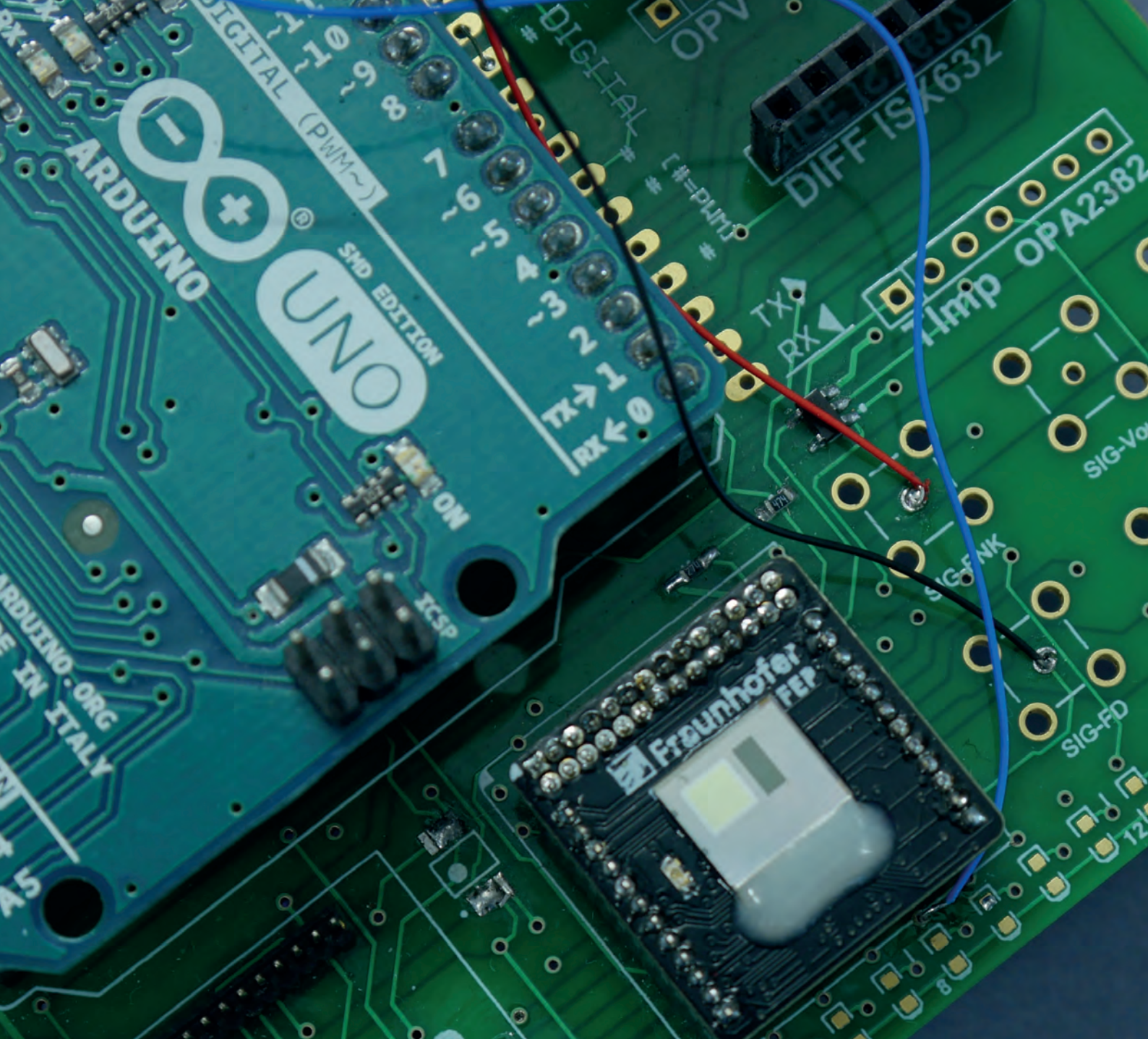


Sensors

Applications – Technologies – Components



Layer by layer
towards a sensor

Sensor technology is considered a key technology for measuring, controlling, regulating, and monitoring of a wide variety of conditions and in many different environments.

