Microelectronics News

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Key handover at the Fraunhofer Group for Microelectronics

On July 1, Prof. Patrick Bressler succeeded Dr. Joachim Pelka as head of the Berlin-based business office. In this interview, the two of them talked about the Group's origins as well as the tasks and challenges that lie ahead. » page 4

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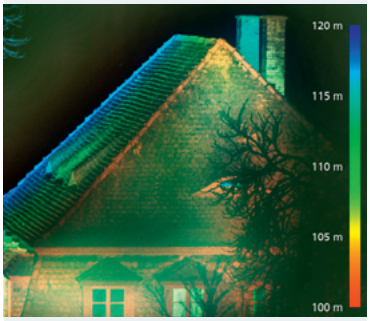

LiDAR – a wide range of research for varied applications.
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■ From the institutes

Fast Internet high above the clouds

Fast Internet on a plane – a dream of both airlines and passengers. So far, it has remained but a dream due to the low strength of data communication signals between the ground and the aircraft. But there is a solution in sight: signals with a transmission rate of 8 Gb/s can now be sent between a plane and a ground station.

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■ From the institutes

Wristband for personalized dementia therapy

In Germany alone, almost 1.6 million patients suffer from dementia. The health and care parameters are often not measured quickly enough – or in a sufficiently structured manner. That is why Fraunhofer IZM is working with partners from industry and research on a wristband that automatically measures and processes this data.

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Sensor system for wastewater monitoring.
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Ceramic embedding for the power electronics of the future

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Robotic lawn mowers: increased safety for children

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Smart glass provides protection against break-ins

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■ The last word …

… today goes to Dr. Ramona Ecke from Fraunhofer ENAS

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Events

Date	Event / WWW	Location	Group institutes involved
11/06 – 11/08	media:net berlinbrandenburg www.medianet-bb.de	Berlin, Germany	HHI
11/06 – 11/08	Vision 2018 www.messe-stuttgart.de/vision	Stuttgart, Germany	Group institutes
11/06 – 11/08	NGMN Industry Conference & Exhibition 2018 ice2018.ngmn.org	Vancouver, Canada	IIS
11/12 – 11/15	COMPAMED www.compamed.de	Düsseldorf, Germany	Group institutes
11/13 – 11/14	VDE Tec Summit 2018 https://tecsummit.vde.com	Berlin, Germany	FMD
11/13 – 11/16	Semicon Europa / 2018 www.semiconeuropa.org	Munich, Germany	FMD
11/13 – 11/16	electronica www.electronica.de	Munich, Germany	Group institutes
11/20	Technologiekompass 2018 www.iis.fraunhofer.de/de/muv/2018/technologiekompass.html	Nürnberg, Germany	IIS
11/26	Chemistry goes digital: Startups Corporate Sciences https://smartdataforum.de/chemistry-goes-digital	Berlin, Germany	HHI
11/27	Gegenwart und Zukunft des Electronic Packaging www.izm.fraunhofer.de/de/news_events/events/gegenwart-und-zukunft-des-electronic-packaging.html	Berlin, Germany	IZM
11/27 – 11/29	SPS IPC Drives https://www.mesago.de/de/SPS/home	Nürnberg, Germany	IIS, IMS
12/05 – 12/07	Photonix www.photonix-expo.jp/en	Tokyo, Japan	IPMS
02/02 – 02/07	Photonics West 2019 www.spie.org/conferences-and-exhibitions/photonics-west/	San Francisco, USA	IMS

Powerful high-frequency circuits based on innovative III-V semiconductor technologies have the potential to significantly increase the data rates of future transmission paths.

Fast Internet high above the clouds

Fast Internet on a plane – a dream of both airlines and passengers. So far, it has remained but a dream due to the low strength of data communication signals between the ground and the aircraft. But there is a solution in sight: signals with a transmission rate of 8 Gb/s can now be sent between a plane and a ground station.

To achieve this high data rate, researchers are using the radio frequency range between 71 and 76 GHz for the first time for an air-to-ground radio connection. Within this range, wide bandwidths are available to achieve multi-gigabit data rates.

This technology could be used in the future to offer broadband Internet and video-on-demand (VoD) on passenger flights. High-definition videos can be transmitted continuously and without compression from a plane, an earth observation satellite, or a drone to the ground. The data rate attained allows for, say, simultaneous transmission of up to 600 different 4k video streams (approx. 16 Mbit/s). Global satellite networks that are linked to terrestrial fiber-glass and wireless networks can make broadband Internet available worldwide and allow for the data-intensive services that form the Internet of Things.

The successful experiment was part of the ELIPSE research project. Within the experiment, a plane was equipped with a powerful transmitter that uses what is known as the "E-band" and flew in circles at an altitude of about 1000 m (3300 ft) and in radius of 5–12 km around the receiving station. A specially developed antenna tracking system on the ground ensured that the relatively highly directional antenna beams of the transmitter and receiver remained directed towards one another at all times.

Researchers from the Fraunhofer Institute for Applied Solid State Physics IAF were involved in the development of the highly linear transmission channel and the ultra-low-noise receiver. Special GaN transmission amplifiers with an output rating of up to 2 W and low-noise reception amplifiers with HF noise values of less than 2 dB allow the data rate to be significantly increased.

Who's involved?
University of Stuttgart • Karlsruhe Institute of Technology (KIT) • Radiometer Physics GmbH • Fraunhofer Institute for Applied Solid State Physics IAF • Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR

Sponsors:
German Aerospace Center (DLR) • German Federal Ministry for Economic Affairs and Energy

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E-band transmitter on the wing of the experimental aircraft. A small parabolic antenna ensures that it is correctly directed towards the ground station. © Fraunhofer FHR / Wolfgang Mies

Baton handover at the Fraunhofer Group for Microelectronics

Prof. Patrick Bressler has been the new head of the business office of the Group for Microelectronics since July 1, 2018. © Patrick Bressler

On July 1, Prof. Patrick Bressler succeeded Dr. Joachim Pelka as head of the Berlin-based business office. In this interview, the two of them talked about the Group's origins as well as the tasks and challenges that lie ahead.

