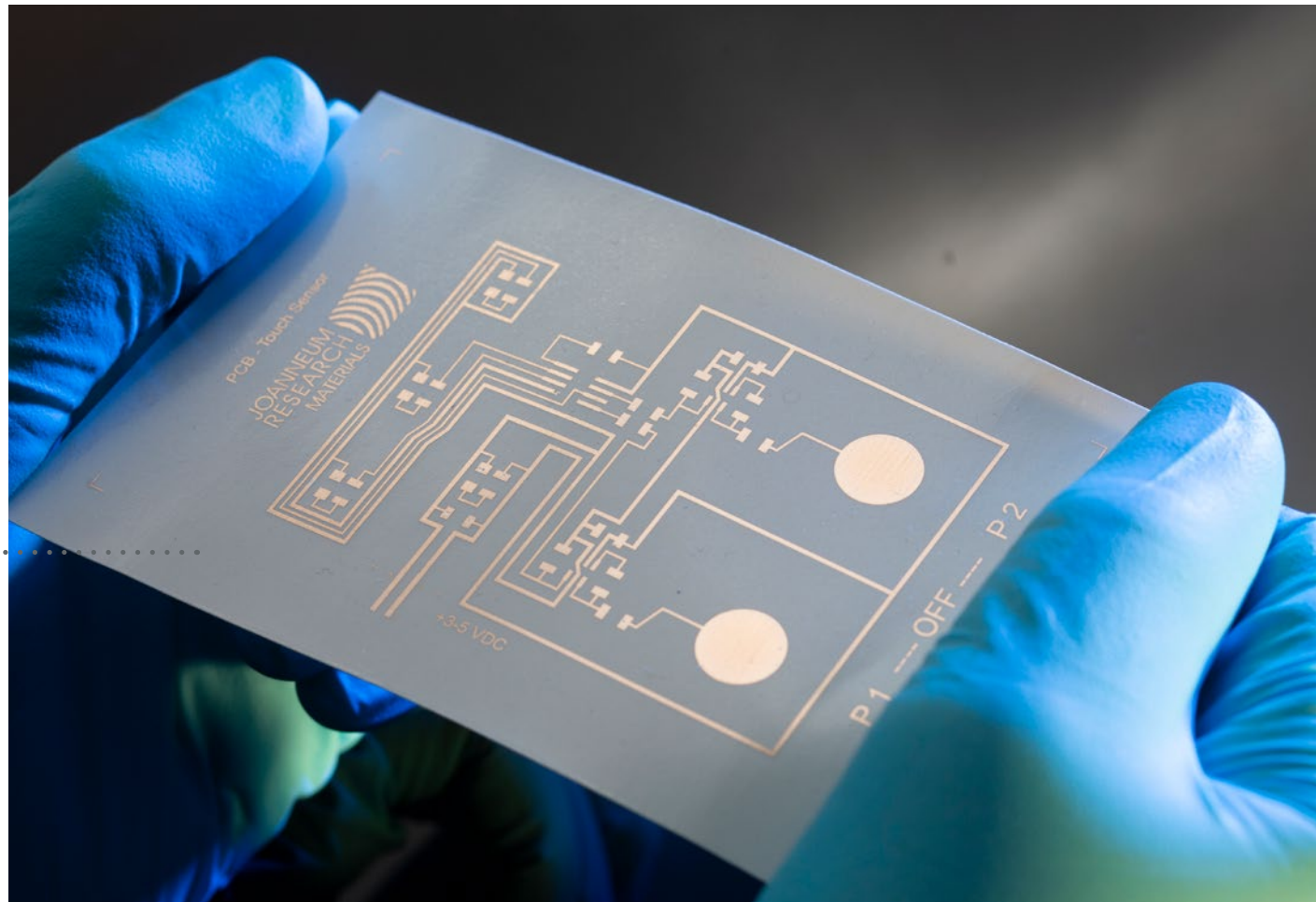
Institute for Sensors, Photonics and Manufacturing Technologies

We offer interdisciplinary solutions for the entire value chain from the initial concept to prototype using cutting-edge technologies and processes based on miniaturisation, integration and material optimisation. Combined with state-of-the-art equipment and infrastructure, we offer trend-setting solutions and services tailored to business and industry-related requirements. The core topics include large-area micro and nano-structuring, bio and chemo-sensors, lighting technologies, functionalised surfaces and laser processes.

