Microelectronics News

Fraunhofer MIKROELEKTRONIK

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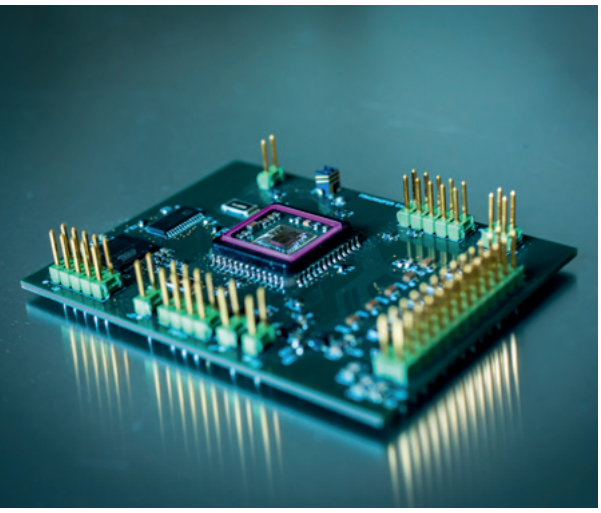
A "Universal Sensor Platform" for medium-sized enterprises



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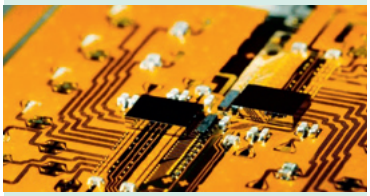
Fraunhofer researchers and GLOBALFOUNDRIES Dresden intend to develop a modular technology for smaller system providers by 2019. This "Universal Sensor Platform" (USeP) will offer smaller companies without their own chip development department the ability to get involved in the Internet of Things. According to the modular principle, medium-sized companies can take advantage of several design variants in order to be able to make their ideas and visions a reality as simply as possible. »» page 4



We would like to congratulate our three Berlin-based Group institutes who are celebrating significant birthdays in 2018. © Fraunhofer IZM
» page 3

■ From the institutes

Galileo PRS receiver

Galileo PRS (Public Regulated Service) is an encrypted navigation service for governmental authorized users and sensitive applications that require high continuity. Together with three partners, Fraunhofer IIS is developing a cost-effective and compact receiver implementation suitable for this PRS technology.

»» page 8

■ From the institutes

A food lab on your phone

High-quality food is in demand – but the actual quality cannot always be detected by the naked eye. Researchers at Fraunhofer IPMS have developed a solution to turn smartphones into food laboratories: spectral analysis is used to analyze the real nutritional value of food while shopping.

»» page 11

Fraunhofer IDMT presents its planar loudspeakers and its solution for producing directional sound. © Fraunhofer IDMT
» page 7

■ Short news

Cognitive Power Electronics 4.0 – powerful and intelligent

»» page 13

■ Short news

Fraunhofer HHI receives an award for 3D Human Body Reconstruction

»» page 13

■ Short news

Meet Fraunhofer Microelectronics at Semicon West in San Francisco

»» page 14

■ The last word …

… today goes to Michael Galetzka fom FMD

»» page 16

■ Content:

Events

Date	Event / WWW	Location	Group institutes involved
05/15 – 05/16	7th FOKUS Media Web Symposium www.fokus.fraunhofer.de/go/mws	Berlin, Germany	FOKUS
05/15 – 05/17	Optatec www.optatec-messe.de/en/	Frankfurt / Main, Germany	IPMS
05/15 – 05/17	The Battery Show 2018 www.thebatteryshow.com	Michigan, USA	ISIT
05/29 – 06/01	Electronic Components and Technology Conference (ECTC) www.ectc.net	San Diego, USA	IZM
06/05 – 06/07	PCIM Europe 2018 www.mesago.de/de/PCIM/	Nürnberg, Germany	Group Institutes
06/05 – 06/07	SMT Hybrid Packaging www.mesago.de/en	Nürnberg, Germany	IMWS, ISIT, IZM
06/11 – 06/15	CEBIT 2018 www.cebit.de/en	Hannover, Germany	IIS
06/11 – 06/15	ACHEMA – World Forum and Leading Show for the Process Industries www.achema.de/en/	Frankfurt / Main, Germany	EMFT, IKTS
06/12 – 06/13	Photonic Packaging: Sub-micron Assembly - Workshop www.izm.fraunhofer.de/en/news_events/events/ws_8.html	Berlin, Germany	IZM
06/18 – 06/22	ICIM 2018 www.icim2018.com	Dresden, Germany	IKTS
06/24 – 06/28	DAC 2018 www.dac.com	San Francisco, USA	IIS / EAS
06/26 – 06/28	SENSOR + TEST 2018 www.sensor-test.de	Nürnberg, Germany	Group Institutes
07/10 – 07/12	SEMICON WEST www.semiconwest.org	San Francisco, USA	Group Institutes

While every care is taken to ensure that this information is correct, no liability can be accepted for omissions or inaccuracies.

Fraunhofer HHI in the Berlin district of Charlottenburg has been closely tied to the Technical University of Berlin since its foundation.
© Fraunhofer HHI

Berlin-based group of institutes celebrate some special birthdays

The Fraunhofer Group for Microelectronics has some celebrating to do – three of its Berlin-based institutes will have a significant anniversary this year. Fraunhofer IZM will turn 25, Fraunhofer FOKUS turned 30, and Fraunhofer HHI can look back on as many as 90 years of institute history. Congratulations!

Researching for tomorrow's digital society

On February 22, the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI, marked its 90th birthday. At a Technology Innovation Science Match, leading scientists presented their ideas and concepts for tomorrow's technologies. In this, its anniversary year, Fraunhofer HHI looks back at highlights of the institute's history in weekly news reports. Today, Fraunhofer HHI is a world leader in the research of mobile and optical communication networks and systems, as well as fiber-optic sensor systems. In its 90-year history, the institute has made contributions that include setting standards in the exploration and encoding of video signals and in image data processing.