Dr. Pelka, from the very beginning you were the head of the business office of the Fraunhofer Group for Microelectronics. A lot is bound to have changed in those 22 years?

Dr. Pelka: It all started in 1996 when I was assistant to the Chairman – what was planned as a part-time job soon became a full-time calling if you took the thinking behind the Group seriously. In 1999, the then-Chairman of the Group, Prof. Herbert Reichl, was able to convince headquarters of the need to establish a business office. Initially, the office's duties were in coordination only. Nowadays, however, we support chairpersons and institutes in developing, formulating, and implementing joint strategies.

How were the first few months and years? How has the Group developed over time?

Dr. Pelka: The first few months were very challenging for me. I had already been at Fraunhofer for many years, but I wasn't aware of how the different institutes need to be addressed differently, that they each have their own specifications. In order to be able to mediate well, the first step was to establish a solid foundation of trust between the institutes in the Group. The institutes now act as partners. Our good coexistence has since grown to take up a lot more space.

What were the most important and exciting tasks you were entrusted with at the Group for Microelectronics?

Dr. Pelka: That was definitely the strategic process that led to the establishment of the Research Fab Microelectronics Germany (FMD). It took several attempts to get the Group institutes to agree to a joint strategy. A strict division between the operative business of the institutes and long-term strategic direction of the overall Group made it possible to develop a shared understanding of core skills and to draw up cross-institute road maps for the first time. These results were submitted as a concept to the road-mapping competition for research infrastructures held by the BMBF. The ministry was convinced and approved funding outside of the competition. The Fraunhofer share of that funding – almost €300 million – is the largest individual grant that the Fraunhofer-Gesellschaft had so far been able to obtain.

Which projects are you planning for the future?

Dr. Pelka: I expect to go seamlessly into the next year and a half as a senior advisor. Together with my colleagues from imec and Leti, I am preparing a European technology initiative for the next generation of edge computing. The concepts need to have been drawn up by about the middle of next year. Maybe an FMD 2.0 will come of it. That would top even our success with today's FMD. Within the Fraunhofer-Gesellschaft, however, we are also trying to establish a close collaboration with the ICT Group, because microelectronics alone only covers hardware.

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Twenty-two years of successful work for microelectronics at Fraunhofer. Dr. Joachim Pelka.
© Fraunhofer Mikroelektronik

In short, what advice would you like to pass on to Prof. Bressler?

Dr. Pelka: Patrick, the next thing on the agenda is the European dimension. That will be your task. We need to continue to expand our European activities and to strengthen the trust between the various actors.

Prof. Bressler, how did you come to choose to study physics, and would you select the same university path if you had to choose again?

Prof. Bressler: With hindsight, individual events and coincidences form a mosaic that you didn't know beforehand but that you later call your career. One significant but also improbable coincidence was that I had an outstanding physics teacher. He knew how to arouse my curiosity for the conceptual models of physics. If I had to choose again, I would certainly still study a science – but which one would depend on the coincidences that happened.

Tell us about the milestones of your professional history.

Prof. Bressler: Before going to university, I spent six months at a metalworking shop where I learned metalwork. Those were my first factory experiences.

While studying physics in Aachen I worked part-time as a student employee in an industrial laboratory, where I characterized fiber glass and operated vacuum evaporation systems. At TU Berlin, I got my doctorate with a thesis on surface physics and magnetic semiconductors. Then, I worked for over a decade as a scientist at the Berlin Electron Storage Ring (BESSY). As a native speaker of English, I was asked increasingly over the years, to look through Research applications, in particular the EU ones, and soon I was an in-demand specialist among the applicants.

Later, as Head of Unit for Physical and Engineering Sciences at the European Science Foundation, I was able to view and evaluate applications and launch new programs – in other words, to do research management. I started to work as a proposal reviewer at the European Community, as well.

During my time in Fraunhofer's Brussels office the focus was increasingly on networking, coordination, and lobbying in the European Parliament for research and development. Finally, as Executive Vice President of Fraunhofer USA in the last 3 ½ years before taking this job, I worked to improve the U.S. business model, negotiated new contracts, and – in conjunction with headquarters in Munich – expanded the collaboration between Fraunhofer USA and the parent institutes. I learned a lot doing that. New areas of expertise, skills, and wider thematic areas were added all the time.

I am now here – in the business office – during an exciting time of change and reinvention for microelectronics. It is always a challenge to inherit the post from a very successful business office head. That is why I am very excited that we will both have a year and a half of overlap and continuity.

Where would you like to place particular emphasis?

Prof. Bressler: As Achim has already empahsized, particular effort will need to be placed on expanding our European and international activities. From my experience in Brussels, I know how important it is to build and maintain networks. Another aim is to promote the strategic development for the Group as a whole, as well as the integration with the FMD. The intention here is to create a coherent view of the future and an operational model that matches that. This needs to be accompanied by PR and communication duties for the business office, as well as studies and market analyses.

Thank you for taking the time to talk to us.

The interview was conducted by Frida Depperschmidt.

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Trailblazer for especially robust vehicle electronics

The partners in the RESIST research project have spent the last three years developing resilient electronic systems for use in vehicles.

Electronic systems in cars and planes are increasingly sophisticated and complex. They are performing an ever-expanding number of functions while becoming smaller and lighter. This improves the performance of the components and allows energy consumption to be reduced. On the other hand, there has been greater sensitivity and vulnerability of electronic components with respect to external influences.

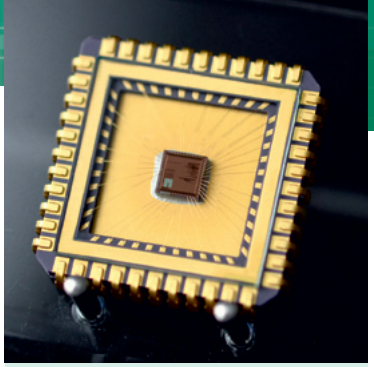
Early warning system to satisfy the highest demands on the electronics

That is why the project came up with new design methods and chip architectures for safety-critical electronics that enable an early warning system for detection of the "health condition" of the electronics. Thus, defects can be identified before failure and corrected, if possible.

