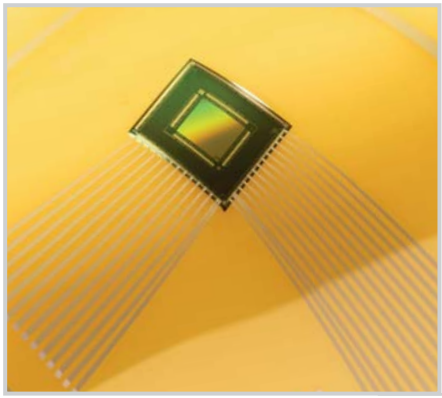
IMS Newsletter 1/20

May 2020

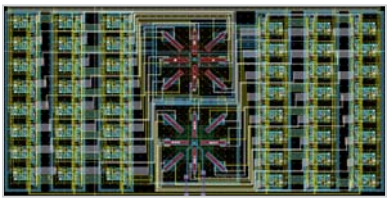


FLEXMAX - flexible active sensor matrix for medical applications

Under guidance of the medical technology manufacturer Osypka, industrial and scientific researchers are working on film-based sensor systems for two specific applications in medical technology: Respiratory monitoring and controlled drug delivery for premature infants and sensor-based movement control of heart catheters.

FLEXMAX page 2

BW-CPS project Multi Sensor ASIC presented



IMS CHIPS has designed a multi-sensor chip as part of the project. For the practical implementation of CPS in industrial applications, a "BW-CPS" initiative supported by the state of Baden-Württemberg was launched and is coordinated by the Hahn-Schickard-Institute in Villingen-Schwenningen. In addition to the Hahn-Schickard-Institutes in Stuttgart and Villingen-Schwenningen, Forschungszentrum Informatik (FZI) in Karlsruhe and IMS CHIPS were also involved.

BW-CPS page 3

BMBF-sponored OPALID project – integrated optical chips for LiDAR systems

IMS CHIPS and the project partners are developing a compact LiDAR system without moving parts for the factory, logistics and automotive industry. The previously rotating unit is replaced by an optical array of phase shifters. The technological implementation is based on silicon photonic chips with integrated optical elements.

OPALID page 3

IMS CHIPS as alliance partner for the production of next generation integrated circuits

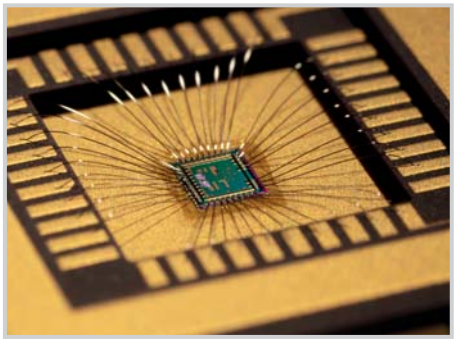
In the next few years, high-performance processors will be required for autonomous driving, AI or large data centers, for example. Within the Ecsel projects TakeMi5 and TapeS3, IMS CHIPS is supporting the development of highly innovative technologies, with which the performance of today's circuits are clearly exceeded.

TAPES3/TAKEMI5 page 4

innBW INNOVATIONSALLIANZ BADEN-WÜRTTEMBERG

Foil systems with integrated chips and sensors

Key applications for flexible electrics in medical technology



Flexible electronic systems are finding more and more applications in medical practice. They are particularly suitable to record important parameters on irregular or changing body shapes, as frequently encountered in medical technology applications. Two examples from medical practice are investigated in the Flexmax project, which is funded by the German Federal Ministry of Education and Research within the "Smart Health" program.

Respiratory monitoring in premature infants increases the chances of a healthy survival in this critical phase of life. In order to optimize the dosage of any inhaled medication and to avoid harmful overdoses, it is desirable to monitor respiratory processes and control artificial respiration. Preliminary work at the University of Braunschweig and the Fraunhofer Institute for Toxicology and Experimental Medicine (ITEM) showed that a flat sensor-film system based on polyimide films with strain sensors is suitable to detect respiration processes. However, in order to obtain more accurate and reliable data, many sensors must be integrated into the sensor patch, which could not provide evaluable results without active electronics for data evaluation and digitization.

