

# MEMS REPORT

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Cover Picture: Opening of the New Fraunhofer Project Hub "Microelectronic And Optical Systems For Biomedicine" in Erfurt, Germany, together with Top Representatives from the Fields of Politics, Science and Business.

Dear Customers, Partners and Friends  
of Fraunhofer IPMS,

Our institute with now more than 300 employees is providing a broad range of technical and scientific expertise. However, we often depend on cooperation in the implementation of our ambitious research and development projects, or rather are just able to offer our services in collaboration with our partners. The content of this MEMS Report shows this in several ways.

Our long-term partnership with the strategic industrial customer GLOBALFOUNDRIES was raised to the next level with a new research agreement. Within the Fraunhofer-Gesellschaft, we started a new project hub to perfectly cover the future market of biomedical systems. Our technological base is strengthened by the cooperation with the Research Fab Microelectronics Germany, which is increasingly becoming closer. Last but not least, we are involved in European Horizon2020 and ECSEL projects and, thus, are able to gain new partnerships in research and industry. Detailed information on these topics can be found in this current issue. We are looking forward to keeping you as a partner or to welcome you for new collaborations.

We wish you an informative reading of the current MEMS report.

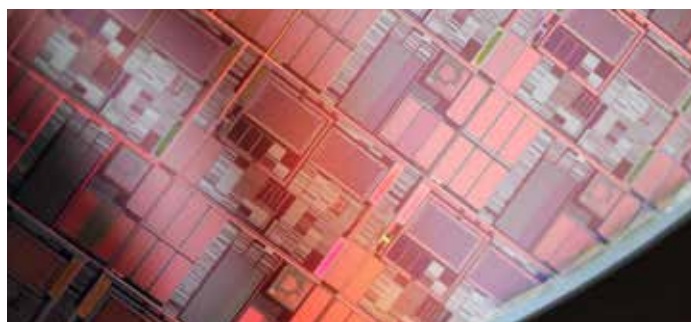


Prof. Dr. Harald Schenk

Prof. Dr. Hubert Lakner

## NEXT "MADE IN DRESDEN" CHIP GENERATION

Dresden-based chip producer GLOBALFOUNDRIES and Fraunhofer IPMS are further expanding their 13-year development collaboration to include the development of innovative materials, components, and processes for energy-saving FD-SOI technology. As energy-efficient as it is powerful and cost-effective, FD-SOI technology is in particular demand in the growing Internet of Things and automotive markets, and will be the focus of our joint work for the next two and a half years. The mutually signed contract encompasses a volume of double digit millions.



In support of these goals, a joint doctoral program of up to 16 young scientists will be formed to specifically guarantee the local promotion of talent in the sector over the long term. Fraunhofer IPMS Managing Director, Prof. Hubert Lakner states, "We are the largest R&D partner of GLOBALFOUNDRIES Dresden. Our research and development services make a decisive contribution to keeping Dresden in the premier league of global microelectronics. We are proud to partner with GLOBALFOUNDRIES in training the next generation of researchers in this field." Thomas Morgenstern, SVP and Managing Director of GLOBALFOUNDRIES Dresden adds, "Fraunhofer and GLOBALFOUNDRIES have worked closely and trustfully in technology development for many years. Our course has now been set to even more intensively and sustainably support our strategic focus on energy-efficient solutions for the automotive sector and the Internet of Things in the future. He continues, "Together we want to ensure that innovative answers to major challenges in these areas (from autonomous driving to new approaches in medical technology, logistics, and aerospace) continue to bear the 'made in Dresden' label." In the course of this project, the Fraunhofer IPMS cleanroom will be extended to approximately 900m<sup>2</sup> and furnished with new equipment. The Federal Ministry of Education and Research (BMBF) supports Fraunhofer IPMS with funding in the framework of the Research Fab Microelectronics Germany (FMD).

## IMPROVED TREATMENT OF COMMON ARTERIAL CALCIFICATION DISEASE WITH INTELLIGENT CATHETERS FROM FRAUNHOFER IPMS

In June 2018, the Fraunhofer IPMS launched the collaborative EU "POSITION II" project researching micromechanical ultrasound transducers for smart catheter applications to ensure more safety in medical examinations of the future.

Arteriosclerosis is the most common of all vascular diseases. Formerly considered a disease of the elderly, it is now increasingly affecting younger people. Arteriosclerosis is the narrowing of arteries, restricting blood flow to organs and other body parts that can lead to critical consequences of life-threatening heart attack or life-changing stroke. Patients diagnosed with arteriosclerosis must undergo surgery to expand narrowed or blocked blood vessels. This surgery consists of a physician inserting a catheter through a vein into the arterial vasculature to relieve harmful constriction using either a balloon or stent.



