Fraunhofer
ICT

FRAUNHOFER INSTITUTE FOR CHEMICAL TECHNOLOGY ICT

ANNUAL REPORT 2016/2017

EDITORIAL NOTES

Editors
Dr. Stefan Tröster
Alexandra Wolf

Layout
Alexandra Wolf

Translation
Carolyn Fisher
Johanna Houkes

Printed by
Kraft Premium GmbH, Karlsruhe

Editorial deadline
01/2017

Photo acknowledgements
Title and pages 5/6: Peter Eich
Pages 15, 30, 31, 37 bottom right: W. Mayrhofer
Page 37 top left: Wolfram Scheible
Page 37 center left: Volker Steger
Page 37 top right and center right: Mona Rothweiler
Page 37 bottom left: Andy Barbaric

Contact

Fraunhofer-Institut für Chemische Technologie ICT
Joseph-von-Fraunhofer-Strasse 7
76327 Pfinztal
Germany

Phone +49 721 4640-0
Fax +49 721 4640-111
info@ict.fraunhofer.de

www.ict.fraunhofer.de

ANNUAL REPORT
2016/2017

ENERGY TRANSITION AT FRAUNHOFER ICT
CONNECTION OF A WIND ENERGY PLANT TO THE INSTITUTE'S ELECTRICITY GRID, AND TO A LARGE-SCALE BATTERY

With the aim of local, cost-effective and environmentally friendly energy storage, Fraunhofer ICT has been working for several years on the RedoxWind project, which is funded by the federal government and the State of Baden-Württemberg. Our wind power plant (two megawatts) has been in operation since spring 2017. It will ensure an efficient supply of electricity to the institute through a direct connection to our grid. Our applied research activity means that we operate numerous testing units and processes on an industrial scale. In addition, over 500 office work stations and numerous laboratories require an energy supply. Our base load is between 400 and 600 kW, and on "normal" weekdays a peak load of over one megawatt is reached.

The wind energy not required in the institute's grid is fed into a new, large-scale battery which we developed in collaboration with regional industrial partners. The interaction between the wind energy plant, the integrated lithium-ion battery and the institute´s grid (including consumers and the large-scale redox-flow battery) is investigated and evaluated scientifically in the current RedoxWind project. Alongside our scientific interest in the combination of individual components and systems we, and the funding authorities, are especially concerned with its transferability to a commercial context. As the energy consumption in our institute is equivalent to that of a municipality, we are already testing the energy transition on a small scale. The knowledge obtained through operating these systems at our site is essential for their nationwide implementation. In the coming years we will implement and enhance further technologies on our campus and test their market viability. Through our "self-experiment", we aim to increase public understanding of these technologies, to ensure that the energy transition remains affordable for consumers, and to modernize our site with cutting-edge equipment.

In this annual report you can find out more about the range of topics we've been working on over the past year. I hope you enjoy reading it. Please feel free to contact me or my colleagues at any time.

With best wishes

CONTENTS

INSTITUTE PROFILE

In 1959 the Fraunhofer Institute for Chemical Technology ICT was founded as the seventh of the 69 institutes and 11 additional research institutions that currently make up the Fraunhofer-Gesellschaft. The Fraunhofer-Gesellschaft is Europe's largest research organization, with around 24,500 employees and a total turnover of 2.1 billion euros. At Fraunhofer ICT's main site in Pfinztal, near Karlsruhe, approximately 540 employees carry out research and development work in the fields of energy, chemistry, process engineering, environmental technology, polymer technology, and explosive technology. The Project Group for New Drive Systems NAS in Karlsruhe has grown to more than 25 employees. With our support, an institution working on microsystem technology, ICT-IMM in Mainz, has become part of the Fraunhofer-Gesellschaft and currently has nearly 100 employees.

Around 73 percent of our revenues come from contract research for commercial companies as well as publicly-funded research projects. The remainder is financed through institutional funding provided by the German federal and state governments. We work on issues that will become relevant to the economy and to society in five to ten years from now.

The total area of the institute in Pfinztal has increased to 210,000 m². Our infrastructure has also been expanded. We commissioned additional pilot plants, laboratories, workshops, test stands, and offices, which means that we currently have over 27,300 m² of cutting-edge infrastructure. Pilot plants make up more than half of this area. Our high-volume pilot plants and industrial-scale equipment enables us to develop and implement new materials, processes and products up to near-industrial level. In addition, we currently have approximately 70 chemistry and physics laboratories equipped according to the latest developments in safety and energy technology, as well as all the analysis and testing procedures necessary for our fields of research.

Our clients and project partners are mostly from the automotive and transport sectors, as well as the fields of energy, environment, defense, security, chemistry and process engineering.

Our security research

We are the only explosives research institute in Germany to offer the entire spectrum from laboratory testing and technical processing through to fully developed systems. We have many years of experience with energetic materials, for example solid rocket propellants, gun propellants or high explosives, and have been a research partner of the German Defense Ministry since the institute was founded 58 years ago.

Aerial view of
Fraunhofer ICT, Pfinztal

ADVISORY BOARD

Dr. Wolfgang Böttger
Dynamit Nobel Defence GmbH, Burbach

Dr.-Ing. Thomas Czirwitzky
Deutsch-Französisches Forschungsinstitut Saint-Louis, Weil am Rhein

Wolf-Gerd Dieffenbacher
DIEFFENBACHER GmbH + Co. KG, Eppingen

Achim Friedl
Federal Ministry of the Interior, Berlin

Dr.-Ing. Axel Homburg
Honorary Chairman

Brigadegeneral Erich Könen
Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support, Koblenz

Dr.-Ing. Guido Kurth
Bayern-Chemie GmbH, Aschau am Inn

Prof. Dr.-Ing. Detlef Löhe
KIT Karlsruhe, Chairman of the Advisory Board

Kay Nehm
Federal Prosecutor General (retired)

Wolf-Rüdiger Petereit
Neuwied

Prof. Dr.-Ing. Stefan Schlechtriem
German Aerospace Center (DLR), Institute of Space Propulsion, Hardthausen a.K.

Dipl.-Kfm. Jörg Schneider
WERIT Kunststoffwerke W. Schneider GmbH, Altenkirchen

MD'in Dr. Simone Schwanitz
Ministry of Science, Research and the Arts Baden-Württemberg, Stuttgart

MinR Norbert M. Weber
Federal Ministry of Defense, Bonn

MinR Dr. Joachim Wekerle
Ministry of Finance and Economics Baden-Württemberg, Stuttgart

Dr. Hans-Ulrich Wiese
Gräfelfing

MinR Dr. Stefan Wimbauer
Bavarian Ministry of Economic Affairs and Media, Energy and Technology, Munich

Dr. Tobias Wirtz
Premium Aerotech GmbH, Augsburg

Beate Zika-Beyerlein
ElringKlinger Abschirmtechnik (Schweiz) AG, Sevelen, Schweiz

Dr.-Ing. Michael Zürn
Daimler AG, Sindelfingen

ORGANIZATION CHART

Director

Prof. Dr.-Ing. Peter Elsner
Phone +49 721 4640 401
peter.elsner@ict.fraunhofer.de

Deputy Directors

Dipl.-Phys. Wilhelm Eckl
Head of Energetic Systems Department

Prof. Dr.-Ing. Frank Henning
Head of Polymer Engineering Department

Administration

Dr. Bernd Hefer
Phone +49 721 4640 125
bernd.hefer@ict.fraunhofer.de

Energetic Materials

Dr. Stefan Löbbecke
Phone +49 721 4640-230
stefan.loebbecke@ict.fraunhofer.de

General Management

Dr. Stefan Tröster
Phone +49 721 4640 392
stefan.troester@ict.fraunhofer.de

Energetic Systems

Dipl.-Phys. Wilhelm Eckl
Phone +49 721 4640-355
wilhelm.eckl@ict.fraunhofer.de

Dipl.-Phys. Gesa Langer
Phone +49 721 4640-317
gesa.langer@ict.fraunhofer.de

Applied Electrochemistry

Prof. Dr. Jens Tübke
Phone +49 721 4640-343
jens.tuebke@ict.fraunhofer.de

Project Group for New Drive Systems NAS, Karlsruhe

Dr.-Ing. Hans-Peter Kollmeier
Phone +49 721 9150 3811
hans-peter.kollmeier@ict.fraunhofer.de

Polymer Engineering

Prof. Dr.-Ing. Frank Henning
Phone +49 721 4640-420
frank.henning@ict.fraunhofer.de

