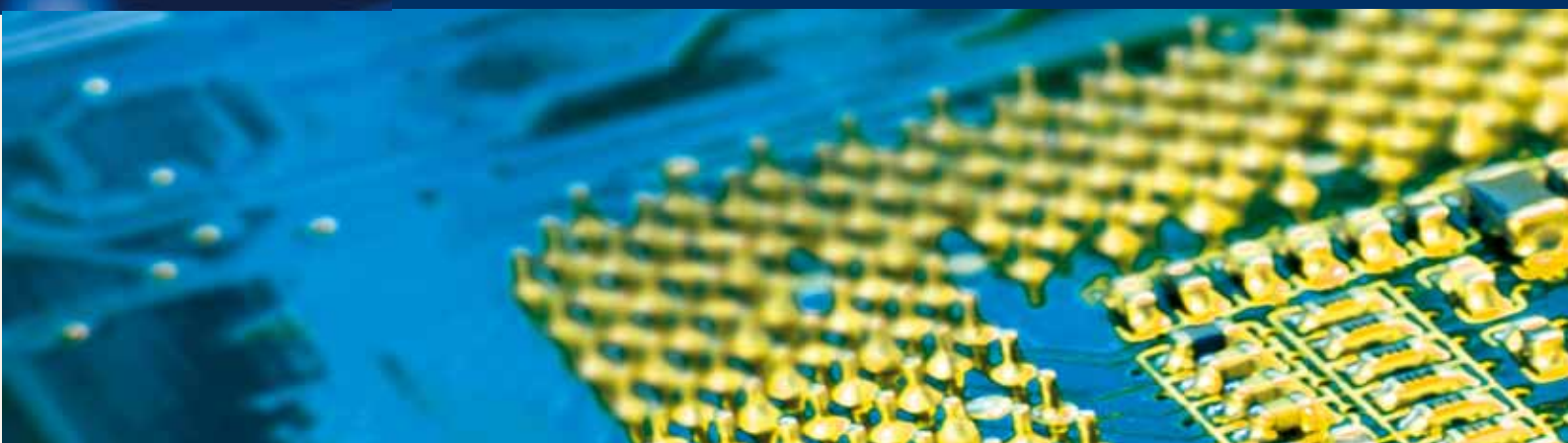
IHP – Innovations for High Performance Microelectronics



IHP - Innovations for High Performance Microelectronics in Frankfurt (Oder) is known for internationally acknowledged research at the highest level. The focus of research at the institute lies in economically relevant issues, resulting in applications for telecommunications, medical engineering, security, aerospace, and automation technologies. The scientists use the high-end technical infrastructure of the Leibniz Institute for basic and application-oriented research.

The academic strength of IHP is visible in numerous scientific contributions to leading international conferences and scientific journals. Through participation in national and international research programs, third-party funds have been increased continuously in recent years. In addition, more and more partners from all over the world use the services of IHP for the preparation of prototypes and small series.

IHP serves as a bridge institution between industry and academia. This is particularly noticeable in the specific concept of “Joint Labs” that combines research at the IHP with academic research and training of students on international and regional level, focused on the region Berlin-Brandenburg.

We invite you to get to know IHP and its services and we are looking forward to welcome you personally in our institute.