Sensors are used in all areas of life, for example, in mobile devices such as cameras for end users.

The number of deployed sensor solutions is multiplying rapidly. Miniaturization and low-cost mass production play a major role here. In industry, on the other hand, ever more sophisticated sensor systems are being developed, e.g. for automation, the automotive sector or in medical technology. High levels of accuracy, reliability and precise integration are required in this field, depending on the environment.

The Fraunhofer FEP has a broad and long-standing know-how in vacuum coating, the development of process technologies, precision coating and organic electronics. The core

competencies of the institute provide innovative technological approaches for novel sensor solutions.

In particular, the use of electron beam technology for surface modification, magnetron sputtering technologies for precision coatings, and also the use of photonic effects in devices with OLED light sources on silicon chips enable extremely precise coating of sensitive material combinations and the development of miniaturized sensor devices and systems.

»» We develop your customized, application-specific sensor solution!«

Overview

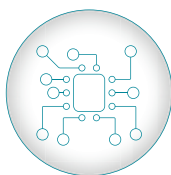
In the following you will find an overview of the range of applications in which our sensor technologies can be used. Many of the technologies can also be adapted to your specific requirements.

Please do not hesitate to contact us. We will be happy to discuss the possibilities of available sensor solutions and ways to develop new technologies with you.

Fields of application:



Displays and Wearables



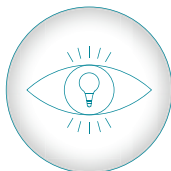
Electronics



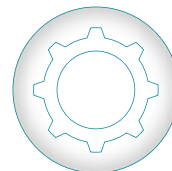
Preservation



Agriculture



Light and Optics



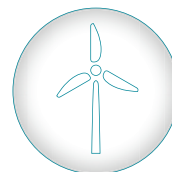
Mechanical Engineering



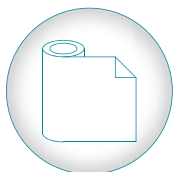
Medical and Biotechnological Applications



Mobility

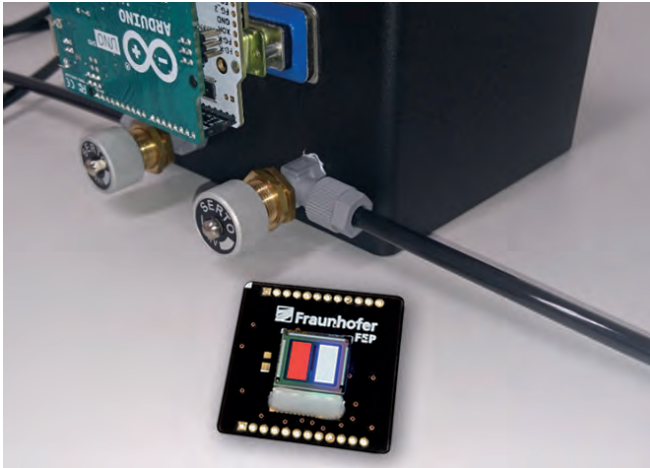


Environment and Energy



Packaging

Universal optical sensor platform



- Sensor platform for optical excitation and readout of sensor layers
- Measurement of material properties using a sensor substance, which changes its optical properties depending on the concentration
- Two typical scenarios for measuring process parameters or concentrations:
 1. Direct contact of the sensor with the medium
 2. Insertion of a sensor layer into the reaction chamber; excitation & readout via an optical fiber connection to the external electronics

Integration level

- Device
- Layers

Media

- Liquids
- Gas

Fields of application:

Agriculture

Light and Optics

Mechanical Engineering

Environment and Energy

Medical and Biotechnological Applications

Bidirectional OLED microdisplays



- Based on OLED-on-silicon technology
- Combination of OLED pixels and photodiodes on one single chip
- Usable e. g. as fingerprint sensor, particle flow sensor, opto-coupler, biosensor or for optical inspection