Methods and chip architectures to realize a zero-defect target

The aim is to contribute to extending the lifespan and failure safety of electronic assemblies in future automotive and aviation applications from the current 10 to 15 years to a period of 25 to 35 years. To this end, new types of chip elements and approaches were developed that allow a forecast to be made during the design phase of a microchip or a system about behavior during later operation. This ensures that devices will tolerate operational loads in the vehicle better than previously and will thus remain fail-safe for longer. The results were tested in various demonstrators. Among the developments is a fail-safe DC converter that still maintains its functionality even if critical subcomponents in its circuitry fail. This allows it to guarantee uninterrupted continued operation of the entire electronics and the electrically powered safety systems.

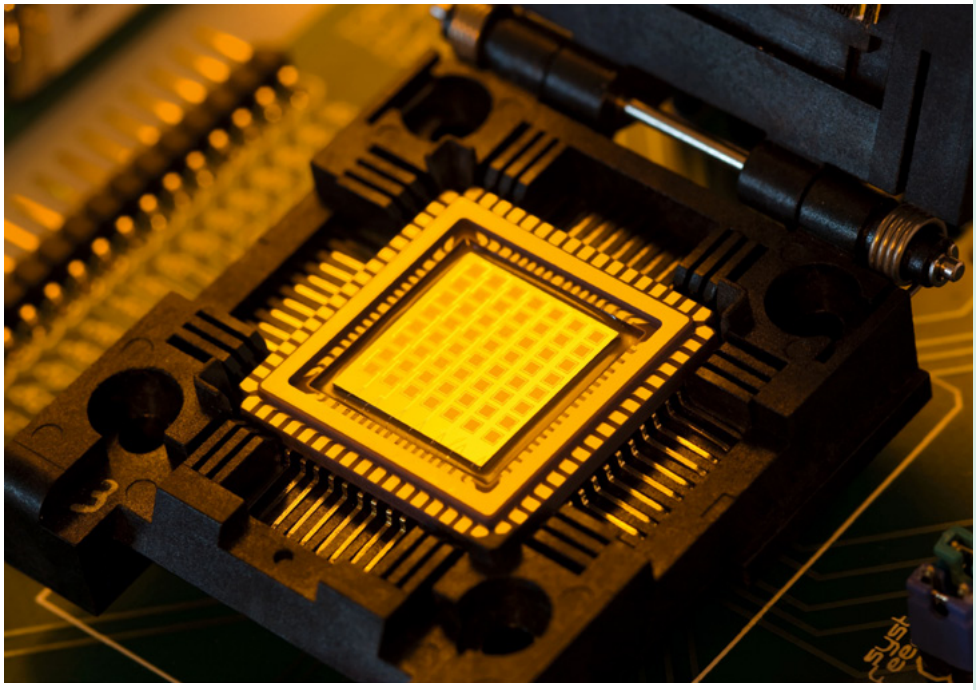
The work of the German RESIST partners was funded to the tune of approximately five million euros by the German Federal Ministry of Education and Research (BMBF) within the framework of the European initiative EUREKA-CATRENE.



RESIST early warning system: monitoring sensor for function monitoring of a circuit.
© Fraunhofer IIS / EAS

About the project:
In addition to Fraunhofer IIS / EAS, the RESIST project team included Airbus Innovations, Infineon Technologies AG, MunEDA GmbH, Nexperia Germany GmbH, Robert Bosch GmbH, and Volkswagen AG. The university partners were Reutlingen University, the Technical University of Munich, and the University of Bremen.

Example of a chip structure. © MEV Verlag



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Test drone. © Fraunhofer HHI

Control via a voice channel

Multicopters, also referred to as drones, offer some promising solutions. Delivery traffic, for example, could be moved from the road to the skies. That would save fossil fuels and reduce CO_2 emissions. Drones could also explore critical deployment zones when it comes to firefighting or hazardous areas. The prerequisite to achieving this is reliable communication for controlling the drones and determining their location. This is currently usually carried out by radio, but the range involved is quite limited. Control via mobile data channels is one additional option, but the risk of dropped connections and network overload is still quite high.

Solution: voice channels of mobile networks

Experts at the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI, have developed a solution that is stable, affordable, not limited in range, and essentially ready to go: controlling drones using the voice channels in mobile networks. "A major advantage is that – unlike the data connections – the voice channels are available almost everywhere and they're highly reliable, too," explains Tom Piechotta, research associate at Fraunhofer HHI.

Global coverage

Controllers on the ground transmit commands to the drone; the device then returns information on its position, altitude, or battery status. "We convert the commands into audio signals, in much the same way as modems used to," explains Piechotta.

Because transmission is via the normal cellular network, a connection to the drone can be established from almost anywhere in the world.

Future-proof control in real time

But how can you control a drone when it is out of sight, perhaps even on the other side of the world? The drone's location can be visualized using an online map service such as Google Maps. Also shown on the map are the drone's position and altitude, which the device transmits in real time. Another option is to install sensors on the drone to detect and avoid unexpected obstacles, such as birds, helicopters, or cranes.

"With our system we rarely come across any dead spots. If a network is down, the connection switches to another mobile communications standard. If the connection is lost, the drone has an automatic call-back function that activates almost immediately," explains Piechotta. "The technology is considered future-proof: mobile communications standards come and go, but voice channels are a permanent feature. Mobile networks will always provide voice channels and, as long as this remains the case, the system we propose is a reliable and affordable alternative to conventional data connections." In short, it's now possible to communicate with drones anywhere, at any time.

