Press Release

BMBF project KoSiF started - companies and researchers working together on flexible and autonomous sensor systems

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Sensory films - smart skin for machines

In industrial products as well as in the household, devices are equipped with sensors which see, taste and feel for machines, thus facilitating safe operation or even stand-alone operation of these devices. These sensors require the ability to process signals and the sensors must be powered. So systems of cables, connectors and electronics with silicon chips are required. It would therefore be preferable if these devices, machines and robots had a sensitive flexible skin that, for example, sensed contact and deformations, relayed this on to other system units and thus could function without a supply cable. A consortium of ten research groups and developers from companies in the Stuttgart area set itself the goal of making these ideas a reality in the next three and a half years. Some of the latest research results that have now been integrated into the newly launched project make this possible.

Even highly complex silicon chips can be manufactured very thinly, mainly with a thickness of just a few micrometers and can be embedded in thin plastic films; aerials, rechargeable batteries and batteries can even be printed directly onto films. Progress in organic electronics is also making it possible for the first electronic circuits to be manufactured on films using printing processes.

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In the KoSiF project -the acronym standing for “Complex Systems in Films”- the basis and the necessary technologies for additional functionality which are necessary for the manufacture of future SiF products are to be researched, assessed and coordinated technologically. This is driven by two demonstrators that are defined and coordinated by industry partners. An example typical to the area of automation and manufacturing technology and secure human/machine interaction is intelligent door locking which, due to the flexible construction, is integrated into the machine with a low space requirement and such that it is barely visible to the user, and monitors the door and its movements in a tamper-proof manner. The second demonstrator will be a bending and strain sensor system, which monitors the movements of a bionic mobile assistant for the company Festo. This gripper, modelled based on an elephant’s trunk, a development awarded in 2010 with the German Future Award, is perfectly suited for work between man and machine due to its construction from flexible plastic elements. Both demonstrators will be developed as autonomous and wireless communicating systems on flexible films in the second project phase and will be tested in application.

The collaborative KoSiF project will be sponsored by the Federal Ministry of Education and Research (BMBF) as part of the Hightech Strategy, based on the BMBF incentive programme “IKT2020” over a period

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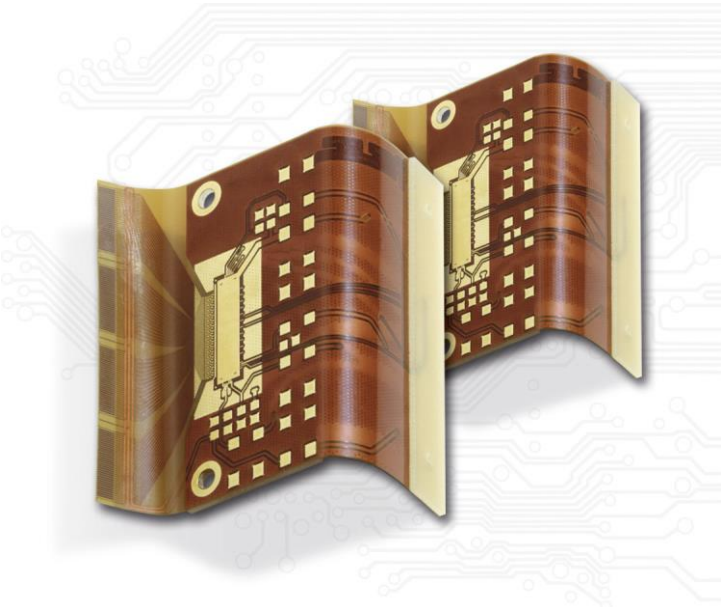
of 3.5 years with a total of around €3.8 million. The collaborative partners are contributing a further €2.2 million approximately.

In the KoSiF project, the companies Festo, Pilz and Würth Elektronik and the University of Stuttgart are working together with the IGM, INES and INT institutes; Stuttgart Media University and Hahn-Schickard-Gesellschaft (Hahn Schickard Society) are working with the IMAT institute; the Max Planck Institute for Solid State Research is working with the Organische Elektronik (Organic Electronics) Group and the Institute for Microelectronics Stuttgart.

Picture:

Next generation System in Foil



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About the partners

Würth Elektronik

Würth Elektronik has evolved from a printed circuit board manufacturer into a system house provider and, within this context, creates complex systems based on flexible or rigid-flexible circuit carriers, which already contain integrated circuit components (IC, sensors) in accordance with state of the art technology. The use and further development of bio-compatible materials and surface finishes as well as collaboration for the integration of system components is the subject of previous and current research projects that Würth Elektronik carries out in national and international networks (e.g. "Chip in Polymer", GloveNet, KRAFAS, TIPS and ORFUS). This technology can be used not only in flexible, but also in rigid applications. The possible areas here range from the manufacture of flexible interposers with embedded chips to the integration of these ultra-thin structures in printed circuit boards which have been constructed with embedded Faltflex®.

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FESTO GmbH

The Festo company is a global leader in automation technology and brings experience in the manufacture and practical use of the bionic handling assistant to the project. The handling system consists of flexible lightweight structures, which are particularly suitable for a flexible sensor approach. Festo has experience in investigating flexible elec-

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tronics in the form of printed carbon pastes on flexible structures (components with substitution of printed circuit boards). Initial investigations into ultra-thin chips on flexible grippers and experiments regarding the assembly and connection technology of these ultra-thin chips and flexible grippers constituted preliminary work for KOSIF.

