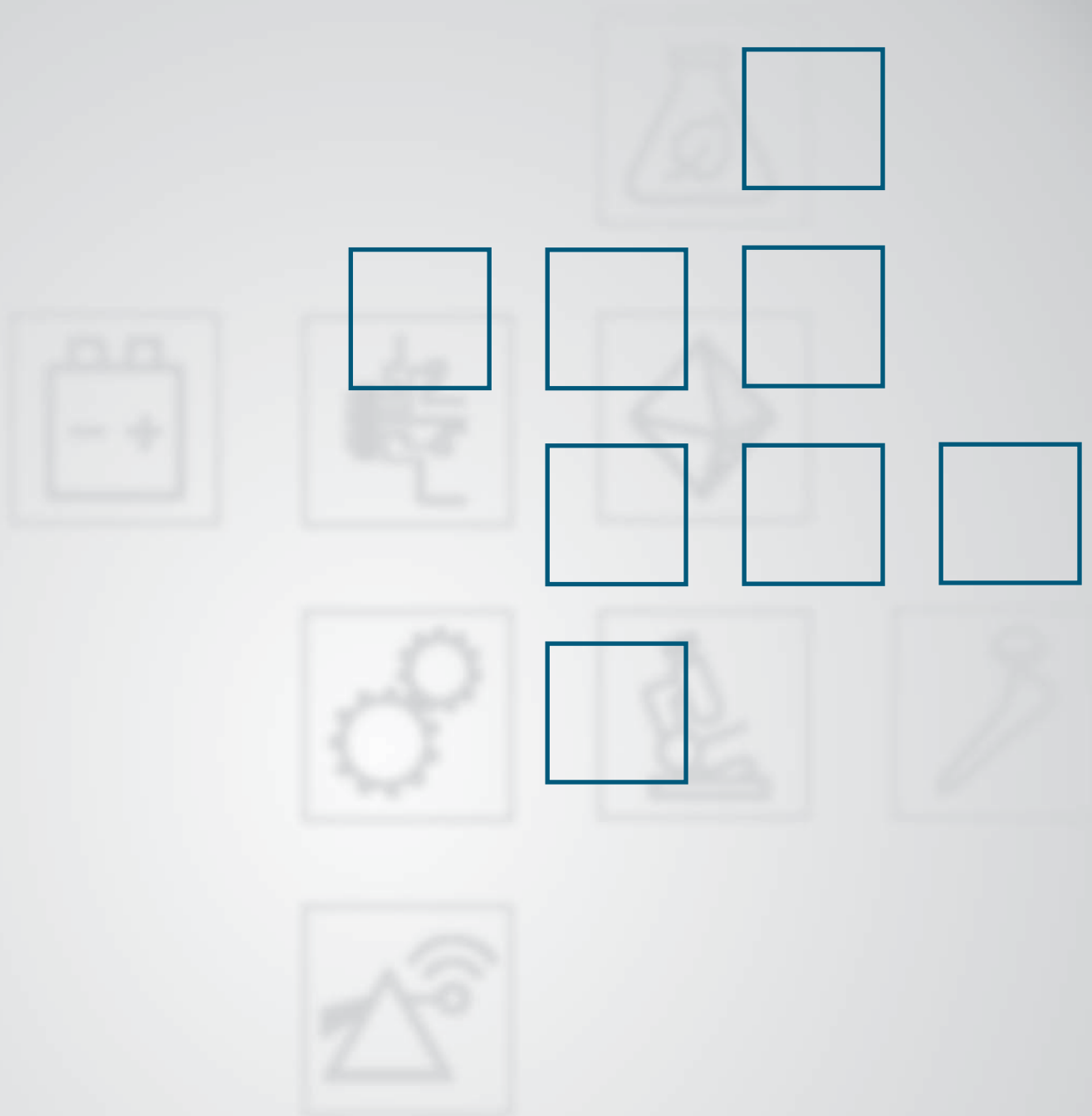


FRAUNHOFER IKTS IN PROFILE



PORTRAIT

FRAUNHOFER IKTS IN PROFILE

The Fraunhofer Institute for Ceramic Technologies and Systems IKTS covers the field of advanced ceramics from basic preliminary research through to the entire range of applications. Superbly equipped laboratories and technical facilities covering 30,000 m² of useable space have been set up for this purpose at the sites in Dresden and Hermsdorf.