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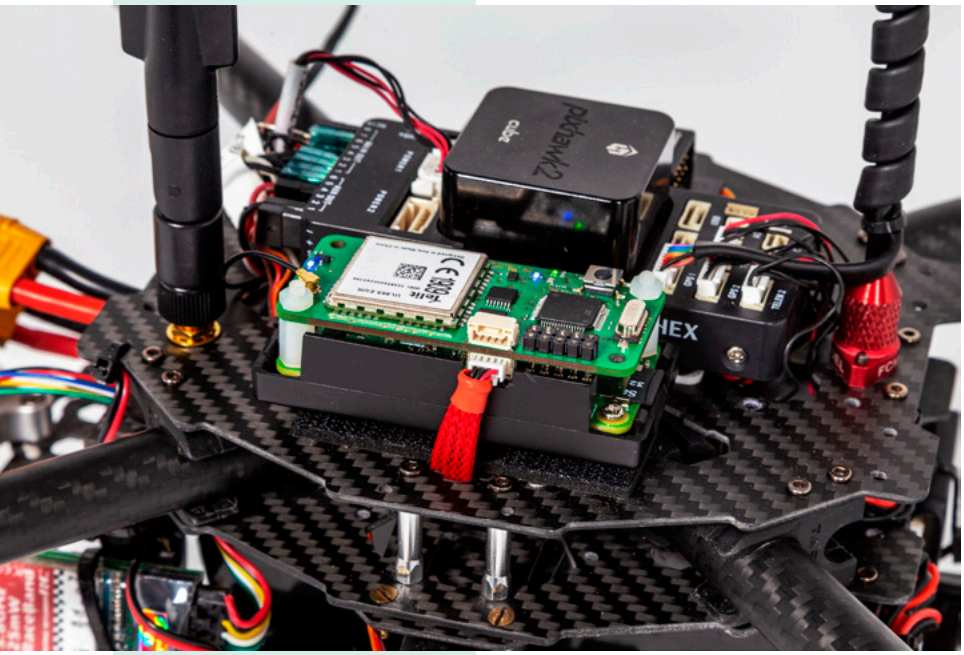


Robust control in real time: the technology is ready to go thanks to its use of conventional voice channels. © Fraunhofer HHI

Electrical connection technology as a smart diagnostic interface

Whether in an automobile – particularly with regard to autonomous driving – or in tomorrow's production systems, plug connections and electrical connection technologies play a central role in digital networking. Researchers at Fraunhofer EMFT are working on a new smart plug with integrated sensor systems. This plug encompasses a wide range of parameters such as energy consumption, faulty conditions, or the ambient temperature.

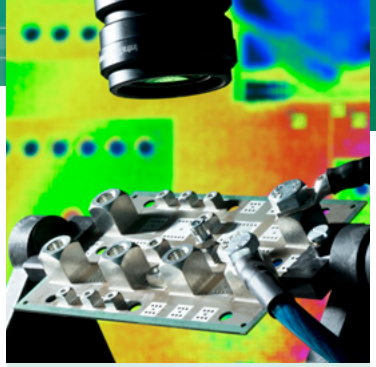
Electrical connection technologies are the main interface between machines, control systems, and data processing devices. They thus form the basis for functionality, simple handling, and reliability within automation technology. Researchers at the Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT in Oberpfaffenhofen are working on a new generation of active, "smart" plug connectors. Their aim is to integrate miniaturized sensor systems into the plugs. This allows the connection quality to be monitored. In the future, these little electronic "helpers" will take responsibility for a type of condition monitoring for the devices connected and, for example, record energy consumption. The data is evaluated inside the plug itself and is then transmitted wirelessly to a mobile end device.

Strict miniaturization requirements

Because the effects to be measured are very small and often only occur without distortion in the immediate vicinity of the electrical contact, a high degree of miniaturization of the sensor technology and packaging used is crucial. At the same time, quality and service life must be maintained. The plug connector must also work absolutely reliably for safety-sensitive applications such as autonomous driving, even in the event of difficult ambient conditions such as vibrations or dirt. For miniaturization and integration, the researchers are making use of solutions from the Fraunhofer EMFT technology portfolio such as foil technology, which allows the embedment of semiconductors and sensors in extremely narrow gaps and in small volumes.

Efficient and safe operation

The integration of these functions into the packaging provides up-to-date parameters for quality measurement; this makes it possible to measure the degradation of plug connectors. That, in turn, allows for an early forecast to be made regarding critical conditions in the plug connectors. Overall, the installation and reliable operation of systems are thus made much easier – be they in automobiles or in production.



High-resolution thermal image analyses of press-fit connections.
© Fraunhofer EMFT / Bernd Müller

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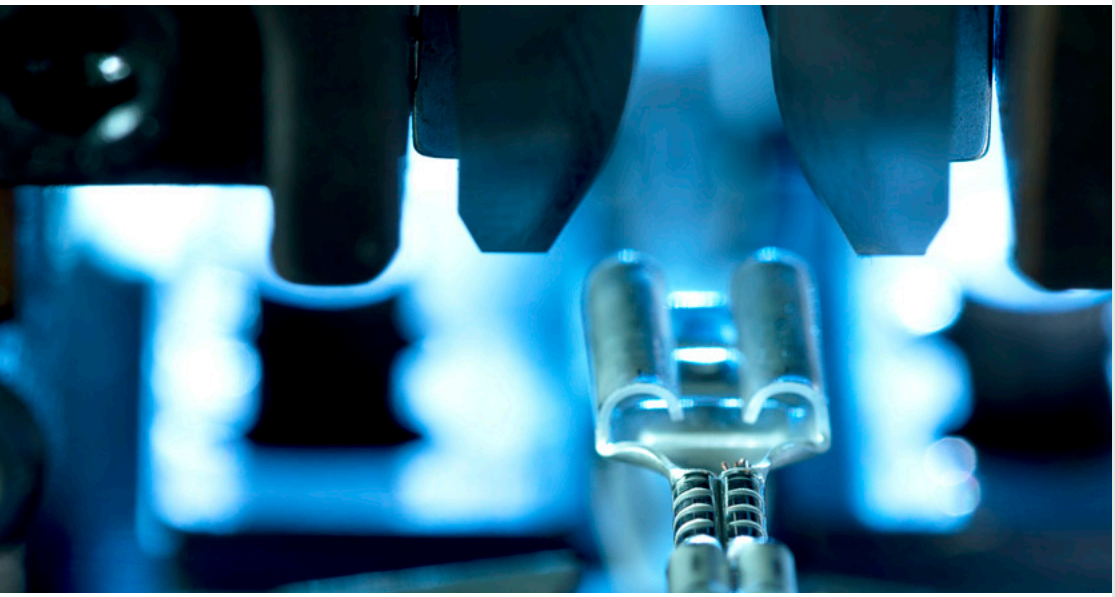
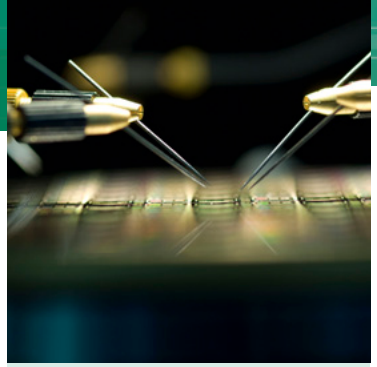