Designing a networked future

The Fraunhofer Institute for Open Communication Systems FOKUS was founded in 1988 under the name "Research Center for Open Communication Systems". It supports business and public administration in designing and implementing digital transformation. As a world-leading research institute in the area of information and communication technology, it is concerned with practice-oriented implementation of digital networking. Under the slogan "Digitalization and beyond", a conference to mark the institute's 30th anniversary was held in Berlin on March 21 and 22. Some of the topics covered were "Digital society," "Digital security", and "Digital value creation".

"Impossible electronics" celebrates its birthday

On November 27, 2018, the Fraunhofer Institute for Reliability and Microintegration IZM in Berlin will celebrate its 25th anniversary. The institute is considered the first port of call worldwide for developing electronics to the limit and integrating electronics into manufacturing processes for tomorrow's products. It was the birthplace of unusual developments such as the world's smallest camera, modules for the fastest Internet connection, and stretchable textiles for an electronic invisibility cloak. Without the institute's work, the Nobel Prize-winning discovery of the Higgs boson would not have been possible. In short, a superlative success story is celebrating its first quarter of a century.

Fraunhofer FOKUS, also located in Charlottenburg, has around 420 employees.
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In addition to the site in the Berlin district of Wedding, there is also the Fraunhofer IZM division in Dresden – known as Fraunhofer IZM-ASSID.
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New technology, individually customizable. © MEV Verlag

A "Universal Sensor Platform" for medium-sized enterprises

Fraunhofer researchers and GLOBALFOUNDRIES Dresden intend to develop a modular technology for smaller system providers by 2019. This "Universal Sensor Platform" (USeP) will offer smaller companies without their own chip development department the ability to get involved in the Internet of Things. According to the modular principle, medium-sized companies can take advantage of several design variants in order to be able to make their ideas and visions a reality as simply as possible.

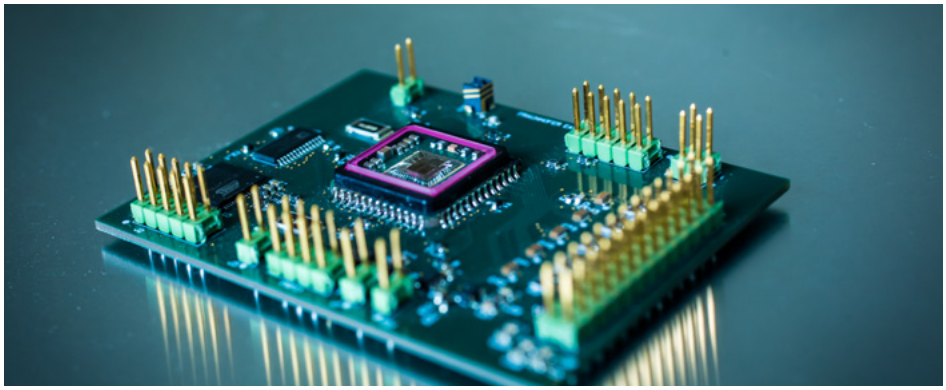
Medium-sized enterprises must keep going

The pace of technological development in the area of microelectronics is constantly accelerating, which poses considerable challenges to mid-sized enterprises. Especially high-performance and highly specialized products are becoming the standard requirements of many customers. However, such "smart" and networked systems are often required only in small volumes and require highly integrated technical solutions. Moreover, the development costs of such modern technologies are frequently too high for many companies, and advances in this area also require employees with detailed expertise in specialized fields of electronics as well as expensive design software that smaller companies often lack. That is why the "Universal Sensor Platform" (USeP) project – funded by the Free State of Saxony and the European Union – was launched by several Fraunhofer institutes and GLOBALFOUNDRIES Dresden.

Modular-based system architecture

By 2019, a technological platform will have been designed that will allow even small and medium-sized enterprises to work with the latest technologies. In the future, and thanks to the modular principle, they should be able to select from a wide range of components according to their needs and then put them together to form an overall system. In addition to the system architecture with flexible building blocks, the easy-to-use platform also offers solutions for hardware and IT security. The aim is to use the sensor module and the various design variants to allow for hundreds of different usage cases. Interested firms can already contribute their ideas and requirements to the research network, help determine the content of demonstration models, and be among the first to test the models.

About USeP:
GLOBALFOUNDRIES Dresden is a worldwide semiconductor production company. It is working on the project alongside four Saxon institutes from within the Fraunhofer-Gesellschaft. These are the Fraunhofer Institute for Photonic Microsystems IPMS and the Fraunhofer Institute for Electronic Nano Systems ENAS, as well as the institute divisions All Silicon System Integration ASSID of the Fraunhofer Institute for Reliability and Microintegration IZM and Engineering of Adaptive Systems EAS at the Fraunhofer Institute for Integrated Circuits IIS. Their know-how is complemented by that of Erlangen- and Berlin-based colleagues. Overall project management is the responsibility of Fraunhofer IIS / EAS.



Example of a chip package. © Fraunhofer IIS / EAS, Katharina Knaut

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Portrait Andreas Brüning.
© Fraunhofer IIS / EAS, Oliver Killig

"Our aim is to make advanced technologies accessible to SMEs"

Small and medium-sized enterprises (SMEs) often do not have the resources to develop individual electronic applications. Fraunhofer Microelectronics spoke to Andreas Brüning from Fraunhofer IIS / EAS about how the joint project USeP is helping SMEs to put together the high-tech product of their choice from a construction kit containing highly integrated elements.

For the research project USeP (Universal Sensor Platform), four institutes within the Group for Microelectronics have joined forces with an industrial partner. How should we imagine the project?

Put simply, we are working together on a type of modular technology for small and medium-sized enterprises. Our medium-sized companies are rightly thought of as drivers of innovation. However – and this is particularly true of the semiconductor industry – change is now happening so quickly that many companies are in effect being left behind. Let's just look at the topic of the "Internet of Things." Electronic applications from this field must be extremely powerful, highly integrated, and smart. However, such individual solutions are generally not made in large batches. Standard semiconductors, which are the type generally now used by SMEs, are no longer of much use. These companies generally do not have the necessary resources to develop their own solutions, however. For a high-end sensor product, the development costs can quickly reach € 20 million or more. What's more, it often takes years until the product is ready. Our aim is to make advanced technologies accessible to SMEs.