Our Services

MATERIALS uses its high level of scientific competence to ensure its customers have access to the latest technologies for implementation into innovative products and services and is the primary contact for the development of technologies and processes for:

- Green photonics and electronics
- Structured (biomimetic) surfaces
- Piezoelectric sensors and energy harvesters
- Large scale production of organic coating (including roll-to-roll nanoimprint lithography)
- (Optical) chemical and bio-sensors
- Laser production technology
- Aerosol and inkjet print
- Laser and plasma-supported deposition processes



Key Areas

We are the primary contact for the development of technologies and processes in the fields of:

Hybrid Electronics and Patterning

- R2R printing and mastering
- PyzoFlex®
- Organic electronics

Light and Optical Technologies

- Optics: design and manufacturing
- Laser micro and laser nano processing
- Photovoltaics and optoelectronics

Laser and Plasma Processing

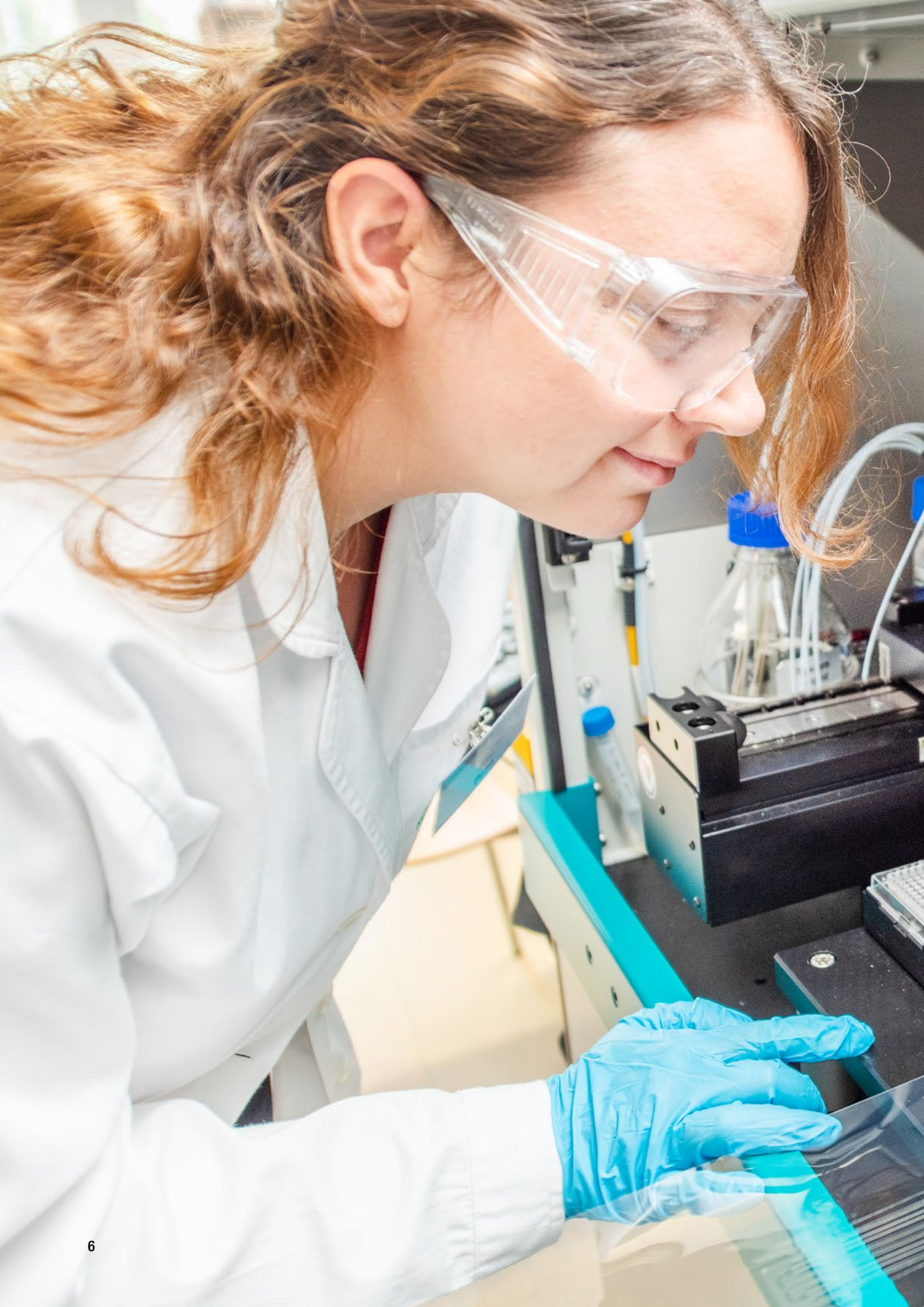
- Laser production technology
- Plasma surface technologies
- Additive manufacturing (metal 3D printing)