Yours sincerely,

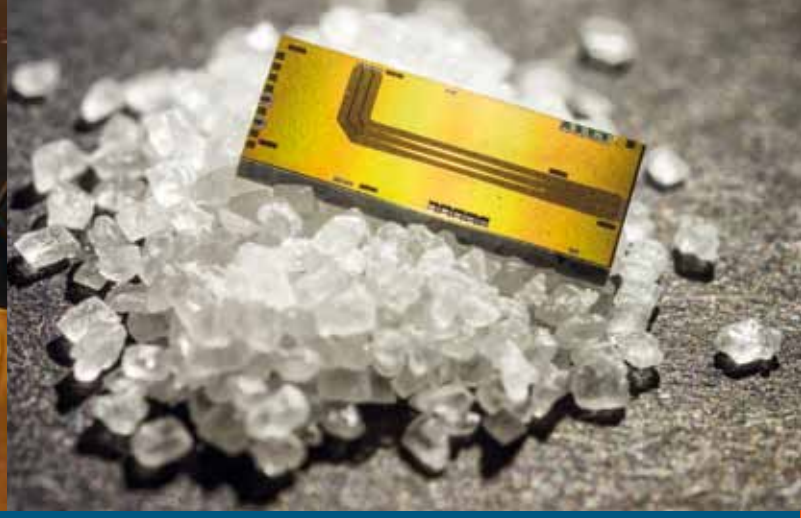
Prof. Dr. Bernd Tillack
Scientific Director

The Exchange of Information is the Motor of Today's World

It seems as if the world is spinning at an ever-increasing pace. Distances are shrinking, moments become shorter.

We observe how the Philae lander touches down on a comet, 510 million kilometres away from Earth. We take our holiday pictures with smartphones and may receive automatically coordinate information and descriptions of what we saw. We share our experiences online with friends and the whole world. Information technology is ever-present. Constantly. Everywhere. Television, telephones, computers and internet are our constant companions. We are an integral part of the world and are continuously aware of what makes the other parts move.

A life without this rapid flow of information is no longer imaginable. We depend on the exchange of information for our daily routines, at work, and in our leisure time. Rapid connectivity worldwide and with our immediate surroundings is essential for us.



We Research and Develop Wireless Communication Technologies

To send photos and videos lightning fast or to communicate with people at the other end of the world - the mobile internet connects people everywhere and allows the exchange of information at all times. Wireless and broadband communication enables high-speed data paths for an increasing amount of data. IHP is researching and developing silicon-based systems, highest-frequency integrated circuits, and special technologies for these purposes.

The research at IHP is structured vertically. The departments System Design, Circuit Design, Technology, and Materials Research represent competences at various levels of the added-value chain and work together on projects in the framework of a uniform strategy.

One particular strength of the IHP is the realization of prototypes and small series with the fast SiGe BiCMOS technologies in IHP's pilot line.

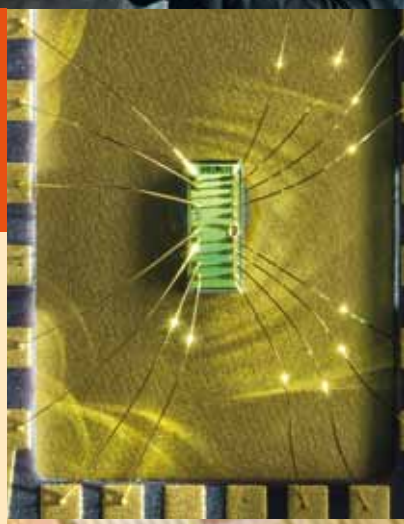
A long-term goal of the institute is to increase operating frequencies into the terahertz range, from the development and integration of innovative components and integrated circuits to the demonstration of systems and their applications.