B-crimp for automotive applications.
© Fraunhofer EMFT / Bernd Müller



Example of sensor technology. © MEV Verlag

Exploiting minerals more efficiently with artificial intelligence

Fürth, Luleå, Berlin, Santiago de Chile: numerous ore deposits have diminishing concentrations of mineable ore. In order to access the hidden ore, the mining industry uses elaborate procedures that consume large amounts of energy and water. Fraunhofer IIS, together with three other partners, intends to use artificial intelligence and sensor fusion in order to analyze the concentration of valuable minerals as early as possible in the process and thereby conserve resources.

About the project:
REWO-SORT is a joint project of Fraunhofer IIS, Luleå University of Technology in Sweden, the Secopta company, and the University of Chile. The work package of the German partners Secopta and Fraunhofer IIS is funded by the German Federal Ministry of Education and Research for a period of three years to the tune of around EUR 520,000.

The overall objective of the REWO-SORT research project is the evaluation of the technical feasibility and development of an improved sorting technology for raw materials by means of a multimodal sensor data fusion of optical and X-ray technologies. The project will also examine the robustness of the methodology under variable geological conditions, such as different rock compositions.

Saving resources with sensor fusion

The early separation of low-value material in the process chain should not only increase the treatment efficiency, but also reduce the water and energy consumption in the subsequent process steps. The fusion of sensor technologies to be developed should provide constant and accurate monitoring of the mineralogy of the mined rock. What's really remarkable is that the geological, mineralogical, rock mechanical, and metallurgical properties of the ore are determined directly while the rock material moves along a conveyor belt. This data will be automatically fed into geological 3D models in order to facilitate mine planning.

Complementing technologies

The combination of laser-induced plasma spectroscopy (LIBS) and multi-energy X-ray imaging (ME-XRT) is particularly promising, as the technologies complement each other very well in terms of their analytical performance: LIBS is able to provide an analysis of the chemical composition of the surface, whereas ME-XRT determines elementary information of the total object volume. "The technological convergence of these two sensor technologies will enable the extrapolation of precise surface information to the entire volume. This allows us to determine representative values for the entire ore. Adaptation to varying ore types and geological parameters will be done using artificial intelligence," explains Dr. Markus Firsching, project manager at the Fraunhofer Institute for Integrated Circuits IIS.

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Extraction of natural resources in the mining industry. © MEV Verlag

Wristband for personalized dementia therapy

In Germany alone, almost 1.6 million patients suffer from dementia – and the number of new diagnoses is on the increase. The health and care parameters indispensable to professional treatment are often not measured quickly enough – or in a sufficiently structured manner. That is why Fraunhofer IZM is working with partners from industry and research on a wristband that automatically measures and processes this data.

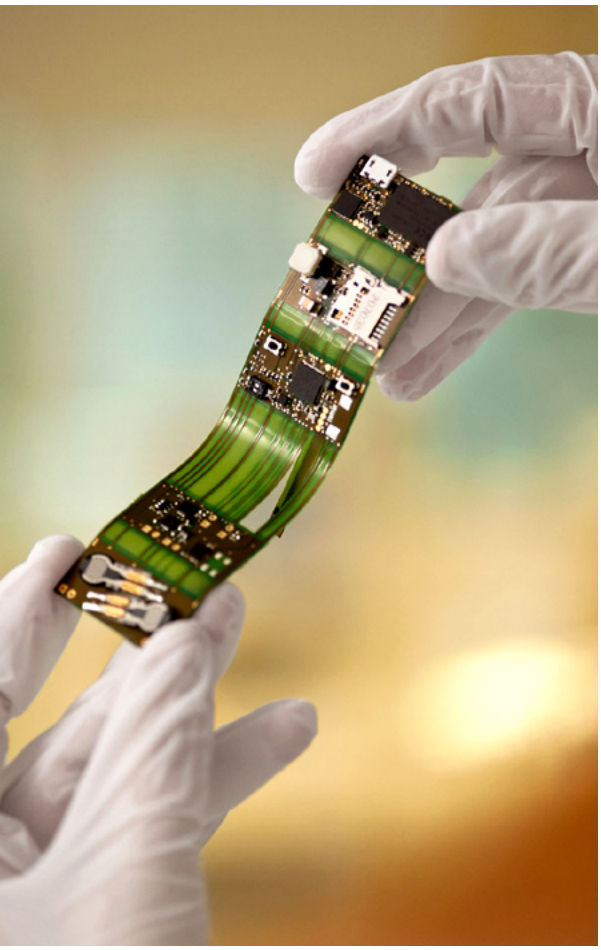
The miniaturized modular measurement and advisory system will have completed development by March 2019 as part of the PYRAMID project and is intended to improve the quality of life of those suffering from dementia and their friends and relatives.

Keeping an eye on all the data

The system measures vital signs, such as heart rate and body temperature, as well as skin resistance and external factors such as room temperature, brightness, and ambient volume level. In addition, the analysis also includes patients' movement patterns and metadata. This data can be used to independently detect emergency situations – such as if a patient falls – but also to determine suitable treatment options on a day-to-day basis or make long-term forecasts about how the condition will progress. The information is provided to the medical professionals and care staff via Bluetooth. This means that patients can continue to live in familiar surroundings for as long as possible, friends and family are provided with relief, and treatment options can be optimized individually.