Based on comprehensive materials expertise in advanced ceramic materials, the institute's development work covers the entire value creation chain, all the way to prototype production. Fraunhofer IKTS forms a triad of materials, technology and systems expertise, which is enhanced by the highest level of extensive materials diagnostics. Chemists, physicists, materials scientists and engineers work together on an interdisciplinary basis at IKTS. All tasks are supported by highly skilled technicians.

The focus is placed on manufacturers and especially existing and potential users of ceramics as project partners and customers. Fraunhofer IKTS operates in eight market-oriented divisions in order to demonstrate and qualify ceramic technologies and components for new industries, new product ideas, new markets outside the traditional areas of use. These include the conventional Materials and Processes, Mechanical and Automotive Engineering, Electronics and Microsystems, Energy, Environmental and Process Engineering, Bio- and Medical Technology, Optics as well as Materials and Process Analysis. The Institute is therefore available as a competent consulting partner and starting point for all ceramics-related issues: a real "one stop shop" for ceramics.

Among our unique areas of expertise, we offer:

End-to-end production lines: from starting materials to prototypes

For any class of ceramic materials, we have access to all the standard processes of raw materials preparation, forming, heat treatment and finish processing. Where it makes sense, the institute can even conduct phase synthesis. In functional ceramics, we hold a particular core competency in paste and film technology. Multiple clean rooms and low-contamination production areas are kept at the ready, among other things, for multilayer ceramics and highly purified oxide ceramics lines of technology.

Multi-scale development

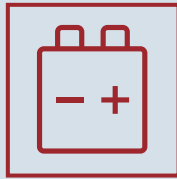
Fraunhofer IKTS can convert developments from the lab into the technical standard. There is industrially suited equipment and machinery of the latest designs available for all relevant lines of technology, in order for partners and customers to realize the prototypes and pilot-production series needed for market launch, to develop production processes, and to implement quality processes. Thus, residual cost risks and time to market can be minimized.

Synergies between materials and technologies

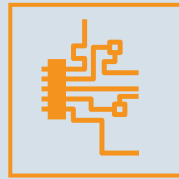
The combination of differing technology platforms, of functional and structural ceramics for example, allows for multi-functional components and systems that intelligently exploit ceramic properties. This enables the production of innovative products with markedly added value at low cost.

Competent analysis and quality assessment

High-performance analysis and quality control are a decisive factor for market acceptance of products, especially in ceramic production processes. Since we understand materials as well as ceramic production processes at a fundamental level, while at the same time master the drafting and integration of complex physical testing systems, we can offer our customers



Energy



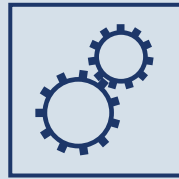
Electronics and
Microsystems



Environmental and
Process Engineering



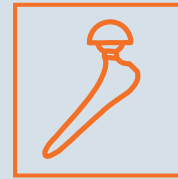
Materials and
Processes



Mechanical and Auto-
motive Engineering



Materials and
Process Analysis



Bio- and Medical
Technology



Optics

unique solutions for materials issues in production and quality monitoring.

Network creator

We are currently associated with over 450 national and international partners in our ongoing projects. In addition, Fraunhofer IKTS is active in numerous alliances and networks. Within the Fraunhofer-Gesellschaft, for example, we work with the Fraunhofer Group for Materials and Components. Furthermore, Fraunhofer IKTS serves as the spokesperson for the Fraunhofer AdvanCer Alliance, which consists of four institutes that specialize specifically in ceramics. We are in a position to support the development of networks that are needed to develop successful processes, and also to convey and to integrate expertise that goes beyond our own abilities. Our efforts on the front lines of research are based on a wealth of experience and knowledge acquired over many years, which is geared toward our partners' interests.