Fraunhofer ICT-IMM Institute for Microtechnology Mainz

Prof. Dr. Michael Maskos
Phone +49 6131 990 100
michael.maskos@imm.fraunhofer.de

Environmental Engineering

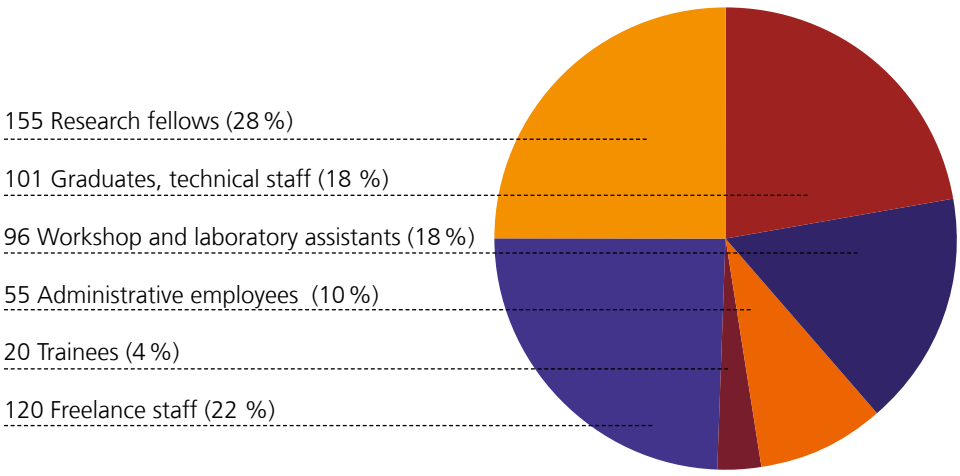
Dipl.-Chem. Rainer Schweppe
Phone +49 721 4640-173
rainer.schweppe@ict.fraunhofer.de

ECONOMIC DEVELOPMENT

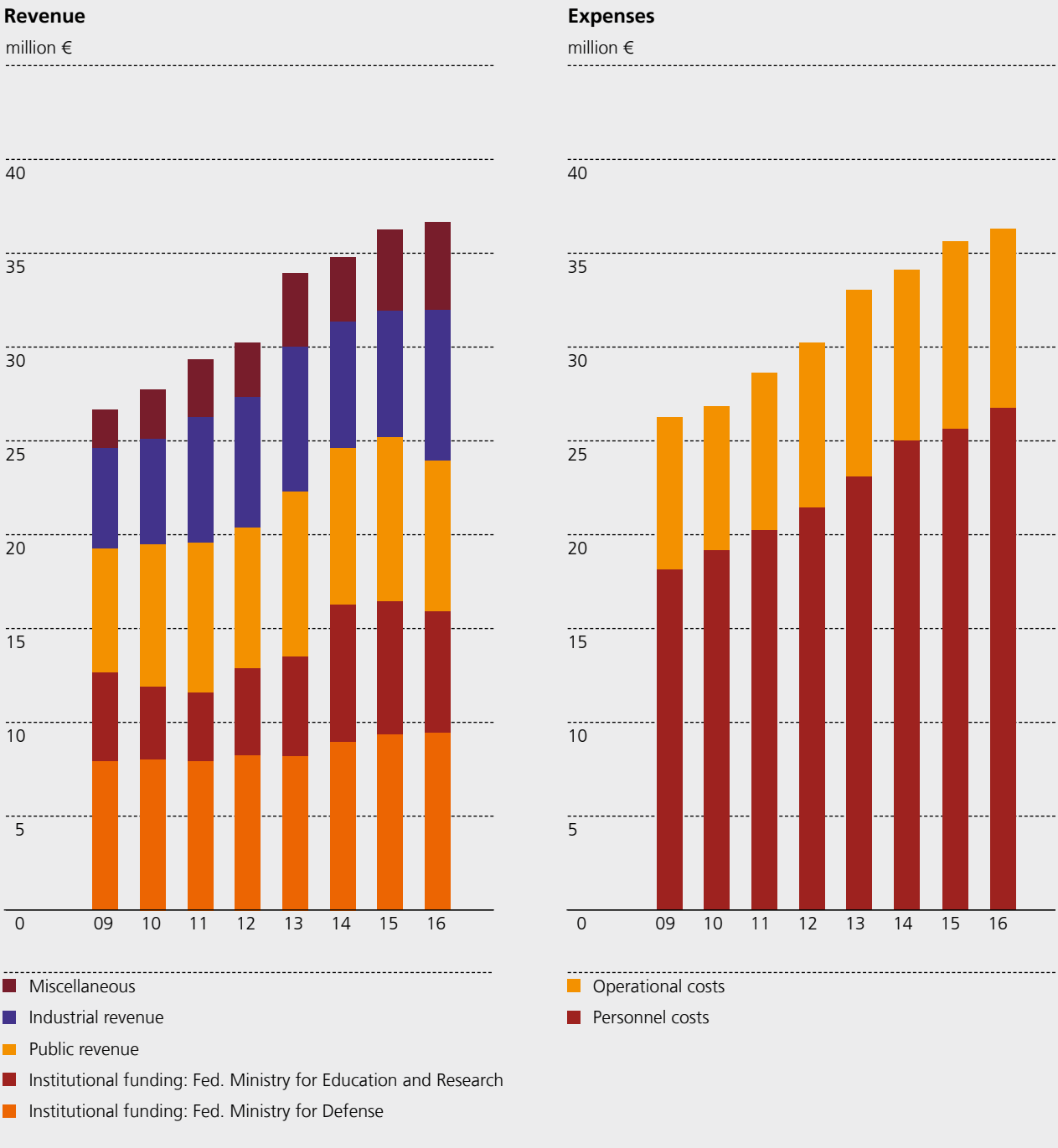
Mirroring the German economy in general, we had a successful year in 2016. In particular our industrial revenues increased significantly, to over eight million euros. This is an increase of approximately 20 percent compared to the previous year. Our revenues from publicly-funded projects decreased slightly to just under eight million euros. This is a result of increasing competition and oversubscription to funding programs, which lowers the prospects of success. Our "defense budget" was nearly 9.5 million euros. The demand for our expertise in this research area remains stable, at the same level as in the previous year. All in all, our revenues are slightly higher than our expenditure, which means that once again we broke even. We financed our new wind energy plant ourselves, to the tune of about three million euros. This was an investment of almost all the institutional funding we had saved over the past years.

Our staff remained constant in 2016. Fraunhofer ICT has approximately 400 employees, 120 external staff (primarily students) and 20 trainees.

Workforce structure of Fraunhofer ICT: Status December 31, 2016.



Financial development of Fraunhofer ICT, 2009 to 2016.



CORE COMPETENCE CHEMICAL AND ENVIRONMENTAL ENGINEERING

The core competence "Chemical and Environmental Engineering" is concerned with the capacity to design and implement novel, resource-efficient chemical processes, from the laboratory to the technical scale. It covers the entire process chain from raw material processing, chemical engineering and downstream processing (e.g. purification and separation technologies) through to subsequent process steps such as product refinement (e.g. crystallization and particle technology) and shaping (e.g. formulation and compounding).

Target parameters of chemical process design and process optimization include product quality, safety, cost-effectiveness and sustainability. Where the processes of fine and specialty chemistry are concerned, high selectivities and yields must be achieved, and specific properties obtained in the target product.

In the search for a cost-effective process, energy-efficient and resource-saving technologies are key topics of research. However, sustainability also requires the minimization of waste streams, the reuse of material fractions and the application of renewable raw material sources.

At Fraunhofer ICT we meet all these requirements through the development of modern process technologies. A successful approach often involves a paradigm shift from discontinuous to continuous processing. For example, continuous processing involving micro chemical engineering is a key element in process design and intensification. It enables processing in new processing windows (for example high temperatures, high pressures, high concentrations, short reaction times) that are difficult or impossible to achieve using classical methods, and in which chemical reaction processes can be optimized from a technical and economic perspective. These are often synthesis steps used in the production of precursors or products in the field of fine and specialty chemistry.

A considerable part of our work is exclusive, commissioned by industrial customers. In addition, continuous processing is being systematically extended to further processing steps and new application fields. These include in particular the intensification of downstream processing (e.g. extraction, purification, phase separation), the size-controlled production of nanoparticles and microcapsules, the development of environmentally-friendly catalytic processes and electrochemical syntheses, and the intensification of multiphase reaction processes (gaseous/liquid, liquid/liquid).

An important tool in process design is cutting-edge process analysis techniques, some of which have been developed in-house. We are currently achieving particularly significant progress in the development and adaptation of rapid spectroscopic and calorimetric process analysis. We can use this to monitor chemical processes with a high temporal and spatial resolution. The techniques often reveal kinetic, mechanical and safety-related data for optimized process design.

Parallel screening of reaction parameters during process optimization of high-pressure reactions.


REACTOR
INFELD

Inside a high-pressure cell during CO_2 extraction.

Our comprehensive know-how in the field of explosive technology means that we have advanced competences in the safe design and operation of hazardous processes (explosive or toxic). In the development of high-pressure processes we also benefit from our long-standing experience in the processing of supercritical fluids (for example supercritical CO_2 or supercritical water). In terms of process safety and stability, tailored process monitoring and control is a core element of our development work. Our capacity to scale up synthesis and increase throughput in multipurpose, mini plant and pilot units developed in-house means that we can prepare larger quantities of substances for testing, and examine safety and economic aspects using realistic operating parameters and scales.

To enable the use of renewable raw materials we develop biorefinery processes and evaluate them from a bioeconomic perspective. Considerable progress has been achieved here in the past few years, especially in the process-controlled flow of solid suspensions in the high-pressure processing of sustainable raw materials. Particularly from an economic perspective, emphasis has been placed on achieving a balance between reasonable particle size and the energy required for comminution, particularly concerning the influence on product distribution and yield. Biogas processes for energy storage complete the bioeconomic activities of Fraunhofer ICT.