Complex system in the smallest possible space

In addition to the measuring and transmission electronics, a USB interface and NFC antenna, the latter of which allows doors to be opened automatically, are integrated into the battery-powered system. The Fraunhofer Institute for Reliability and Microintegration IZM, together with the smE partner Binder GmbH, is responsible for the implementation of the hardware, the integration of measurement components, and the miniaturization for optimum usability. Concept and design studies have already been completed, and now a demonstrator is being developed. After the first successful trials with test subjects and prototype demonstrators, additional trials are planned by the end of this year.



Sample view of a shape-adapted electronic layout in the wristband.
© Fraunhofer IZM / Volker Mai

The measurement and advisory system for dementia treatment being developed by Fraunhofer IZM increases the quality of life of patients and their friends and families. © MEV Verlag

About the project:
In addition to Fraunhofer IZM, the following project partners are also involved in the PYRAMID project: • ClinPath GmbH (coordinator) • Charité University Hospital Berlin • Otto von Guericke University Magdeburg • Johner Institut GmbH • Pilotfish GmbH • Binder GmbH. The project is being funded by Germany's Federal Ministry of Education and Research (BMBF).

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Close-up of a wide-band-gap device embedded using DCB embedding technology. © Fraunhofer IISB

Ceramic embedding for the power electronics of the future

The trend towards miniaturization and three-dimensional integration is pushing power devices to their limits, particularly with regard to temperature resistance and high switching speeds, while also maintaining a long service life. The applicability of established setup concepts based on PCBs (printed circuit boards) and LTCC (low-temperature co-fired ceramic) is limited here. This is where an innovative setup concept comes in, based on embedding of devices in a ceramic circuit carrier.

In this technology, which is known as DCB (direct copper bonded) embedding, the power semiconductors are integrated into specially prepared DCB substrates using suitable packaging and are then enclosed in a grout. The DCB substrate is prepared using laser structuring. The considerable copper layer thicknesses result in a high current-carrying capacity. Various ceramic materials can be used for insulation. A suitable material is selected by considering the optimization of high-temperature resistance, heat management, and mechanical properties. The electrical connections are formed by means of integrated vias (through-plating). The use of additional vias allows the manufacture of multi-layer DCB stacks, which are of particular benefit in low-inductance applications. Development of DCB embedding technology at Fraunhofer IISB will continue intensively over the years to come in order to fully exploit the potential offered by wide-band-gap devices for use in power-electronic applications.

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Specimen preparation with microPREP

For accelerated materials development and reliable quality control, industry is placing its trust more and more in microstructure diagnostic methods. The required preparation processes, however, have at some points been inflexible, slow, and expensive. With microPREP™ , jointly developed by Fraunhofer IMWS and 3D-Micromac AG, these workflows are considerably accelerated and made reproducible.

This system, which received the TÜV SÜD Innovation Award 2018, offers a high level of process stability and an intuitive user interface. The ultra-short pulse laser technology used allows for "athermal" preparation of specimens: pulse lengths in the picosecond range are used to shape the specimens appropriately, hardly heating them in the process. The modular system is suitable for the preparation of semiconductors, metals, ceramics, glass, and composite materials and is ready to be used for a multitude of preparation workflows.

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From left to right: Prof. Thomas Höche, Michael Krause, and Georg Schusser developed the specimen preparation device microPREP™ in close cooperation with 3D Micromac AG. © Fraunhofer IMWS

Robotic lawn mowers: increased safety for children

Levels of digitalization and automation are increasing not only in industrial environments but also in our everyday lives. More and more people today are using robotic devices to vacuum the floors or mow the lawn. These devices have to precisely monitor their surroundings to avoid causing material damage or injury. A test conducted by German consumer safety group Stiftung Warentest, however, indicates that not all robotic lawn mowers stop in time when children are crawling nearby – in fact, none of the devices stopped when a replica of a child's hand was placed in front of them.

A LiDAR-based sensor system from Fraunhofer IMS in Duisburg prevents the robots from getting close to children playing nearby in the first place, and if a child does happen to approach it, the device shuts down immediately. The sensors use state-of-the-art image processing technology to generate three-dimensional representations of the surroundings in real time, thus making it possible to distinguish between people and objects.

In addition to developing photodiodes, which convert incident light into electrically usable signals, the researchers are exploring methods to reduce the adverse effects of sunlight. The first systems are set to go into production in late 2019.

You will find out about the varied applications of LiDAR systems on page 14.

LiDAR Owl – the time-of-flight imaging camera that could be used with robotic lawn mowers.
© Fraunhofer IMS

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Sensor system for wastewater monitoring

As part of the microMole project, Fraunhofer IZM is working on a system for comprehensive monitoring of wastewater systems.

The system independently measures environmental parameters such as pH value, electrical conductivity, and temperature. The various functions – from sensors to energy storage – are distributed among single, individually configurable modules. These are mounted on a steel ring, which also provides the mechanical fixation in the pipe system. Radio modules allow communication between several rings in the wastewater pipe.

Together with Fraunhofer IIS, a thermoelectric energy harvester was developed to ensure self-sufficient and maintenance-free operation of the system. Optimized circuits and a sampling algorithm that only activates individual sensor functions in previously determined conditions minimize energy consumption. Specially developed housings protect the sensor system from the wastewater flowing through the pipes without restricting the contact necessary for the measurements. Clogging is largely precluded. The functionality of the sensor system has already proved itself in the first laboratory and field tests. The next step is to further optimize the individual elements.

The microMole project is being funded by the European Union as part of the Horizon 2020 program.

The modular system allows the sensor system to be adapted to individual requirements.
© Fraunhofer IZM / Volker Mai

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Smart speakers with Fraunhofer technology. © Yandex

A Russian-speaking smart speaker

Erlangen/Moscow – Yandex, the operator of a leading Russian search engine and developer of smart products and services for machine learning, has integrated Fraunhofer's upHear® Voice Quality Enhancement technology into the company's first smart speaker. This enables the device to accurately hear voice commands issued from anywhere in a room.