Integration level

- System
- Device

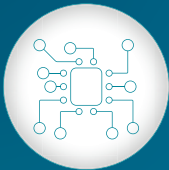
Media

- Surfaces


Fields of application:



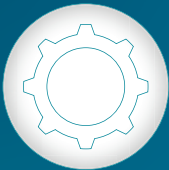
Displays and Wearables



Electronics



Light and Optics



Mechanical Engineering

Organic photodiodes, OPD-on-CMOS image sensors



- Photodiodes integrated monolithically and on wafer level on a CMOS readout circuit
- Adaptation of the spectral behavior is possible
- Detection of wavelengths outside the visible range

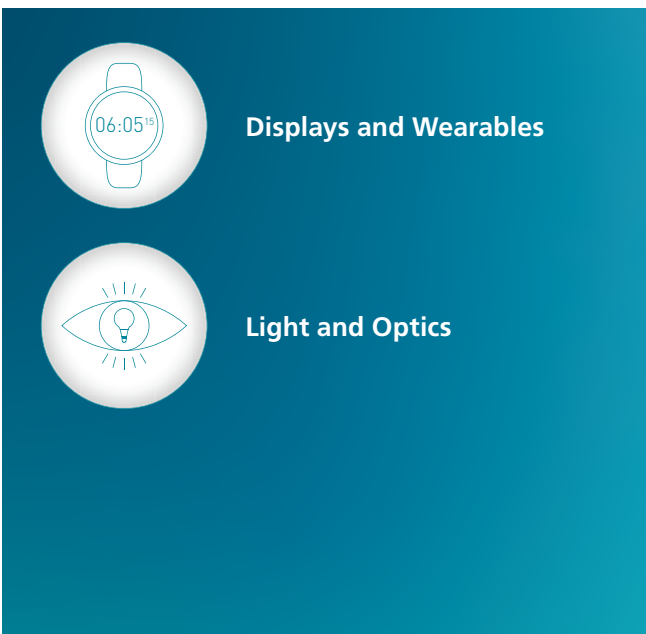
Integration level

- Device
- Layers

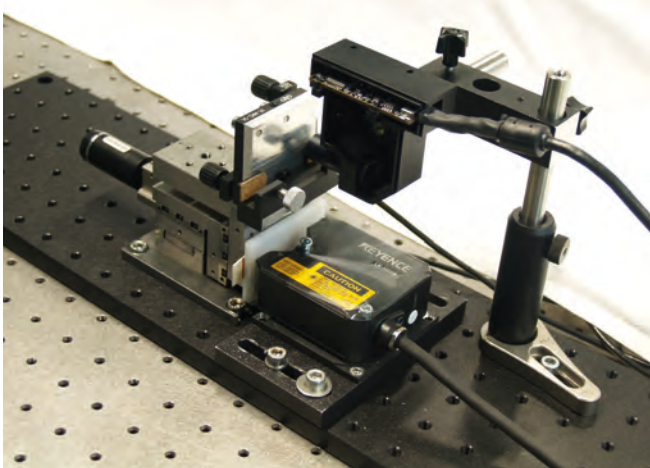
Media

- Surfaces

Fields of application:



Position and inclination sensor based on bidirectional OLED microdisplays



- Compact optical component: projection lens is the imaging lens at the same time
- Ultra-compact optical measuring system for surface metrology
- Compared to conventional confocal sensors, the inverse-confocal sensor detects a minimum of backscattered light when the object is in the focal level

Integration level

- Device

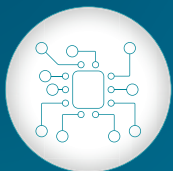
Media

- Surfaces

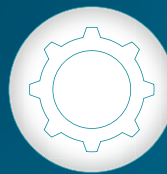
Fields of application:



Displays and Wearables



Electronics

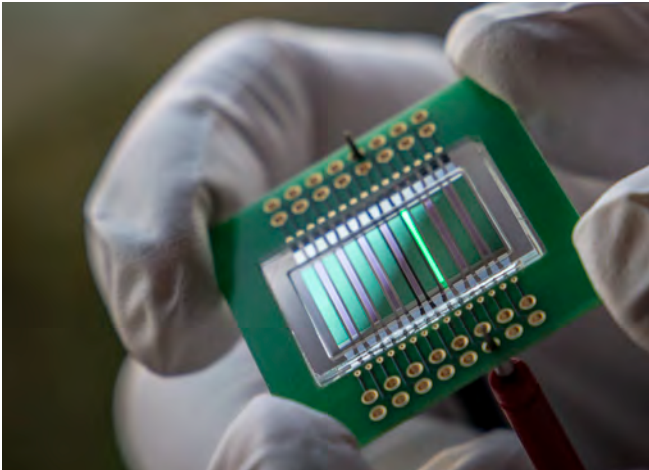


Mechanical Engineering



Mobility

Optoplasmonic sensor



- Rapid on-site analysis of quality and safety parameters in milk
- One measurement for the analysis of 6 ingredients
- Functionalization of the sensor with specific antibodies for different parameters of milk safety and milk quality

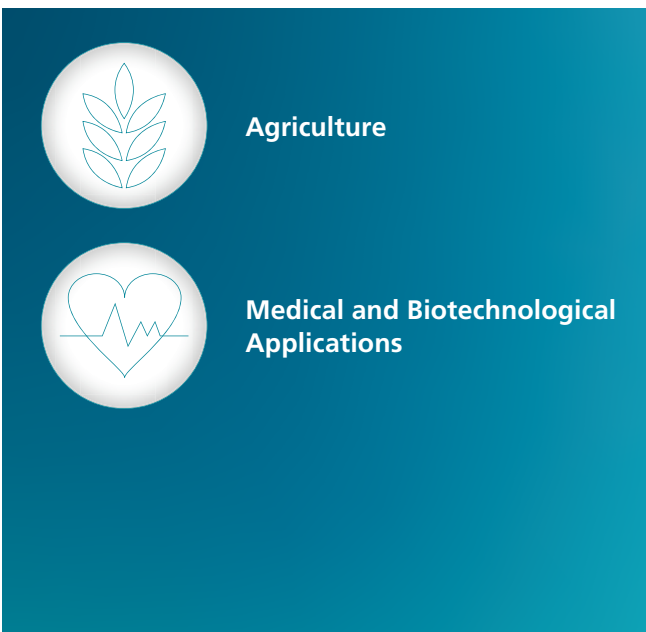
Integration level

- Device

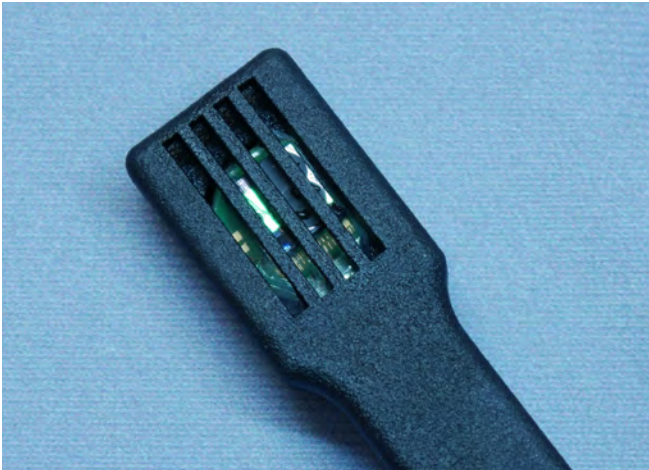
Media

- Liquids

Fields of application:



Multimodal sensor test bed (SensBio) as a measuring facility for gas sensor technology



- Sensor test bed with modular design to cover the widest possible range of measurement parameters:
 - large main vessel with external accesses of different sizes
 - gas mixing station for 2 gases each in any mixing ratio
 - gassing of the system via gas phase and via liquid phase
 - system temperature control
 - pH variation by chemical dosing