How can USeP help?

We have simply rethought product development. Our solution is based on a technological platform that SMEs can use to manufacture a sensor node from various devices. This gives them not only a system-on-chip (SoC), as currently already offered by semiconductor manufacturers, but a complete customized package. This means that SMEs can help themselves to the contents of a construction kit containing the most modern highly integrated elements and put their desired product together. In addition to an SoC, they can choose from among various sensors and are given an energy supply system and interfaces for communication with the outside world. Order processing for the SMEs is intended to be about as simple as configuring a car. They enter their desired specification and receive a suitable sensor node for their products for a fraction of the usual cost and within a few months.

The Engineering of Adaptive Systems EAS division of the Fraunhofer Institute for Integrated Circuits IIS is managing the project. What are your duties as the responsible coordinator?

We organize the cooperation between the partners and ensure that all the parts of the puzzle fit together at the end and make a whole picture, even though they are made in different places. With our innovative approach, that is not an easy task, as a lot of good ideas need to be discussed, evaluated, and integrated into the overall concept.

How can SMEs get involved even at the project stage?

It is particularly important to us that SMEs get involved, because we want to make sure that our developments match their needs. Medium-sized firms that are interested can contribute their requirements to the research network, help determine the content of demonstration models, and be among the first to test the models.

Mr. Brüning, thank you very much for taking the time to speak with us.

Mr. Brüning was talking to Maximilian Kunze.

About:
Andreas Brüning can look back at 23 years of experience in the microelectronics industry, focusing on product development for sectors such as computing, consumer goods, automotive, and wireless. For more than 17 years he has also held leadership roles in large international and decentralized companies in Europe and the US, as well as in research institutions. He currently heads the Efficient Electronics department at Fraunhofer IIS / EAS. In addition to his experience in project and program management, as well as designing development processes with international and intercultural teams, his activities focus on the methodical development segment with digital design, software development, analog/mixed-signal design, and verification.

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Agriculture 4.0 in Portugal

In Lisbon, the Fraunhofer-Gesellschaft and the Portuguese research funding organization FCT (Fundação para a Ciência e a Tecnologia) have signed a letter of intent to conduct research into new agricultural technologies. A task force in which Fraunhofer IKTS is also involved will develop possible areas of deployment and usage scenarios for these kinds of technologies, paving the way for "Agriculture 4.0."

Ideas and goals

The aim of the cooperation is to use agricultural and silvicultural areas more efficiently and sustainably. In addition to efficient management, aspects such as targeted pest control and controlled plant growth play an important role.

This will require agriculture to be modernized with the use of new types of Information technologies and software. The ability to access data from satellites and drones that pass over cultivation areas will be necessary to achieve this digital transformation. In the future, agricultural vehicles will also have embedded sensors to collect relevant data. This new generation of agricultural machinery will be small, electrically driven swarm vehicles that will be able to manage the fields more or less independently.

It is intended to develop apps for tablets and smartphones for the evaluation and interpretation of the data. With their help, irrigation systems could be optimized, for example, or sustainable circulatory systems for plant feeding could be established. The technology required will need to be as energy-efficient as possible in order to contribute to sustainable agriculture.

Planned field tests

The technologies to be developed will need to prove themselves in field tests – and we use the term quite literally. Tests in vineyards and on vegetable and grain fields in and around Porto are planned. The undertaking will thus also create a lot of jobs.

Fraunhofer Center AICOS in Porto

Since 2008, the Fraunhofer-Gesellschaft has operated the Fraunhofer Center for Assistive Information and Communication Solutions AICOS in Porto, together with the University of Porto. This center plays an important role in creating precision agriculture, particularly due to its know-how of information and communication technologies. The undertaking also promotes further scientific cooperation within the EU.

Fraunhofer and FCT are developing technologies for a digital transformation of agriculture.
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The precision agriculture undertaking is intended to make the cultivation of wine more sustainable and efficient, among other aims.
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The Fraunhofer IDMT planar loudspeakers can be easily integrated into furniture such as cabinet doors. © Fraunhofer IDMT

Fraunhofer IDMT presents its planar loudspeakers and its solution for producing directional sound

New loudspeaker technology for the sound of the future: Planar loudspeakers can be integrated flexibly into walls or furniture and are able to direct sound in any direction as targeted – like the beam of a flashlight. At imm cologne 2018, the international interiors show, Fraunhofer IDMT presented its latest developments.

Simple integration and freedom of design

When loudspeakers are to be integrated in private homes two basic approaches are used: either the speakers should function as an eye-catcher or they should be positioned unobtrusively in the room, taking up as little space as possible. "Our planar speakers come with a space-saving, modular design and can be installed nearly anywhere," says Dr. Daniel Beer of the Fraunhofer Institute for Digital Media Technology IDMT.

As the speakers are extremely variable in size and design, requiring a depth of enclosure of less than 2 cm, designers of furniture as well as interior designers will not be limited in their freedom of design. At imm cologne, the Fraunhofer booth showcased three versions of the speaker being integrated with another object: a picture frame, a rack, and a cabinet door. The loudspeakers can also disappear into sofas, chairs, tables, or walls – regardless of whether the surface in question is flat or curved.

Sound zones for more listening comfort

Another innovation presented at the show was what the developers refer to as their "Personal Sound Zones". In combination with the speakers, a special signal processing algorithm is used to direct sound to exactly defined areas in a room. This allows a living room, say, to be divided into separate sound zones into which music or spoken content can be emitted.

"We are very confident that our solution will soon be available for home use. Our idea is to have two, three, or even more listening events in a room at the same time, without the listeners being distracted by the other content." This is how Daniel Beer explains the goal of the development work.

Other areas of application could be lobbies or spa areas in hotels, exhibition areas in museums, at trade shows, or in supermarkets – in short, wherever a number of individual sound zones need to be created with the help of unobtrusive, flexibly adjustable loudspeaker technology.