*Intelligent catheters equipped with Fraunhofer IPMS CMUT technology should offer more features, make things easier for doctors, and increase the safety of medical procedures.*

The majority of these surgeries can be performed using minimally invasive procedures supported by a variety of smart imaging and sensory catheters, allowing doctors to see exactly where a catheter is at any point during operative treatment.

In the recently launched POSITION II project aiming to further develop features of intelligent catheters, Fraunhofer IPMS strives to make procedures easier for doctors and safer for patients. The project aims to provide more functional medical instruments based on micromechanical ultrasonic transducers, making them smaller and cheaper as well as safer and easier to use.



*Catheters equipped with Fraunhofer IPMS micromechanical ultrasonic transducers provide better functionality, are smaller, cheaper to manufacture, and easier to operate.*

Ultrasound transducers for medical imaging are currently based primarily on the piezoelectric effect for both signal generation and evaluation, using special, potentially-toxic piezo materials. These materials are also difficult to manufacture, making them very expensive. In implementing MEMS structures (so-called MUT components) for the construction of ultrasonic transducers, Fraunhofer IPMS technology sidesteps these important challenges to achieve a compact design and the associated higher miniaturization. Integration into CMOS processes using special technology (as a post-CMOS-module) provides for production cheaper than possible with piezo-based ultrasonic transducers. In addition, higher frequency can be achieved, resulting in better resolution allowing for more accurate analysis of medical imaging.

Existing MUT technologies will be compared and further developed within the POSITION II project to allow key players in the industry the opportunity to select optimal variants or combinations of concepts, technologies, and components for each application. In conclusion, the project will provide an application matrix as well as a roadmap for MEMS-based ultrasound transducers in Europe with particular focus on intelligent medical applications.

Funded by the Electronic Components and Systems for European Leadership Joint Undertaking (ECSEL JU) initiative of the Federal Ministry of Education and Research (BMBF) Framework Program of the European Union (H2020/2014-2020) and national authorities (ECSEL-783132-Position-II-2017-IA), the joint project has been granted a term of three years.



## LARGEST MICROELECTRONICS RESEARCH COOPERATION IN EUROPE LAUNCHES FIRST PLANTS



*Full Steam Ahead – opening ceremony for the first FMD integration line at the very first Innovation Day event in Berlin on September 28, 2018. From left to right: Prof. Matthias Kleiner (President of the Leibniz-Gemeinschaft), Prof. Georg Rosenfeld (Fraunhofer-Gesellschaft, Member of the Board), Prof. Hubert Lakner (Chairman of the FMD Steering Committee and Fraunhofer IPMS Managing Director), and Dr. Michael Meister (Parliamentary State Secretary at the Federal Ministry of Education and Research).*

The Research Fab Microelectronics Germany (FMD) collaboration promises easier access to future developments and nationwide coordinated technology know-how from a single source. A year and a half after the project started, the cooperation partners and their funding associates at the Federal Ministry of Education and Research (BMBF) inducted the new research equipment with a ceremonial celebration held at the first Research Fab Microelectronics Germany Innovation Day on the premises of the Fraunhofer Institute for Reliability and Microintegration IZM located in Berlin.

In recent months, Research Fab members made up of eleven Fraunhofer Institutes of the Microelectronics Alliance and the Leibniz FBH and IHP Institutes have been intensively involved in expanding the cross-location network. Now, the first equipment for the modernization of the laboratory facilities purchased from the 350 million Euro BMBF funding is going into operation as represented by the commissioning of the first integration line at the Fraunhofer IZM in Berlin on September 28, 2018. Hosts included BMBF Parliamentary State Secretary Dr. Michael Meister, Leibniz-Gemeinschaft President Prof. Matthias Kleiner, Fraunhofer-Gesellschaft Board Member Prof. Georg Rosenfeld, and FMD

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Steering Committee Chairman and Fraunhofer IPMS Managing Director Prof. Hubert Lakner. More than 130 guests had the opportunity to view the Fraunhofer IZM cleanroom facilities during the first FMD Innovation Day event and films depicting the current state of modernization progress at all 13 member institutes – including the new equipment acquisition for the clean rooms of the Fraunhofer IPMS – were shown to demonstrate the merger of micro- and nanoelectronics research across the nation.

### **An Important Step for Innovation from Germany**

The German and European semiconductor and electronics industry have been provided a unique opportunity with the establishment of the Research Fab Microelectronics Germany. Parliamentary State Secretary of the Federal Ministry of Education and Research (BMBWF) Dr. Meister, M.D. underscored the potential of this unprecedented cooperation in microelectronics research saying, “In the digitization age, we again need more high-tech growth in Europe. Because we want to play a decisive role in shaping the future and develop the microelectronics of the day after tomorrow, we are combining state-of-the-art equipment with a new form of nationwide collaboration for the first time through the Research Fab Microelectronics Germany project. We are providing our industrial research partners, particularly small and medium-sized enterprises, with an internationally competitive and decentralized research opportunity. In doing so, we are expanding Germany as center of innovation – keeping an eye on Europe, economic growth, and jobs as well as on the benefits to our private and professional daily lives.”

