

Fraunhofer Group for Microelectronics Session



J. Pelka
Managing Director
Fraunhofer Group for Microelectronics, Berlin, Germany

Biography

Dr. Joachim Pelka is the Managing Director of the business office for the Fraunhofer Group for Microelectronics. He studied electrical engineering, with an emphasis on semiconductor technology, at Berlin's Technical University and was awarded a doctorate there for his work on semiconductor components. He has been with the Fraunhofer-Gesellschaft since 1983.

Today, following many years in the organization, Dr. Pelka is the Managing Director of the Fraunhofer Group for Microelectronics. His previous position was as the Fraunhofer ISIT's department head responsible for the simulation of semiconductor patterning processes. He also spent two years in the JESSI coordination office (also located at the ISIT). As managing director he is responsible for strategic planning and for the coordination of work in the microelectronic institutes of the Fraunhofer-Gesellschaft.

Under his directorship, the business office carries out studies on current areas of research that form the basis for the Group's strategic planning. In the past, this included for example the "MST fireside chats", a series of workshops conducted on behalf of the project sponsor, Mikrosystemtechnik VDI/VDE IT and a study concerning road mapping activities of microelectronics on behalf of the CATRENE Scientific Committee.

In keeping with deepening European integration, Dr. Pelka today functions more and more as a contact person for other European research facilities such as CEA-Leti, CSEM, IMEC and VTT. He represents the Group, complementing the Chairman of the Group, in the Heterogeneous Technology Alliance HTA.

Dr. Pelka is a member of the ENI2 Steering Committee and the organizational committee of the INC Conference Series. The International Nanotechnology Conference on Communications and Cooperation INC9 held in Berlin in 2012 was organized under his supervision. Currently, he has been focusing on a study named "smart cities" commissioned by the CATRENE Scientific Committee.

Fraunhofer Group for Microelectronics: The strategic core competence "Design for Smart Systems"



P. Schneider
Director
Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS,
Dresden, Germany

Abstract

New types of components from micromechanics, microphotonics, power electronics, and high-frequency technology, as well as modern mixed-signal circuit concepts, are important building blocks when it comes to realizing innovative microelectronic products. The increasing performance of digital circuits also plays an important role. The combination of functional sensor and actuator units with high-performance modules for signal processing and communication allows smart systems to be implemented in a wide spectrum of applications. However, this also leads to particular challenges that must be overcome in the design process. The causes are the functional variety and complexity of the systems and the influence of manufacturing and integration processes on a system's function.

The strategic core competence "Design of smart systems" comprises research, services, and developments

in the area of digital, analog, and mixed-signal systems, including sensors and embedded software. The design competence of the Fraunhofer Group for Microelectronics thus forms the link between technology and the system level. Thanks to the varying focuses of the member institutes, the Group is able to cover a very wide spectrum. The close cooperation and interconnectedness of design activities in the Group for Microelectronics allows us to combine know-how from different areas and to input it into tailor-made system solutions for customers. The expertise of the Group for Microelectronics includes:

- System design for smart systems
- Component design, particularly in the areas of RF, sensors and sensor interfaces, analog front ends, digital SoCs, power electronics, and optics and opto-electronics
- Consideration of special design constraints: Low power, design for reliability, design for functional safety, design for radiation hard devices, and design approaches for harsh environmental conditions
- Development of design tools: Algorithms and design environments as well as models and model libraries

Biography

1993 Diplom-Ingenieur in electrical engineering from Dresden University of Technology

1993 Research scientist at Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS

2000+ Group Manager "Heterogeneous Systems"

2006+ Head of the department "Heterogeneous Systems" at Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS

2010 Ph.D. in Electrical Engineering at TU Dresden

2011+ Director at Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS

Fraunhofer Group for Microelectronics: The strategic core competence "Semiconductor-based technologies"



H. Lakner
Executive Director
Fraunhofer Institute for Photonic Microsystems IPMS, Dresden, Germany

Abstract

There is scarcely a technology sector where global competition is as challenging as in electronic systems. Invisible to the naked eye as they usually are, hidden under the surface of the product, electronic systems with a high degree of complexity must be designed, manufactured, and brought to market in an extremely short period of time and they must work absolutely reliably and energy efficiently. Basic technological research, customer-specific process development, and reliable production are the key to the development of innovative system solutions.