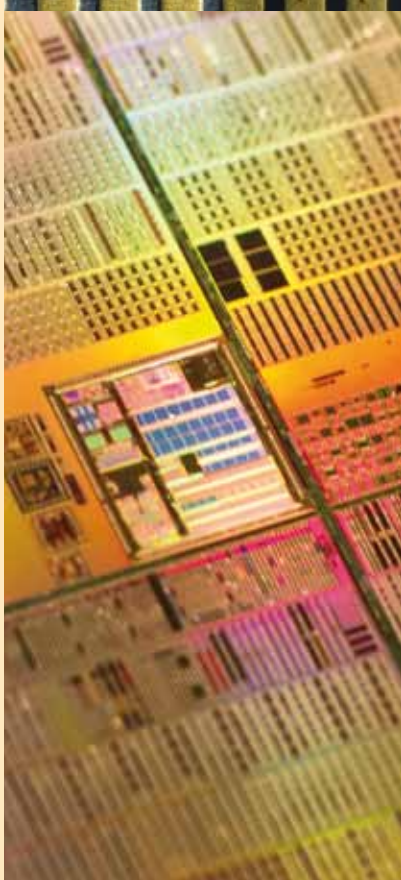
People, Facts and Figures

Semiconductor research has a long history in Frankfurt (Oder). IHP was founded in the city in 1983. In 1991 it was re-established as a non-university institute in the legal form of a limited liability corporation (GmbH) and included in the so-called “Blaue Liste”, today known as the Leibniz Association.

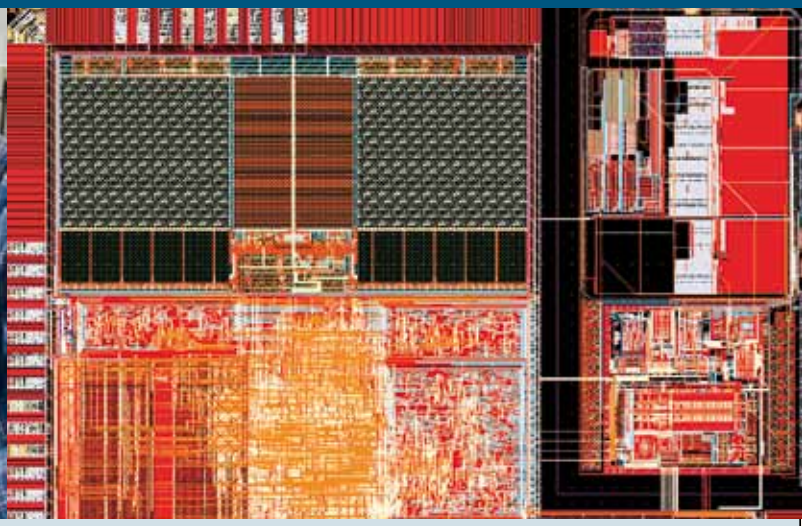
In 1999 a new institute building was constructed in the Technologiepark Ostbrandenburg. It has more than 12.000 m² of utilizable space and a 1.000 m² class 1 clean-room with a full pilot line. Because of the strong increase in the number of employees due to the many research projects, an extension was built in 2013. More than 300 people from over 20 different countries are employed at the institute. Of these, about the half are scientists, primarily engineers and physicists. The Scientific Director is Professor Bernd Tillack. Manfred Stöcker is the Administrative Director.

IHP receives annual institutional grants of more than 29 million Euros, provided equally by the Federal Republic of Germany and the State of Brandenburg. In addition, the institute obtains funding from national and European research programs and from its cooperation with industrial partners. The extent of this funding has been increasing for many years and has clearly exceeded the mark of 14 million Euros in 2016. Within the framework of investment projects promoted by ERDF (European Regional Development Fund) the institute has been able to modernize and adapt its infrastructure to the requirements of state-of-the-art research projects at the highest level.