Thanks to special signal processing, sound can be directed into a space. © Fraunhofer IDMT

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Galileo PRS receiver

Galileo PRS (Public Regulated Service) is an encrypted navigation service for governmental authorized users and sensitive applications that require high continuity. Receivers for this service are currently cost-intensive and only suitable for mobile use in limited circumstances. Together with three partners, Fraunhofer IIS is developing a cost-effective and compact receiver implementation suitable for this PRS technology.

The encrypted Galileo PRS prevents time and positional information from being falsified. The PRS service is also more resilient to jammers than the OS (open service) alternatives and is thus qualified e.g. for critical and security-related applications.

The GUaRDIAn project

Within the GUaRDIAn (Galileo pUblic Regulated service Digital Asic) project, a baseband subcomponent of a PRS receiver will be developed as an ASIC/chip set by the end of 2019, together with a demonstrator.

Current PRS receivers are based on field programmable gate arrays (FPGAs) with sizes in the region of 8 × 5 cm² and power consumptions of at least five watts. This leads to issues with highly mobile applications. The components of the new GUaRDIAn chip set are not only cheaper to manufacture; they can also be deployed in energy-efficient miniatures. This opens up new usage possibilities. The GUaRDIAn project is financed by the Federal Ministry of Transport and Digital Infrastructure (BMVi) within its national Galileo PRS program.

PRS receivers for highly mobile use

As part of the SORUS (Spoofing Resistant Unmanned Aerial Vehicles) initiative, an innovative PRS receiver concept was developed based on the example of drones. Firefighters or other emergency services could use this technology to gain a better overview of critical situations, in road traffic, or at large-scale public events. Within the SORUS concept, it was particularly important to reduce the mass and size of the PRS receiver in order not to impair the drone's airworthiness. To this end, the PRS security-relevant processing steps are moved to a secure environment. The sequences required for PRS access are then calculated in advance individually for each mission location and time before uploading them into the drone.

Everything in sight: drones allow a bird's-eye view of situations to be captured. SORUS technology will soon allow them to be fitted with secure Galileo PRS technology without impairing their airworthiness. © MEV Verlag

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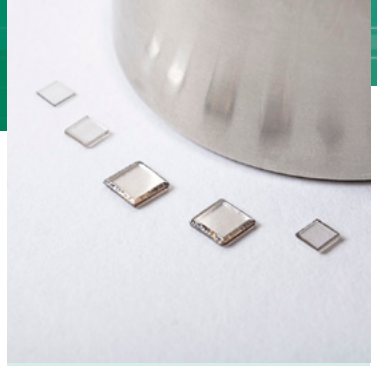
The SORUS team led by Alexander Rügamer received several awards in the European Satellite Navigation Competition 2017. © AZO



Ultra-pure diamond produced at Fraunhofer IAF for quantum-physical applications. © Fraunhofer IAF

Measurements in the nanometer range – a quantum sensor made of diamond finds even the smallest defects

Integrated circuits in electronics are becoming more and more complex, and the structures on them are getting ever smaller. In modern hard disks, the individual magnetic bits – the zeros and ones – are only 10 – 20 nm in size. Tiny magnetic fields need to be measured in order to detect the current flow through electronic circuits or to find defective segments of the hard disk. This is now possible thanks to a new quantum sensor made of diamond, which is being developed by Fraunhofer IAF in conjunction with the Max Planck Institute for Solid State Research.

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The sensor itself is nanoscale: its tip is made of synthetic diamond. Five nanometers below the surface of this diamond, a carbon atom is replaced with a nitrogen atom. Directly beside it, there is a carbon gap, and its potential traps an electron. The magnetic moment (spin) of this single electron can be oriented, which allows it to function as the smallest possible "sensing magnet" in the tip of the diamond. It reacts to external magnetic fields such as those found on hard disks and in the conductor paths of electronic circuits.

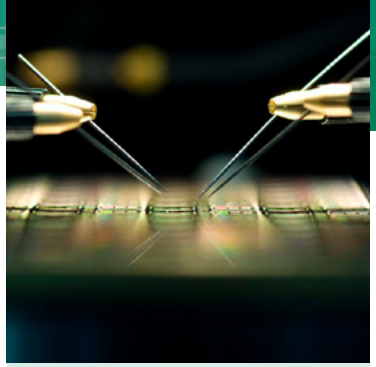
Artificial production of diamonds has been continuously developed and optimized at the Fraunhofer Institute for Applied Solid State Physics IAF over the last few decades. In microwave plasma reactors, the crystals are synthesized from the carbon atoms contained in methane by adding hydrogen. In the reactor, the diamond layers grow on special substrates that are separated using a laser and are then polished. Their planned deployment in quantum sensors places particular demands on the crystals: all starting materials must be pre-cleaned in order to guarantee that the diamond layers are ultra-clean. The methane used to manufacture the diamond sensor must be isotopically pure to ensure that only the electron in the tip of the diamond has a magnetic moment.

The special ellipsoid shape of the plasma reactor developed at Fraunhofer IAF allows large-scale growth of diamond. © Fraunhofer IAF

Conductor paths and hard disks can be examined in detail

The sensor is intended to precisely determine both the position and strength of even the smallest magnetic fields. Optically detected electron spin resonance spectroscopy makes this possible. Using this process, the nitrogen vacancy center in the diamond is irradiated with laser light while "feeling" the locations to be inspected. The sensor is thus excited into emitting its own light. The characteristic properties of the backscattered light allow conclusions to be drawn about the position and strength of the magnetic field being measured.

The sensitive sensor can detect magnetic fields of individual electrons and atomic nuclei in structures that are only a few nanometers in size. In the case of an electronic circuit, the quantum sensor can be used to test the functionality of conductor paths, for example. One other important area of application of the quantum sensor is the quality control of hard disks. This measuring method can be used to quickly and precisely identify defective data segments; these segments can then be skipped during disk reading and writing. This significantly reduces the reject rate and thus also the production costs for future hard disks.



Automated test of microsensors.
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Reflex over reaction

As part of the MARS project, Fraunhofer IIS / EAS and GLOBALFOUNDRIES have advanced the development of highly reliable 22 nm FDSOI components. These components are intended to pave the way for "tactile intelligent systems" made in Dresden. Areas such as autonomous driving and applications in intelligent production will benefit enormously from such wirelessly networked systems capable of communicating with each other in real time.