In order to be able to offer a stable process platform as the basis for innovative continued development, the employees of the Fraunhofer Group for Microelectronics work on a shared technology platform. This cooperation takes place under the auspices of the Fraunhofer Institute for Photonic Microsystems IPMS. The strategic core competence "Semiconductor-based technologies" bundles the specialist knowledge of the member institutes in this technology platform - particularly within the area of More-than-Moore technologies, as they are known. The basics are the technologies available at the institutes, such as:

- Si process technology for wafer diameters of 150 and 200 mm
- Individual processes on 300 mm wafer
- Special aspects of 450 mm technology
- MEMS specific add-on technologies
- Development of SiC materials and technology for power electronics
- GaN process technology for power and ultra-high frequency applications

Biography

Hubert Lakner (born in 1958) received his diploma-degree in physics at the Eberhard-Karls-Universität in Tübingen in 1986. After one year in the industry he joined the Gerhard-Mercator-University in Duisburg where he worked in the field of nanocharacterization of mesoscopic semiconductor structures. He received his PhD (Dr.-Ing.) in Electrical Engineering in 1993. From 1994 until September 1998 he was appointed Lead Engineer (»Oberingenieur«) at Gerhard-Mercator-University. His work was focussed on high frequency and high speed circuits based on compound semiconductor heterostructures. From October 1998 until December 2001 he was head of the Department of Micromechanical Sensors and Actuators (a group of 25 employees) at the Fraunhofer Institute for Microelectronic Circuits and Systems (IMS, now IPMS) in Dresden. There, his research fields were Spatial Light Modulators (SLM) like micromirror arrays and scanning micromirrors. From January to December 2002 he was Acting Director of the Fraunhofer Institute for Microelectronic Circuits and Systems IMS in Dresden. Since January 2003 he has been the director of the new Fraunhofer Institute for Photonic Microsystems IPMS which emerged from the former IMS Dresden. At the same time, Dr. Lakner was appointed Professor for »Optoelectronic Devices and Systems« in the Department of Electrical Engineering and Information Technology at the Technical University Dresden. Prof. Dr. Lakner is cochairing the annual international SPIE conference on »Micro Opto Electro Mechanical Systems (MOEMS) and Miniaturized Systems« which is part of Micromachining and Microfabrication at Photonics West. Since January 1st 2011 he has been Chair of the Fraunhofer Group for Microelectronics.

Fraunhofer Group for Microelectronics: The strategic core competence "Power Electronics and System Technologies for Energy Supply"



L. Frey
Executive Director
Fraunhofer Institute for Integrated Systems and Device Technology IISB, Erlangen,
Germany

Abstract

Demand-actuated supply of electrical energy is a globally important issue. In the smart power grid of the future, a large number of energy sources, storage options, and grid levels will be linked together in complex infrastructures. The energy will be used in a very wide range of areas of application and power classes: Largely regenerative, decentralized energy production, high-efficiency sub-grids, and the coupling of electrical energy with other types of energy (chemical, mechanical, thermal) are becoming more and more important. At the same time, electrical and secondary storage options are being more heavily integrated into the grid and load shifting effects are exploited. Large overall systems with a high degree of independence (industry, large building complexes, towns, etc.) need new types of energy concepts.

The Fraunhofer Group for Microelectronics develops high-efficiency systems and components to provide the technology needed for sustainably efficient yet cost-effective energy supply. The strategic core competence "Power Electronics and System Technologies for Energy Supply" bundles the specialist knowledge of the member institutes in the areas of power electronics and information technology for the smart grid as well as energy harvesting, energy storage, and energy management.

In addition to minimizing energy losses and lowering costs, the focus is placed particularly on issues of reliability and robustness as well as increased grid quality and stability. Application-specific optimization of installation space, weight, and material consumption is another aim of the research and development.