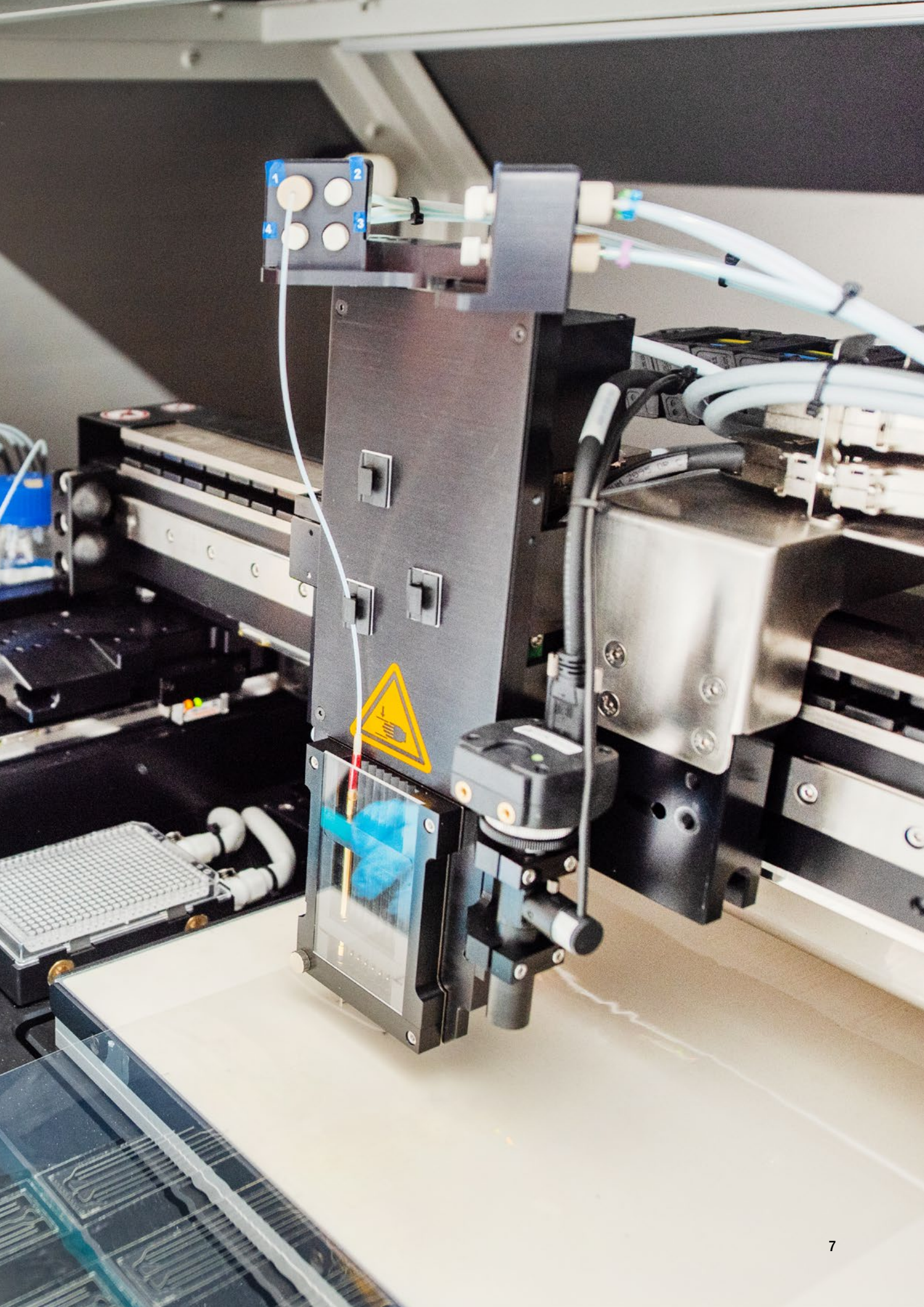
Sensors and Functional Printing

- Functional printing
- Chemical and bio-sensors
- Microfluidic lab-on-a-foil systems

Smart Connected Lighting

- Intelligent electronic systems
- Systems of systems: connectivity and communication
- Integrative lighting

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Hybrid Electronics and Patterning

We develop flexible micro- and nanostructured layers with integrated components. The major application fields include organic electronics and microfluidics, printed physical and biological sensors, large-area optoelectronics, and biomimetic functional films.

Core Competences

- Functional surfaces
- Piezoelectric sensors
- Organic electronics
- Microfluidics / lab-on-a-foil systems (lab-on-chip)

Processes

- Design and simulation:
  - Design of sensors
  - Circuit design for organic and printed electronics
  - Electrical, optical and microfluidic simulations
- Lithographic processes:
  - Photolithography
  - Electron beam lithography
  - Maskless laser lithography
- Printing processes:
  - Multimaterial inkjet printing
  - Screen printing
  - Gravure printing
  - Transfer printing
- Imprinting processes:
  - Micro- and nanostructuring by UV-imprinting and hot embossing
  - Step & repeat UV-imprinting
  - Roll-to-roll UV-imprinting

Material Portfolio

ORF-News-Clip „Rolle-zu-Rolle“

- NIL Cure®: (Bio-based) UV-curable imprint resins for tailored wetting, mechanical, optical and electrical properties with high UV and weather stability
- PyzoFlex®: printable inks and sensors with piezo-, pyro- and magneto-electric properties and high dielectric constants
- Photostructurable dielectrics for organic thin-film transistors

Applications

Pyzoflex

- Decorative surfaces
- Biomimetic surfaces (water-repellent, anti-reflectiv drag-reducing, structural colored)
- Optical films for light management in lighting, photovoltaics and / or sensor technology, free-form microoptics
- Biosensor technology, microfluidic components and lab-on-a-foil
- Human-machine-interfaces with free form factor
- Motion-sensing floors and smart wearables
- Self-powered sensor networks for condition monitoring
- Transparent electrodes and heaters

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Light and Optical Technologies

Our core competence includes simulation and rapid prototyping of optical structures over a multiscale size range.

The focus of our work is light in its diverse applications: Light management in complex optical applications, precision machining, patterning and characterization of optical components in the micro- and nanometer range.