Every second counts? No – in an age of increasingly networked applications, even this is far from sufficient. Many systems must respond within mere fractions of a second. Examples of areas in which even faster applications will be required in the future include Car2X communication by autonomously driving vehicles and robot-assisted surgical operations. This will be made possible by the next generation of wireless real-time communication in what are called tactile intelligent systems (TIS) – systems characterized by real-time control, high computing power, numerous different sensors and actuators, high data rates, and minimal latency. With TIS, devices are not only capable of responding more quickly to signals from other systems, the environment, or users; they can also act "reflexively." This opens up the possibility of a completely new form of interaction and networking. The market potential is correspondingly great. Due to their extremely low latency of less than a millisecond, tactile intelligent systems are of particular interest in areas such as Industry 4.0, robotics applications, medical technology, and the automotive industry.

Powerful and energy-efficient

One milestone for TIS is the production-ready 22 nm FDSOI (Fully Depleted Silicon on Insulator) technology developed in Dresden by GLOBALFOUNDRIES. FDSOI transistors contain a very thin but electrically very strongly insulating barrier layer of silicon dioxide that effectively prevents leakage current in the substrate. This means that less current is lost and the transistors can switch faster. In the case of the new chips from Dresden, this allows an almost hundredfold increase in the working speed of radio-controlled actuation and receiver units while also keeping energy consumption extremely low.

Forecasting models calculate aging processes even before production

Because the technology is intended primarily for use in safety-critical processes, 100-percent reliability must be guaranteed. The goal is to demonstrate that the components can do their work without issues even after extended periods of service. In the MARS project, researchers at the Fraunhofer Institute for Integrated Circuits IIS, Division Engineering of Adaptive Systems EAS have therefore worked on software tools, models, and methods that support the design capabilities and functional reliability of the 22FDX components. "The focus was on methods for simulations capable of verifying ten- to twenty-year reliability for the components," explains Roland Jancke, who was responsible for the MARS work at Fraunhofer IIS / EAS. This included researching new and informative aging models for the new components. In contrast to earlier empirical models, these newly developed models are based on the actual physical effects. As a result, they permit predictions regarding the reliability under various usage conditions even before the first silicon is produced. Within the framework of the research project, the partners have been able to show that the prediction models and the initial measurement data already fit together well. More work is planned to take additional effects into account in the models.

The MARS project was funded by the European Union and the Free State of Saxony within the scope of the European Regional Development Fund (ERDF) (project number 100225166).

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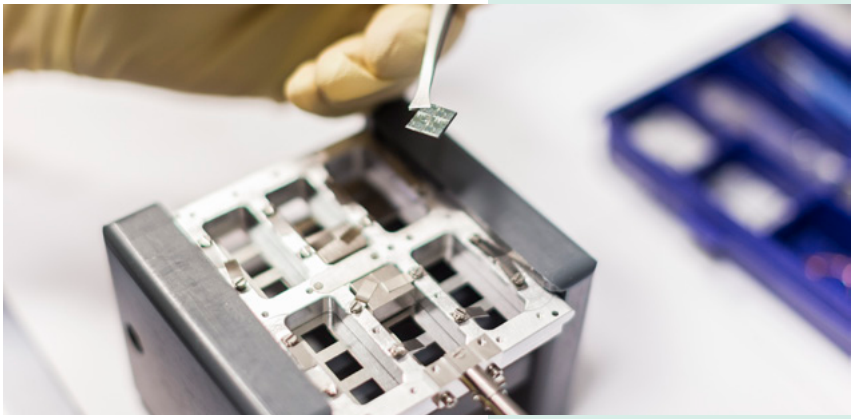

Chip reliability: wafer test carried out by the semiconductor manufacturer in Dresden.
© GLOBALFOUNDRIES Dresden

Should I buy this or not? This is a decision that could soon be made easier by a food scanner on your smartphone. © Fraunhofer IPMS

A food lab on your phone

High-quality food is in demand – but the actual quality cannot always be detected by the naked eye. Researchers at Fraunhofer IPMS have developed a solution to turn smartphones into food laboratories: spectral analysis is used to analyze the real nutritional value of food while shopping.

It's what's inside that counts – a statement that most people would concur with when it comes to nutrition. An appetizing appearance does not tell us much about the quality of a foodstuff, such as the ripeness of fruit or the actual fat and protein content of a piece of meat. In order to obtain deeper information of this nature, complex laboratory analyses have been necessary up until now. The idea of carrying out the same complex analysis on a phone seems radical at first. That, however, is the very aim of a research team at the Fraunhofer Institute for Photonic Microsystems IPMS in Dresden. As part of Fraunhofer's Food Chain Management alliance, the institute, in conjunction with other Fraunhofer institutes, is developing a cellphone-based food scanner.

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A microscanner tells us about a foodstuff's inner qualities

The Dresden-based researchers have developed a microspectrometer that should be capable of being integrated into common smartphones. The basis of the application is a near-infrared spectrometer that is used to determine the percentage of water, sugar, starch, fat, and proteins in the products. To this end, the device illuminates the sample with broadband light. Depending on the composition of the probe, it reflects light of different wavelengths with varying strength in the near-infrared range. Smart algorithms that can immediately analyze the spectra recorded and compare them with templates allow for a determination as to how much of each substance is in a foodstuff. At the core of the development is a microscanner with a diffraction grating, which was developed at Fraunhofer IPMS. The mechanical movement of the mirror means that a simple and cost-effective detector can be used. This offers significant cost advantages within the wavelength range needed for the measurements (e.g. NIR above 1100 nm).

Individual purchase recommendation

The vision is that smartphones will not only be able to analyze individual food products with regard to their quality, but that they will be able to become individual nutrition and fitness advisors. Smart algorithms link data from the food analysis with the user's individual parameters (height, weight, etc.) as well as data from movement analysis. The ratio between nutritional intake and expenditure can thus be calculated and a recommendation can be made to the user. With a personal shopper like this at one's side, there should no longer be anything standing in the way of health and fitness.