Biography

Lothar Frey received the Diploma degree of physics and the Dr. rer. nat. degree in 1983 and 1987, respectively, from the University of Würzburg, Germany. In 1987, he joined Rice University, Houston, for a post-doc position working on new laser sources. In 1989, he returned to Germany to the new Fraunhofer AIS, Erlangen, to build up a group on semiconductor characterization. In 1993, he joined the University of Erlangen-Nuremberg being responsible for the clean room facility of the university and also heading the department of silicon technology of Fraunhofer IIS-B in Erlangen. In 2004 he completed his habilitation (venia legendi) at the University of Erlangen-Nuremberg. During this period, research focused on micro technology for electron devices with special emphasis on ion-beam-based technologies and the introduction of new materials to silicon technology. In 2005, these activities brought him in to Infineon Technology (Qimonda) Dresden. Two years later, he became full professor for applied physics at the Technical University of Freiberg. Since 2008, Lothar Frey is holder of the Chair of Electron Devices (LEB) at the University of Erlangen-Nuremberg and director of the Fraunhofer Institute of Integrated Systems and Device Technology IISB, Erlangen. Current activities cover semiconductor technology and power electronic systems for application in energy supply and mobility.

Fraunhofer Group for Microelectronics: The strategic core competence "Sensors and Sensor Systems"



O. Ambacher
Executive Director
Fraunhofer Institute for Applied Solid State Physics IAF, Freiburg, Germany

Abstract

It's impossible to imagine life today without sensors to determine measured data. Sensors are often directly linked to increasingly sophisticated data processing systems as well as wireless data transmission. These types of sensor systems form the backbone of modern concepts such as home automation, medical engineering, and industrial process monitoring. The demands being placed on them, however, are becoming ever more varied. The normal development path - prototype construction, troubleshooting, and optimization - is often not sufficient to deal with this level of complexity.

The member institutes of the Fraunhofer Group for Microelectronics bundle all the technologies needed for the development of reliable, robust, energy-efficient, yet cost-effective sensor systems in the "Sensors and Sensor Systems" core competence:

- Micro- and nano-sensors, CMOS-compatible sensor processes
- MEMS and NEMS technologies, add-on technologies, system integration (including 3D)
- Transmission systems, RF technologies
- System and application design
- Systems, signal processing, sensor data fusion

This basis allows us to offer our customers tailor-made sensor solutions from a single provider - from design to the finished system, reliability monitoring, and accompanying services.

The presentation will be focused on microelectronics sensory systems dedicated to increase the safety and security critical infrastructures and production lines.

Biography

Dipl.-phys. - 1989 (LMU-Munich); Dr. rer. nat. - 1993 (Technical University Munich); Habilitation - 2000 (Technical University Munich); Professor of Nanotechnology - 2002; Head of the Institute of Solid State Electronics - 2002, Head of the Center of Micro- and Nanotechnologies - 2004 (Technical University Ilmenau); Chair of Compound Microsystems - 2007 (University Freiburg); Head of the Fraunhofer Institute of Applied Solid State Physics - 2007

Oliver Ambacher received his Dipl.-Phys. and Dr. Degrees with honors from the Ludwig-Maximilians and Technical University Munich, in 1989 and 1993, respectively, where he was involved in the deposition and characterization of amorphous silicon for solar cells. In 1992 he received a German Science Foundation Graduate Research Fellowship. In 1993, he joined the Walter Schottky Institute of the TU-Munich to investigate the epitaxial growth of group-III nitrides based heterostructures. Since 1995 the research of his group is focused on fabrication of GaN based devices like UV detectors, surface acoustic wave devices or microwave amplifiers as well as on the understanding of polarization induced effects in group-III nitride heterostructures and quantum wells. 1998/99, he spent one year at Cornell University, Ithaca, NY, as an Alexander von Humboldt fellow, where he was involved in the optimization of polarization induced AlGaIn/GaN HEMTs for high frequency and high power applications. He became a Professor of Nanotechnology and head of the Institute for Solid State Electronics located at the Technical University of Ilmenau in 2002. In 2004 he was elected as head of the new Center of Micro- and Nanotechnologies. Since 2007 he is the head of the Fraunhofer Institute for Applied Solid State Physics and Professor for Compound Microsystems in Freiburg, Germany.

