ims chips
Institut für Mikroelektronik Stuttgart

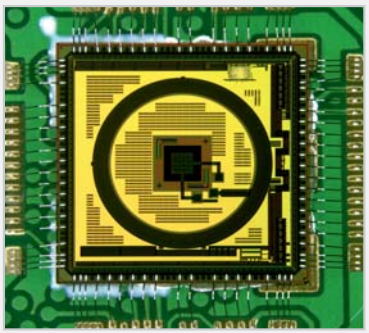
IMS Newsletter 2/21

QSens - Quantum Sensors of the Future

As part of the BMBF's QSens - Quantum Sensors of the Future - the two universities of Stuttgart and Ulm, three Stuttgart-based research facilities and 19 industrial partners have joined forces to bring quantum sensors to market over the next nine years. The BMBF is funding QSens with as much as 45 million euros.

QSens page 2

Project INOSENS - Research on an innovative optical rotation angle sensor



The INOSENS research project is investigating a novel, high-resolution optical rotation angle sensor installed on a miniaturized sensor platform. In addition to the rotation angle of an axis, the ambient temperature and vibrations of the housing can also be measured. Thanks to a powerful micro controller, all sensor values are analyzed, stored and combined in an intelligent equipment condition monitoring.

INOSENS page 3

Flexible electronics for medical technology - Intelligent sensor technology through integrated evaluation ASICs

In the recently completed Flexmax project, two examples of flexible electronic systems for applications in medical technology were demonstrated. Equipped with ASICs designed by the IMS to evaluate bent sensors and proven technologies for hybrid foil integration, novel cardiac catheters and a foil system for the respiratory monitoring of premature infants were developed and tested in initial application scenarios.

Flexmax page 3

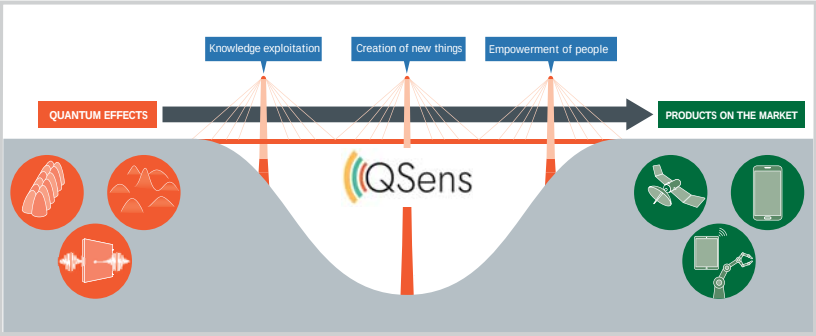
MST Kongress 2021 – Symposium for Microsystems Technology in Ludwigsburg

From November 8th thru 10th, 2021, the MikroSystemTechnik Kongress took place in Ludwigsburg, a joint BMBF and VDE event, which is organized every two years. At this largest German conference for microsystems technology, experts spent three days exchanging information on the latest developments and research topics. Chairman at this year's event was Prof. Dr. Joachim Burghartz, Director and CEO at Institut für Mikroelektronik Stuttgart.

MST Kongress page 4

QSens enters its first implementation phase on Nov. 1

The QSens vision: Utilizing the disruptive potential of quantum sensors in everyday life



Driven by the digital generation´s strive for data and the increasing proliferation of autonomous technical systems, the fields of metrology and sensor technology have undergone rapid developments in recent years and now represent integral components of all modern products and processes. Sensors are therefore needed in unprecedented numbers to meet the growing demand in autonomous technical systems for the everyday activities in mobility, healthcare, IoT and sustainability. However, the sensors used today are increasingly facing technological limits in terms of their functionality and the sensitivity that can be achieved with them. Examples include the lack of sufficiently sensitive and accurate as well as cost-effective sensors for personalized medicine or autonomous driving. This basically means that many future-oriented applications cannot be realized with existing technologies and require completely new, disruptive approaches.

In view of the „second quantum revolution" the availability of novel quantum sensors offers a unique opportunity to fundamentally improve sensor performance. This value commitment is based on previously successfully demonstrated measurements in research laboratories and emphasizes the enormous potential in quantum technologies. Examples include revolutionary increases in the sensitivity of diamond-based magnetic field sensors, which open up completely new directions in personalized medicine, a precision enhancement of quantum gyroscopes, which achieve hundredfold increased angular resolution for high-precision navigation, or the availability of calibration-free quantum standards, which form the basis for a reliable functioning of all autonomous systems.