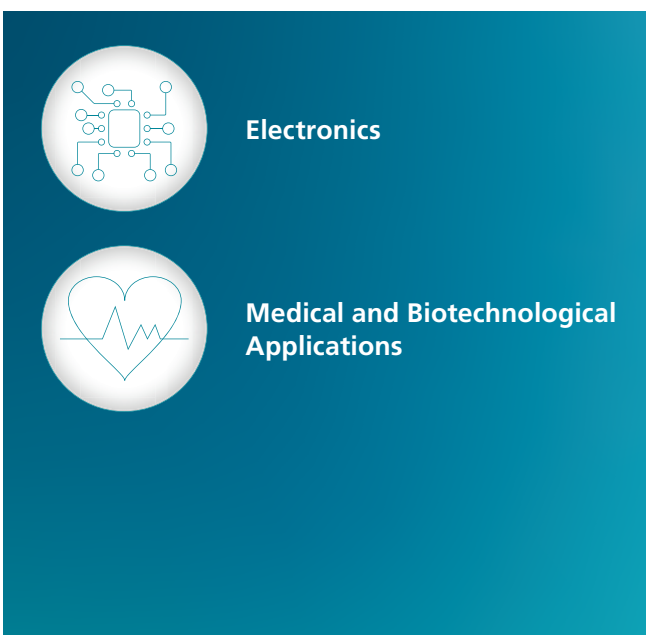
Integration level

- System

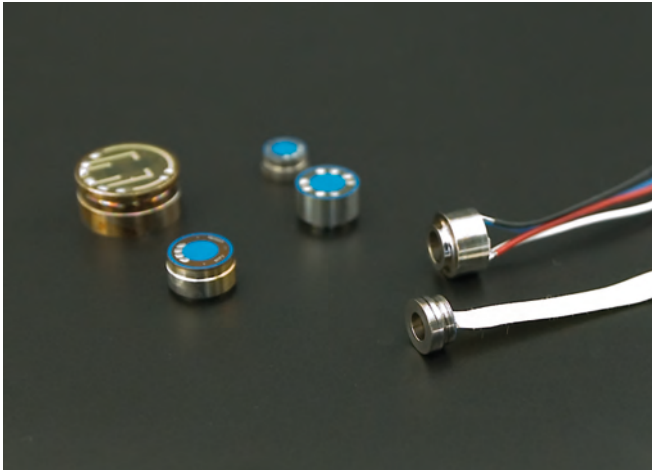
Media

- Gases
- Liquids

Fields of application:



Insulation layers and barrier layers



High temperature pressure sensors

- Deposition of low defect insulation layers by reactive magnetron sputtering for pressure sensors
- Insulation layers with minimal proton diffusion and very good insulation strength, dielectric strength up to 2000 V for metal thin-film sensors
- Stable even at very high temperatures
- High deposition rate of approx. 2 – 3 nm/s
- Barrier layers against hydrogen diffusion

