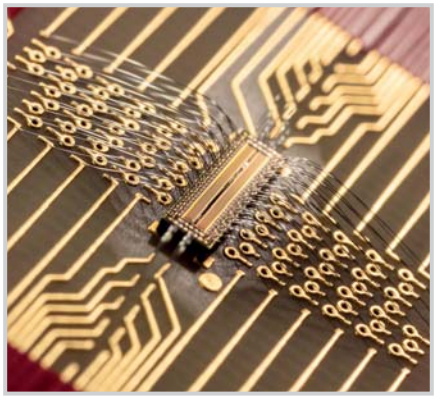
IMS Newsletter 2/20

November 2020

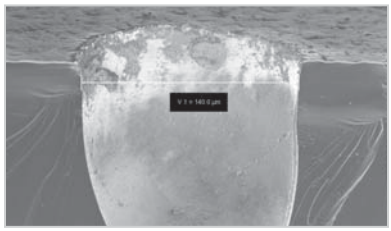


POSITION II – pilot line for the next generation of intelligent catheters and implants

New innovation and the introduction of open technology platforms provide the foundation for the next generation of catheter and implants. Miniaturization, signal acquisition as close as possible to the object, wireless communication and adapted encapsulation play a central role.

POSITION II page 2

ZIM project Fiber Coupling



Within the ZIM joined project, a fast and precise assembly technique to connect optical fibers to optical chips is being developed. For this purpose, guide structures for the glass fiber absorption on the silicon are manufactured using a laser and etching process. The project partners are InnoLas Photonics GmbH, Arges GmbH and the INT of the University of Stuttgart.

Modernization of wet chemistry and upgrade to 200 mm line

At IMS CHIPS a gradual replacement of the wet chemical equipment has been taking place since 2019. The new line includes state-of-the-art machines with increased cleaning efficiency and improved quality control. The newly purchased equipment enables the fully automatic processing of wafers with diameters of up to 200 mm with higher throughput, optimized reproducibility and a safe execution of wet etching and cleaning processes.

HDRC®-AeroPantoCam – a sensor system for visual and thermal monitoring of railed vehicle pantographs

A torn overhead line causes train cancellations and delays. Within the ZIM joint project HDRC®-AeroPantoCam IMS CHIPS and the project partners KST and Gevitec are developing a novel and extremely robust sensor system for visual and thermal monitoring of the pantographs of rail vehicles in outdoor areas.

Fiber Coupling page 3 Upgrade wet chemistry page 3 HDRC®-AeroPantoCam page 4

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Next generation of catheters and implants

Innovation in in-vivo measurements for medical technology

Source: Osypka

Catheters and implants are used in human medicine to measure bio signals and to determine tissue damage. Well-known examples of such catheter-based measurements are bio signals along the inner wall of the heart or the detection of coronary vessel narrowing. Implants, on the other hand, are usually inserted for a longer period of time and require suitable encapsulation. The catheters and implants used in today's medical technology consist of reliable and robust technologies in a comparatively outdated state of the art. In a large number of catheters and implants, the physiological signals to be measured are recorded directly at the area to be examined, but the actual signal evaluation and digitalization often takes place outside the body at the expense of signal quality.

The goal of the POSITION II project is now to develop the next generation of different catheters and implants through specialized innovations and the introduction of open technology platforms that can be used by all project partners. The aim is to replace previously used conventional techniques with new concepts and technologies and to explore new opportunities in terms of signal quality and integration. A focus is on signal acquisition and processing as close as possible to the object at the actual measurement site, with subsequent digitization of the data. This requires the integration of additional electronics while further miniaturizing and encapsulating the catheters or implants.

IMS CHIPS cooperates with other companies in the consortium on the sub-project "digital MRI (magnetic resonance imaging) of safe EP (electro physiology) catheters". The aim of the sub-project is to develop a miniaturized catheter which can be used to detect cardiac arrhythmias and local tissue damage. In healthy hearts, electrical signals are transmitted without delay along the inner wall of the heart. However, if there is damage to any part of the heart, this transmission can be disturbed causing cardiac arrhythmia. These arrhythmias are usually detected by recording electrical signals in the atrium. To achieve this, special catheters are inserted through veins directly into the heart and the heart signals are recorded by means of electrodes at the tip of the catheter. By scanning the area of the heart and mapping the signals, the physician can determine the condition of the heart. Once a damaged area has been identified, a second catheter is used to desolate the area and the signals can once again spread unhindered throughout the heart. The actual detection of the site is often time-consuming and is determined by the number of electrodes. The newly developed EP catheter solves this problem. With 96 electrodes at the tip of the catheter, the EP catheter helps to localize affected areas more efficiently and precisely, which has a positive effect on treatment time and stress in humans. An integrated circuit developed by IMS CHIPS sits on the tip of the EP catheter and ensures the acquisition, preparation and further processing of the electrical signals transmitted by the electrodes. An additional task of the integrated circuit is the digitalization of the data and their transmission via an innovative optical interface. For this purpose, novel circuit and filter concepts were developed and the resulting individual blocks were combined in a very small area to allow integration into the EP catheter. For the electrical characterization of the integrated circuit a development board was designed and put into operation (Fig. 1).

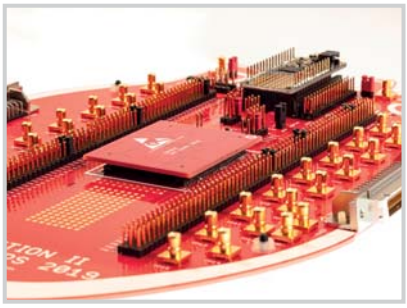

Fig. 1: Development board to characterize the integrated circuit

The innovative optical interface also offers the advantage that the catheter does not require a metallic line to the catheter. This allows the catheter to be used in an MRI environment and significantly reduces the patient's radiation exposure. The project is funded by the European Union and the German Federal Ministry of Education and Research. (BMBF funding code: 16ESE0304 / EU: Ecsel-783132-Position-II-2017-IA.) For further information, please refer to: www.position-2.eu.