With the Chip-Film Patch Technology developed at IMS CHIPS, it is possible to embed thin silicon chips into polyimide films, to contact them and, thus, integrate them into such a sensor patch so that the extremely low signals of the sensors are acquired by a specially developed ASIC, evaluated and digitally transmitted to the control unit. The first half of the project saw the chip development as well as a further development of the sub-processes (sensor production, chip integration in CFP, photographic data acquisition in premature infants in order to adapt the premature model and construction of the respiration triggering). Following the ASIC production and successful commissioning of the evaluation chips, the partners are now working on the completion of the foil system, which will be evaluated on a lifelike model. At the same time, work is being done on the software for the clinical operation of the system, with the partner Activoris Medizintechnik defining the user requirements for the systems and using usability tests to check the usability in accordance with the standards. This is to ensure the rapid implementation of the research results into clinical practice.

The second application is the sensor-based movement control of heart catheters, which is to be used by the medium-sized catheter specialist Osypka in future products. The idea behind this is the effort to minimize the burden on patients in the treatment of coronary heart disease by means of permanent X-ray exposure during catheter movement, without taking risks regarding movement control. An elongated sensor foil system for tracking catheter movement, i. e. the deformation of the catheter in the human body, is to be used to visually display the movement for the physician and, thus, reduce X-ray exposure. In addition to the demands on the sensitivity of the evaluation chip, the spatial restrictions and mounting requirements for the complex sensor system are, of course, a particular challenge in this application. In order to be able to install the foil system with evaluation chip and bending sensors in an ablation catheter, the ICs must be barely wider than 0.5 mm and less than 30 micrometers thick. They are equipped with enlarged and gold-coated contact pads and embedded in sensor foils and connected by our partner Cicor in Ulm. The foil mounting and integration into the catheter system is then carried out by Osypka.

Ablation catheters for the treatment of heart disease

After testing the individual components, work is now underway on the production of the two demonstrators, which will be completed and tested by the end of the year.

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BW-CPS project Multi Sensor ASIC presented

Smart sensor solutions for cyber-phyical systems

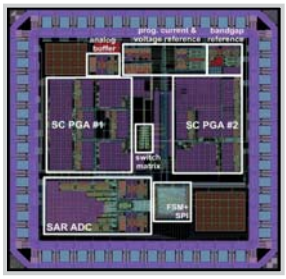

Fig 1: Universal multi-sensor chip

Cyber-physical systems, CPS, can generally be described as systems consisting of virtual and real components that are linked together via information networks. The term CPS is applied to a wide range of systems: from intelligent workpieces in production to solutions for building automation, from self-propelled cars to intelligent power grids - everywhere highly networked complex systems consisting of software and hardware components can be found. CPS play a central role in the fourth industrial revolution ("Industrie 4.0") currently underway. They are increasingly replacing manufacturer-specific measurement and control solutions in production, logistics and the entire life cycle management of products. CPS are characterized by a high degree of interoperability and the ability to automatically adapt to environmental conditions ("plug & work").

Within the BW-CPS project, funded by the state of Baden-Württemberg, IMS CHIPS has designed universal evaluation chips for smart multi-channel sensor applications and implemented them as sample solutions. These multi-sensor ASICs are suitable for CPS applications in climate sensor technology for precise measurement of temperature, humidity, pressure and radiation, among others. Certain sensor quantities, such as temperature, radiation and bending stress can be measured directly on-chip (see front page) and other quantities can also be acquired and digitized with external sensors (figure 1). Flexible sensors realized in foil technology can also be used. At the IEEE symposium "International Conference on Flexible and printable Sensors and Systems" (FLEPS2019) in Glasgow in July 2019, the project also presented advanced foil-based climate sensors in the form of a student paper and was awarded a "Best Student Paper Award".