Standardized management for sustainable quality assurance

Quality, traceability, transparency and sustainability: to us, these are our most important tools for setting ourselves apart from the competition. The IKTS therefore administers a standardized management system per DIN EN ISO 9001, as well as an environmental management system in accordance with DIN EN ISO 14001. Furthermore, each site of the institute is certified according to additional guidelines, including the German Medical Devices Act, and is regularly subjected to a variety of industrial audits.

CORE COMPETENCIES

MATERIALS AND SEMI-FINISHED PARTS

STRUCTURAL CERAMICS

- Oxide ceramics
- Non-oxide ceramics
- Hard metals and cermets
- Powders and suspensions
- Polymer ceramics
- Fiber composites
- Composite materials
- Ceramic foams

FUNCTIONAL CERAMICS

- Non-conducting materials
- Dielectrics
- Semiconductors
- Ion conductors
- Magnets
- Pastes and tapes
- Solders, brazes and glass sealings
- Precursor-based inks and nanoinks
- Composites

ENVIRONMENTAL AND PROCESS ENGINEERING

- Substrates**
 - Granulates
 - Plates
 - Tubes
 - Capillaries
 - Hollow fibers
 - Honeycombs
 - Foams
- Membranes and filters**
 - Oxides, non-oxides
 - Zeolites, carbon
 - MOF, ZIF, composites
 - Ion and mixed conductors
- Catalysts**
 - Oxides
 - Metals, CNT

RAW MATERIAL AND PROCESS ANALYSIS, MATERIALS DIAGNOSTICS

- Analysis and evaluation of raw materials**
 - Analysis of particles, suspensions and granulates
 - Chemical analysis
- In-process characterization in ceramic technology**
 - Characterization
 - Process simulation and design
 - Quality management

- Characterized materials**
 - Steel, non-ferrous metals
 - Ceramics, concrete
 - Materials of semiconductor industry
 - Plastics, composite materials (GFRP and CFRP)
 - Biomaterials and tissues

Process design, process monitoring

TECHNOLOGY

COMPONENTS AND SYSTEMS

Powder technology
Shaping
Heat treatment and sintering
Final machining
Precursor technology

Fiber technology
Additive manufacturing
Pilot production and upscaling
Coating technology
Joining technology

Component design
Prototype production
Wear-resistant components
Tools

Optical components
Heating systems
Medical device technology and implants
Filters

Thick-film technology
Multilayers
- HTCC, LTCC
Aerosol and inkjet printing

Thin-film technology
Electrochemical machining
Galvanics

System definition and plant development
Modeling and simulation
Design and prototype production

Validation/CE marking
Test stand construction
Support in field tests

Materials separation
- Filtration
- Pervaporation
- Vapor permeation
- Gas separation
- Membrane extraction
Catalysis

Biomass technology
- Preparation
- Conversion
Photocatalysis
Chemical process engineering

Samples and prototypes
- Membranes, filters
- Membrane modules
- Membrane plants
Filtration tests
- Laboratory, pilot, field
- Piloting

Modeling and simulation
- Material transport
- Heat transport
- Reaction
Reactor development
Plant design

Material and component characterization
- Microstructure and phases
- Mechanical and physical properties
- High-temperature properties
- Corrosion

Component and system behavior
- Damage analysis
- Failure mechanisms
- Measurement and simulation of component behavior
- Testing in accordance with certified and non-certified standards