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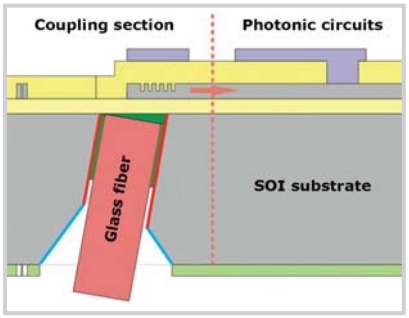
ZIM project Fiber Coupling

Laser-manufactured guide structures for chip-fiber coupling



Schematic cross-sectional drawing of the management structure

The signal technical connection of photonic components is made using optical fibers, which couple light into the chip via microscopic structures (grid couplers). The efficiency of this fiber coupling is decisive for the overall properties of the circuit. Currently there is a conflict of objectives between the necessary coupling efficiency and throughput capability of the relevant procedures (glass fibers need to be precisely aligned and attached in six axes). The project's objective is to develop new grid couplers with a particularly high degree of couple efficiency which simultaneously meet future cost requirements using processes and procedures suitable for mass production. The core idea is to use special laser-assisted etching processing to create guide structures in the form of buried structures in the wafer, into which the fibers are inserted (see front page: SEM cross-sectional image of a laser hole with a diameter of 140 µm). At the same time, assembly-optimized fiber-chip interfaces are developed in cooperation with the INT. The project is breaking new technological ground in several areas - starting with a power-amplified 2 µm laser from InnoLas Photonics GmbH, a new scanning system from Arges GmbH, pulse-on-demand methods and novel, selective etching processes up to the fiber-chip interface itself. IMS CHIPS' project part will see the development of an etching process which removes the laser-treated structures in silicon with higher selectivity than the untreated structures. In the meantime, the shape of the channel with undercut for the fiber optic coupling should be created. Parallel to this, photonic chips with novel coupling elements are manufactured.

Funded within the framework of the Central Innovation Program for Medium-Sized Businesses (ZIM) of the Federal Ministry of Economics and Energy (funding code: ZF4429203DF8).

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Modernization of wet chemistry and upgrade to 200 mm

Procurement of new modern equipment for wet chemical etching and cleaning processing

Investing a total of 1.6 mio. Euro, IMS CHIPS started renewing the equipment for the wet etching and cleaning processing in 2019. The modernization of the wet chemical line enables the execution of different processes adapted to the customer requirements. In addition, this opens up various development work for both front-end and back-end processes. This high degree of automation allows cleaning and etching of up to three parallel running batches, an increased throughput and a better reproducibility of the processes. The use of state-of-the-art filters and the regulation of supply and exhaust air enhances the cleanliness and quality of the processes. In addition, the supply and exhaust air management as well as the encapsulated design of the systems including the use of numerous sensors promote working at the highest safety level.

Simultaneous automatic processing of 150 mm and 200 mm substrates

Modern fully-automatic machine with higher cleaning efficiency and improved quality control

New stainless steel plant to process products using organic solvents

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ZIM joint project HDRC®-AeroPantoCam

A novel and extremely robust sensor system for visual and thermal monitoring of the pantographs of rail vehicles in outdoor areas

Fig 1: Pantographs on traction vehicles

A torn overhead line paralyzes numerous connections! Unfortunately, a frequent or similar headline in the press. Affected passengers often have to wait for hours or switch to alternative transport, such as buses or other trains with longer travel delays. Often, the disruption duration until the damage is repaired cannot be predicted. The main causes of overhead line damage are problems in pantographs of locomotives and traction units (Fig. 1).

The aim of the HDRC® AeroPantoCam joint project is to research and develop a novel and robust sensor system for outdoor railroad applications with integrated real-time data evaluation and automatic early warning function in the driver's cab.

During operation, the pantograph will be continuously monitored during travel using a high-resolution and highly dynamic logarithmic HDRC®-HD megapixel image sensor (visual) as well as the area of the sliding contact strip using an infrared temperature sensor array (thermal). With the help of special data fusion processes, critical conditions even under unfavorable lighting and environmental conditions, such as backlighting caused by sunlight, rain, etc., will be detected reliably and early before any failure occurs. The system developed with this project (see front page) is thus intended to prevent decisive disruptions to rail traffic caused by overhead line damage and will, therefore, also contribute to passenger safety.

Supported by: Federal Ministry for Economic Affairs and Energy on the basis of a resolution of the German Bundestag (Förderkennzeichen: ZF4429202GR8).

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News Flash

Publication in Nature magazine: CMOS chip by IMS CHIPS used as hologram projector Scientists at Max Planck Institute for Intelligent Systems and the University of Stuttgart have developed an ultrasound projector for high-resolution moving holographic images. The researchers published an article on this in the renowned Nature magazine`s September issue.

"Beams & More" The 18th Workshop for Lithography at the IMS has been postponed to next year. The workshop will take place at the IMS on November 18th, 2021.

Projekt PanaMEA launched The aim of the BMBF-funded project is the development of an intelligent implant to measure blood sugar levels up to the in-vivo proof of concept. The electrical activity of the islets of Langerhans in the pancreas is a measure for the blood sugar level and is to be measured in the body by means of an ASIC. IMS CHIPS will be responsible for the development and sample production of this ASIC.

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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