The biorefinery processes at Fraunhofer ICT include the feed materials wood, natural fats and oils, carbohydrates, and other biomass materials which do not compete with food production. The products of these chemical reactions form completely new platforms for a range of useful chemicals, such as aromatic and aliphatic secondary products for industrial use. Various processes for the synthesis of platform chemicals from sustainable raw materials have already been produced on a mini-plant scale.

The economical downstream processing of the product streams is also often a frequent point of interest in the development of biorefinery concepts. We are therefore currently working on the intensification and energy optimization of classic separation techniques, and the development of continuous and next-generation separation technologies ("molecular sorting"). Outstanding results were achieved using membranes to separate mixtures consisting of complex biomass breakdown products. However, low-concentration pure material solutions were also economically processed using nested membrane and extrusion processes.

In the field of resource efficiency and waste management, sustainability is a core concern in terms of waste streams reduction, material recycling and the use of renewable raw materials. Sustainable product design (eco-design), life cycle assessment (LCA) and the substitution of critical raw materials also form part of our research to enable the reuse of secondary materials.

Besides this, Fraunhofer ICT uses environmental simulation to predict product service life, which is an important aspect of sustainable economics. In this process, environmental influences on technical products from a wide variety of sectors – including automotive, automotive supply, electrical and electronic equipment, packaging and construction – are simulated, and the effects are measured in vulnerability assessments.

CONTACT

Dr. Stefan Löbbecke
Tel. +49 721 4640-230 | stefan.loebbecke@ict.fraunhofer.de
Rainer Schweppe
Tel. +49 721 4640-173 | rainer.schweppe@ict.fraunhofer.de

Part of a stainless steel autoclave cover.

OLEFINS OBTAINED FROM ALCOHOLS

Increasing efforts are being made to substitute fossil resources with sustainable raw materials, as the supply of these materials depends only on the area available for their cultivation. Supply security and independence from imports can therefore be ensured. In addition, material supply and individual processes within the chemical industry can be successively adapted to biomass, without significant changes to the processing methods. The shift in the raw material base can therefore take place step by step within the existing infrastructure.

Within this context, a method has been developed for producing olefins by dehydrating alcohols extracted by fermentation in supercritical water. The dehydration of alcohols to olefins is conventionally carried out in the gas phase. However, this catalytic process requires up to 100% purity in the starting materials. As fermentation does not normally produce aqueous concentrations of more than 10%, these solutions would need to be rectified up to the azeotrope point and subsequently dried to increase the concentration. It follows that this method is energy-intensive and expensive.

A direct conversion of the fermentation solution would be far more cost-efficient. With its exceptional properties, supercritical water is a reaction medium which enables a direct conversion. At high temperatures and pressures water has multiple additional advantages: for example, it is a reaction accelerator and catalyzes the separation of water from alcohols.

In the context of a research project, Fraunhofer ICT has developed a continuous process for the extraction of olefins from fermented alcoholic solutions. The investigations ranged from process design and control, the quantitative chemical analyses of complex mixtures of substances and the reprocessing of fermentation solutions, through to questions of technical design. The project demonstrates a shift from fossil resources to next-generation biogenic raw materials. Emphasis was placed on the synthesis of the olefins propene, butene and ethene from the corresponding aqueous alcohol hydrolysate, obtained through the fermentation of lignocelluloses.

At temperatures of 400 °C, process pressures of 260 bar and residence times of 90 seconds, yields of 98 % propene were obtained. Using catalysts containing alumina, for instance, the selectivity to propene reached values between 96 and 98 mol%. Taking into consideration the measurement errors, the selectivity to ethylene reached a maximum value of 99.5 mol% with a turnover of 98.9 mol%. The dehydration of 1-butanol, with a turnover of 81 %, showed an 81 % selectivity to all butene isomers, but yields could be increased using different catalyst systems.

CONTACT

Rainer Schweppe
Tel. +49 721 4640-173 | rainer.schweppe@ict.fraunhofer.de

FACILITIES AND EQUIPMENT

- Various synthesis techniques for chemical and mechanical processing
- Pilot plant for upscaling into the 50 kg or 50 l range
- Safety boxes for the remote control of reactions in hazardous processes
- Microprocessing test stands and synthesis units
- Facilities for the parallel screening of synthetic approaches (including under high pressure)
- Numerous reaction calorimeters (batch and continuous)
- Cutting-edge process spectrometer for inline, online or atline process monitoring (UV/Vis, NIR, IR, Raman)
- Continuous and discontinuous high-pressure plants for hydrothermolysis, oxidation, hydrogenation, and reactions in subcritical and supercritical water
- High-pressure extraction units for extraction in supercritical carbon dioxide
- Pilot plants for crystallization from solutions via supercritical fluids
- Systems to determine solubility and phase equilibria at high pressures
- Various distillation units for the thermal separation of high-boiling/sensitive material mixtures (down-flow evaporator, high-temperature vacuum rectification)
- Units for liquid/liquid and solid/liquid extraction
- Mobile equipment for reverse osmosis, nano- and ultrafiltration
- Equipment for solution and melt polymerization
- Coating processes
- Spray and melt crystallization processes
- Comminution technology
- Particle size and crystal structure analyses
- Extensively equipped chemical, spectroscopic, thermal and mechanical analysis laboratories
- Units for surface analysis, volumetric and gravimetric sorption measurements
- Computer tomography
- Environmental simulation units (climate, vibration, destructive gases, corrosion, protection category)
- Facility for the measurement of volatile organic compound (VOC) emissions from materials and components

CORE COMPETENCE
POLYMER ENGINEERING

Fraunhofer ICT has been researching in the core competence "Polymer Engineering" since 1994, working on the practical application of technical polymers, from polymer synthesis and material technology, plastics processing, component development and manufacture through to recycling.

In the area of polymer synthesis, we mainly work on the further development of so-called classic polymers such as polyurethane, polyesters, and polyamides. Our aim is to develop new properties, such as improved heat resistance, which make these polymers suitable for a wider range of applications. One example is the targeted synthesis of special thermoplastic polyurethanes (TPUs). These have numerous advantages over other elastic materials in terms of processing. Another important field is the optimization of the synthesis of additives and flame retardants for new material compounds, for example based on biopolymers. The process adjustments required to change the material system are usually determined directly as the further processing steps are investigated.

Our highly specialized team for compounding and extrusion concentrates on process and material development for processing technologies. Particular attention is paid to extractive compounding processes to reduce emissions. In terms of material development, our main focus is on biobased polymer compounds for high-quality injection molding products.

Our competence in the field of nanocomposites lies in the production, processing, and characterization of functional composites using nano-scale additives (especially carbon nanotubes) to improve the electrical, mechanical or thermal properties of the materials. In the area of foam technologies, special emphasis is placed on particle foam technology and the manufacture of foamed semi-finished products in the direct foam process. Besides the optimization of conventional materials, priority is given to foams made of biobased polymers, and foams made of technical raw materials which are usually resistant to increased temperatures.

In the field of thermoplastic processing the focus of our R&D work is on standardized and specialized injection molding and compression molding processes, including for the integrative processing of local reinforcement elements or inlays for hybrid components, and on thermoplastic fiber composite materials and their processing technologies.

The main research and development focus in the area of thermoset processing is material and process development for the large-scale manufacture of long-fiber-reinforced composite components used for structural and surface parts. Our competences in this field include sheet molding compounds (SMC), PU fiber spraying, and thermoset injection molding.

The key research fields in the area of high-performance fiber composites are the further development and industrialization of the resin transfer molding process (RTM), in terms of the large-scale manufacture of components made of thermoset and thermoplastic high-performance fiber composites (T-RTM). An important element of our research is the production of textile preforms and their handling and subsequent resin infusion under high pressure.

In the field of microwave and plasma technology, our competences include the development of production unit and measurement technology for microwaves and microwave-based plasmas, and the numerical simulation of electromagnetic fields. Possible applications include the microwave-based heating of polymers and resin systems and the generation of plasmas for the surface modification of components. Particular emphasis is placed on corrosion-resistant layers, especially for metals.

CORE COMPETENCE
POLYMER ENGINEERING

Model wind turbine with blades made of thermoplastic sandwich materials.

Hybrid door frame structure of a Daimler Actros HGV.

In the area of online process monitoring, spectral and microwave-based measurement methods are developed for integrated process and material monitoring and for process control. Extensive experience in the field of probe technology, the integration of sensors into processing, and process-specific know-how in the evaluation of the raw data obtained, form the basis for Industry 4.0 projects.

In the area of recycling and waste management, we develop processes and technologies for the material recovery and reuse of polymers. Concept strategies for the recycling of composites (GFCs, CFCs) are particularly significant. After the fibers are exposed (e.g. through solvolysis or microwave-assisted pyrolysis processes) they are reprocessed to manufacture a high-quality composite. Extraction processes, e.g. for the extraction of flame retardants from materials, are gaining importance, and are a key research topic for example in the recycling of flame-resistant external thermal insulation composite systems (ETICS).

Fraunhofer Project Centre FPC for Composites Research FPC@WESTERN

Through the cooperation between the Fraunhofer Project Centre for Composites Research (FPC) at Western University in London, Ontario, Canada, and Western University itself, the competences of Fraunhofer ICT in the field of fiber composite materials are combined with the know-how of the Canadian university in the fields of material and surface research. The FPC uses cutting-edge technology for the processing of fiber composites. Commissioned research projects, in particular for the automobile industry, can therefore be carried out on an industrial scale. The close cooperation and the exchange of engineers, technicians and researchers allow the comprehensive development of materials and processes tailored to the respective market requirements.