Optics – design and manufacturing

- Covering the complete process chain: design – simulation – mastering – fabrication
- Numerical modeling of freeform micro-optics, diffractive and refractive optical elements
- Virtual prototyping using optical simulation (Lighttools, ASAP, Zemax, Ansys-Lumerical, VirtualLab)
- Fabrication of micro-optics on flexible substrates e.g. polymer films
- Optimization of optical and photonic systems

Laser micro- and laser nano processing

- Fabrication of master structures for optical applications (laser lithography, laser ablation)
- Fabrication of optical structures in the volume of transparent media (optical waveguides, etc.)
- High precision laser processing: ablation, drilling, cutting, sintering
- Laser-induced etching and smoothing processes
- Functionalization of surfaces (e.g. hydrophilicity/hydrophobicity)

Photovoltaics and optoelectronics

- Further development and efficiency enhancement of established (silicon, III-V or CIGS based) and novel (e.g. OPV, perovskite) photovoltaic technologies
- Intelligent light control in PV modules or optoelectronic devices
- Efficient coloring of solar cells and solar glasses for building integrated photovoltaics (BIPV)
- LED and LD technology (e.g. lifetime models, reliability analyses)

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Laser and Plasma Processing

We develop materials, processes and coatings using lasers (100 W to 8 kW) and plasma-based surface and coating technologies for a wide range of industrial applications such as metalworking, power generation, aerospace, automotive, medicine. We combine in-depth materials science knowledge with extensive know-how in the development of manufacturing and coating processes for a wide range of applications. For example, in the field of medical technology, the combination of 3D printing and surface coating enables hemocompatible, antibacterial and osteoinductive components for a new generation of heart valves, spinal implants and implantable electronic actuators and sensors. The combination of different additive manufacturing processes allows the production of large components with complex details for e.g. applications in aircraft construction. Our expertise is based on many years of experience of our team and includes the following competencies:

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Laser production technology

- Laser welding of metallic alloys with the new TRUMPF Brightline technology and a spot size up to 50µm
- Trademarked laser alloying for significant improvement of surface hardness and reduced wear
- Laser cladding for wear-resistant and hard coatings in harsh industrial environments
- Laser beam analysis

Additive manufacturing

- Laser Direct Energy Deposition (L-DED) with comprehensive quality control and monitoring for component repair, refurbishment and manufacturing
- Metal 3D printing (additive manufacturing by Powder Bed Fusion PBF/Selective Laser Melting SLM) with test facility for powder development and production system

Plasma surface technologies

- Laser and plasma-assisted coating processes: Magnetron sputtering, plasma-enhanced chemical vapor deposition (PACVD) in high to fine vacuum
- Low temperature coating processes
- Plasma activation and plasma cleaning
- Atmospheric pressure plasma coating with trademarked INOCON jet technology

We offer

- Process and material development for industry, consulting on materials, design, manufacturing and development of new applications
- Support in the creation of plant concepts and transfer of processes to serial production, process optimization and quality assurance

New Research Building

Sensors and Functional Printing

ORF-News-Clip
NextGenMicrofluidics

We develop chemo- and biosensors as well as novel printing processes and combine these technologies, for example, into bioanalytical lab-on-a-foil systems.

- We work on opto-chemical sensor materials and their adaptation to the respective measurement task as well as electronics development and instrumentation for corresponding digital readout systems.
- The development of novel functional inks and digital printing processes such as aerosol jet or ink jet printing and microarray spotting focuses on material, process and application development in the areas of printed electronics, heterogeneous integration of different materials, optics and sensor technology
- Microfluidic systems form the basis of integrated bioanalytical and diagnostic chips (lab-on-chip) and enable the production of very compact analytical and sensor systems. We pursue a comprehensive systems approach from simulation to prototyping to large-scale manufacturing methods for microfluidic structures on polymer films. This includes their functionalisation with sensor elements such as biomolecules or electrodes.

Fields of applications

- Bio- and environmental analytics
- Medical analytics and diagnostics
- Process engineering and biotechnological process control
- Automotive and aeronautics
- Semiconductor industry
- Printed electronics

The extensive expertise in the fields of material development, surface chemistry, micro and nano structuring technologies as well as sensor technology, optics and electronics enables the comprehensive development of complex systems and suitable manufacturing processes:

- Simulation-based design and layout
- Development of innovative sensor materials and ink systems
- Development of industrial printing systems and processes such as ink jet, aerosol jet, microarray spotting, screen printing or flexographic printing
- Development of electronic instrumentation
- Prototypes and demonstrators
- Transition to series production

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Smart Connected Lighting

We develop innovative and networked lighting solutions for the domestic, working and industrial worlds of today, tomorrow and the day after tomorrow.