High Performance Wireless – We're Working on It

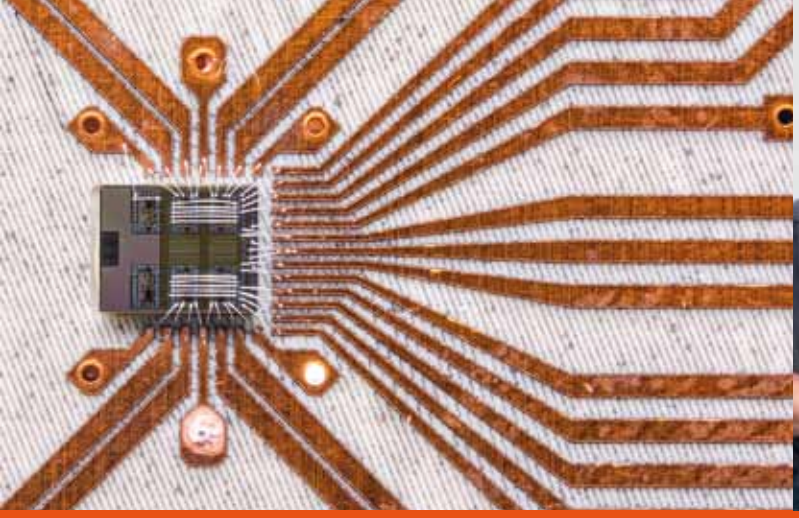


System Design

Large volumes of information are becoming accessible in any place, all the time. This requires faster, more reliable, and secure wireless transmission systems, which consume little energy. That is why scientists at IHP are working on systems by which data volumes of more than 100 gigabits per second can be transferred wirelessly over short distances. With this technology, it is possible to load a complete Blu-ray disc on a mobile device within a few seconds. In the long run, this comes down to researching the limits of the achievable rate of transmission.

Other applications, for instance sensor networks, demand devices with an extremely low energy consumption, where batteries should not require changing for years. Here we are working on intelligent methods for minimizing energy consumption at all levels, from the software to the hardware and from the system to the technology.

To obtain broad user acceptance, wireless transmission must be secure and reliable. That is why we are constantly working on further improvement of our already powerful security processors and we adapt our systems to new technologies and methods of attack.



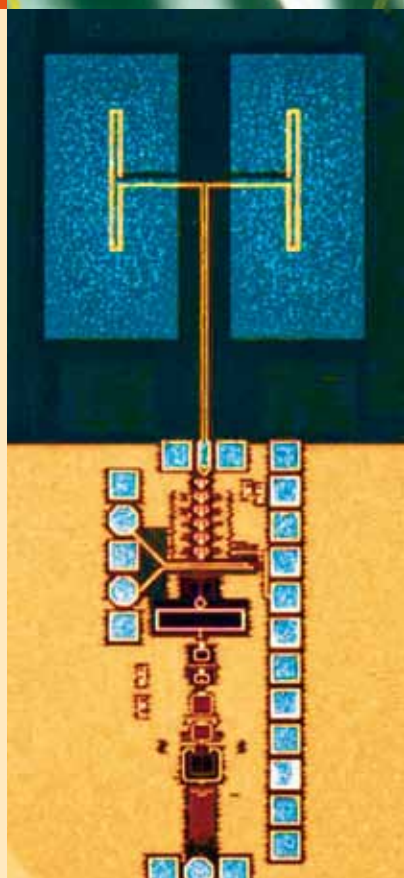
High-Frequency Integrated Circuits as the Key to New Systems

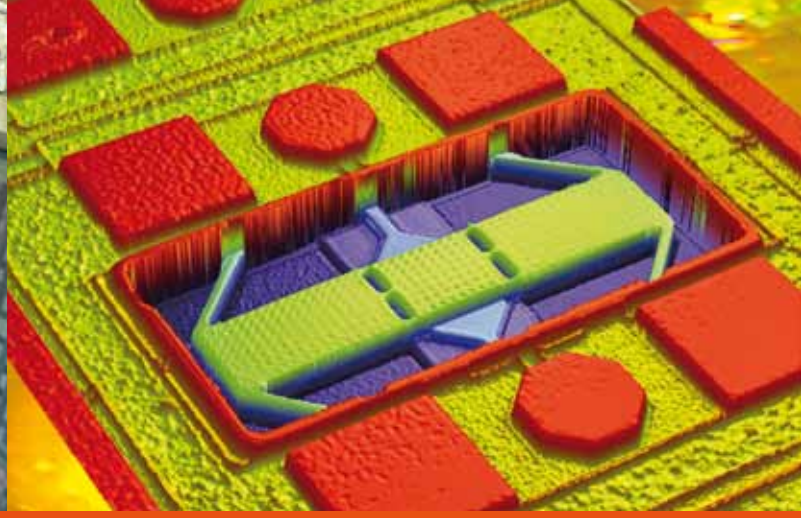
Circuit Design

Analog circuits with highest frequencies, highest data rates, and low power dissipation are the key to new systems for IHP. In order to realize future high-precision non-contact detection of surroundings and transmissions with very high data rates, transmitter and receiver circuits with frequencies of 60 GHz to over 500 GHz are currently being developed. Innovatively designed RF-sensors also work in this frequency range and will be applied in industrial automation and biomedical technology.