Fraunhofer Project Centre FPC for Composite Research FPC@UNIST

The key fields of research at FPC@UNIST in Ulsan, South Korea, are production processes for fiber-reinforced composites, new material solutions and the introduction of lightweight design to mass production. This is made possible by a close interdisciplinary cooperation between process engineering and materials science for the implementation of process chains suitable for large-series production, on an industrial scale. The cooperation benefits from the competences of UNIST in the field of material science on the one hand, and the competences of Fraunhofer ICT in the field of processing technologies on the other. The special feature of FPC@UNIST is its emphasis on the entire value chain within the automotive industry: we work together with OEMs, their suppliers, mold makers and raw material producers.

Networks and alliances

Close thematic networking with other Fraunhofer institutes within the Fraunhofer alliances "Building Innovation", "Lightweight Construction" and "Nanotechnology" enables us to provide system solutions from a single source.

CONTACT

Prof. Dr. Frank Henning
Tel. +49 721 4640-420 | frank.henning@ict.fraunhofer.de
Rainer Schweppe
Tel. +49 721 4640-173 | rainer.schweppe@ict.fraunhofer.de
Wilhelm Eckl
Tel. +49 721 4640-355 | wilhelm.eckl@ict.fraunhofer.de

Microwave module attached to the pultrusion nozzle.

COALINE – ACCELERATING THE PULTRUSION PROCESS USING MICROWAVE TECHNOLOGY

Pultrusion is a continuous process for the cost-effective manufacture of fiber-reinforced plastic profiles with consistent cross-sections. It has been used in industrial applications for over 60 years. In the pultrusion process, fibers or woven fabrics are impregnated with thermosetting resins and pulled through a heated metal nozzle. There they are compacted and the resin is cured. The cured profile is then cut to the desired length. Although production has become increasingly automated, the speed of the pultrusion process depends on the relatively long curing times of the resins - in particular for epoxy or polyurethane resins. The length of the metal nozzle directly affects the costs of the production process: a longer nozzle means that higher pultrusion forces are required to overcome the friction. The manufacture of the metal nozzle itself is complex and expensive because only high quality surfaces inside the nozzle can sufficiently reduce the friction. In addition, further steps such as varnishing cannot be integrated into the pultrusion process. Subsequent processes, such as the impregnation of fibers, lead to higher emissions and more resin waste.

Aware of these disadvantages of the pultrusion process, the European Union funded the project Coaline (FP7/2007-2013, grant agreement n° 609149) in order to develop a solution. In September 2013, a consortium of 12 partners began to develop an improved pultrusion process. A key aspect was the integration of microwaves into the metal nozzle, which significantly reduced the curing times and made it possible to monitor the degree of curing of the resins. This enabled the use of shorter metal nozzles, and lower pultrusion forces. Furthermore, the possibility to monitor the curing meant that the profiles could be varnished inside the metal nozzle. The varnish and the resin are both injected into the metal nozzle. Due to the closed injection system, no emissions are released and the amount of resin waste can be significantly reduced.

Fraunhofer ICT's contribution to the project was the microwave technology. A core aspect of the work was to develop a mechanism for introducing microwaves into the metal nozzle for a rod and a rectangular hollow profile made of glass-fiber-reinforced polyester.

Metals reflect microwaves. For this reason they can't be introduced through the nozzle wall. Instead, a ceramic component must be inserted into the pultrusion nozzle. Where profiles are pultruded, by contrast, the microwaves can travel through the profile itself, which makes it significantly easier to introduce them. Microwaves can be directly introduced through a device attached to the pultrusion nozzle, without modification of the nozzle itself (e.g. through the introduction of a ceramic component). It is therefore simple to add the technology to the pultrusion nozzle of an existing plant, in order to increase the throughput.

Microwaves are electromagnetic waves in the frequency range between 300 MHz and 300 GHz. Microwaves with frequencies of 915 MHz and 2.45 GHz are available for industrial applications.

CONTACT

Dr. Rudolf Emmerich
Tel. +49 721 4640-460 | rudolf.emmerich@ict.fraunhofer.de

FACILITIES AND EQUIPMENT

- Various twin-screw extruders
- Optimized compounding technique
- Gravimetric dosing systems for granules, powders, fibers, etc.
- Dosing systems for liquid and highly viscous media
- Strand pelletizing, underwater pelletizing and hot die pelletizing
- Various dryers, vacuum pumps, and melt filters
- Laboratory for reactive extrusion
- Parallel hydraulic compression molding machines for plastic processing with clamping forces of 6,300 and 36,000 kN
- Direct LFT plant
- Hydraulic compression molding machine with intermediate table and 2,400 kN clamping force
- Injection molding units with clamping forces between 350 and 7,000 kN
- Advanced processing technologies for injection molding, injection embossing, multicomponent injection molding, thermoplastic foam injection molding, expansion foaming
- Injection molding compounder with 40 mm twin-screw extruder and 7,000 kN clamping force
- Automated thermoplastic tape-laying process for non-woven fabrics up to 2 x 2 m²
- Winding technology for the manufacture of complex loop structures
- Particle foam technology with twin-screw extruders, underwater pelletizing, prefoamers, and a steam chest molding machine
- Tandem foam extruder for foamed semi-finished products
- Various gas dosing stations
- SMC production line
- Polyurethane processing PU-RIM and PU fiber spraying technology
- Thermoplastic RIM/RTM processing
- Thermoset RIM/RTM technology for high-pressure injection and high-pressure compression RTM processes
- Automated preform center for the manufacture of textile preforms
- High pressure CO_2 foam autoclaves
- Microwave units with generators in the range of 60 kW at 915 MHz, 12 kW to 6 kW at 2.45 GHz, 0.8 kW at 5.8 kW and 0.8 kW with a variable frequency from 5.8 GHz to 7.0 GHz
- Microwave-based sensor technology for process monitoring
- Low pressure area plasma with 500 x 1,000 mm application area and 8 x 2 kW power
- Low-pressure plasma system with 8 gas channels, ECR plasma and 1,000 mm plasma length
- Universal testing machine 50 kN
- Impact pendulum and falling dart test
- HDT/Vicat device
- High-pressure capillary viscometer
- Rheotens® device for measurement of the extensional viscosity
- Melt index test device
- Plate-plate viscosimeter
- Contact angle measurement device
- Tensiometer
- Differential scanning calorimetry (DSC)
- TG-MS, pyrolysis-GC-MS
- Molar mass determination by gel permeation chromatography (GPC)
- TGA and microwave ashing for the measurement of fiber content
- Light microscopy (incident and transmitted light), polarization
- (Cryo-)microtome, grinding and polishing machines
- White light interferometer
- Scanning electron microscopy with element analysis (REM-EDX)
- FTIR with ATR attachment, IR microscope
- UV-VIS and NIR
- Test stands for flame retardants
- Thermal conductivity measurement devices
- Laboratory for generative manufacturing processes for thermoplastics

CORE COMPETENCE
ENERGY SYSTEMS

Sustainable and affordable energy supply and efficient energy management are key areas in current research policy. Fraunhofer ICT's core competence "Energy Systems" is concerned with energy storage devices for mobile and stationary systems, comprising fuel cells, thermal storage and material energy storage. The institute's electrochemical and chemical know-how has been accumulated over more than 30 years, laying the foundations for the development of efficient and cost-effective storage devices and converters.