Smartphones will soon be able to analyze food via cellphone-based food scanners. © Fraunhofer IPMS

Structuring process for deep nano-trenches

Together with the Center for Microtechnologies (ZfM), Fraunhofer ENAS has developed a structuring process for silicon nano-trenches with a high aspect ratio.

The aspect ratio refers to the relationship between the depth of the trench and its lateral extension. The deeper the trench, the higher its aspect ratio. The developed process flow allows the fabrication of trenches with a depth of more than 5 µm at a period of only 200 nm and an aspect ratio of more than 25:1.

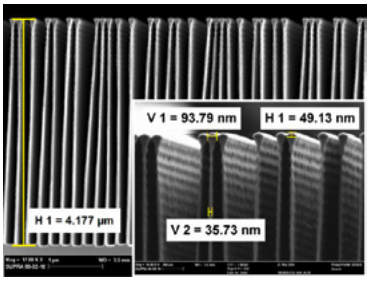
New perspectives

Deep nano-trenches can be used to manufacture nano-meshes for X-ray Fabry-Perot interferometers for micro- and nano-electrical mechanical systems (known as MEMS or NEMS). The fabrication of piezo-resistive silicon nano-wires for inertial sensor technology or vertically arranged reactive multi-layer systems (v-RMS) for packaging is also conceivable.

The process

The manufacturing process includes several steps: first, chemical vapor deposition (PECVD) is applied to the surface of a silicon wafer in order to create a hard mask of silicon dioxide (SiO_2). Subsequently, the nano-structures are transferred from a specially prepared foil into a viscous resist using the SmartNIL™ process (NIL: nano-imprint lithography).

For preparation of nano-imprint lithography, the initial nanostructures are manufactured on a master wafer using electron-beam lithography and then transferred onto an elastic foil into a polymer. By applying a force to a movable roller, linear contact between the foil and the NIL resist is realized. The result is a significantly reduced defect rate.

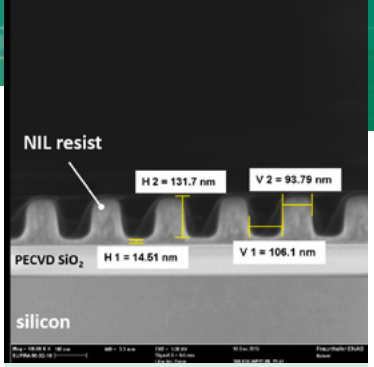


REM image of the depth-etched silicon after the DRIE process. © Fraunhofer ENAS

The resist is displaced by the polymer nano-structures, which forms a copy in the NIL lacquer. After etching the SiO_2 hard mask, the silicon is deeply structured using deep reactive ion etching (DRIE).

Outlook

Especially for applications in the field of MEMS and NEMS technologies even higher process stability is necessary. True-to-size structure transfer with even lower tolerance deviations is at the forefront. There is also a plan to research the possibilities of extending the process to various metals.



REM image of the structured NIL resist after the SmartNIL™ process. © Fraunhofer ENAS

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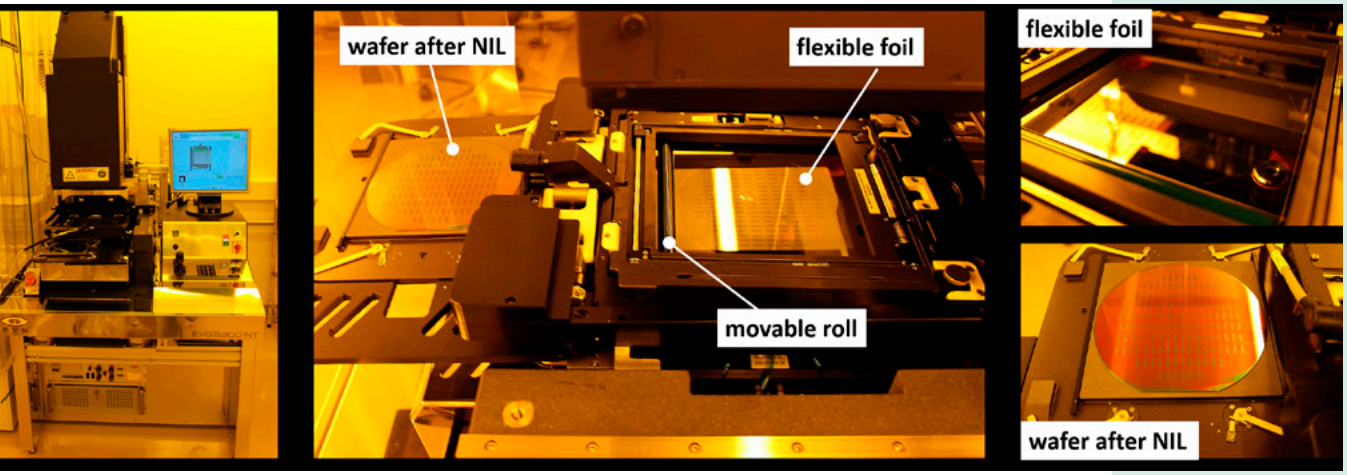

SmartNIL™ system from EV Group. © EVG

DC-Grid Manager.
© Fraunhofer IISB / Kurt Fuchs

Cognitive Power Electronics 4.0 – powerful and intelligent

With their concept of Cognitive Power Electronics 4.0, researchers at Fraunhofer IISB demonstrate how the next stage of evolution for power electronics could look in the age of the Internet of Things (IoT). The concept combines proven power electronics system technology with new functionalities from the area of digitalization: Additional controllers can be embedded in power converters, for example, which increases connectivity and intelligence. Power electronics with this kind of expansion can be used, for instance, as a sensor platform: certain sets of data are an inherent part of systems such as power converters and form the basis for intelligent decisions and advanced regulation strategies. Based on this sensor platform, the power electronics monitor the data from internal and external sensors and use it for fault detection or real-time optimization of the application in question. To allow functions such as remote operation or remote maintenance, the power converters can be connected to existing networks and cloud services.

