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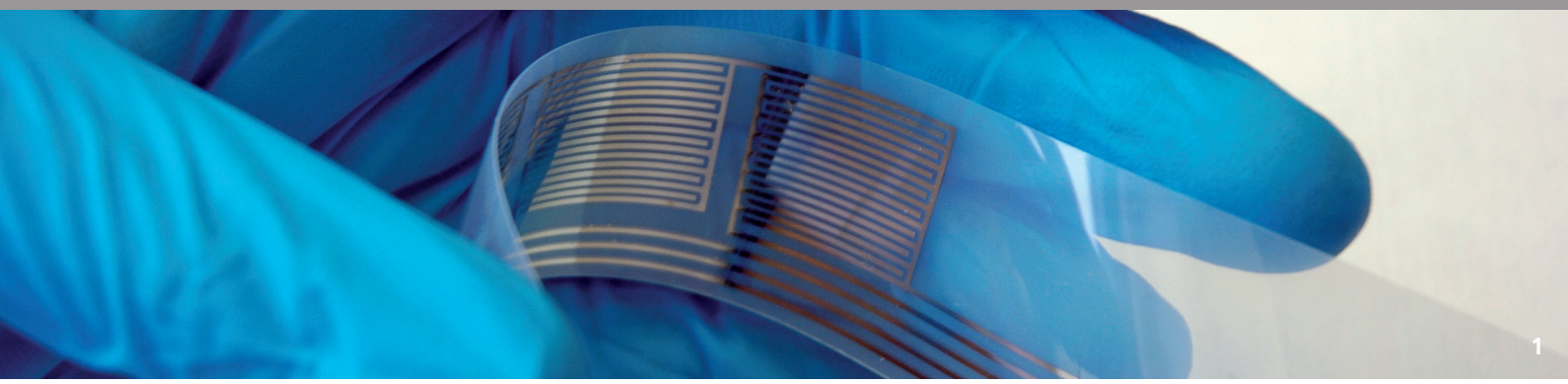

1 *Ink Jet-printed capacitive sensors*

THIN-FILM ELECTRONICS PHYSICAL SENSORS

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Thin-film Electronics

Thin and flexible yet affordable and rugged thin-film solutions enable novel solutions for applications in the automotive, industrial, energy and packaging sector.
Adding sensor capabilities to existing systems results in higher performance and yield. Rethinking designs leveraging the advances in thin-film and printing technology reduces costs and design complexity and allows unique products.