The objective of the QSens cluster is to transfer the outstanding basic research findings in quantum sensor technology from physics labs into everyday industrial applications (see front page).

The vision of the QSens cluster goes well beyond the format of traditional collaborative funding. In order to utilize the immense potential provided by quantum technologies as quickly and efficiently as possible and to secure it for Germany as a business location in the long term, QSens is designed much like a holistic ecosystem. Due to its interdisciplinary structure, QSens will be able to independently generate new market-relevant innovations for society´s challenges of mobility, healthcare, IoT and sustainability by making use of quantum sensors and transfering them into market products.

To achieve this, QSens relies on a high degree of local capacities and combines the scientific excellence of university partners in basic research and engineering with the experience of innovative large companies as well as the dynamics of SMEs and start-ups. This also creates the kind of sustainability that makes it possible to bridge the „valley of death" in the transition from the research lab to everyday life, see figure above.

Specifically, in the first three-year QSens implementation phase, application-driven work is done on the market introduction of quantum sensor technology in the areas of (bio)medical technology, industrial sensor technology and sensors for research within the framework of six joint research projects. In addition, there are two joint research projects dealing specifically with the scalable production of quantum sensors in diamond and/or silicon carbide, see figure below. The cluster is rounded off by two cluster-forming projects, one of which is dedicated to interdisciplinary topics such as a dissemination in industry and society and the support of QSens spin-offs. The second cross-cluster project, „Quantum4SME", is dedicated to establishing an ecosystem that will enable fabless manufacturing of quantum sensors for SMEs and startups before too long. IMS CHIPS is an integral part of QSens assuming a central role in the scalable fabrication of quantum sensors and will be home to a large part of the „Quantum4KMU" platform in the future.

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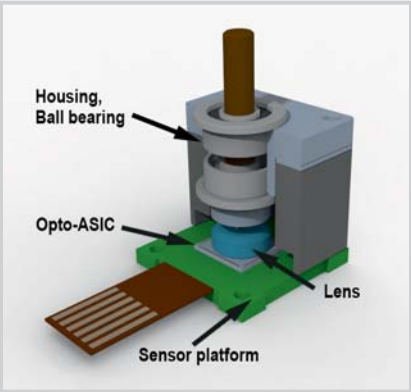
Project INOSENS

Researching an innovative optical rotation angle sensor



Schematic structure of the encoder

The trend towards integrating as many different sensors as possible in a small space and processing their measured values as close to the sensor as possible also opens up new possibilities and areas of application for optical rotary angle sensors. In addition to determining the angle of rotation of a connected axis, which is part of the basic function of the optical rotary encoder, other proximity parameters can also be recorded. These include the operating and ambient temperature as well as possible vibrations of the encoder. The idea behind this is to generate a status monitoring of the encoder, which warns early of exceeding maximum values or an imminent failure.

IMS CHIPS is cooperating with Hahn-Schickard-Gesellschaft in Stuttgart in developing an intelligent optical angle of rotation sensor, which detects and processes several environmental parameters. This complex sensor system is created by combining a novel optical approach to determine the angle of rotation and a miniaturized sensor platform. The package as well as all optical components have been specifically designed for the miniaturized setup. The central component of the optical encoder is a circuit developed by IMS CHIPS with integrated photodiodes (Opto-ASIC, see front page) to determine the angle of rotation and temperature measurement. The miniaturized sensor board serves as carrier for all sensor elements and interconnects the optical circuit, the gyroscope and a powerful micro controller. The gyroscope can be used to detect increased shaft vibrations and generate a warning in case of damage, for example. All sensor information from the encoder is analyzed by a micro controller and connected to intelligent functions to provide status monitoring.

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Flexible electronics for medical technology

Intelligent sensor technology through integrated evaluation ASICs

Chipfilm-Patch with embedded ASIC

Evaluation ASICs made by IMS CHIPS integrated in flexible foil systems with bending sensors create new solutions for medical technology. The small electrical signals deriving from bending sensors in thin and flexible polyimide foils are evaluated and digitalized by ASICs, which are integrated directly next to the sensor arrays in the foil. The ASIC chips, which are only about 30 µm thick, are embedded in the chip-film patch foil (pictured above), bonded to the large-area sensor array and contacted via metal connections.