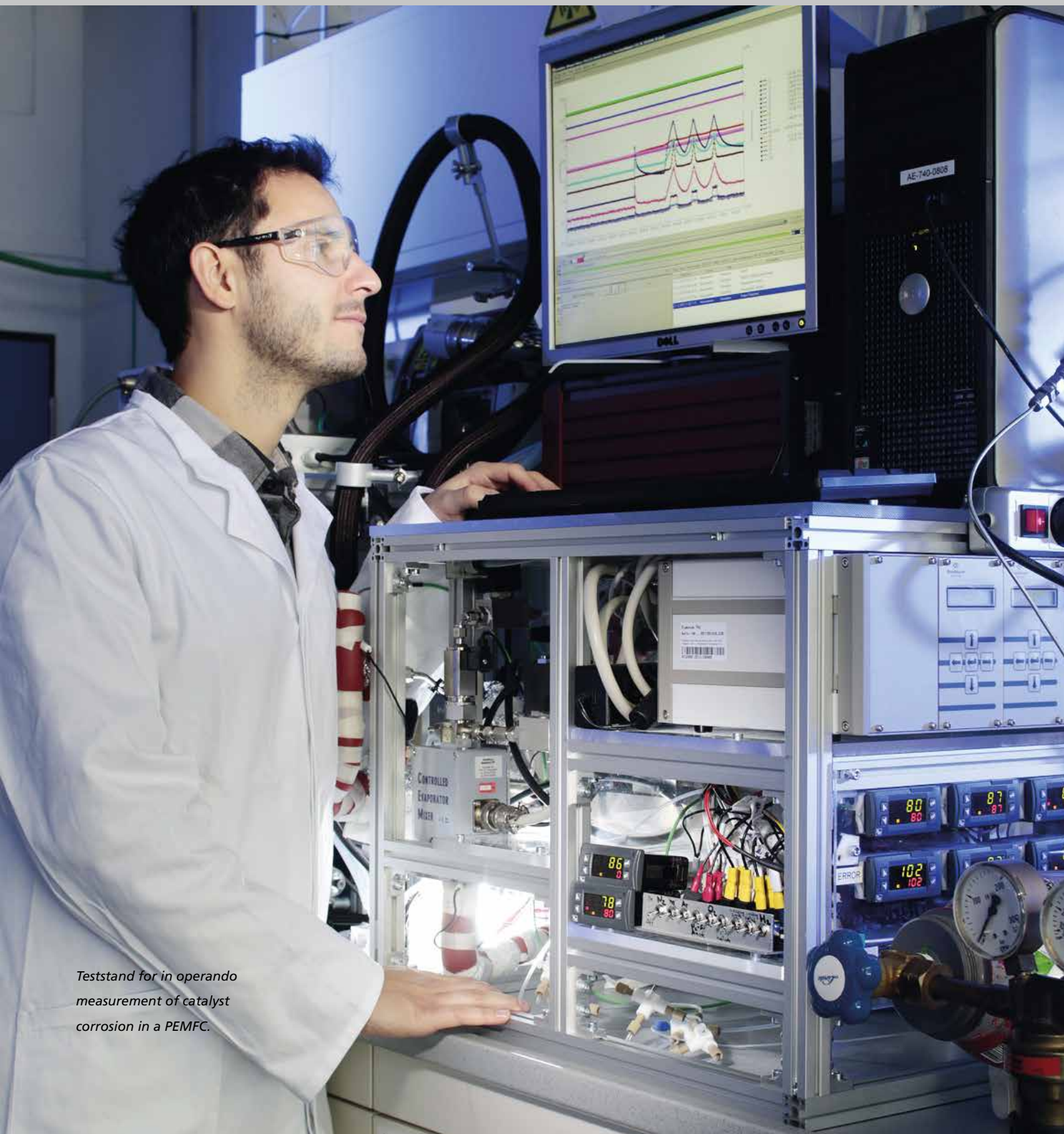
New storage possibilities are developed for electrical energy storage, and already known or commercially available batteries are investigated and further developed. Emphasis is placed on lithium-ion batteries, all-solid-state batteries, redox-flow batteries and so-called post-lithium-ion systems, such as lithium-sulfur or sodium-based batteries. Cells and battery modules are thermally and electrically characterized and simulated, and can therefore be designed for different applications and requirement profiles. Other topics of interest are safety and abuse investigations with gas analysis, post-mortem investigations on cells and battery modules, and the development and validation of safety concepts for operation, transport and storage.

Electrocatalysts for next-generation fuel cells are the focus of work in fuel cell development, and the aim is to increase the power density of liquid-powered systems, and, if possible, to avoid the use of platinum as a catalyst. In the area of direct-alcohol fuel cells, emphasis is placed on the development of alkaline direct-alcohol fuel cells, e.g. the development of palladium non-noble metal alloy catalysts for alcohol oxidation, or ionomers with a high stability in alkaline alcohol solutions. For operation with fuels available for military logistics, anode catalysts are developed which have a high tolerance for contamination, especially for sulfurous impurities. These developments draw on the institute's significant competence in the online analysis of electrochemical processes. These processes are also used for the investigation of degradation in automobile PEMFCs. Fuel cell systems can be designed, constructed and extensively characterized for operation with liquid fuels or hydrogen. This also includes the design of systems for application in unusual environments, e. g. under water.

Our work on solid-oxide fuel cells (SOFCs) centers on characterizing their performance under different operating conditions, and on aging tests on membrane materials to investigate the aging mechanism, and the subsequent optimization of new membrane materials. In electrolysis mode the degradation of the electrode and support materials can be characterized. In collaboration with EIFER, a research institution of the French energy provider EdF, multiple test stands are operated, in which cells and stacks for solid oxide electrolysis are tested. In power-to-gas/ liquids/ chemicals technology, the influence of pressure on the interconnector materials and coatings is investigated, and suitable coatings are developed.

Another possibility for the efficient use of electrical energy is the extraction of chemical products. In this area, Fraunhofer ICT is concerned with the development of electrochemical reactors including electrocatalysts and electrodes, as well as process integration, and connection to a subsequent process. A current example is the electrochemical extraction of hydrogen peroxide through a partial reduction of atmospheric oxygen, with subsequent use of the catalysts in a selective oxidation.

Thermal storage devices based on phase-change materials (PCMs) or zeolites are developed and characterized. This involves basic physical and chemical characterization, including the modeling and characterization of adsorption and desorption phenomena using thermoanalytical methods. The design, construction and testing of sorption storage systems and heat storage systems based on phase-change materials, as well as that of latent heat storage systems, are strongly



Teststand for in operando measurement of catalyst corrosion in a PEMFC.

market-oriented and complement our fundamental research activities. Besides thermal storage, material energy storage also makes an important contribution to the energy economy. Here Fraunhofer ICT is concerned with hydrogen as an energy carrier.

Fraunhofer ICT further contributes to the safe application of renewable energies, for example through the safe handling of hydrogen, especially storage and transport, the development and performance of specific safety tests and the evaluation, concept and design of hydrogen storage systems.

Networks and alliances

Fraunhofer ICT pools its competence with other institutes of the Fraunhofer-Gesellschaft through Fraunhofer networks and alliances. Fraunhofer ICT leads the Battery Alliance (spokesman Prof. Dr. Jens Tübke) and consequently has strong networks within Fraunhofer in the core competence of energy systems. Fraunhofer ICT is also active in the alliances "Energy", "Space" and "Nanotechnology" in relation to this topic.

Services and technology transfer

We offer our customers a wide range of development services for electrical and thermal storage devices and electrical converters for various civil and military application fields. The design and development of, for example, range extenders or APU fuel cell systems for stationary applications and vehicles includes the following core areas:

- Complete characterization of PEMFC, HT-PEMFC and DMFC fuel cell stacks
- Environmental simulation tests on stacks and systems, such as climate tests, effects of shock etc.
- Development of operating strategies, optimization of the interaction between the fuel cell and the battery
- Safety assessments using FMEA methods

We also develop electrocatalysts suitable for use with various fuels (hydrogen, alcohols) in acidic or alkaline fuel cells.

To evaluate battery materials like electrodes, separators, electrolytes and conductors, a wide variety of test cells and numerous specially developed measurement cells are available. We offer our customers the following investigations and services:

- Conductivity measurements (electrolyte, membrane, separator)
- Evaluation of electrodes (e.g. NCA, NCM, graphite, Si, LCO, LTO, O_2 cathodes etc.)
- Tests on separators, and investigation of electrolytes (organic, inorganic, ionic liquid, solid ion conductive) to determine performance and stability
- Thermal simulation and cooling concepts for cells, modules and batteries, and development of module and battery concepts with customers' cells
- Research on next-generation systems (e.g. Li-S, air cathodes, Na-systems, solid ion conductors)

In our abuse test laboratories we conduct thermal, mechanical and electrical safety tests on Li-ion cells and on modules up to 6 kWh. These tests can be planned according to customer specifications, and the gases released can be analyzed qualitatively and quantitatively. We also conduct inorganic and organic analyses of battery electrolytes and battery electrolyte mixtures with the help of specific head space methods, gas analyses of cells after internal gas formation and post-mortem analyses of failed cells. We characterize electrode materials, cells and modules in terms of thermal behavior, such as reaction heat, thermal capacity, thermal conductivity, and heat transfer.

CONTACT

Prof. Dr. Jens Tübke
Tel. +49 721 4640-343 | jens.tuebke@ict.fraunhofer.de
Wilhelm Eckl
Tel. +49 721 4640-355 | wilhelm.eckl@ict.fraunhofer.de
Prof. Dr. Karsten Pinkwart
Tel. +49 721 4640-322 | karsten.pinkwart@ict.fraunhofer.de

Battery test.

SAFETY TESTS ON BATTERIES

In the past few years the energy density of lithium-ion batteries has increased significantly. New cathodes with high nickel content enable particularly high energy densities of over 200 Wh/kg, while maintaining a low internal resistance. These properties, however, are associated with particularly intensive reactions and the release of significant amounts of energy when the systems are abused. It is therefore essential to obtain a thorough understanding of the integrated lithium-ion cell, and to adjust the safety features accordingly on a cell, module and battery level, if spectacular fires are to be avoided. We offer our customers tailored safety tests on battery cells and modules, including know-how to prevent thermal propagation from one cell to another by the use of smart materials.

An intrinsically safe cell is the ideal of every researcher and consumer. In Fraunhofer's internal MaVo LiScell project we, together with our sister institutes IWS, FEP and IVI, have come a major step closer towards making this reality. The aim of the project is to develop, characterize and understand a high-energy cell based on a sulfur cathode and a lithiated silicon anode. Corresponding cells have an average discharge voltage of approximately 1.8 V. This is a significantly lower cell voltage than that of lithium-ion technology, which has an average discharge voltage of approximately 3.6 V. Because of the very high possible capacities of both the sulfur cathode and the silicon anode, however, this disadvantage is easily overcompensated, and a slightly higher gravimetric energy density can be obtained. In the project, continuous manufacturing processes for the anode and cathode were developed and optimized. Emphasis was placed on developing strategies to produce the silicon anodes while remaining competitive, despite the use of plasma thin film technology.