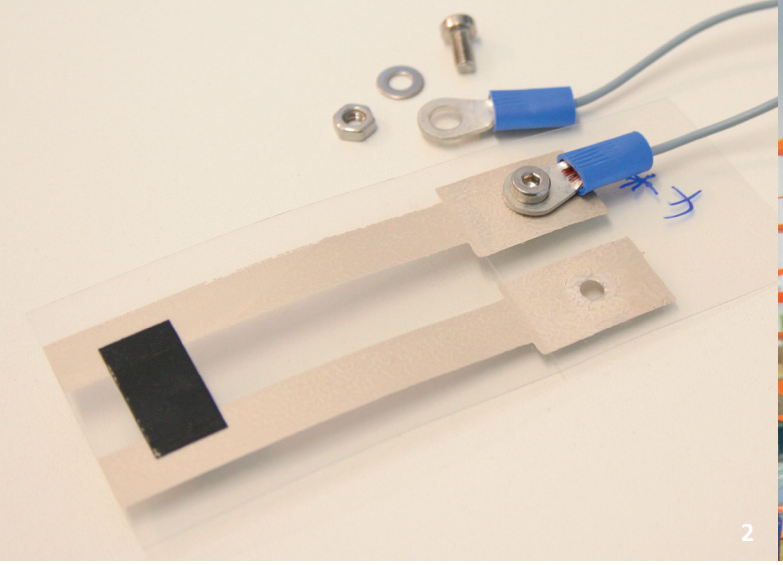
Thin-film sensor fabrication

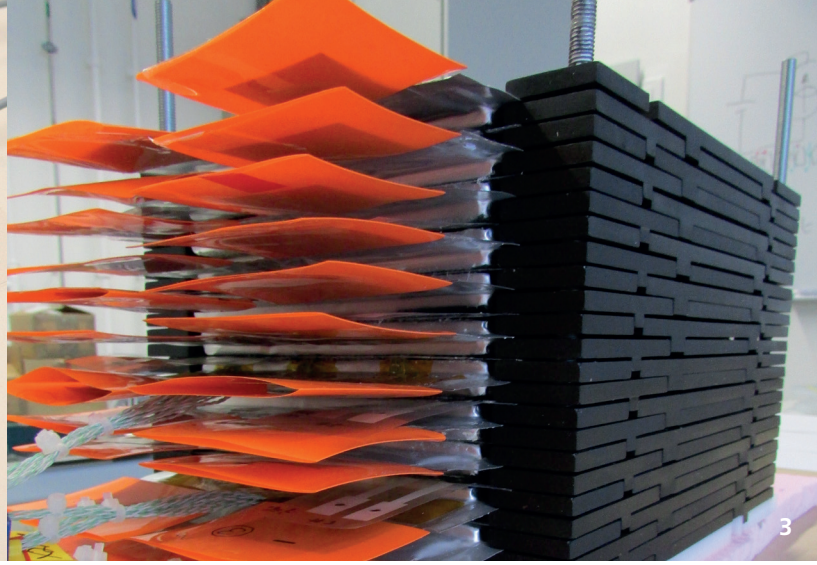
At Fraunhofer IISB, several dedicated laboratories for thin-film and printed electronics (TOLAE) as well as a cleanroom facility (π-Fab) fully equipped for 200 mm CMOS processing are available. The unique advantage of Fraunhofer IISB exists in long standing expertise in all relevant film deposition techniques and experience with complementary specialty processes.

Experienced operators, engineers and scientists perform service and development tasks. This technological know-how is translated into specialty sensors by the thin-film systems work group. One field of activity are temperature, capacitive and pressure sensors as well as arrays of them for integration with existing products.

Sensors Arrays and Systems

The biggest advantage of printed electronics is the ease of creating arrays of heterogeneous components to combine sensors for various purposes without challenging packaging or mounting requirements. The increasing availability of active components for printed electronics allows for the integration of read-out amplifiers and multiplexers and will allow printed logic to incorporate functions currently reserved to silicon devices.





Capacitive Sensors

A great way to detect and distinguish objects and fluids is through their interference with electrical fields. In many cases it is sufficient to measure the change on the near static capacitance to discern if buttons are pressed or if containers are filled. More challenging applications may require asymmetric sensitivity, RF analysis to distinguish between fluids or enhanced detection distances.
Fraunhofer IISB offers the whole development chain from definition of application concept, electro-magnetic field simulation, sensors printing until the implementation and test of readout circuitry in conventional as well as thin-film electronics.

Temperature Sensors

Since the decay of many products is greatly influenced by temperature, constant monitoring to allow better prediction of asset conditions is highly beneficial. For perishable food products this requires either costly air conditioning or highly localized and distributed measurement through cheap devices, possibly forming part of an internet of things. Furthermore, shelf life may by defined by real condition data including the temperature history rather than by a pre-defined expiry date. These devices are by necessity ultra-low power, include very limited circuitry and will need to be integratable into existing packaging processes.
Other goods like batteries, displays or solid-state lighting equally benefit from temperature monitoring.
Highly advantageous here is the possibility to produce fully transparent sensor systems. For other purposes the flexibility or availability of large area circuits is a key feature.

Pressure Sensors

Forces normal or tangential to surfaces are important to technical applications in human-machine interfaces, robotics, and liquid handling. Sensors detecting mechanical loads applied to support structures, pressure inside of containers or between functional units. The ideal sensors for these applications are distributed over the entire area, are highly sensitive but exceedingly robust and cheap as well as easy to apply to existing systems. Printed electronics is all that and can be customized widely, e.g. deliver arrays of point sensors vs average over area vs detection of maximum point pressure.

Packaging Technologies

An unfortunate challenge associated with hybrid technologies are the interfaces between them. Experience with interfacing technology and knowledge of specialty providers result in low ohmic, physically and mechanically stable connections in both low volume and at scale processesmechanically stable connections in both low volume and at scale processes.

2 *Screen printed temperature sensor*

3 *Flexible thin-film sensors integrated with battery system*

ROLL-OUT

The ROLL-OUT project combines the competences of top-level European research groups and large and small- and medium-size industries involved in Large Area Electronics. ROLL-OUT intends to create a multi-purpose technology for thin, large-area, high-performance, smart, and autonomous systems comprising integrated circuits (ICs), sensors, and electronics, advancing the packaging, automotive interiors and textile industries beyond their traditional scope. The key features are high-performance circuits and components. Novel, hybrid, moderate-temperature, roll-to-roll processes, namely sputtering, atomic Layer Deposition (ALD) and screen-printing on thin, flexible, large-area substrates are methods to be used.

Within this cooperation, funded as part of the Horizon 2020 program, we join in developing intelligent containers permitting the monitoring of a set of parameters in fully printed electronics.

http://www.roll-out-2020.eu

roll-out