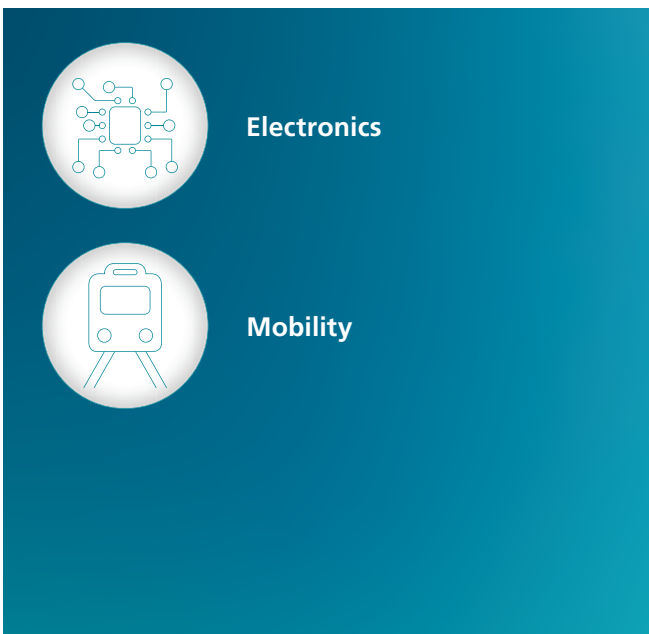
Integration level

- Layers

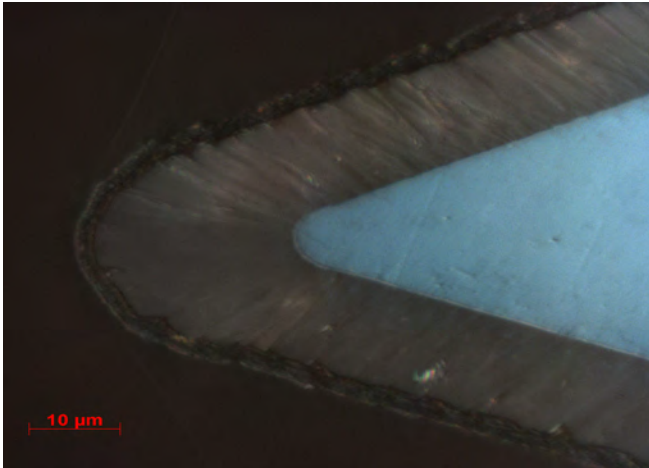
Media

- Gases, Liquids (also hydrogen)
- Surfaces

Fields of application:



Thin layers for component-integrated sensor technology



Component-integrated condition monitoring and force, deformation and torque sensors

- Sensor and insulation layers for directly integrated strain gauges
- Directly applied piezoelectric AlN- and $Al_xSc_{1-x}N$ -layers for
 - acoustic and sensing elements
 - force measurement close to the point of action
- Stable even at very high temperatures
- Applicable in tooling machines

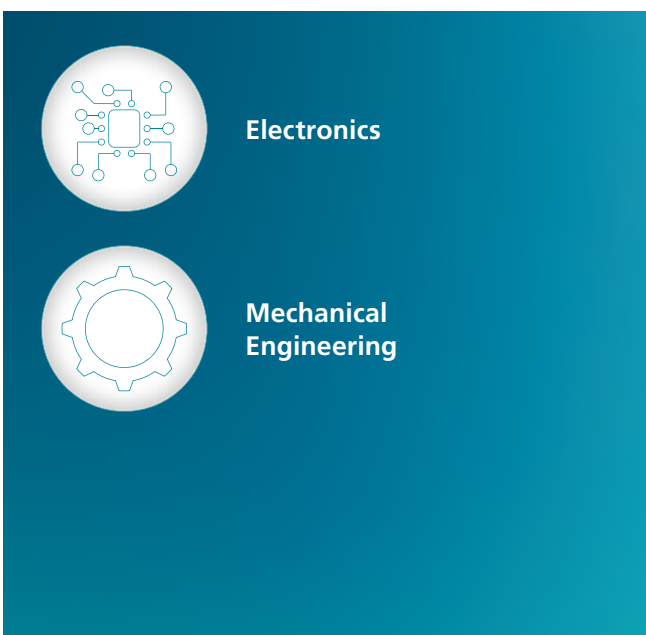
Integration level

- Layers

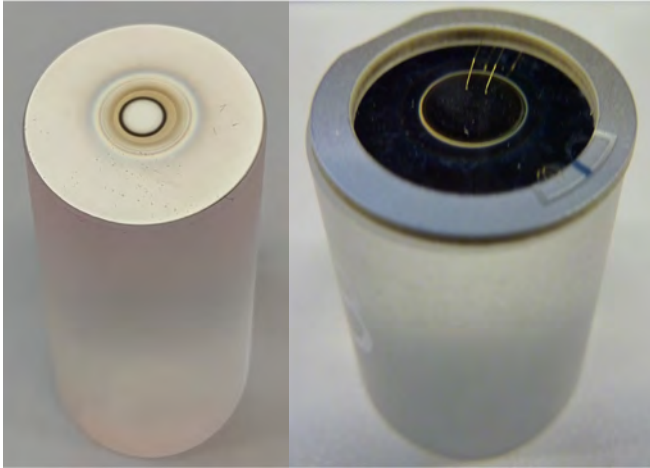
Media

- Surfaces (devices)