One work package carried out by Fraunhofer ICT included an investigation into the safety of full cells with a pre-lithiated silicon anode, and comparing these with typical lithium-ion cells, and cells with a sulfur cathode against lithium metal. Overcharge and thermal ramp tests were carried out, and demonstrated that lithium-sulfur cells were much safer than conventional lithium-ion cells. The (non-clamped) lithium-sulfur cell performed very well in the overcharge test according to IEC62660 and had a hazard level of only 1-2. Thermal runaway could only be forced at a voltage of 20 V. The voltage to force thermal runaway in a cell with a silicon anode was as high as 80 V. In comparison, lithium-ion cells reach hazard levels of between 4 and 7 when overcharged, leading to the emission of significant amounts of gases, fire and even massive explosions. Both systems with sulfur cathodes displayed excellent properties in the thermal tests. Thermal runaway in lithium-ion systems normally starts at temperatures of ~140 °C, but in the lithium-sulfur cell it did not occur until temperatures just below the melting point of lithium (180 °C) – i.e. temperatures far higher than conventional separators can tolerate. The silicon-sulfur cell performed even better, resisting thermal runaway at surface temperatures of nearly 350 °C.

In conclusion, sulfur cathodes in lithium-based systems lead to a significant safety improvement. Another ongoing project – SePaLiS – which is funded by the Federal Ministry for Education and Research (BMBF, grant number: 03XP0031A) aims to improve the service life, which is still relatively short.

CONTACT

Dr. Markus Hagen
Tel. +49 721 4640-716 | markus.hagen@ict.fraunhofer.de

FACILITIES AND EQUIPMENT

- Charging and discharging stations for battery cells and module characterization
- Argon protective gas box
- High-speed and infrared cameras
- Cryostats and climate chambers from -70 °C to 250 °C
- Scanning tunneling microscope (STM) / atomic force microscope (AFM) with 3D imaging in the atom / nano range
- Digital microscopy with magnification factor up to 5,000 in two- or three-dimensional image
- Scanning electron microscope (SEM) / X-ray diffractometer (XRD)
- RAMAN and infrared (IR) spectroscopy
- Thermal, mechanical and electrical safety testing facility for battery cells and modules up to 6 kWh, fuel cell modules
- Synthesis options for supported electrocatalysts up to gram scale
- Measuring stations for electrochemical catalyst characterization and aging tests on membrane-electrode assemblies
- Differential electrochemical mass spectrometry (DEMS) for the investigation of reaction and corrosion products
- Medium-temperature cell (120 °C – 200 °C) with online mass spectrometry (HT-DEMS)
- Spraying devices for the production of membrane electrode units
- Multiple individual test stands to characterize membrane electrode units for hydrogen PEMFCs, PEM- and AEM-, and HT-PEMC-based direct-alcohol fuel cells, HT-PEMFCs operated on reformate, and PEM electrolysis
- Measuring stand for time-resolved online mass spectrometry measurements to investigate transient processes in automobile PEMFCs, such as corrosion during gear shifting processes or gas exchange of inert gases
- Test stand for the investigation of short stacks (PEMFC, DAFC and HT-PEMFC) up to 500 W
- Test stand for the stack characterization of hydrogen-air and hydrogen-oxygen PEMFCs with operating pressures up to 5 bar
- System development and investigation of components through hardware-in-the-loop method
- Environmental simulation, in particular mechanical tests (vibration, impact etc.) on fuel cell stacks and systems
- Online mass spectrometer with membrane flow unit for analysis of the liquid phase
- Sputtering unit for coating with metals
- Test stand for differential electrochemical mass spectrometry (DEMS)
- Various high-temperature ovens with the possibility to simulate H_2, CO, CO_2 or SO_2-containing atmospheres up to 800 °C, and under pressures up to 50 bar

CORE COMPETENCE
EXPLOSIVES TECHNOLOGY

As the only German research institution covering the entire system development chain for explosives, from the raw product through to the prototype, Fraunhofer ICT offers its long-standing expertise to the German Federal Ministry of Defense, the public sector and industrial customers, carrying out investigations into current challenges in the field of national and international security.

The institute draws on the competence of its employees in the research and development of improved chemical energy sources and systems for the German army, and thus helps to ensure the strong decision-making capabilities of the German Federal Ministry of Defense (BMVg). Research is focused on the synthesis, development, characterization, formulation and production of components for rocket propellants, gas generators, gun propellants, explosives and new ignition systems. Further elements in the portfolio are non-lethal capabilities, safety and security systems such as airbag gas generators, flame retardancy coatings for ammunition boxes, and pyrotechnic flares with spectral emissions that spectrally resolving seekers cannot distinguish from those of real engines.

In the development of propellant and explosive systems, performance, sensitivity, handling safety, functionality and environmental compatibility are adjusted and optimized for individual application profiles and requirements. To this end components are synthesized and modified in Fraunhofer ICT's laboratories, new binder systems and formulations are developed and the energetic products are fabricated in the institute's pilot plants. The research group for interior ballistics and detonics then characterizes the reaction behavior, sensitivity and performance data of the products in the laboratory, detonation chamber or open-air testing ranges, up to the kilogram scale. Current research topics include innovative, high-performance rocket propellants for military and civil applications, foamed propellant structures, insensitive high-performance explosives, gel propellants for rockets enabling controllable thrust phases, sensors embedded in rocket engines that enable non-destructive monitoring of the state-of-aging of the propellant, and investigations into the compatibility and stability of new energetic substances, as well as the prediction of their aging behavior and performance.

Another competence is the detection of explosives. Using special molecular adsorbers even the smallest quantities can be detected. So-called terrorist explosives are fabricated at Fraunhofer ICT, evaluated in terms of their handling safety and detectability, made available to the security agencies for tests. Activities extend to the development of concepts to detect the illicit fabrication of explosives, the design of civil or military security areas and checkpoints, and the standardized evaluation of detection systems, such as those used for security controls at airports, on an international level. At the same time, emphasis is placed on the development of protection systems against terrorist attacks.

Networks and alliances

In the field of explosives technology and security research, Fraunhofer ICT is a member of the Fraunhofer Group for Defense and Security (VVS), in which seven Fraunhofer institutes and three guest institutes have pooled their competences and work together to coordinate and implement research activities. Fraunhofer ICT is also a member of the Fraunhofer Space Alliance, in which 15 Fraunhofer institutes cooperate to perform applied research in the field of space technology.

CORE COMPETENCE
EXPLOSIVES TECHNOLOGY

Coating of explosives in the fluidized bed.

Mechanical test with video image correlation.

With its competence in explosives, the institute is also actively involved in numerous national and international projects (BMVg, EDA, NATO, EU, BMBF, BMI, BMWi). It also works with the BMVg in the context of bilateral research agreements. Operating as a test center on behalf of the German Federal Police, the institute contributes its know-how to international committees aiming to improve aviation security.

Services and technologies

We carry out research in every area of explosives technology, on behalf of the Federal Ministry of Defense, the defense and security industry and the automotive and aerospace sectors. Emphasis is placed in particular on the development, design and evaluation of energetic products and systems, drawing on our chemical know-how and high-safety facilities. We are able to carry out or evaluate every step in the development of pyrotechnic gas generators for safety devices (such as airbags) according to the specific application or customer requirements. In our test center for explosive detection systems, we offer the manufacturers of airport scanners and detection devices the opportunity to carry out tests with real explosives and reference substances, in order to evaluate and optimize their systems.

Furthermore, in cooperation with the German Federal Police, the institute tests and certifies such systems for use in European airports.

We also provide assistance in identifying REACH-compatible substitutes, developing selective sensors for explosives or designing microreaction technology for hazardous processes such as the synthesis of explosive components.

Software-assisted analysis and design tools enable the screening of new propellant and explosive formulations, for example based on their performance and environmental compatibility. Where gun propellants or ballistics are concerned, this explicitly includes the system characteristics of weapons and ammunition.

CONTACT

Wilhelm Eckl
Tel. +49 721 4640-355 | wilhelm.eckl@ict.fraunhofer.de
Dr. Stefan Löbbecke
Tel. +49 721 4640-230 | stefan.loebbecke@ict.fraunhofer.de
Gesa Langer
Tel. +49 721 4640-317 | gesa.langer@ict.fraunhofer.de

Explosion in water spray.

SUBCOP

The increasing number of terrorist attacks involving PBIEDs (person-borne improvised explosive devices) presents a challenge to European security forces in terms of protecting the public and first responders. Fraunhofer ICT is a partner in SUBCOP (Suicide Bomber Counteraction and Prevention): a pan-European project working on specialized non-lethal methods and systems in relation to suicide bombings.