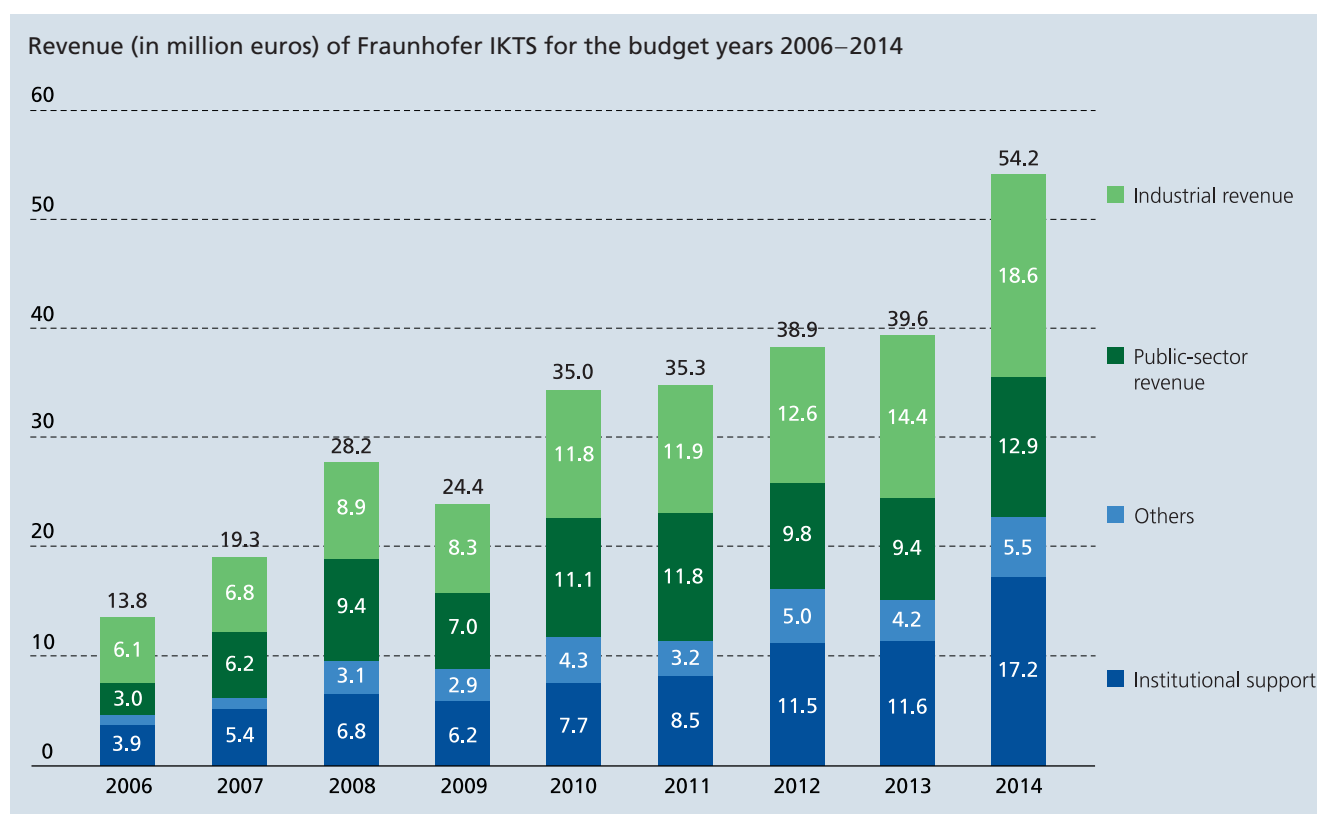
Technologies
- Micro- and nanoanalytics
- Ultrasonic testing
- High-frequency eddy current
- Optical methods
- X-ray methods

Components, systems and services
- Sensors and sensor networks
- Testing heads and systems
- Structural health monitoring
- Data analysis and simulation
- Biomedical sensor systems
- Testing in accordance with certified and non-certified standards

Component behavior, reliability analysis, lifetime and quality management, calibration

FRAUNHOFER IKTS IN FIGURES

FRAUNHOFER IKTS IN PROFILE



Operating budget and revenue

Due to both the organic growth of the cost centers and the integration of the former Fraunhofer IZfP Dresden, the overall operating budget of Fraunhofer IKTS has increased by 14.7 million euros to a total of 54.2 million euros.

The volume divides into 50.1 million euros for the operating budget itself and 4.1 million euros for investment budget. The largest sums are allocated to the IKTS on Winterbergstrasse with an operating budget of 26.3 million euros and an investment budget of 2.9 million euros. In the first joint budget year, the IKTS in Dresden-Klotzsche made a considerable contribution to the costs, overproportionally to its profit share, with 13 million euros operating budget and 1.1 million

euros investment budget. Appropriate actions were initiated here. Regarding an independently considered, balanced budget, the IKTS in Hermsdorf contributed to the operating budget with 10.8 million euros and to the investment budget with 0.1 million euros. Further substantial resources for equipment in Hermsdorf were provided as part of the new research building and the battery pilot plant, which are not included here.