During his welcome speech, Leibniz-Gemeinschaft President Prof. Matthias Kleiner was convinced that “Cooperations such as the Research Fab Microelectronics Germany and a strong interdependency of scientific results and their economic application are the keys to successful innovation. The Research Fab is particularly promising because it quite naturally unites what was, for a long time and sometimes still, thought of separately: research and application, research and processing, research and production.”

Prof. Georg Rosenfeld, Board Member of the Fraunhofer-Gesellschaft for Technology Marketing and Business Models, also looked optimistically into the future stating, “With the investments that have been made, we are able to offer solutions with a high degree of technical maturity for a broad range of industries along the entire innovation chain – for large, medium-sized and small companies as well as start-ups.”

Chairman of the FMD Steering Committee and Fraunhofer IPMS Managing Director Prof. Hubert Lakner added, “It is particularly important to make entry barriers for these high technologies allowing new and young companies easier access. We plan to build a consistent technological basis for that purpose over the next five to ten years.”

### **Development from First Draft to Finished System**

On the first day of this year's Research Fab Microelectronics Germany Innovation Day event, participants were provided the opportunity to get information on the latest FMD technical contributions in lecture sessions on sufficient microsystems, LiDAR, and Industry 4.0. They were also able to exchange their views with experts and users. In the framework of the complementary “Smart Micro Systems” trade fair, member institutes displayed technological know-how with visual highlights and live demonstrators such as the compact LiDAR camera for fast and reliable distance measurement, and the ball screw drive for process-controlled condition monitoring of, until now, difficult-to-reach or inaccessible positions of machinery and equipment. Guests to the trade fair were able to view complete prototypes.

### **More Power for German Microelectronics Research**

With more than 2,000 scientific staff, the Research Fab Microelectronics Germany is already the world's largest pool of technologies in the field of smart systems. Cross-location collaboration focuses on future-relevant topic areas including the newest silicon technologies for sensor and information processing, semiconductors with state-of-the-art materials used in communication technology and to save energy, novel combinations of silicon and other semiconductors for the Internet of Things, as well as for design, testing and reliability of quality and safety.

In addition, the 13 partner institutes are exploring technological issues of the future. Important challenges include the industrial use of quantum technologies, the development and integration of atomic functional blocks, systems for the terahertz area, reducing the power requirements of electronic circuits, and the storage and transmission of the largest of data amounts (petabytes). Economically important application areas include energy technology, transport and mobility, digital life, industrial manufacturing, and health and safety.

## NEW FRAUNHOFER PROJECT HUB "MICROELECTRONIC AND OPTICAL SYSTEMS FOR BIOMEDICINE" IN ERFURT OPENS ITS DOORS



*From left to right: Prof. Ulrike Köhl, Managing Director Fraunhofer IZI, Prof. Frank Emmrich, Director Fraunhofer IZI, Prof. Hubert Lakner, Chairman Steering Committee Project Center and Managing Director Fraunhofer IPMS, Prof. Reimund Neugebauer, President of the Fraunhofer-Gesellschaft, Wolfgang Tiefensee, Thuringian Minister of Economy, Science and the Digital Society, Carsten Schneider, MP, Prof. Andreas Tünnermann, Director of the Fraunhofer IOF, Walter Rosenthal, President of Friedrich Schiller University Jena*

On October 19, 2018, the Fraunhofer project hub "Microelectronic and Optical Systems for Biomedicine" (MEOS) celebrated its opening in Erfurt, Thuringia, together with top representatives from the fields of politics, science and business. Three Fraunhofer institutes – the Fraunhofer Institute for Photonic Microsystems IPMS, the Fraunhofer Institute for Applied Optics and Precision Engineering IOF and the Fraunhofer Institute for Cell Therapy and Immunology IZI – will conduct joint research projects into new biomedical applications in this area in future, working closely together with business partners.