Fraunhofer's upHear® Voice Quality Enhancement (VQE) technology reduces background noise and acoustical echoes, ensuring that Yandex's new smart speaker and the embedded intelligent assistant Alice can understand verbal commands, even when the speaker is streaming music at the same time. Fraunhofer provided a software solution that applies microphone array technology for far-field voice capturing to supply Yandex.IO with a processed audio signal. This ensures that the keyword spotter and speech recognizer receive a clean voice signal.

Yandex's AI assistant Alice listens for and understands Russian-language requests with almost-human precision and provides contextually relevant answers using Yandex's search engine and other services. Alice, which was initially offered in Yandex's iOS and Android apps, is the first virtual assistant designed to serve the needs of Russian-speaking users.

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Foundation stone for the new research building

With the laying of the foundation stone on June 1, 2018, Fraunhofer IIS / EAS celebrated the start of the construction of its new institute building. In the presence of the Saxon State Minister, Dr. Eva-Maria Stange; the Parliamentary Secretary of State in the Federal Ministry of Research, Member of the German Parliament Thomas Rachel, and the Fraunhofer President, Professor Reimund Neugebauer, the work thus began on the new five-story building. The investment, which is worth around €25 million, will give research into complex electronic systems, intelligent sensors, and automation solutions more space in Dresden.

The new premises represent a significant improvement of the general conditions for research work. In particular, the numerous areas for experimental halls, electronics laboratories, and measuring rooms will offer the researchers ideal conditions for new developments.

The future workplaces are expected to be ready to occupy in 2020 and will have an overall area of around 4,300 m². Furthermore, the property also offers good prospects for future growth, possible extensions, and new workplaces.

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From left to right: Architect Thomas Heinle; Dr. Peter Schneider, Director of Fraunhofer IIS / EAS; Thomas Rachel, Parliamentary Secretary of State in the Federal Ministry of Education and Research; Dr. Eva-Maria Stange, State Minister of Saxony for Science and Art; Prof. Reimund Neugebauer, President of Fraunhofer-Gesellschaft; Prof. Albert Heuberger, Executive Director of Fraunhofer IIS. © Fraunhofer IIS / EAS, Oliver Killig

LiDAR – a wide range of research for varied applications

LiDAR (Light Detection and Ranging) is a laser-based process for measuring distances and speeds. The systems in question measure the time that the light emitted from a laser needs to be reflected by an object and be detected using a sensor. LiDAR technology plays a key role particularly in the area of autonomous mobility. The measurements can be used as the basis for, say, allowing an autonomous vehicle to move safely through its environment.

Color-coded distance image of a building.
© Fraunhofer IAF, Fraunhofer IOSB, AIM Infrarot-Module GmbH

For each individual component of a LiDAR system, there is a varied spectrum of research and development activities within the Research Fab Microelectronics. The scientists there are continuously advancing the laser sources, sending optics, and beam steering systems as well as receiving optics and detectors. This is because the demands on the systems are increasing – for example due to longer ranges, growing cost pressures, and new fields of application. Research is currently focused on pulsed laser diodes in the nanosecond range, powerful micromirrors, and highly sensitive detector arrays (SPADs, APDs, and SiPMs).

LiDAR technology is being advanced with industrial partners. The research know-how can thus be tailored to the individual applications and the resulting system specifications. You will find out on page 12 how LiDAR systems can make robotic lawnmowers safer.

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Smart glass provides protection against break-ins

The windows of jewelers, galleries, and banks are alarmed and fitted with toughened glass. The disadvantage is that the pane, or part of the pane, needs to break before the alarm is triggered. An innovative alarm system from researchers at the Fraunhofer institutes INT and IPMS, however, can detect even an attempt to manipulate a window. The system can register both temperature changes and impacts on the glass in real time – meaning that burglars don't stand a chance. Even a gentle hit against the toughened glass or manipulation using a flame is enough to trigger the alarm. The application of force changes the mechanical properties of the pane, and the new system can register this. The anti-break-in protection now exists as a demonstrator.

Conventional toughened glass has to break before the alarm is triggered.
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Volumetric studio opens in Babelsberg

On June 11, 2018, the starter's pistol was fired for the volumetric studio in Potsdam's Babelsberg district. Actress Emilia Schüle (known from Ku'damm 59, Traumfabrik) was the first person to be recorded in the volumetric studio. The studio's 3D Human Body Reconstruction technology from Fraunhofer HHI creates hologram-like representations of real people. The actors recorded in this way can be integrated into real and virtual worlds and spectators can view the person from different angles. For the first time in Europe, the new technology can also be used for commercial productions.