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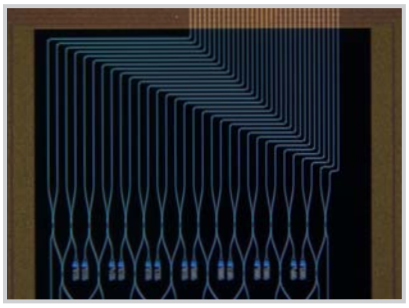
BMBF project OPALID

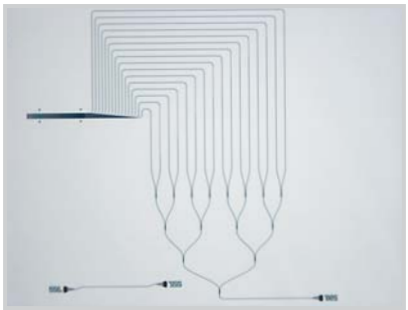
Integrated optical chips for LiDAR systems

Sensor systems for factory and logistics automation as well as the automotive industry require multi-modal sensors to enable redundant and, thus, safe systems. LiDAR systems are indispensable here, especially to proof depth information.



Optical waveguide network with phase shifters

However, current LiDAR systems have rotating transmitter and receiver systems, which on the one hand leads to large dimensions and on the other hand involves sensitive, moving parts. Small and robust systems are essential, especially for use in the automotive sector. However, compact systems generally open up great scope and new markets with new fields of application for LiDAR, such as systems integrated in robot arms, LiDAR on drones, for autonomous vehicles in the field of production and logistics, and, thus, represent an important step towards Industrie 4.0.
The design of a system without moving parts is achievable by integrating silicon photonics, namely replacing the large rotating transmitter with an OPA (Optical Phased Array) as optical silicon circuit. The technological challenge lies in the extreme density of optical components at more than 100 optical phase shifters per chip including their complex wiring and processing.
The overall project´s focus is on the research and development of a small, reliable and cost-efficient LiDAR systems without moving parts for the optical sensor technology in Industrie 4.0 and a flexible networked production. IMS CHIPS is responsible for the development and manufacture of the LiDAR system´s transmitter based on a matrix of optical phase shifters (OPA) integrated on a silicon photonic chip.



Optical chip with passive optical distribution network

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TapeS3/TakeMi5

IMS CHIPS as alliance partner for the production of next generation integrated circuit

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EUV stepper system with sketched beam path of the EUV light

Moore's Law has described the steadily increasing performance of integrated circuits for about 50 years. The established technologies for the production of these circuits are currently reaching the limits of what is technically feasible and economically reasonable at technology nodes of 10 nm and smaller. The core of the new technology is the use of extreme ultraviolet (EUV) light radiation, which can be used to further reduce the physically achievable structure widths.

The main goal of the TapeS3 and the TAPES3 projects is to develop and demonstrate lithography, measurement technology and processing modules for 3 nm technology hubs.

IMS CHIPS is partner in both projects with the Lithography and EUV Mask Infrastructure work packages. The Lithography work package will see the development of high-precision diffractive optical elements (DOE) for surface testing of EUV mirrors and the EUV mask infrastructure package by the IMS will see the research on new concepts regarding masks with alternative absorbers. The total volume of both Ecsel Joint Undertaking projects amounts to more than 300 million Euros, they are in part accompanied by BMBF projects.

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News Flash

Projekt INOSENS gestartet The goal of the project funded by both, BMBF and AiF is to further increase the resolution of a miniaturized optical rotary encoder by interpolation and to detect possible failures early on with additional sensor information. The IMS CHIPS is responsible for the development and commissioning of the Opto-ASIC in the INOSENS project.

Future cluster "QSens" - Quantum sensors for the future Among the 16 finalists of the first round of the competition, who are now allowed to submit a full proposal, is the cluster sketch "Quantum sensors of the future (QSens)", in which the Universities of Stuttgart and Ulm, the Institut für Mikroelektronik Stuttgart (IMS CHIPS) and various industrial partners have joined forces. https://www.uni-stuttgart.de/universitaet/aktuelles/presseinfo/Quantensensoren-fuer-die-Zukunft/

New wet chemistry – The IMS began upgrading its wet chemical cleaning systems to the latest state of the art in October 2019. The higher degree of automation increases the throughput and the larger tanks allow for a treatment of substrates up to 200 mm diameter. The conversion of the wet chemical cleaning system is scheduled to be completed in the 3rd quarter of 2020.

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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