Fraunhofer Group for Microelectronics: The strategic core competence "System Integration Technologies"



K.-D. Lang

Executive Director

Fraunhofer Institute for Reliability and Microintegration IZM, Berlin, Germany

Abstract

The wide-ranging demands placed on the packaging of electronic systems can be summarized in three main trends:

- Customer-specific solutions in increasingly large batch sizes
 - Greater functionality
 - Fusing product and electronics
- In order to maintain existing strengths and to take advantage of new opportunities, close internal cooperation and a merging of technological possibilities are required.
- 3D system integration of digital and analog components on the wafer (use of Si interposers), package (SiP, PoP), and panel (SoF, embedding) levels
 - Comprehensive range of technology for system-in-package on the following levels: wafer, package, panel (incl. flex)
 - Integration of MEMS components, sensor-actuator components and electronics
 - Integration of photonic device and electronics
 - Compact power electronics
 - System integration in atypical materials for electronics (textiles, stretchable substrates)
 - Draft analysis of software-based embedded systems
 - Networking of embedded systems
 - Tool prototypes for integration of embedded systems with multicore processors.

The strategic aim of Fraunhofer Group for Microelectronics is to establish a cross-institute technology platform that will create a critical mass and will focus on Germany's industrial strengths to ensure that a significant part of the value creation can be returned to Germany. The platform concentrates on the following aims:

- Comprehensive range of technology for system-in-package on the following levels: wafer, package, panel with system solutions from a single provider
- 3D system integration of digital and analog components with TSV in active wafers
- Integration of MEMS components and electronics including package with derogations
- Compact power electronics with integrated driver electronics
- Integration of photonic device and electronics
- Online networking of embedded systems with cyber physical systems
- Tool chains for comprehensive integration of embedded multicore systems

Biography

Prof. Lang studied Electrical Engineering from 1976 to 1981 at Humboldt University in Berlin. He received his M.S. Equivalent Diploma (Metallization Layers on GaAs) in 1981. During his employment at Humboldt University from 1981 to 1991 he worked in the research fields of microelectronic assembly, packaging and quality assurance. In 1985 and 1989 he got his two Doctor Degrees (Wire Bonding of Multilayers and Quality Assurance in Assembly Processes).

In 1991 he joined the company SLV Hannover to build up a department for microelectronic and optic components manufacturing.

In 1993 he became Section Manager for Chip Interconnections at Fraunhofer IZM (Institute for Reliability and Microintegration Berlin). From 1995 to 2000 he was the Director's personal assistant at Fraunhofer IZM, also responsible for Marketing and Public Relations.

From 2001 to 2005 he coordinated the Branch Lab "Microsystem Engineering" in Berlin-Adlershof and from 2003 to 2005 he headed the Department "Photonic and Power System Assembly". From 2006 to 2010 he

was Deputy Director of Fraunhofer IZM. Since 2011 he is Director of the institute and responsible for the chair "Nano Interconnect Technologies" at Technical University Berlin.

Prof. Lang is a member of numerous scientific boards and conference committees. Examples are the SEMI Award Committee, the Scientific Advisory Board of EURIPIDES, the Executive Board of VDE-GMM and the scientific chair of the Conference "Technologies of Printed Circuit Boards" and "SMT/HYBRID/PACKAGING". He is a member of DVS, IEEE, IMAPS and he plays an active role in the international packaging community (e.g. German Chapter Chair IEEE-CPMT) as well as in the field of conference organization (e.g. Committee member SSI).

Prof. Lang has authored and co-authored 3 books and more than 130 publications in the field of wire bonding, microelectronic packaging, microsystems technologies, chip on board and others.

Fraunhofer Group for Microelectronics: The strategic core competence "Quality and Reliability"



E. Zschech
Director of Materials and Nanoanalysis Division
Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Dresden, Germany

Abstract

As part of increasing production closeness and the addressing of higher technology readiness levels (TRLs), the investigation of reliability aspects is becoming more important within the Fraunhofer Group for Microelectronics. Reliability is evaluated at different levels of integration, starting from the system and passing over the electronics assembly, the interconnect device, the device itself, and the semiconductor, right up to rewiring and the transistor structures. To assure the quality of electronic systems, the Fraunhofer scientists in the Microelectronics Group are working on coming up with solutions for inspection along the entire added-value chain.