These enable emergency personnel to react quickly to a potential threat and preserve as many lives as possible. Ethical reflections are combined with the development of cutting-edge technologies to avoid unnecessarily risking the life of a potential attacker in the event of a false alarm. Emphasis is placed on three points:

- separating the suspect from innocent civilians
- protecting innocent civilians and first responders from the impact of a bomb explosion, and preventing remote ignition of the bomb
- arrest of the suspect

The SUBCOP strategy enables a more nuanced and thus effective response according to the degree of threat. The focus of the project was a scenario in which a potential suicide bombing is already suspected. In such situations it is important to be aware that the accuracy of this information cannot always be verified. If a concrete suspicion is confirmed, the arrest of the potential suicide bomber may help to obtain important information on the individuals behind the attack, leading to the unmasking of entire networks.

Fraunhofer ICT's contribution to the project relates to two considerations in a critical suicide bombing situation: it is firstly important to separate the suicide bomber from his target persons as quickly as possible, and to protect emergency personnel. For this purpose, a ballistic, quickly inflatable structure was developed which minimizes the damage caused to people and the environment by bomb fragments in the event of a detonation. The second contribution of researchers at Fraunhofer ICT involved reducing the destructive effect of the pressure waves generated by the detonation of explosives. These waves also cause injuries and damage which can lead to the collapse of building structures. The experiments at Fraunhofer ICT were carried out with a fine spray of water mist (see photograph). Water sprinkler installations are available in almost all public spaces in case of fire.

SUBCOP is a collaborative project involving eleven different organizations from six European and associated countries. It was conducted in 2016. The project received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration, under grant agreement no. 312375. It was coordinated by the Swedish Defense Research Agency (FOI).

CONTACT

Dr. Jochen Neutz
Tel. +49 721 4640-314 | jochen.neutz@ict.fraunhofer.de
Johanna Bernewitz
Tel. +49 721 4640-555 | johanna.bernewitz@ict.fraunhofer.de

FACILITIES AND EQUIPMENT

PILOT PLANTS AND TEST STANDS

- Chemical plants and synthesis laboratories for explosives
- Pilot plants for the production and modification of explosive products
- Safety boxes and testing sites for explosion and safety/ security investigations
- Test Center for Explosives Detection
- Test bunker (up to 2 kg TNT)
- Test stands for guns up to 20 mm caliber
- Combustion test stand for rocket engines and flares
- Combustion stand for investigation of pyrotechnic systems

EQUIPMENT

- Pilot plant for fabrication of ultra-fine particles
- Micro reaction test stands and synthesis units
- Fluidized-bed coater
- Spray crystallization unit
- High-pressure unit for isostatic compression molding
- Detonation chamber (up to 2 kg TNT-equivalent)
- Special kneaders, mixers and presses with explosion protection

ANALYTICAL EQUIPMENT AND LABORATORIES

- Atomic force microscope, field emission scanning electron microscope (FESEM) with variable pressure and energy-dispersive X-ray analysis (EDX)
- Micro-computed tomography
- Thermoanalytical laboratory, micro- and reaction calorimeter, test stand for aging behavior
- Laboratory for mechanical testing and rheology
- Ballistic and optical facilities to determine combustion speed and measure flame temperature
- Laboratory for X-ray diffractometry
- Laboratory for chromatographic and spectroscopic analysis (IR and RAMAN microscopy)
- Online spectroscopy (UV/VIS/NIR/RAMAN)

Laser welding of a stainless steel reactor using a 1 kW/cw disk laser.

FRAUNHOFER ICT-IMM INSTITUTE FOR MICROTECHNOLOGY, MAINZ

Scientists at Fraunhofer ICT-IMM carry out research and development work in the two fields of "Chemistry and Energy Technology" (processes, reactors, plants) and "Analysis Systems and Sensors" (methods, components, systems). This includes idea generation, performance enhancement, the optimization of existing systems and components, methodology development and the implementation of specific, intelligent and pilot-scale applications with maximum integration of technology.

The product area "Energy Technology" deals with current and future issues concerning mobile and decentralized provision and storage of electrical energy, thermal management in the automotive industry and the production of synthetic (bio)fuels.

The product area "Chemical Technology" focuses on the intensification of chemical production using methods and devices of chemical micro process engineering.

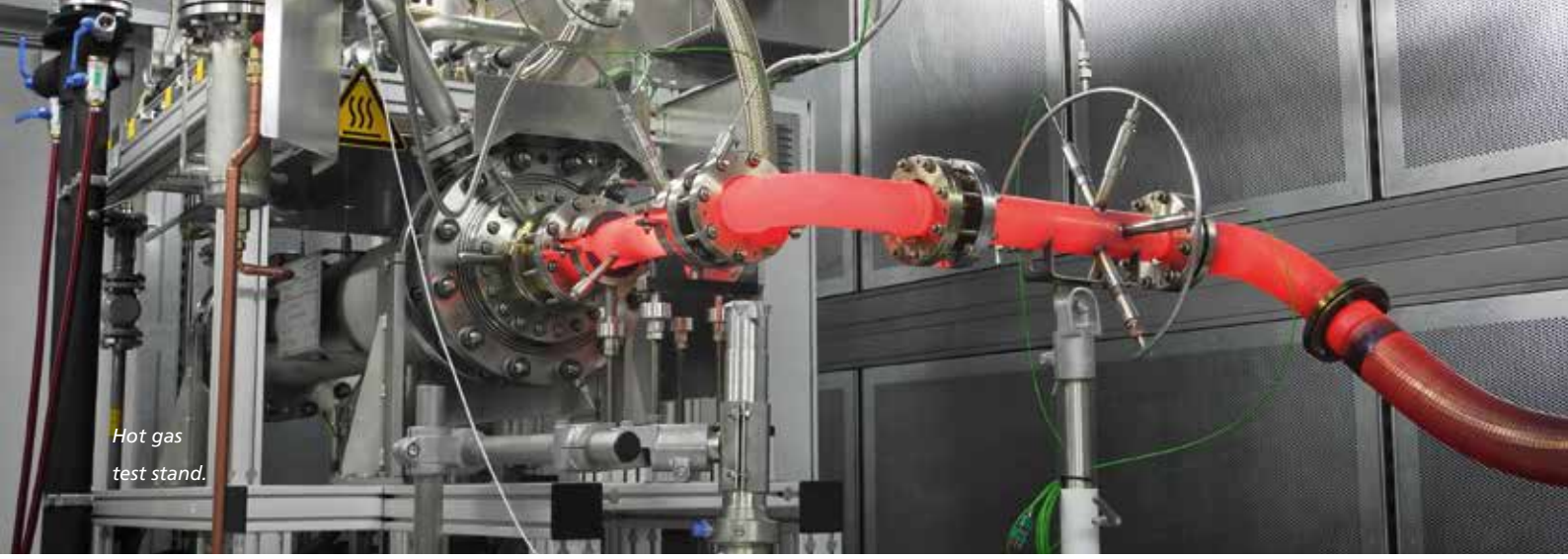
The product area "Nanoparticle Technologies" is concerned with the production and characterization of nanoparticles and their potential application in medicine, pharmaceutics and the consumer goods industry.

The product area "Microfluidic Analysis Systems" develops fully-integrated and automated systems based on a "microfluidic construction kit".

In the framework of "Systems Engineering" the production portfolio of ICT-IMM extends to equipment engineering. This includes the integration of microfluidic cartridges or silicon-based sensors into mechanical constructions. Competences in the design of microstructured components and their system integration, combined with a broad spectrum of micro fabrication technologies, enable the development of customer-specific optical, electrochemical and MEMS sensor systems.

CONTACT

Prof. Dr. Michael Maskos
Tel. +49 6131 990-100 | michael.maskos@imm.fraunhofer.de



Hot gas test stand.

PROJECT GROUP NEW DRIVE SYSTEMS NAS

In 2016 the Fraunhofer Project Group New Drive Systems continued its very positive development. Along with applied research projects in the fields of conventional powertrains, hybrid powertrains and electromobility, and lightweight powertrain design, the project group plays a key role in a newly-founded performance center aiming to strengthen the regional specialization in mobility systems in Karlsruhe.

Research results

Based on successful developments in the area of lightweight powertrain design, including the development of a single-cylinder test engine with a lightweight cylinder casing, several further projects were carried out over the past year. The focus was on developing lightweight multi-cylinder crankcase structures and monolithic cylinder head covers.

In a publicly funded project, the project group worked on developing and manufacturing a compact electric engine suitable for urban and regional mobility requirements. An important focus of this work was developing an integral cooling concept which aligns the continuous and the maximum output.

Various industrial and research projects, such as aging tests of components similar to exhaust gases and the validation of electrical compressors, were carried out on the in-house hot gas test stand. Adding hardware to the hot gas test stand also enabled thermo-mechanical investigations.

Cluster management of the High-Performance Center "Profilregion Mobilitätssysteme Karlsruhe"

In early 2016 the High-Performance Center was founded, as part of an initiative to strengthen Karlsruhe's regional specialization in mobility. The aim is to bring together a network of regional partners in the field of mobility research, in order to develop efficient, intelligent and integrated solutions for future mobility within one performance center. The Project Group for New Drive Systems is involved in three of the seven initialization projects and plays an active role in the cluster management, making it a key player for cross-linking research activities in the field of mobility in Karlsruhe.