The computing power of modern power converters can also be used to implement advanced data analyses and customized machine learning algorithms, to deploy self-learning and self-adapting converters, or to implement predictive maintenance for the entire electronic system. To this end, a modular design is available that can be combined with an application-specific plug-and-play functionality. The hardware and software of these innovative power converters can be reconfigured. The converter detects changes in its environment (e.g. operating mode, fluctuations in the power grid) and adapts to the application's requirements. Beyond this adaptability, the converter can also have a failsafe and fault-tolerant design: If a hardware component within the electrical system fails, the converter intervenes to ensure that the application can continue to operate. Examples of this include the DC Grid Manager and the Modular Power Distribution System from Fraunhofer IISB.

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Fraunhofer HHI receives an award for 3D Human Body Reconstruction

Around the world, volumetric video is considered the next important stage of development within media production. Volumetric video is currently developing into a key technology, particularly in the area of Virtual Reality (VR) and Augmented Reality (AR). At Fraunhofer HHI, a technology is being developed to complement it: 3D Human Body Reconstruction (3DHBR). This is a process that allows a realistic image of a person to be integrated into a virtual world.

Example for a 3D Human Body Reconstruction. © Fraunhofer HHI

Using several cameras simultaneously, the technology captures images of real people and generates dynamic 3D models that exhibit natural movements and can be viewed in the virtual world from any number of angles. Post-processing modules allow for direct integration into standardized post-production applications and virtual reality players for VR glasses. In contrast to conventional animation, facial expressions and the movement of clothing are captured visually and reconstructed using geometric details and texture quality. The entire processing procedure is fully automated and additional post-processing poses no problems.

Furthermore, an integrated multi-camera and lighting system has been developed for complete 360° image capturing of people. The system allows uniform illumination from every direction and flexible multi-camera arrangements. Avoiding green screens and allowing uniform illumination also provides the best possible conditions for subsequent illumination of the 3D models.

This year, the technology has already been presented with the AIS Technology Innovation Award 2018, a prize awarded for outstanding achievements in developing and producing moving-image content.

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Meet Fraunhofer Microelectronics at Semicon West in San Francisco

For the first time, there will be a multi-institute Fraunhofer presence at the semiconductor trade fair SEMICON WEST in San Francisco. From July 10 to 12, 2018, the institutes within the Fraunhofer Group for Microelectronics will present their exhibits on the Research Fab Microelectronics Germany. At the 70 m² booth, visitors will be able to attend a range of presentations given by invited clients and selected Fraunhofer experts. The focus will be on cross-institute topics from within the Research Fab Microelectronics Germany group: power electronics (towards zero power); smart sensor systems (sensors, radar, LiDAR); system integration technologies (assembly, packaging, 3D); and communication technology (optical data communication, high-frequency transmission). We were fortunate to obtain keynote speakers including Jörg Amelung to lecture on the Research Fab Microelectronics Germany, Professor Hubert Lakner on smart sensor systems, and Professor Klaus-Dieter Lang on system integration technologies.

We welcome you at our booth. © Fraunhofer Microelectronics / Bernd Müller

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Electrostatic micro-actuators from Lusatia

On January 1, 2018, the Fraunhofer project group MESYS at Brandenburg University of Technology Cottbus-Senftenberg (BTU) was added as a new business unit of Fraunhofer IPMS under the name "Monolithically Integrated Actuator and Sensor Systems."

MESYS (Mesoscopic Actuators and Systems) was launched in 2012 as a collaboration between Fraunhofer IPMS and BTU. The focus of the research lies on innovative electrostatic micro-actuators known as nanoscopic electrostatic drives (NEDs). The new class of actuator developed and patented by MESYS is CMOS-compatible and solves some fundamental problems of electrostatic actuators. It represents an alternative to piezoelectric MEMS bending transducers. This increases the performance of these microsystems and opens the door to entirely new kinds of design solutions.

The possible applications for NED technology are mostly to be found in the micro range: these uses could stretch from micropumps and microvalves to positioning systems. This technology has already been put to practical use in micro-loudspeakers integrated into silicon. This could pave the way for potential new uses in hearing aids, hearables, or in-ear headphones. The scientific successes of MESYS are also to be put to good use in industry as quickly as possible. The scientists expect this technology to create new scientific impulses – particularly for the eastern German region of Lusatia.