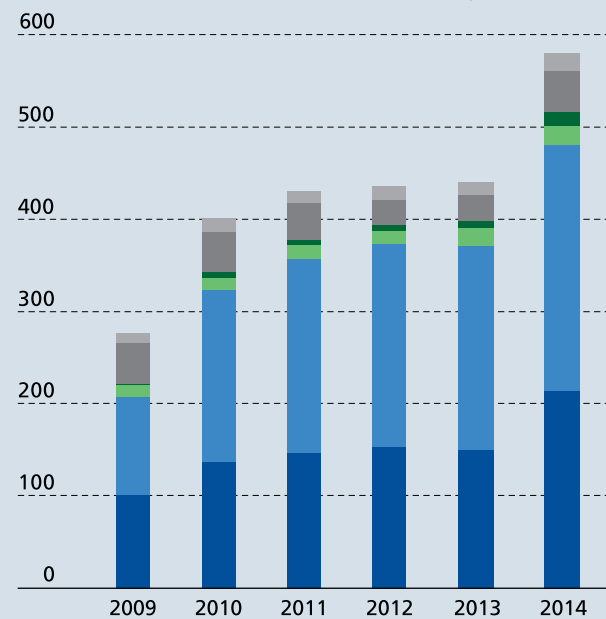
Staff development

The staff level reached a new maximum with 138 new full-time positions. Altogether 64 additional scientific employees strength-en the Fraunhofer IKTS team. Furthermore, 20 scientists currently work on the completion of their PhD theses. Hence, the amount of scientists achieved with 40 % the level, which existed before the integration of Hermsdorf. Another focus was placed on technical and administrative jobs with 19 apprentices.

Expansion of the research basis

The enhancement of the research field Materials Diagnostics due to the integration is a unique chance for ceramics research and the IKTS industry partners. The access to the system experts was prepared by integration projects. The year 2014 was represented by the premise of qualifying personnel and equipment. Further efforts are necessary here because the specific material properties cannot be sufficiently analyzed with the existing methods. New processes and their application fields as well as the testing automation in ceramic manufacturing were focal points of 2014 and are further enhanced in 2015 in the context of industry 4.0.

Personnel developments at Fraunhofer IKTS
 Number of employees 2009–2014, full-time equivalents
 Personnel structure on December 31 of each year



	2009	2010	2011	2012	2013	2014
■	9	15	13	16	14	19
■	45	43	40	27	28	44
■	2	6	6	5	8	16
■	13	13	14	15	19	20
■	106	187	211	221	223	267
■	101	137	147	154	150	214
=	276	401	431	438	442	580

- Apprentices
- Student workers, trainees, undergraduate students
- Part-time and contract workers
- PhD candidates
- Employees with university degrees and technicians
- Scientists

1 Institute management of IKTS, f.l.t.r.:
 Prof. Michael Stelzer, Dr. Christian Wunderlich,
 Prof. Alexander Michaelis, Dr. Michael Zins,
 Dr. Ingolf Voigt.