Fields of application:



Piezoelectric thin films for ultrasonic applications



- Technology for deposition of AlN and Al_xSc_{1-x}N layers by reactive magnetron sputtering
- Thin film transducer for
 - high resolution ultrasonic microscopy
 - flow rate measurement
 - non-destructive condition monitoring


Integration level

- Layers

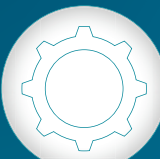
Media

- Surfaces (devices)
- Gases
- Liquids

Fields of application:



Electronics

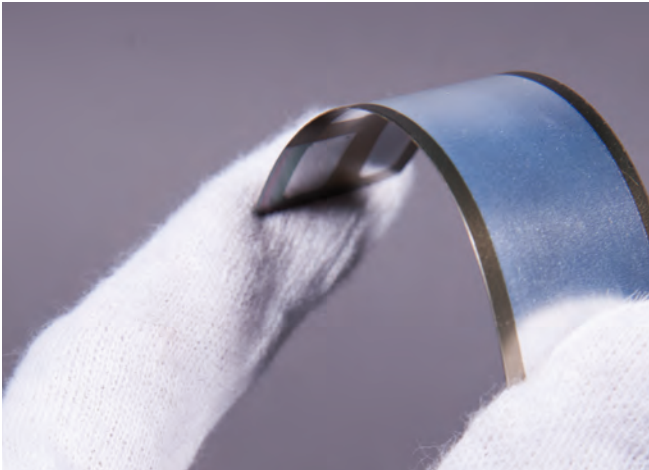


Mechanical Engineering



Medical and Biotechnological Applications

Micro-energy harvesting for energy self-sufficient sensor technology



- Electromechanical simulation of the load condition
- Technology for deposition of AlN and Al_xSc_{1-x}N layers by reactive magnetron sputtering
- Deposition of thin, homogeneous piezo layers for the piezo-based energy generation from mechanical energy (deformation, vibration)
- Self-sufficient on-site power generation for sensor applications

Integration level

- Simulations
- Layers

Media

- Surfaces

Fields of application:

Electronics

Mechanical Engineering

Medical and Biotechnological Applications

Mobility

Thin-film corrosion sensors for monitoring sensitive objects



- Real-time corrosion sensor to monitor ambient air for corrosive gases
- Deposition technologies for reproducible, precise deposition of thin metal layers
- Sensor consisting of thin metal layer (Cu, Ag, Pb, Fe or bronze) applied to an insulating ceramic carrier plate

Integration level

- Component

Media

- Surfaces

Fields of application:

Fields of application:

- Electronics
- Preservation
- Mobility

Fields of application:

- Environment and Energy
- Packaging

Sensor systems for engine diagnostics



- High temperature pressure measurement directly in the combustion chamber
- Pressure sensors
- Torsion sensors

Integration level

- Layers

Media

- Gases
- Solids

Fields of application:



Mobility

Thin film systems for radar sensors



- Transparent, functional coatings for headlight assemblies
- Radar beams can be shaped and directed in a targeted manner
- Coating can manipulate beam spread differently depending on application
- Coating does not affect the color of the light source
- Withstands temperature fluctuations between -30°C – $+120^{\circ}\text{C}$

