

Customized functionalization of parts using printed sensors

Precise application of sensor structures



Aerosol Jet® printed thermocouple
of type T (Cu-CuNi) on bearing
(in cooperation with MAHLE)

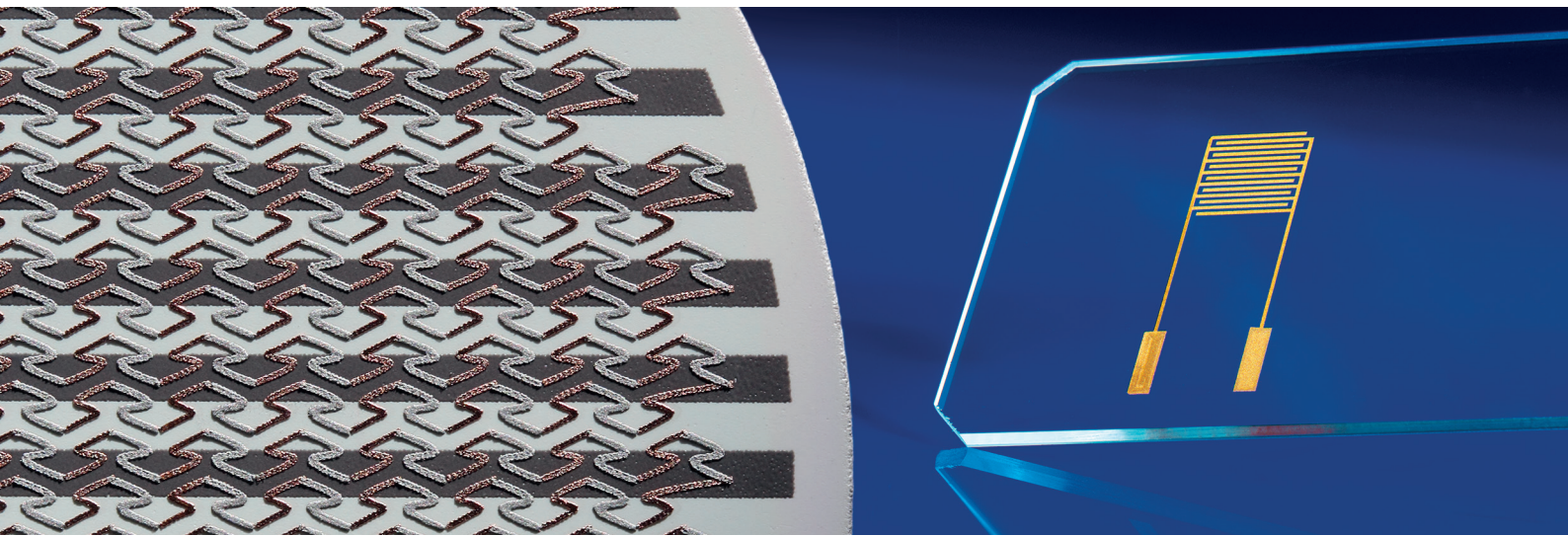
Various sensors can be integrated in parts based on customers needs. Sensor application using digital printing processes enables a high level of flexibility and also requires fewer resources. Parts can be functionalized, the sensors can be individually designed and integrated to fulfil the requirements.

Printed Sensors

Printed sensors can measure temperature, mechanical stresses, impact, crack, humidity, or can act as an actuator. Biofunctionalized sensor structures can be produced for optical or electrochemical detection. Electrically conductive tracks are applied as well as insulating layers and structures. In the interaction with 3D printing technologies sensor integration can be realized. The processes range from

- conception of the sensor layout through substrate selection, modification, and preliminary structuring
- formulation of printable inks and pastes
- structured application of materials, using various printing methods like inkjet printing, aerosol printing, dispensing technologies, and screen printing.

Process stability of digital printing processes is of crucial importance to ensure the consistent quality and reliable conductivity of the printed structures in their later environment. This can be achieved by advanced technology development and evaluation of basic assembly and connection techniques to link microelectronic and non-electronic micro components to a complete system. Overall performance validation tests can be carried out at the end with respect to printed sensors. This ensures that the final digital printing process is stable and conforms to industry standards. Sensor data can be used for digitalization purposes or structural health monitoring of parts and components. Printed sensors are mainly used in automotive industry, aviation, energy, electronics, and in life science.



Printed strain gauges

Measurements of mechanical stresses using strain gauges are very important to ensure high reliability of single parts and complete systems at any time. The required monitoring can be achieved by the utilization of printed strain gauges and crack sensors. These sensors can be applied directly on specified locations on parts using functional printing technologies. This allows a direct and flexible sensor integration.

Printed piezo sensors

For pressure detection printed piezo-electric (PTZ) sensors can be implemented. PZT sensors are based on piezo-electric materials, which applying pressure produces a voltage. These sensors are able to measure and localize an impact by measuring the time difference of the arrival of the signal from different PZT sensors.

Printed thermocouples

Temperature monitoring is an important aspect of many industrial applications. Common types of thermocouple pairs (e. g. type T: Cu-CuNi or type K: NiCr-Ni) can be applied on foils or parts using functional printing technologies. An individual layout of the thermocouple structures with structure widths less than 100 µm can be realized. The direct contact between thermocouple structures and the

substrate surface is important for optimal thermal coupling. Applications for a printed thermocouple of type T is a temperature measurement directly on a bearing or a printed thermocouple network for increased measurement accuracy.

Biofunctionalized sensor structures

Sensors with high sensitivity and good selectivity are required to control and monitor gas mixtures. For this purpose, sensorial areas made of enzymes, proteins, other ligands or so-called capture molecules are applied to a printed, electrically conductive interdigital gold structure. Smallest amounts of toxic substances can be detected using these sensitive biofunctionalized sensor structures and characterized optically and electrochemically via coupling reactions.

Our offer

To functionalize parts by sensor integration, we offer the following R&D services:

- Concept studies as well as experimental feasibility studies for functional integration of various sensors
- Formulation and adaptation of sensor materials for various printing processes
- Functional sensor integration in components and on surfaces
- Know-how and technology transfer

Left: Printed thermocouple network for increased measurement accuracy (in cooperation with Ecomatik)

Right: Printed gold structure for selective sensors assembly

**Fraunhofer Institute
for Manufacturing
Technology and
Advanced Materials
IFAM**

Wiener Strasse 12
28359 Bremen, Germany

Contact

Smart Systems
Dr. Ingo Wirth
Phone +49 421 2246-232
ingo.wirth@
ifam.fraunhofer.de

Jonas Deitschun
Phone +49 421 2246-239
jonas.deitschun@
ifam.fraunhofer.de

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