ORGANIZATIONAL CHART

FRAUNHOFER IKTS

FRAUNHOFER IKTS IN PROFILE

Institute Director

Prof. Dr. habil. Alexander Michaelis

Deputy Institute Director / Head of Administration

Dr. Michael Zins

Deputy Institute Director / Marketing and Strategy

Prof. Dr. Michael Stelter, Dr. Bärbel Voigtsberger

Deputy Institute Director

Dr. Ingolf Voigt

Deputy Institute Director

Dr. Christian Wunderlich

Materials

Nonoxide Ceramics

Dipl.-Krist. Jörg Adler

Nitride Ceramics and Structural Ceramics
with Electrical Function

Carbide Ceramics and Filter Ceramics

Oxide Ceramics

Dr. Isabel Kinski

Materials Synthesis and Development

Pilot Manufacturing of High-Purity Ceramics

Oxide and Polymerceramic Composites

Processes and Components

Dr. Hagen Klemm

Powder Technology

Shaping

Component Development

Finishing

Process Technology and Silicate Ceramics

Sintering and Characterization / Non-Destructive Testing

Dr. habil. Mathias Herrmann

Thermal Analysis and Thermal Physics*

Heat Treatment

Ceramography and Phase Analysis

Environmental and Process Engineering

Nanoporous Membranes

Dr. Hannes Richter

Zeolite Membranes and Nano-Composites

Carbon-Based Membranes

Membrane Prototypes

High-Temperature Separation and Catalysis

Dr. Ralf Kriegel

High-Temperature Membranes and Storages

High-Temperature Separation

Catalysis and Materials Synthesis

Biomass Technologies and Membrane Process Engineering

Dr. Burkhardt Faßauer

Biomass Conversion and Water Technology

Mixing Processes and Reactor Optimization

Membrane Process Technology and Modeling

Technical Electrolysis and Geothermal Energy

Chemical Engineering and Electrochemistry

Dr. Matthias Jahn

Modeling and Simulation

Process Systems Engineering

Electrochemistry

Technische Universität Dresden

ifWW – Inorganic-Nonmetallic Materials
IAVT – Electronic Packaging Laboratory
DCN – Dresden Center for Nanoanalysis

Friedrich-Schiller University Jena

Technical Environmental Chemistry

Prof. Dr. habil. Alexander Michaelis
Prof. Dr. habil. Norbert Meyendorf
Prof. Dr. habil. Ehrenfried Zschech

Prof. Dr. Michael Stelter

Powder and Suspension Characterization*
Quality Assurance Laboratory*, Mechanics Laboratory
Chemical and Structural Analysis
Hard Metals and Cermets
Accredited Test Lab* * accredited according to DIN EN ISO/IEC 17025

Electronics and Microsystems Engineering

Smart Materials and Systems

Dr.-Ing. Holger Neubert

Multifunctional Materials and Components
Appl. Material Mechanics & Solid-State Transducers
Systems for Condition Monitoring

Energy Systems / Bio- and Medical Technology

Materials and Components

Dr. Mihails Kusnezoff

Joining Technology
High-Temperature Membranes and Storage Materials
Ceramic Energy Converters
Materials MCFC

System Integration and Technology Transfer

Dr. Roland Weidl

System Concepts
Validation
Mobile Energy Storage Systems
Stationary Energy Storage Systems
Thin-Film Technologies

Bio- and Nanotechnology

Dr. Jörg Opitz

Bio- and Nanosensors
Acoustical Diagnostics
Optical Coherence Tomography
Bio-Nanotechnology Application Lab

Hybrid Microsystems

Dr. Uwe Partsch

Thick-Film Technology and Photovoltaics
Microsystems, LTCC and HTCC
Functional Materials for Hybrid Microsystems
Systems Integration and Electronic Packaging
Technical Center Renewable Energy HOT
Ceramic Tapes

Testing of Electronics and Optical Methods

Dr. Mike Röllig

Optical Test Methods and Nanosensors
Speckle-Based Methods
Reliability of Microsystems

Systems for Testing and Analysis

Jun.-Prof. Henning Heuer

Electronics for Testing Systems
Software for Testing Systems
Eddy Current Methods
Ultrasonic Sensors and Methods

Microelectronic Materials and Nanoanalysis

Prof. Dr. habil. Ehrenfried Zschech

Micro- and Nanoanalysis
Materials and Reliability for Microelectronics

Project Group Berlin

Prof. Dr. habil. Norbert Meyendorf

BOARD OF TRUSTEES

FRAUNHOFER IKTS IN PROFILE

The President of the Fraunhofer-Gesellschaft has appointed the following people to the board of trustees at Fraunhofer IKTS:

Dipl.-Ing. R. Fetter

Thuringian Ministry of Economy, Science and the Digital Society
Department 5 / 54