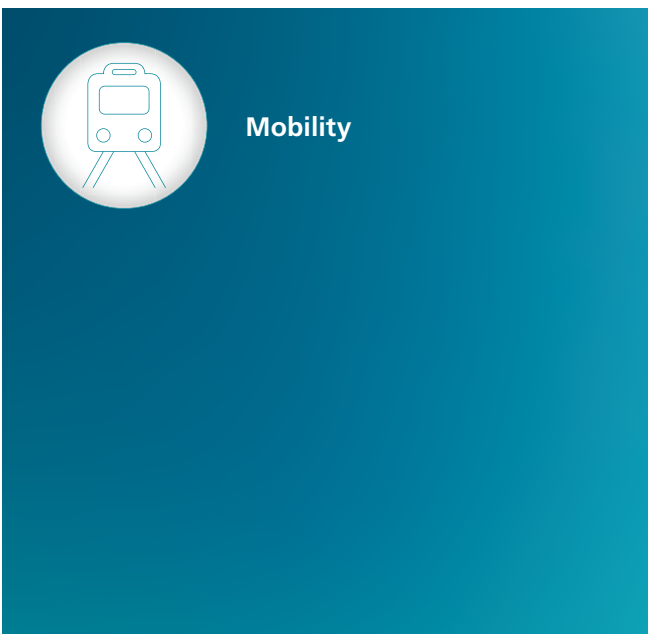
Integration level

- Layers

Media

- Surfaces

Fields of application:



Technology

Optoelectronics

Thanks to our core competences especially in organic electronics and IC and system design we realize highly integrated micro-optical lighting and detection components on a smart single chip and on-chip signal processing as well as organic photodiodes (OPD) on simple glass substrates or polymer films. This enables us to develop a wide range of devices from interactive optical fingerprint sensors to lab-on-chip modules with embedded microfluidics or bio- and microfluidics or bio- and environmental monitoring.



Organic Electronics



IC Design

Thin films

We qualify plasma processes and electron beam technologies for industrial application and production. In particular, we develop sputtering, evaporation and PECVD processes to apply optical, electrical, acoustically or magnetically effective coatings and coating systems with high quality and low number of defects at high coating rates.

In addition, our portfolio includes various types of coating and surface functions. These include mechanical protective coatings for magnetic heads and sensors as well as electrical insulator, barrier and other coatings for sensors (e. g. gas sensors)



Organic Electronics



Plasma-assisted Large-area and Precision Coating



Electron Beam Technologies



Roll-to-roll Technology

Electron beam welding

With our know-how in electron beam technology, we offer the possibility to develop and carry out welding processes with electron beams. A focused electron beam causes the material to melt at the joint of the workpiece. The local overheating of the molten pool due to the high power density of the electron beam creates a vapor capillary and thus the possibility to melt the joint very locally down to great depths. With gap-free positioning of the joint, welds with very large aspect ratios are thus possible without filler metal. A low heat input compared to the weld seam dimension allows low-distortion welds for highly stressed and sensitive components and can be used in particular for the development of sensor components.



Electron Beam Technologies

Services

Test bed for measuring gases in liquids



Sensor solution

- Newly designed sensor test bed SensBio
- Calibratability of the system enables fulfillment of high requirements in terms of reproducibility and data acquisition
- Modular design allows adaptation to future developments
- Measurements of gaseous substances (oxygen, nitrogen, carbon dioxide, ...) in liquid media or aqueous solutions (water <5%, alcohol <5%, NaCl <3%) possible
- Turbidity, suspensions and bacterial count have no influence on measurements

Our offer

- Basic functional tests
- Verification of functional correlations between conditions and measured value (calibration)
- Long-term stimulations under challenging environmental conditions
- Simulation from ideal laboratory conditions to close-to-operating conditions

Other services



- Barrier measurements
- Insulation strength measurement of thin films
- Laboratory services
- Laboratory analytics
- Feasibility and market studies
- Simulations
- Process development
- Device and system development
- Prototypes and demonstrators
- Characterization and testing
- Pilot production
- Process transfer, licensing

Funding authorities

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Contact

**Fraunhofer Institute for Organic Electronics,
Electron Beam and Plasma Technology FEP
Winterbergstr. 28
01277 Dresden, Germany**

Marketing

Ines Schedwill
Phone +49 8823 238
ines.schedwill@fep.fraunhofer.de

Scientific Contact

Dr. Hagen Bartzsch
Static Precision Coating
Phone +49 351 2586 390
hagen.bartzsch@fep.fraunhofer.de

www.fep.fraunhofer.de

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