

Research into Terahertz Signals and Friction-optimized Metals

Christian Koos and Christian Greiner of KIT Receive ERC Consolidator Grants



Christian Koos (left) and Christian Greiner (right) are awarded ERC Consolidator Grants. (Photos: Laila Tkotz/KIT)

At Karlsruhe Institute of Technology (KIT), Professor Christian Koos combines photonic and electronic methods to generate terahertz signals and to make them usable for data transmission and measurements. Dr. Christian Greiner studies the behavior of metals in friction contacts in order to reduce friction and wear and, thus, decrease the consumption of energy and raw materials. The European Research Council (ERC) has now decided to award Consolidator Grants to both scientists. In the next five years, their projects will be funded with about EUR 2 million each.

Ultrarapid wireless communication at data transmission rates of up to 1 terabit per second and highly precise signal processing for medical imaging, non-destructive materials testing, or security technology – these are examples of potential applications of concepts developed under the **TeraSHAPE** project. At the Institute of Photonics and Quantum Electronics (IPQ) of KIT, scientists of the team of **Professor Christian Koos** combine photonic and electronic methods to gener-

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ate and detect electromagnetic signals with bandwidths in the terahertz range. In the electromagnetic spectrum, terahertz radiation is located between microwaves and infrared radiation. The TeraSHAPE (Terahertz Waveform Synthesis and Analysis Using Hybrid Photonic-Electronic Circuits) project focuses on frequencies between 100 gigahertz and 1 terahertz (1000 gigahertz). Researchers use optical frequency combs together with highly parallelized signal processing in digital electronic circuits for the precise synthesis and analysis of waveforms in the optical range. For conversion of these optical signals into terahertz waveforms, the researchers developed new concepts of electro-optical modulators and plasmonic photodetectors with bandwidths of hundreds of gigahertz.

Since 2010, Christian Koos has been professor at KIT. Since 2013, he has been heading the Institute of Photonics and Quantum Electronics (IPQ) and has been Member of the Board of the Institute of Microstructure Technology (IMT). Since 2012, he has been Coordinator and Spokesperson of the Helmholtz International Research School for Teratronics (HIRST). For his research on nanophotonics and optical data transmission, he was granted an ERC Starting Grant in 2011, the Alfried Krupp Prize for Young University Teachers in 2012, and the State Research Award of Baden-Württemberg in 2014.

Friction and wear are responsible for one third of the energy consumed in traffic and substantially influence the service lives of many products. To reduce consumption of energy and raw materials, it is indispensable to develop friction-optimized metal alloys. **Dr. Christian Greiner** and his team study how the microstructure of materials changes under so-called tribological loading. Tribological loading occurs when components are in contact with and move relatively to each other. The Institute for Applied Materials – Computational Materials Science (IAM-CMS) of KIT and the MicroTribology Center μ TC, a joint initiative of KIT and the Fraunhofer Institute for Mechanics of Materials (IWM), provide an ideal environment for this research. Within the framework of the **TriboKey** (Deformation Mechanisms Are the Key to Understanding and Tailoring Tribological Behavior) project, the team of Christian Greiner studies deformation processes of various alloys under friction loading and the resulting structural changes inside the metals. Using a unique approach, they couple friction experiments with non-destructive testing methods, data science algorithms, as well as high-resolution electron microscopy. The project is aimed at defining guidelines for the development of materials with tailored friction and wear behavior.

Since 2010, Christian Greiner has been conducting research at KIT. Since 2013, he has been heading the Emmy Noether Research

Group “Materials Tribology – Materials under Tribological Loading” at IAM-CMS. In 2015, he was granted the status “KIT Associate Fellow” for excellent young scientists. Among others, he received the Masing Memorial Prize of the Deutsche Gesellschaft für Materialkunde (DGM, Association for Materials Science and Engineering) in 2015 and the Lecturer Award of the Federation of European Materials Societies (FEMS) in 2014.

The ERC 2017 Consolidator Grant

With the Consolidator Grant, the European Research Council funds projects of excellent scientists with 7 to 12 years of experience since completion of their doctorates, whose independent research teams are in the consolidation phase. In 2017, the ERC awarded Consolidator Grants in the total amount of EUR 630 million to 329 projects. 2583 proposals had been submitted. The approval rate, hence, is 13%.

Being “The Research University in the Helmholtz Association,” KIT creates and imparts knowledge for the society and the environment. It is the objective to make significant contributions to the global challenges in the fields of energy, mobility and information. For this, about 9,300 employees cooperate in a broad range of disciplines in natural sciences, engineering sciences, economics, and the humanities and social sciences. KIT prepares its 26,000 students for responsible tasks in society, industry, and science by offering research-based study programs. Innovation efforts at KIT build a bridge between important scientific findings and their application for the benefit of society, economic prosperity, and the preservation of our natural basis of life.

Since 2010, the KIT has been certified as a family-friendly university.

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