Dr. habil. M. Gude

Thuringian Ministry for the Environment, Energy and Nature Conservation
Head of Department Energy and Climate

Dr. P. Heilmann

arxes Information Design Berlin GmbH
Manager

A. Heller

Landrat of the Saale-Holzland region

Prof. Dr. C. Kaps

Bauhaus University Weimar
Chair of Building Chemistry

Dr. W. Köck

PLANSEE SE, Reutte
Executive Director

A. Krey

State Development Corporation of Thuringia (LEG), Erfurt
CEO

Dr. R. Lenk

CeramTec GmbH, Plochingen
Head Service Center Development

Dr. C. Lesniak

ESK Ceramics GmbH & Co. KG, Kempten
Vice President Technology and Innovation

Dr. H.-H. Matthias

Tridelta GmbH, Hermsdorf
Managing Director

Dr. R. Metzler

Rauschert GmbH, Judenbach-Heinersdorf
Managing Director

Dipl.-Ing. P. G. Nothnagel

Saxony Economic Development Corporation, Dresden
Managing Director

Dipl.-Ing. M. Philipps

Endress+Hauser GmbH & Co. KG, Maulburg
Head of Business Division Sensor Technology

Dr.-Ing. W. Rossner

Siemens AG, München
Head of Central Department Technology, Ceramics

Dr. K. R. Sprung

German Federation of Industrial Research Associations
"Otto von Guericke", Berlin
CEO

Dr. K.-H. Stegemann

X-FAB Dresden GmbH & Co. KG
Manager Business Development

Dr. D. Stenkamp

TÜV Nord AG, Hannover
Board of Management

MR C. Zimmer-Conrad

Saxon State Ministry for Economic Affairs, Labour and Transport
Head of Technology Policy and Technology Funding Department

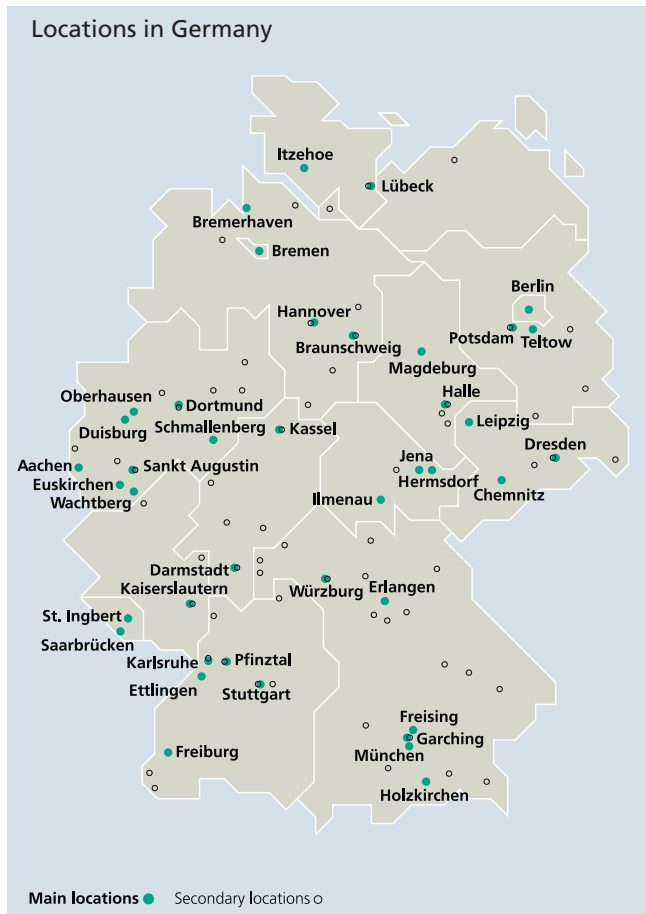
THE FRAUNHOFER-GESELLSCHAFT

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 66 institutes and research units. The majority of the more than 24,000 staff are qualified scientists and engineers, who work with an annual research budget of more than 2 billion euros. Of this sum, more than 1.7 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and *Länder* governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.



As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.