Festo GmbH // Ruiter Straße 82 // 73734 Esslingen

Pilz

The Pilz company has been working in the area of control technology for years and is a world market leader in secure controls. Customised sensors are an important component for this field of application. Pilz developed various products, such as simple sensors for monitoring the position of safety doors or a camera-based safety surveillance system (SafetyEYE), a development together with IMS CHIPS.

Pilz GmbH // Felix-Wankel-Straße 2 // 73760 Ostfildern

HDM

Stuttgart Media University and the Central Institute for Applied Research (I-AF) there aim to expand fast and cost effective production methods for printing technology to new applications, mainly in the area of electronics and sensors, as part of the focus on "Innovative Applications in Printing Technology" (printed aerial structures, printed rechargeable batteries, printed thermocouples, fine line printing, printing transparent layers based on hybrid systems from CNT and PE-

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DOT/PSS). In KOSIF, expertise and technology are mainly incorporated in the area of printed flexible thin film batteries, which have been established through the projects "PrintAkku" and "BatMat". The industry partner Varta contributed the necessary electrode materials and the corresponding expertise in the past and will also do this within the scope of KOSIF as an associate partner.

Stuttgart Media University // Nobelstraße 10 // 70569 Stuttgart

HSG-IMAT

HSG-IMAT currently employs over 40 members of staff and has now been working closely with the University of Stuttgart's Institute for Time Measurement, Fine and Microtechnology (IZFM) for 14 years in the field of MID technology for constructing plastic-based multifunctional 3D packages with a high level of miniaturisation and complex 3D requirements. HSG-IMAT has particular experience in precision toolmaking and the ultra-precision processing of optical components, micro injection moulding, transfer moulding and simulation, the metallisation of MID with chemical and PVD processes, laser-based microstructure technologies, 3D assembly and assembly technology for bare chips and SMD components, printing technology such as Aerosol Jet®, inkjet, screen and pad printing and the characterisation of MID components with various methods. Thus an integrated approach is being taken in HSG-IMAT, through which all issues relating to the creation of complex plastic-based 3D structures can be addressed practically. For

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KOSIF, HSG-IMAT's comprehensive knowledge and many years of experience in printing conductive, semi-conductive and isolated layers with various technologies as well as the design and characterisation of various sensors, is important.

HSG-IMAT // Allmandring 9b // 70569 Stuttgart

The University of Stuttgart

IGM

For more than twenty years, the University of Stuttgart's Institute for Large Microelectronics (IGM) (until 2011, the Chair for Display Design) has been operating a clean room laboratory unique to universities in the Western world (Europe and the USA) to research thin-film transistors on substrate surfaces up to 40cm x 40cm. Recently, a number of projects have been worked on in the area of thin-film transistor-based circuits on flexible substrates, which, among other things, have led to the world's first full-colour liquid crystal display on thin glass substrates and to frequently cited work in the area of the use of carbon nanotubes for flexible displays. Since the founding of the laboratory, much application-oriented research work has been carried out in close cooperation with industry partners and as part of publically funded consortia.

INES

The Institute for Nano and Microelectronic Systems (INES) conducts research and teaching in the field of analogue, digital and mixed-signal

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circuit technology in CMOS technology and alternative technologies, such as organic electronics. The institute is also involved in circuit technology for high voltage and power applications. Various bachelor, masters and doctorate work is supervised in these areas. There is access to advanced design and simulation tools (Cadence, Silvaco, Ansys) for microelectronics and microsystems to carry out this work. There is also access to a test environment (Agilent), through which the circuits developed can be analysed and characterised.

INT

The Institute for Electronic and Optical Telecommunications (INT), under the direction of Prof. Dr.-Ing. Manfred Berroth, handles the key research areas of integrated circuits, high frequency power amplifiers and components for optical telecommunications. Nine scientific employees work in the integrated circuits work group. A special focus of the work is on circuits for quick serial data transfer, such as analogue to digital convertors, digital to analogue convertors, quick digital decoders and circuits to precorrect or equalise data signals. Another key area of the integrated circuits work group is on the design of integrated high frequency circuits. A second group focuses on efficient power amplifiers for mobile communications and investigates both discretely constructed as well as integrated power amplifiers, and in particular

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switching amplifiers. A third group works on the design and characterisation of optoelectronic components, with a focus on optical receivers.

MPI

The Organic Electronics research group established in August 2005 at the Max Planck Institute for Solid State Research (MPI FKF) develops materials and manufacturing processes for the production of organic thin-film transistors (TFTs) on flexible film substrates. The focus here is on reducing the supply voltage of the organic transistors to operational values, continually improving the performance and long-term stability of the transistors, as well as the interconnection of up to several hundred of these transistors to analogue or digital integrated circuits. Thus, for example, the supply voltage of organic transistors could be reduced from more than 20 volts to 2 volts by developing an innovative gate dielectric, where the interconnection of these organic transistors is significantly simplified through silicon circuits. In collaboration with the Institute for Microelectronics Stuttgart (IMS Chips), it was possible to increase the switching frequency of organic transistors from 10 kHz to over 1 MHz and demonstrate a 6-bit digital to analogue convertor with very good linearity and a data rate of up to 100 kS/s. In addition, a means of realising a high level of performance and long-term stability on flexible film substrates and p-channel and n-channel transistors and integrating energy-saving complementary circuits was developed.

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Institute for Microelectronics Stuttgart

The Institute for Microelectronics Stuttgart (IMS Chips) is a non-profit organisation in Baden-Württemberg and carries out applied research in the field of microelectronics in the areas of silicon technology, application-specific integrated circuits (ASIC), nanostructuring and image sensors, and is involved in professional development. Approx. 90 highly qualified employees work under the direction of Prof. Dr. Joachim Burghartz in the important fields of microelectronics and their application in practice.

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