The cross-institute expertise in quality assurance and reliability of materials, devices, assemblies, and systems are multifaceted and are merged together within the strategic core competence "Quality and Reliability" in three central working areas:

- Monitoring and characterization of semiconductor process technology
- Characterization of active and passive devices, MOEMS, and smart systems (SoC)
- Reliability evaluation, test, and service life analysis from the wafer level and the packaging to the overall systems

Biography

Ehrenfried Zschech is Director of Materials and Nanoanalysis Division at Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden, which he joined in 2009. He received his diploma degree in solid-state physics and his Dr. rer. nat. degree from Dresden University of Technology. After having spent four years as a project leader in the field of metal physics and reliability of microelectronics interconnects at Research Institute of Nonferrous Metals in Freiberg, he was appointed as a university teacher for ceramic materials at Freiberg University of Technology. In 1992, he joined the development department at Airbus in Bremen. There he managed the metal physics group and worked on laser-joining metallurgy of light metals. From 1997 to 2009, Ehrenfried Zschech managed the Materials Analysis Department and the Center for Complex Analysis at AMD in Dresden. In this position, he was responsible for the analytical support for process control and technology development, as well as physical failure analysis. His current research interests are in the areas nanomaterials and nanoanalysis, with the focus on thin film technology and nanotechnology. He has published three books and more than 170 papers in scientific journals in the areas of solid-state physics, materials science and reliability engineering. He holds honorary professorships for Nanomaterials at the Brandenburg University of Technology in Cottbus-Senftenberg and for Nanoanalysis at the Dresden University of Technology. Ehrenfried Zschech is acting as Past President of the Federation of European Materials Societies (FEMS).

Fraunhofer Group for Microelectronics: The strategic core competence "RF and Communication Technologies"



P. Schneider
Director

Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS,
Dresden, Germany

Abstract

Information and communication technologies are changing our society significantly in many areas of life and work. As the largest innovation engine in Germany, key technologies of this kind form the basis for new products, processes, and services. Embedded systems comprising hardware and software components are, for example, decisive when it comes to the successes of the strong European sectors of automobile construction and mechanical engineering, energy technology, medical engineering, and safety and security technology.

The networking of the member institutes of the Fraunhofer Group for Microelectronics covers both hardware and software aspects. With the cross-institute technology platform "RF and Communication Technologies" for wireless network solutions, the Group for Microelectronics is pursuing the aim of countering today's heavy, sometimes even extreme, dependency on external suppliers. The shared thematic focuses cover:

- Algorithms for broadband communication (physical layer)
- Broadband communication (upper protocol layers)
- Localization and navigation
- Digital broadcasting
- Adaptive and cognitive transmission technologies
- Radar systems
- Microelectronically realized components (e.g. AD/DA, RF, power amps)
- Broadband signal processing
- Media technologies
- Networking of embedded systems (fields of application: automotive, industry)

At the same time, a range of development aims for highly specialized niche markets are being pursued:

- Cross-layer real-time-capable test beds for LTE applications
- Application-specific extension to the LTE standard (machine type comms)
- Special telemetry (point-to-point/network, long-range, low-power, high data rate)
- Special telemetry (long-range, low-power system solutions for communication in special application fields (Smart Grid, Car2X))
- Platforms for high-rate signal processing
- Broadband networking of embedded systems (including automotive Ethernet/IP)
- SDR-based cognitive radio demonstrators

Biography

1993 Diplom-Ingenieur in electrical engineering from Dresden University of Technology

1993 Research scientist at Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS

2000+ Group Manager "Heterogeneous Systems"

2006+ Head of the department "Heterogeneous Systems" at Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS

2010 Ph.D. in Electrical Engineering at TU Dresden

2011+ Director at Design Automation Division EAS of Fraunhofer Institute for Integrated Circuits IIS