Opening of the volumetric studio in Babelsberg.
© Stefan Kny

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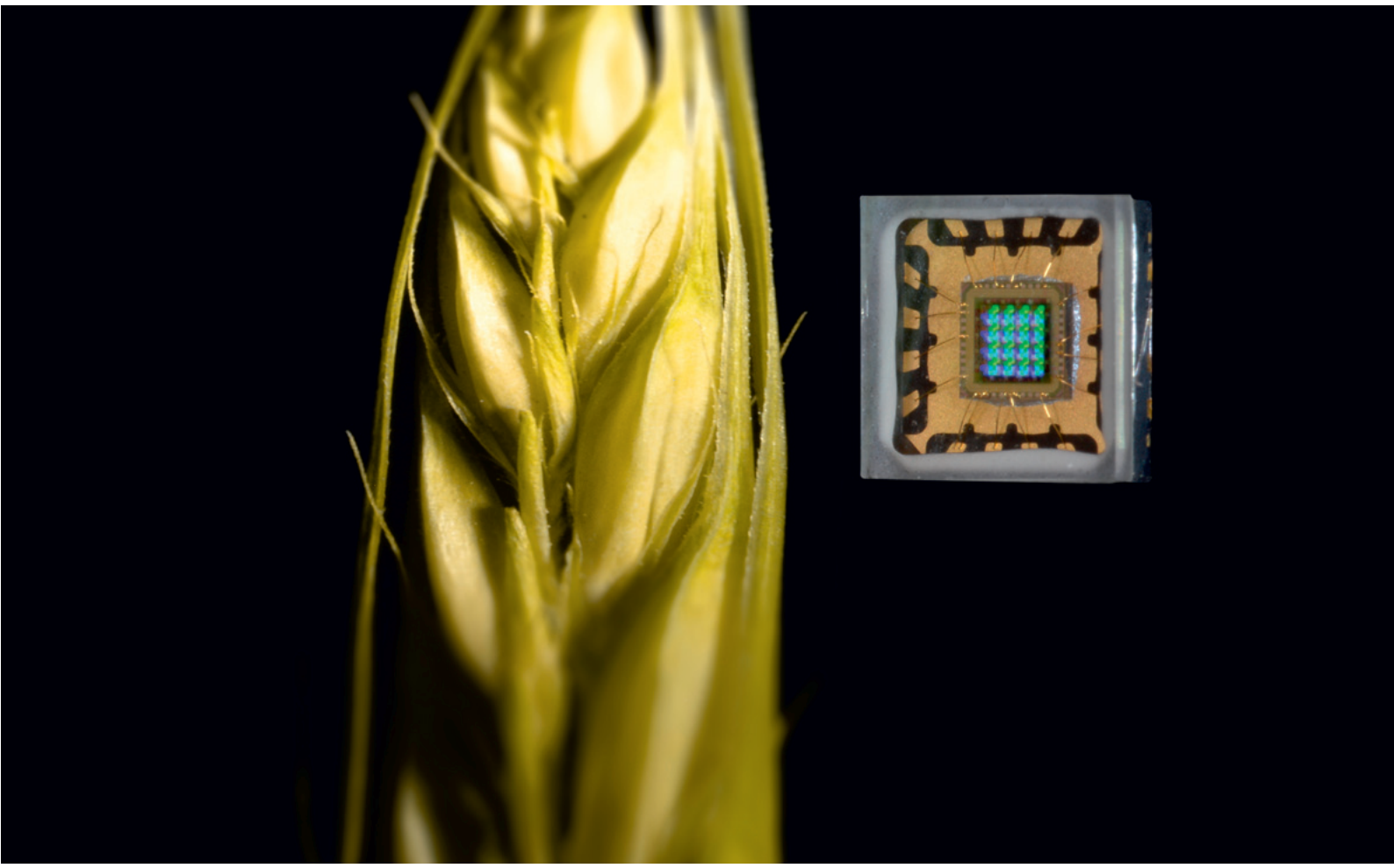

Capturing the spectral properties of light is the aim of scientists at Fraunhofer IIS who are developing application-specific color and multispectral sensors in CMOS technology. The highly integrated color sensors are used for smart farming, for the analysis of gases and liquids as well as for the color regulation of LED lighting systems. Our photo shows a multispectral sensor with twelve spectral channels. © Fraunhofer IIS / Wladimir Tschekalinskij

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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The last word ...

Dr. Ramona Ecke. © Fraunhofer ENAS

About Ramona Ecke:
Dr. Ramona Ecke studied Materials Sciences at TU BA Freiberg, specializing in anorganic/non-metallic materials. She then worked as a research associate at the Center for Microtechnologies at the TU Chemnitz, and got her doctorate in 2006 in tungsten-based diffusion barriers for copper metallization. Dr. Ecke was then a postdoc at the International Postgraduate Program "Materials and Concepts for Advanced Metallization Systems" with TU Chemnitz, Fudan University and Jiao Tong University in Shanghai. She coordinated the program throughout its entire term of ten years. In 2009, she moved to the newly founded Fraunhofer ENAS as a group leader for process integration and has been the deputy head of department for back-end of line for two years.

Dr. Ecke, what are you working on at the moment?

The Saxon "Function Integration for Micro-/Nanoelectronics" Center of Excellence was one of our pilot projects. We are currently in a transitional phase towards a Transfer Center and are preparing for the topical profiling of the next funding period. I coordinate the specialist collaboration at the Institute and with the Technical University of Chemnitz as well as with the other core institutes (Fraunhofer IPMS, IIS / EAS, and IZM-ASSID).

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

As you know, I am also involved in the Research Fab Microelectronics Germany (FMD). This also gives you great insights into the other institutes within the Group for Microelectronics and the two associated Leibniz institutes IHP and FBH. The interesting thing is how differently our institutes are organized – from the operational concepts of the cleanrooms and the tasks assigned to the researchers and technical personnel for the systems and processes, up to and including logistics.

At a training session in July, I got to know a colleague from the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI. It's certainly very interesting to learn about all the things you can make out of wood, particularly when you consider it from the point of view of a renewable resource.

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

The MP3 format. It got rid of all my mountains of cassettes and CDs. And you no longer waste time looking for the CD you want.

What do you wish you had more time for?

Now that my children are grown up, I bought myself a motorcycle this year. I did have a sense of trepidation at first, as I hadn't ridden for twenty years. But, in the end, it's just like riding a bike – you never really forget. Unfortunately, I only have the weekends available to ride, and there are also plenty of other things I could be doing.

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

For the next five years, I expect the Transfer Center and the FMD to be my central tasks. They are both cross-institute projects and I hope that, with my work, I can contribute to establishing a new type of cooperation and of helping people to internalize the idea that we are a unit. I would also be very pleased if our ATTRACT group, headed by Prof. Heidemarie Schmidt and in which I am a mentor, has established itself both topically and technologically and is able to stand on its own two feet.

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

I actually quite like to have peace and quiet around me. These days, I rarely consciously listen to music, but my playlist would have to have Gary Moore's "Still Got the Blues" or "Let Me Make Something in Your Life."

What was the last book you read?

The Rosie Project. It's about a man who applies a very exact and scientific approach to finding the ideal woman. To do so, he draws up a 16-page questionnaire. As you might expect, no woman gets 100 % and things end up turning out quite differently.

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

Don't spend time thinking about what you're missing, but about what you have!

Dr. Ramona Ecke with doctoral candidates Deng Junwen (l.) and Si Wenping (r.) on the Huangpu River in Shanghai. © Private collection

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