We work on the development of comprehensive light and illumination concepts including sensors, control, networking and communication. This mirrors the international trend towards connectivity and digitalisation that contains luminaires and the light infrastructure as crucial components in an overall concept.

The required sensor and communication components are being increasingly integrated directly into the lighting infrastructure. This transforms it into the main artery of networked domestic and industrial worlds and into the communication centre of the internet of everything.

We conduct research in the following areas

- Smart electronic systems
- Systems of system: Connectivity and communication
- Integrated lighting

Application areas

- Smart buildings
- Smart cities
- Human centric lighting
  (e.g. motivator: circadian rhythms)
- Technical environments (e.g. production lines)
- Automotive
- Agriculture (smart farming)

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Special Topic Pilot Lines

Pilot lines for advanced manufacturing

Our pilot lines enable our customers to implement new ideas and products from initial concept to prototypes and to develop the corresponding production processes. To support this, our institute provides state-of-the-art infrastructure, the specialist operating staff required, and competence in numerous technical and natural science disciplines.

The benefit for customers using our pilot line lies in the bridging of the often difficult phase between research, achieving market maturity, and the provision of an often complex value chain.

Our pilot lines

- Roll-to-roll micro and nano-structuring
- Sensor systems
- Lab-on-chip devices
- Functional thin films
- Laser production
- Printed and flexible electronics
- Optical components

We are partner in the following H2020 pilot line and open innovation test bed projects:

- NextGenMicroFluidics (development of microfluidic lab-on-chip systems)
- Phabuloμs (manufacturing technologies for optical free-form microstructures)
- MedPhab (photonic technologies for medical diagnostics)
- FlexFunction2Sustain (sustainable plastic and paper products)
- EMERGE (emerging printed electronics research infrastructure)

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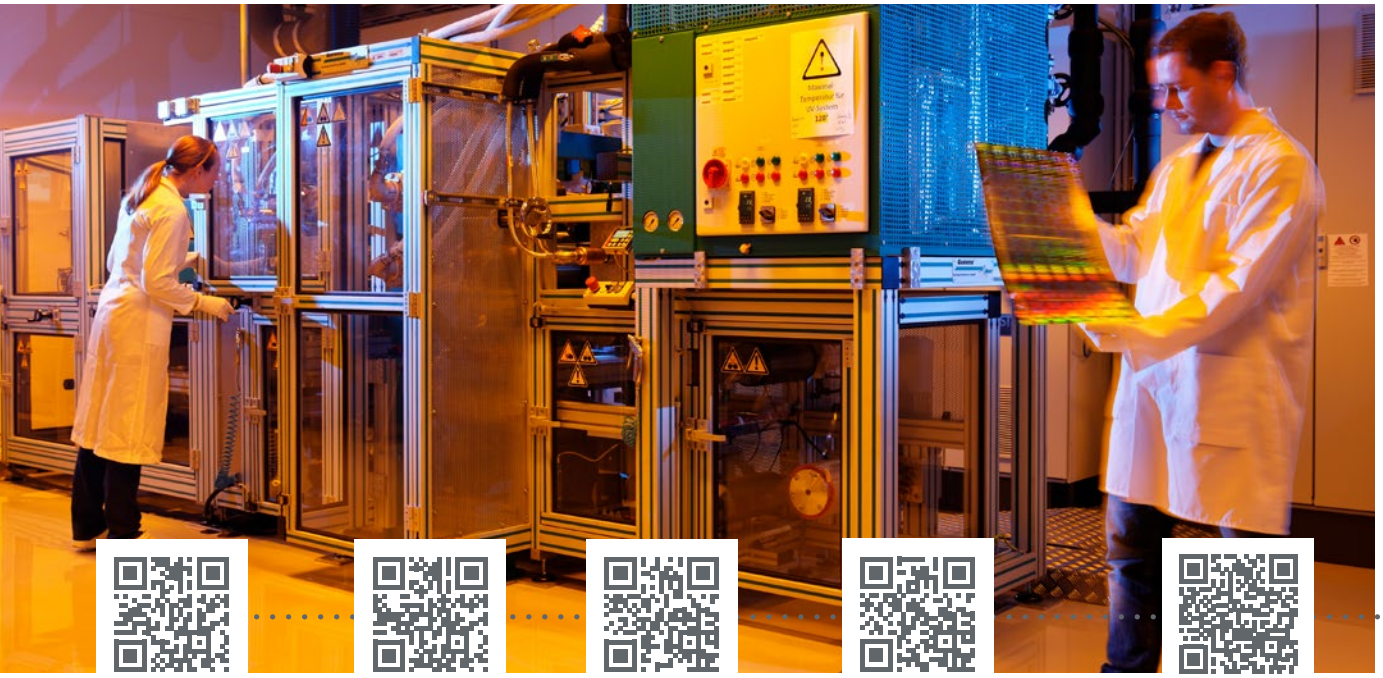
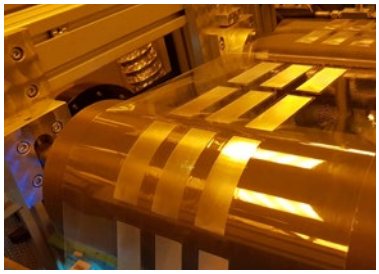