Data transmission via glass fiber is the backbone of communication in the internet and in big data processing centers. The constantly rising amount of data requires ever faster circuits for ever higher transmission rates. Based on the silicon photonics technology of IHP, circuits for complex optical modulation techniques with data rates up to 400 gigabits per second are currently being developed.

Battery-powered, wireless communications systems are continuously being integrated into living und industrial environments. This trend will be supported by the development of energy-efficient and thus battery-saving radio circuits.





“More than Moore”– Technology Research for High Frequencies and High Functionality

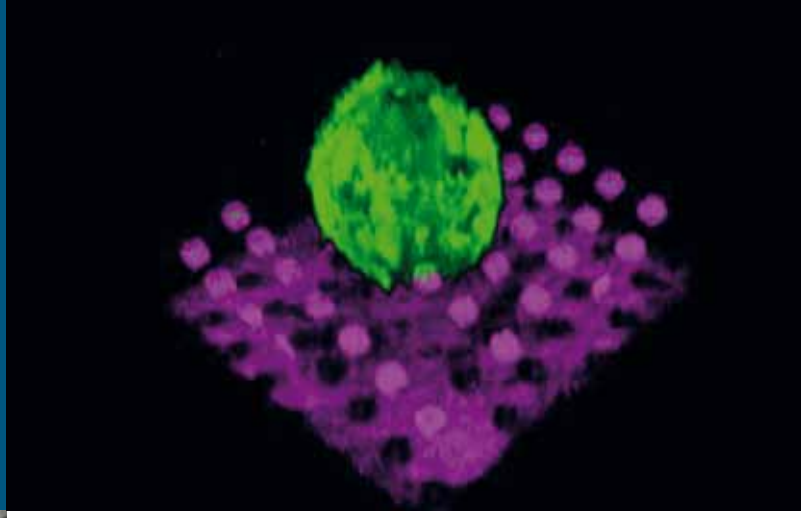
Technology

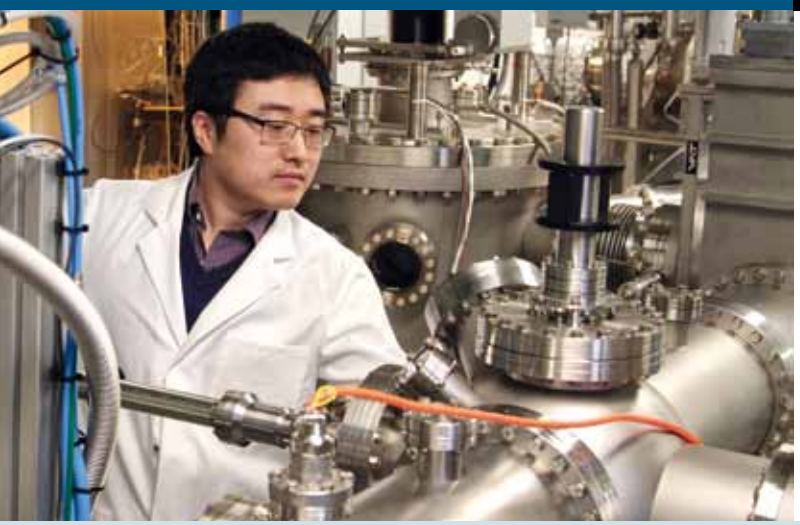
The continuous scaling of the devices as well as the integration of new devices for multiple functionalities are the main driving forces for the new research and developments in semiconductor technologies. IHP’s main technology competence is on the latter topic, which is also well known as the concept “More than Moore”.