German journalist Ludwig Börne chose his words wisely when he once noted: "There are thousands of diseases, but only one health." It is with good reason that a person's health is viewed as their greatest asset. Health, demographic change and wellbeing are key social challenges that can only be resolved using interdisciplinary approaches that draw on the close cooperation of various players from business, science and society. The advancement of new biomedical applications and the development of innovative medical engineering solutions also play a role here. The use and continued development of key technologies in areas such as life sciences, microelectronics, optics and photonics are especially important. Hence the opening of the new Fraunhofer project hub

"Microelectronic and Optical Systems for Biomedicine" (MEOS) in Erfurt on October 19, 2018. Thuringian Minister for Economic Affairs, Science and Digital Society Wolfgang Tiefensee, President of the Fraunhofer-Gesellschaft Professor Reimund Neugebauer, member of the German parliament from Erfurt Carsten Schneider and Chairman of the Steering Committee and Executive Director of Fraunhofer IPMS Professor Hubert Lakner all attended the opening event. The three Fraunhofer institutes IPMS, IOF and IZI will carry out research into new biomedical applications in this field in future, in close cooperation with business partners. At the opening, attendees even got a first glimpse of the center's future laboratories.

The consolidation of Fraunhofer IPMS, a leading research service provider in the field of microelectronics and microsystem technology, Fraunhofer IOF, a recognized center of competence for optics and photonics, and Fraunhofer IZI, a prominent player in the field of life sciences, brilliantly demonstrates how core competencies should be pooled and exploited in an interdisciplinary manner in future. Key to the success of the project center is also the location in Erfurt, with its research infrastructure, established local companies and connections to the universities in Erfurt, Ilmenau and Jena.

This was underscored by Thuringian Minister for Economic Affairs and Science Wolfgang Tiefensee: "For years now, the Fraunhofer-

Gesellschaft has helped point the way for medium-sized businesses in Thuringia. It ensures that research results are swiftly transferred into marketable products and services and thus supports one of the core goals of Thuringia's innovation policy. With the new project center, the location is being further strengthened at the interface between the state's key industries of optics, medical technology and microelectronics." The state will bear half of the overall costs of the start-up phase ending in 2022, totaling 35 million euros. "Together with all of the players in Erfurt, we will do all we can to make the new center a lasting success for the Fraunhofer-Gesellschaft and the technology hub that is Thuringia."

Fraunhofer President Professor Reimund Neugebauer explained: "The opening of this new Fraunhofer project center shows another side to Fraunhofer's continued strong presence in the Free State of Thuringia and demonstrates its commitment to this prosperous scientific center. The field of biomedicine poses a scientific challenge that bears significance to society as a whole, which is why it can only be advanced using interdisciplinary approaches. We will therefore pool together the core competencies of three research institutes at the very highest level here in Erfurt in future."

The Fraunhofer project hub will initially focus on three specific technology platforms: optical systems for high-resolution microscopy, improved medical imaging and biosensor technologies. Looking ahead, activities may well be expanded to other fields of application.

Professor Hubert Lakner, executive director of Fraunhofer IPMS and chairman of the steering committee for the project hub, concluded by saying: "Transferring research and development into industrial technologies and pilot production will be an intrinsic part of the project center from the word go. Here in Erfurt, it will not be long before medical technology, analytics, diagnostics, biotechnology and photonics systems as well as pharma and food economics systems are developed to application maturity and transferred into industry. We look forward to a trusting and fruitful cooperation with industry in Thuringia and beyond."

Start-up funding of 20 million euros split over five years to cover initial scientific projects will be divided equally between the Fraunhofer-Gesellschaft and the Free State of Thuringia. Investments amounting to 15 million euros to develop and equip the new project center are also being split equally. Once this initial funding period has ended, the project hub is expected to fall under the federal and state financing received by the Fraunhofer-Gesellschaft.

## UPCOMING EVENTS

### VISION

Stuttgart, Germany November 6 - 8, 2018  
Stuttgart Convention Center, Hall 1, Booth 1G42

### electronica

Munich Germany November 13 - 16, 2018  
Munich Convention Center, Hall C5, Booth 426

### sps ipc drives

Nuremberg, Germany November 27 - 29, 2018  
Nuremberg Convention Center, Hall 7A, Booth 246

### Photonix

Tokyo, Japan December 5 -7, 2018  
Makuhari Convention Center, Hall 2, Booth 6-12

### SPIE Photonics West

San Francisco, USA February 2 - 7, 2019  
Moscone Center, Booth 4238

[www.ipms.fraunhofer.de/en/events.html](http://www.ipms.fraunhofer.de/en/events.html)

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### Further Information:

Aron Guttowski, Head of Business Development  
Phone: +49 351 88 23 229  
E-Mail: [aron.guttowski@ipms.fraunhofer.de](mailto:aron.guttowski@ipms.fraunhofer.de)

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Phone: +49 351 88 23-0, Fax: +49 351 88 23-266, [www.ipms.fraunhofer.de](http://www.ipms.fraunhofer.de)

Editor: Romy Zschiedrich, [info@ipms.fraunhofer.de](mailto:info@ipms.fraunhofer.de)

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