Infrachip.eu phabulous.eu medphab.eu multimold.eu emerge-infrastructure.eu

Research Infrastructure

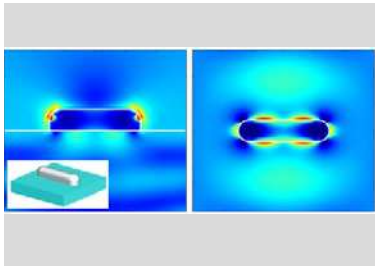
Cleanroom 360° Tour

Class 6 cleanrooms certified according to ISO 14644

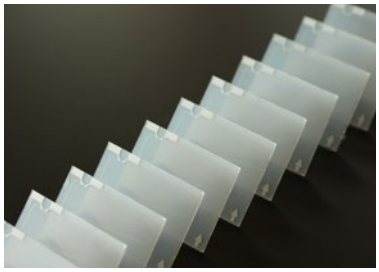


Roll-to-roll nanoimprint lithography and hot embossing

Grey level lithography and mastering

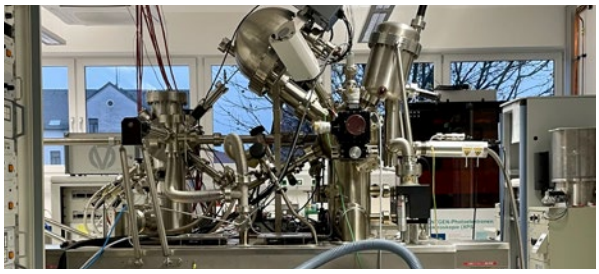


Optical and multiphysics simulation

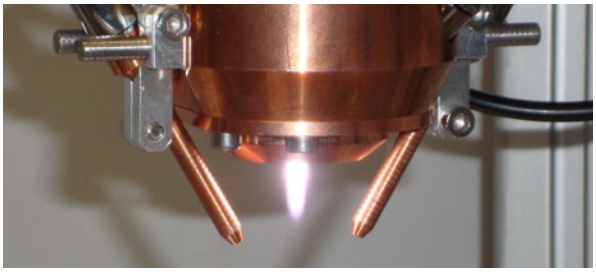


Functional printing

Chemical and physical sensors



Surface, coating and material analysis



Vacuum and plasma coating processes

Laser systems and industrial-grade robot-controlled processing plants

Light and integration laboratory


Coatema
Coating Machinery GmbH

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