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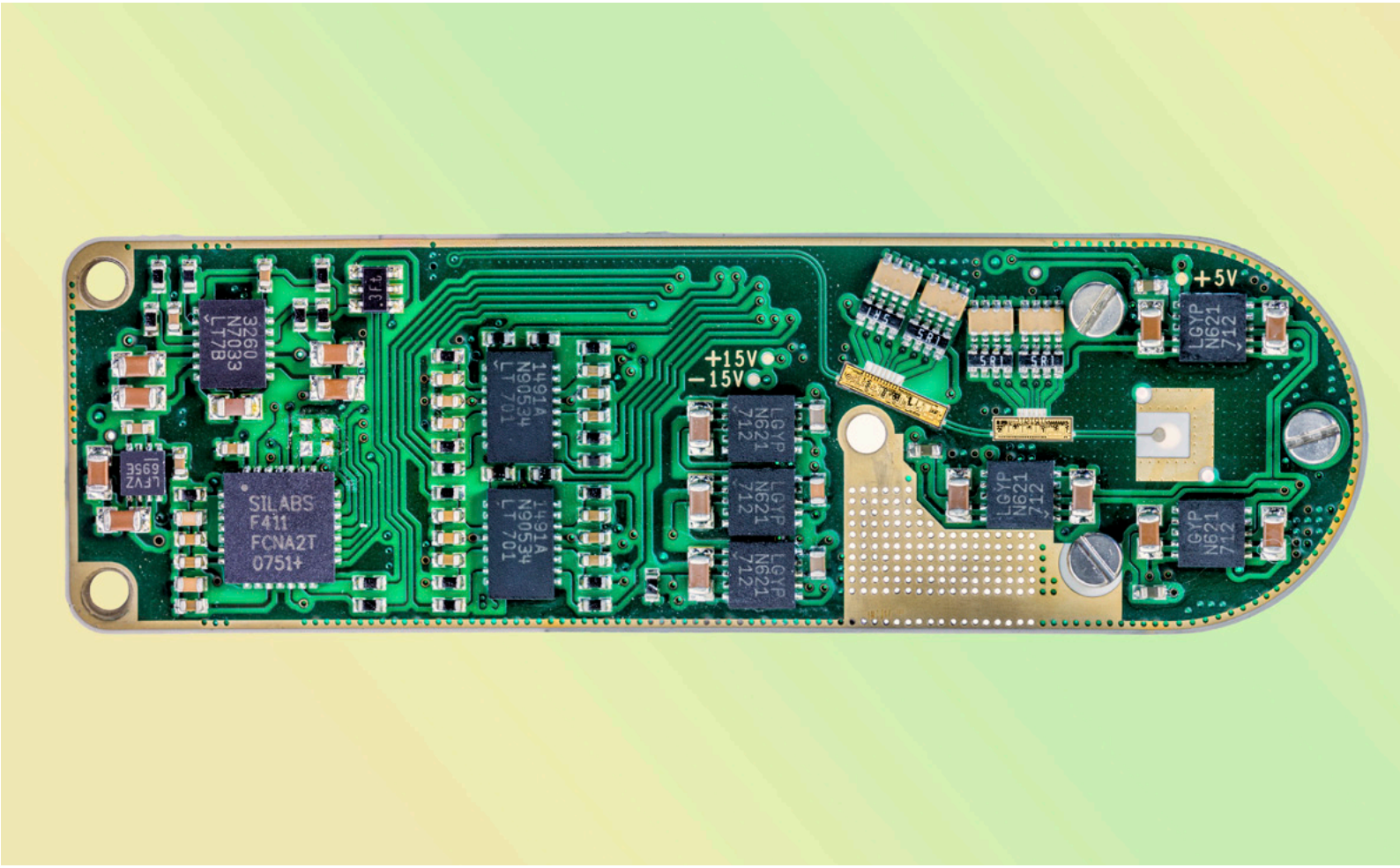
Miniaturized loudspeakers for hearables, hearing aids, and in-ear headphones. © Fraunhofer IPMS



The photo shows a co-integrated 94 GHz transmission channel only 1.8 × 5.9 cm² in size. When constructing this element, the scientists applied the heterointegration method. Three different semiconductor technologies were applied to a shared hybrid circuit board (GaN transmission amplifier, mHEMT frequency multiplier, and silicon-based CMOS actuation electronics). That makes the high-frequency transmitter both very small and extremely powerful. The completed device can be used in radar sensors or ultra-wide-band communication systems, for example. © Fraunhofer IAF

Editorial notes

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The Fraunhofer Group for Microelectronics, founded in 1996, combines the expertise of 17 Fraunhofer institutes, with a total of more than 3,000 employees. Its main focus is the preparation and coordination of interdisciplinary research projects, conducting studies and to assist in the process of identifying strategies.

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... today goes to Dr. Michael Galetzka from the FMD

Dr. Michael Galetzka.
© Fraunhofer IIS / Karoline Glasow

Dr. Galetzka, you are the Head of Technology Park "Design, Test and Reliability" within the Research Fab Microelectronics Germany (FMD). What does your role entail?

Within this technology park, the institutes are using a wide range of sophisticated technologies to develop electronic systems in such a way that they quickly reach product maturity while also functioning reliably and robustly. With the increasing complexity of the systems, this is a great challenge. It is my task to organize cooperation on these research topics efficiently and to ensure that cooperation continues to develop as we would wish.

The FMD has now existed for almost a year. What lessons have you already learned from this new type of cooperation?

I have been able to visit all 13 institutes within my technology park. I am very impressed as to the exciting topics they pursue with both great dedication and great expertise. And, wherever I've gone, I have perceived a striking sense of openness about trying out this new type of cooperation together.

What specific projects are you currently working on?

One important topic for everyone within the FMD is the strategic and organizational direction that the research fab should take. For me, one particularly exciting question is how we can gradually change the overall conditions that our partners work within in order to make this new type of cooperation more future-proof.

Let's look into the future. What would you like to have achieved in five years' time?

In five years' time, the FMD will have become a model of success for modern cooperation within the Fraunhofer-Gesellschaft and beyond – and I will have contributed to achieving this in these critical early days.

Which of the projects being worked on by your colleagues in other Fraunhofer institutes interests you in particular?

I am still bowled over by the sheer variety of exciting research work being done at all the institutes I have just visited. I cannot and do not want to choose just one.

What invention would you not like to do without in daily life?

My smartphone. It means that, given the regular train delays on my way home from Berlin to Dresden, I don't have to stand around in a cold station for too long.

What do you wish you had more time for?

Together with my wife, I wish I had more time to take advantage of the great range of concerts on offer in Dresden.

What kind of music moves you?

At the end of November, I attended Brahms' Requiem at Dresden's Frauenkirche (Church of Our Lady), which really moved me. Aside from that, I can almost always listen to Johann Sebastian Bach, no matter what my mood.

What song belongs to the "soundtrack" of your life?

There are a few, but one of them would have to be "Get Lucky" by Mark Knopfler.

Last, but not least: can you tell us what motto you live by?

I have never really thought about a life motto – but since you ask, two lines from a Leonard Cohen song do occur to me: "There is a crack in everything, that's how the light comes in."

In his free time, Dr. Michael Galetzka likes to listen to classical music, such as Brahms in Dresden's Frauenkirche. © MEV Verlag

About:
Dr. Michael Galetzka studied information technology at the TU Dresden. He then worked as a research associate at the Central Institute for Cybernetics and Information Processes and, from 1992, at the Dresden branch of Fraunhofer IIS. His work focuses on testing, verification, and simulation within system design. From 2001 to 2011, he was a group manager focusing on embedded system development and the design of communication systems. In 2007, he received his doctorate from the TU Dresden. Since 2011, he has been the head of business development at the division Engineering of Adaptive Systems EAS of Fraunhofer IIS. When the FMD was launched in April 2017, he assumed responsibility of the "Design, Test and Reliability" technology park.

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