

PRESS RELEASE

PRESS RELEASE

June 4, 2021 || Page 1 | 3

Terahertz technologies for visionary innovations in communications and sensor technology

In the recently launched joint project "T-KOS" of the Research Fab Microelectronics Germany (FMD), terahertz technology is now to be developed synergistically for industry in the fields of communication and sensor technology for the first time. Innovative system solutions in both areas can make a significant contribution to the successful implementation of future issues such as digitalization, Industry 4.0 or resource efficiency and thus strengthen Germany as a business location in the long term. In the project, Fraunhofer IPMS is working on high-frequency front-end solutions from 60 - 500 GHz as well as an energy-efficient AI accelerator based on in-memory computing.

In our digitalized, high-tech world of life and work, the availability of communications and data connections is a basic requirement. The increasing mobility of users, the flexible use of broadband multimedia content (e.g., entertainment, medicine, logistics), and future technologies such as the Internet of Things or autonomous driving are increasing both the volume of data in mobile networks and the demands on the communications networks themselves. One promising option for increasing data capacity and usable bandwidth is the additional use of terahertz technologies. This forms the basis for innovation not only in the area of radio systems, but also in the area of non-destructive testing (NDT). Terahertz waves can penetrate most electrically non-conductive materials, such as ceramics or plastics, in a similar way to ultrasound and X-rays, but they operate without a coupling medium and require neither complex mechanical guidance nor radiation protection measures because, unlike X-rays, they are harmless to the human organism.

Although terahertz radiation is predestined for a wide range of applications, for example in security technology, quality assurance or materials testing, industrial introduction has so far failed due to the lack of availability of inexpensive, fast and high-resolution systems with optimized, AI-based image recognition

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algorithms. This is where "T-KOS", initiated by FMD and funded with 10 million euros by the Federal Ministry of Education and Research (BMBF), comes in.

PRESS RELEASE

June 4, 2021 || Page 2 | 3

Using synergies to enable innovations

In the joint project "T-KOS", which started on May 1, 2021, a total of nine cooperation partners of FMD are working together with Fraunhofer ITWM to synergistically develop terahertz technology for wireless radio transmission, non-destructive testing technology, spectroscopy, and non-contact inline measurement technology. To this end, the technological competencies for communication and sensor technology distributed in the FMD are being brought together and expanded by know-how in the area of signal processing in order to be able to offer industrial customers innovative system solutions. During the one-year project period, various demonstrators will be developed that address the future fields of high-frequency electronics, terahertz photonics and wireless, high-bit-rate communication.

Dr. Dirk Nüßler, project leader and deputy director of Fraunhofer FHR, explains, "The overall project goals are to establish a German value chain to terahertz wireless links, e.g. for high-bit-rate communication in industrial production, inline monitoring of production processes with AI-based, real-time imaging processing for resource-efficient production, and first-of-its-kind industrial-grade terahertz communication and sensor technology by combining scalable electronic and photonic concepts."

To achieve these project goals, the project is organized along three parallel development strands that are interconnected at key points. "For the development strands terahertz photonics, terahertz line scan camera and terahertz communication, various demonstrators can be realized within the comparatively short project duration of 12 months, which go far beyond the

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current state of the art," explains Prof. Björn Globisch, group leader at Fraunhofer HHI and professor for "Terahertz Sensor Technology" at TU Berlin.

PRESS RELEASE

June 4, 2021 || Page 3 | 3

Dr. Andreas Grimm, technology park manager for compound semiconductors at FMD concludes: "The existing collaboration within FMD has been the basis for the project development, so we are delighted that the BMBF funding will give us the opportunity for the first time to leverage the synergies of terahertz technology and make an offer to industry for various applications."

Fraunhofer IPMS in the T-KOS project: RF front-end solutions and efficient AI accelerators

In the project, Fraunhofer IPMS is dedicated to RF/millimeter-wave front-end solutions with high output power in the frequency range of 60-500 GHz. On the other hand, energy-efficient AI accelerators based on in-memory computing are designed in technology nodes such as 28 nm HKMG as well as 22 nm FDSOI. In T-KOS, building on already developed transceiver systems at 240 GHz and 480 GHz in SiGe BiCMOS technology, a solution for near 300 GHz with increased transmit power dynamics is being developed in the front-end area. Furthermore, an FPGA implementation is being developed as a precursor to an in-memory computing ASIC core to establish an optimal bitwise computing architecture for radar data classification requirements.

About project T-KOS

In the joint project "T-KOS", the nine cooperation partners of FMD, Fraunhofer ENAS, HHI, FHR, IAF, IMS, IPMS and IZM as well as Leibniz FBH and IHP work together with Fraunhofer ITWM. The project is funded by the German Federal Ministry of Research and Education (BMBF) (grant numbers 16KIS1404K, 16KIS1405 and 16KIS1406).

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PRESS RELEASE

June 4, 2021 || Page 4 | 3



T-KOS

**Terahertz-Technologien für
Kommunikation und Sensorik**

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