This enables the analysis of the breathing of premature infants through a film patch attached to their chest and allows targeted drug delivery by inhalation. The risk of harmful overdoses during inhaled drug administration in this critical phase of life is minimized and the chances of healthy survival are increased.

Researchers at the Fraunhofer Institute for Toxicology and Experimental Medicine (ITEM) were able to capture respiratory cycles through photographic data acquisition on a premature infant model and match them with sensor data to ensure respiratory triggering of drug delivery. The flexible sensor patch on the infant's chest barely interferes with the mobility.

The Flexmax project covered another important application of flexible electronics with the development of a sensor system for cardiac catheters. A sensor-based motion control of cardiac catheters, which will be used by the medium-sized catheter specialist Osypka for future products, requires near-location and highly sensitive measurements and digitization of the sensor signals, just like respiratory triggering. A particular challenge in endoscopes and catheters, of course, are the space limitations and mounting requirements for the complex sensor system. The ASICs, which are barely wider than 0.5 mm and less than 30 micrometers thick, measure the signals from four bending sensors each; a total of seven to eleven such sensor elements are needed for the motion control of an ablation catheter for heart disease. Data from the demonstrator test and further studies with users will show the extent to which the use of the new technology can reduce the time required for X-ray visualization and thus the radiation exposure for the patient.

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MST Kongress 2021

Symposium for Microsystems Technology in Ludwigsburg

The MST Kongress 2021 opened its doors on Monday, November 8, with the registration of the participants and the opportunity for field trips to visit the laboratories of Hahn-Schickard in Stuttgart, the technology area at Institut für Mikroelektronik Stuttgart, and the 200 mm wafer fab at Bosch in Reutlingen, followed by an opening event in the evening at Forum Ludwigsburg. The following two days saw a wide-ranging conference program with the latest developments on a variety of topics. In line with the current situation, the first session on Tuesday was on pandemics, where new techniques and solutions for point-of-care diagnostics and rapid analysis systems were presented. Parallel to this, three other sessions discussed Mobility, Integrated Hybrid & Micro-hybrid Systems, as well as Optical and Photonic Components. In the afternoon, the projects of the Bosch IoT Innovation Challenge and the student competition COSIMA were presented and the winners of the Dr. Wilhelmy Award, the GMM Prizes and the Alfred-Kuhlenkamp Award of the GMM were introduced and honored. These were followed by sessions on innovative microsystems, sensors & quantum sensors, process technologies, and economics & sustainability. The sessions and events were accompanied by a main exhibition area, where IMS CHIPS was also present, as well as poster sessions and a start-up pitch.

Wednesday featured the sessions Materials, Quantum Sensors on the Way to Market, Robust & Reliable Microsystems, Health & Care, Assembly & Interconnection, and Microactuators & Energy Harvesters, some of which went on all day. The Optical and Photonic Components sessions continued from the previous day. As on the previous day, the technical presentations were accompanied by extensive poster sessions and the exhibition area.
The event program and further information can be obtained at www.mikrosystemtechnik-kongress.de.

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News Flash

„Beams & More“ – This title defines the 18th lithography workshop be held at the IMS. The workshop will take place as webinar on November 18th, 2021. For further information and registration, please go to http://beams-and-more.ims-chips.de.

Project DoRiE – Data-oriented realization in a real-life industrial environment launched. The project shows how different implementations can be realized quickly and flexibly from an Edge AI modular system. In QuickChecks, project ideas from companies are analyzed in detail free of charge. For further information, please visit https://ki.ims-chips.de.

ID2PPAC project – Integration of processes and modules for the 2-nm node launched. This project consolidates and integrates the technological solutions for the 2-nm node identified in the previous project IT2. The goal is to demonstrate that the Performance Power Area and Cost (PPAC) requirements for this new generation of leading logic technology are within reach. For more information, please visit: https://www.elektronikforschung.de/projekte/id2ppac.

Research Association
of the Institut für Mikroelektronik Stuttgart e.V.

The non-profit Research Association of the Institut für Mikroelektronik Stuttgart was established in 1983 and supports the contacts between industry and research. It is a contact point for talents from Germany as well as from abroad that will be supported by the IMS with a scholarship. It opens doors to member companies that sponsor them.
An annual member meeting takes place every year. Members receive a discount on trainings and events.
For further information, please refer to www.ims-forschungsverein.de.

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