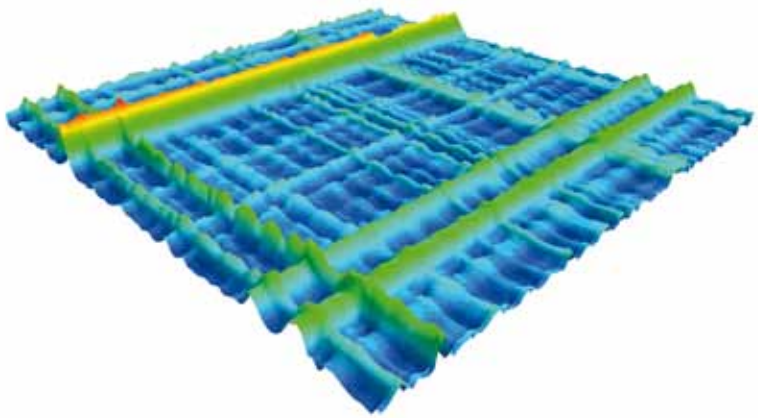
The technological developments mainly focus on integration of devices with higher frequencies up to the terahertz range, e.g. SiGe-heterobipolar transistors reaching fmax of 720 GHz, as well as new functional devices as microelectromechanical systems (MEMS), microfluidic channels, and the integration of optical and electro-optical components in silicon together with high frequency SiGe transistors.

IHP’s 200 mm pilot line with 0.25 and 0.13 µm SiGe BiCMOS technologies is jointly used for many different technological developments, numerous research projects and as a MPW (Multi-Project-Wafer) service for partners requiring the highest performance for low number of units.

The Integration of New Materials Overcomes Limits





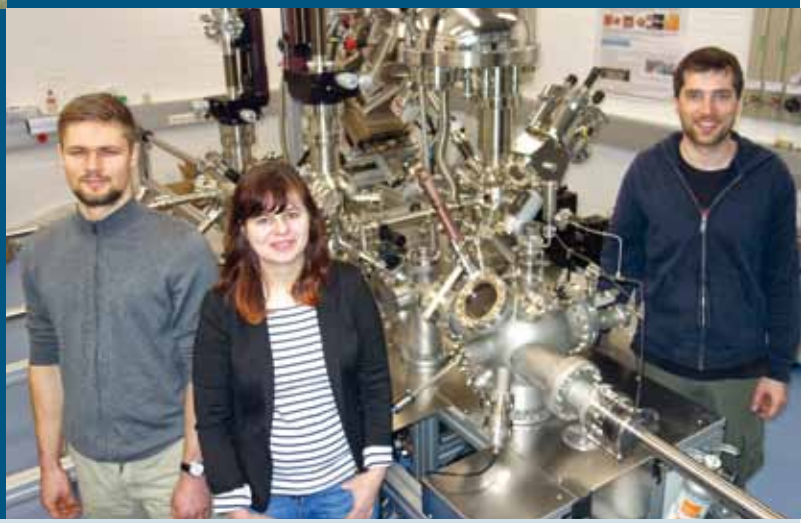


Materials Research

Modern materials research for a high functional „More than Moore“ silicon microelectronics forms the cornerstone of the activities. They deal with aspects of basic physical research to rate early the potential of new materials (e.g. 2D materials) with regard to future applications. In addition test modules are realised and researched in close collaboration with other IHP departments for a statistic evaluation of future component concepts.

For handling this wide range, modern methods of growth, processing as well as characterisation of materials with a high precision right up to the atomic scale are used. To overcome limitations in the nano-materials-characterisation they use modern synchroton methods.

The main emphasis is on materials for the future group IV photonics, THz applications as well as functional sensors. Another main issue is the support of partners from universities and industry.

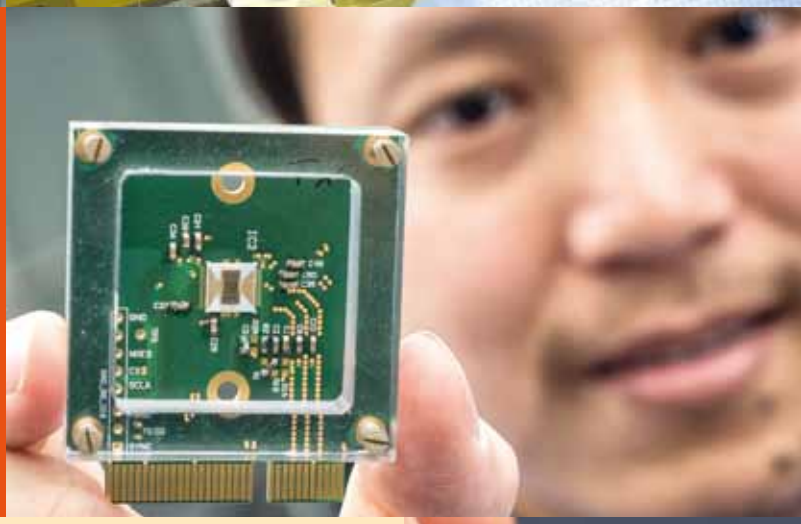


Joint Labs

Joint Labs create a bridge between the research at the institute and the education and research at universities and colleges. Capabilities are combined through close cooperation with regional academic institutions and selected international partners. Each Joint Lab is working on specific, future-oriented research topics. As part of the cooperation IHP is involved in the training of future specialists, in particular in the region Berlin-Brandenburg.

Since 2000, this successful concept is constantly evolving. Currently, there are regional cooperations with the Brandenburg Technical University Cottbus-Senftenberg, the Technical University of Applied Sciences Wildau, the Technical University of Berlin, the Humboldt University of Berlin, and the University of Potsdam.

The first international Joint Labs started in 2014. The theme of the Joint Lab with the Technical University of Poznań is „Połączyć – Interfacing – Verbinden“. It is the basis for joint research activities in the field of modern materials research for silicon microelectronics. The Joint Lab with the Sabancı University in Istanbul is focused on the exploration and development of integrated circuits, components, MEMS (Microelectromechanical Systems), NEMS (Nanoelectromechanical Systems), and micro / nano electronics.



Cooperations and Services

IHP is an important and reliable partner for businesses. Cooperations range from the support of regional companies to the use of IHP know-how by small and medium-sized companies, to joint ventures with major corporations in the framework of bilateral contracts or national or European joint research projects.

The institute is an attractive partner for the education of high school and university students, offering lectures and internships as well as and jointly conducted bachelor, master, and doctoral theses.

Research results as technologies, circuit and system solutions are available for transfer to industry. Since 2015, this is the business area of the 100 percent owned subsidiary of IHP called IHP Solutions GmbH. It acts as commercial and market-oriented interface for customers to IHP and of its research results. In addition, IHP provides services such as the manufacturing of small series in the pilot line with its fast SiGe BiCMOS technology through MPW and prototyping. The utilization of technological steps as well as analysis and high-frequency measurement is also offered.

innovations
for high
performance
microelectronics

IHP GmbH – Innovations
for High Performance
Microelectronics / Leibniz-Institut
für innovative Mikroelektronik
Im Technologiepark 25
15236 Frankfurt (Oder)

Telefon +49 335 5625 0
Fax +49 335 5625 300
ihp@ihp-microelectronics.com
www.ihp-microelectronics.com

10 / 2017

Konzeption & Design: Giraffe Werbeagentur
Fotos: Creative Collection, Fotolia, Pleul und Schweizer

Leibniz Association

Forschungsfabrik Mikroelektronik Deutschland

Fraunhofer Group for Microelectronics in cooperation with the Leibniz institutes IHP and FBH