You can find further information on the initiative's website (German only): www.profilregion-KA.de

CONTACT

Dr.-Ing. Hans-Peter Kollmeier
Tel. +49 721 9150-3811 | hans-peter.kollmeier@ict.fraunhofer.de

OUTLOOK

In 2015, as part of our strategy initiative, we identified our thematic priorities for the next five years. Our achievements over the previous three years (e.g. publications, patents and project revenues) formed a basis for this process. We are still implementing our strategy with no significant deviations from the original plan. The substantial increase in our industrial revenues – 20 percent compared to the previous year – shows that we focused on the right topics. Our current projected figures show that this positive trend is likely to continue in 2017. However, some large-scale projects, especially EU-projects, will conclude in 2018. Our experience also suggests that the German elections in the fall of 2017 may lead to a temporary freeze in federal funding. For this reason we are putting increasing effort into project acquisition to prevent a gap in our finances over the coming year.

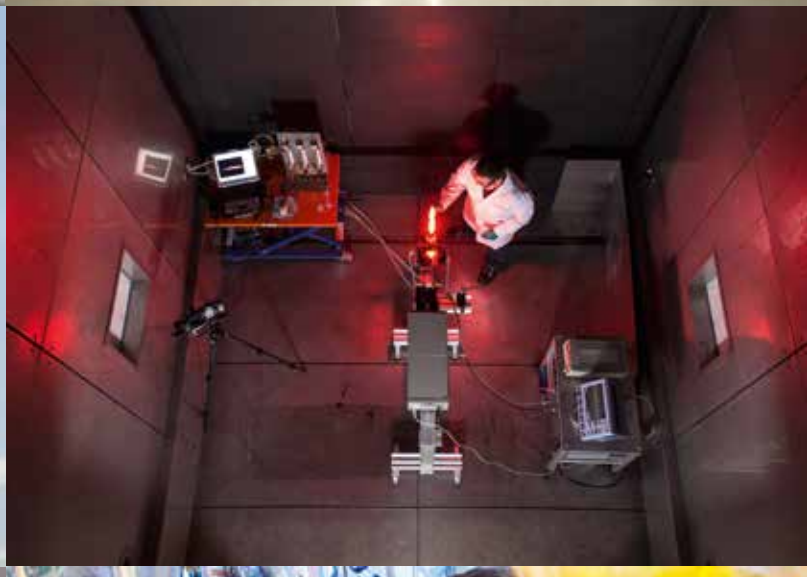
Our personnel planning still aims to preserve our current competences in both civil topics and defense-related work. This means that we continue to plan for 550 members of staff (a full-time equivalent of approx. 400 employees).

Our branch for Functional Lightweight Design FIL in Augsburg became independent last year and, together with several other Fraunhofer institutes, formed the Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV. The branch ICT-IMM in Mainz is also performing very well. We are supporting our colleagues in Mainz during the integration of the Mainz branch into the Fraunhofer-Gesellschaft. The development is extremely positive which means that, according to current planning, ICT-IMM will become independent on January 1st, 2018.

All in all, we are continuing on a promising path!

OUR EMPLOYEES ARE OUR MOST VALUABLE RESOURCE, BOTH NOW AND IN THE FUTURE.



APPENDIX

PARTICIPATION IN FRAUNHOFER GROUPS, ALLIANCES AND INNOVATION CLUSTERS

The institutes of the Fraunhofer-Gesellschaft work together, collaborating in groups and alliances or pooling different skills in flexible structures as and when needed. This secures their leading position in the development of system solutions and the implementation of comprehensive innovations. The Fraunhofer ICT participates in the groups, alliances and clusters listed below.

FRAUNHOFER GROUPS

Institutes working in related subject areas cooperate in Fraunhofer Groups and foster a joint presence on the R&D market. They help to define the Fraunhofer-Gesellschaft's business policy and act to implement the organizational and funding principles of the Fraunhofer model.

Fraunhofer Group for Materials and Components

- Health
- Energy and environment
- Mobility
- Construction and living
- Machinery and plant engineering
- Microsystem technology
- Safety

Fraunhofer Group for Defense and Security Research VVS

- Security research
- Protection and deterrence
- Reconnaissance and surveillance
- Explosives and safety engineering
- Decision-making support for government and industry
- Localization and communication
- Image processing

FRAUNHOFER ALLIANCES

Institutes, or departments of institutes, with different competences collaborate in Fraunhofer Alliances, in order to carry out joint research work and market implementation in a specific business area.

Fraunhofer Battery Alliance

- Materials: Development, characterization, processing, up-scaling
- Design concepts: Mechanical design, electrical connection, thermal design, safety concepts
- Battery management: Monitoring, performance analysis, charge management, functional safety
- Production: Processes, systems engineering, process reliability, green production
- Simulation: Material-based, cell, battery, model reduction
- Testing, certification: Performance, reliability, safety and abuse, aging

Fraunhofer Building Innovation Alliance

- Product development
- Components, construction systems, buildings as integrated systems
- Software
- Construction sequence, construction planning
- Logistics, construction management, life cycle consideration of buildings
- International projects, construction work in other climatic zones

Fraunhofer Energy Alliance

- Renewable energy sources: Solar energy, biomass, wind power
- Efficiency technologies: For example Combined Heat and Power (CHP) technologies, natural gas provision, storage and energy conversion technologies, fuel cells
- Buildings and Components: Lowest-energy house, building energy technologies
- Digitalization of the energy industry: Collection, analysis, transport and use of energy data
- Storage and micro-energy technologies: Lithium technologies for batteries, fuel cell systems

Fraunhofer Lightweight Design Alliance

- New materials and material composites
- Manufacturing and joining technologies relevant to lightweight construction
- Functional integration
- Design and configuration
- Non-destructive and destructive test methods

Fraunhofer Nanotechnology Alliance

- Nanomaterials / nanochemistry
- Nano optics / electronics
- Nanobiotechnology
- Modeling / simulation
- Manufacturing technologies, handling
- Security and policy consulting

Fraunhofer Space Alliance

- Communication and navigation
- Materials and processes
- Energy and electronics
- Surfaces and optical systems
- Protection technology and reliability
- Sensor systems and analysis

INNOVATION CLUSTERS

Innovations are the lifeblood of our economy. To achieve success on the international market, a company has to be quicker and better at developing new, attractive products than its competitors. There is no shortage of good ideas in our companies, but being able to transform them swiftly into top-quality marketable products is an equally important factor in the business equation. The effectiveness of an innovation process depends decisively on efficient cooperation between development and production. For this reason, it is important for providers of research and development services to work in close collaboration with industry.

Innovation Cluster Technologies for hybrid lightweight construction KITe hyLITE, Karlsruhe

- Development of composite materials and production technologies for the implementation of function-integrated lightweight-design solutions
- Implementation of these solutions in economically viable industrialproduction processes for the automotive and machine tools sectors

Regional Eco Mobility 2030 (REM 2030) – Concepts for the urban mobility of the future

- Local emission-free driving in cities and urban areas
- Drive system technology and lightweight construction
- Driver and mobility assistant systems
- Energy-efficient use of electric vehicles as part of a broader energy-management concept
- New business models for changing mobility needs

TEACHING ENGAGEMENT AND PUBLIC BODY MEMBERSHIP

Teaching activities and public body membership are important tasks of a research institution. In 2016 our employees held numerous lectures at the KIT and various other universities and colleges. In this way we contribute to the skills of scientists and technicians and our own future researchers. In 2015 we also participated in numerous working groups and public bodies, to help shape the future of our research fields.

TEACHING ENGAGEMENT

KARLSRUHE INSTITUTE OF TECHNOLOGY KIT

Institute for Applied Materials – Material Science and Engineering (IAM-WK)

Elsner, Peter
- Polymer Engineering (2 units per week, WT + ST)
- Working techniques for mechanical engineering (2 units per week, ST)

Weidenmann, Kay André
- Material processing technology (3 units per week, WT)
- Internship material processing technology (1 units per week, WT)
- Seminar material processing technology (2 units per week, ST)
- Materials for lightweight design (2 units per week, ST)

In 2017, the course "Material processing technology" (to which Fraunhofer ICT contributes) received the Fritz Weidenhammer Award from the KIT Presidential Council, for outstanding teaching in the Mechanical Engineering Department.

Institute for Vehicle Systems Technology (FAST)

Henning, Frank
- Lightweight vehicle construction– strategies, concepts, materials (WT)
- Fiber-reinforced plastics – polymers, fibers, semi-finished products, processing (ST)

Institute for Piston Machines (IFKM)

Kollmeier, Hans-Peter
- Drive systems and options for increasing efficiency (1 unit, WT)

Institute for Mechanical Process Engineering and Mechanics

Tübke, Jens
- Materials and methods for electrochemical storage devices and converters (2 units/week, WT + ST)

KARLSRUHE UNIVERSITY OF APPLIED SCIENCES – TECHNOLOGY AND ECONOMICS

Department for Electronic and Information Technology

Graf, Matthias
- Sensor laboratory 1 (2 units per week, WT + ST)

Hefer, Bernd
- Chemistry and exercise (2 units per week, ST)
- Physical chemistry (4 units per week, ST)

Pinkwart, Karsten
- Bio-chemosensors III (2 units per week, ST)
- Batteries, fuel cells and super-capacitors (2 units per week, ST, WT)
- Renewable electricity generation and storage (2 units per week, ST)
- Electrochemical energy storage systems (2 units per week, WT)

Urban, Helfried
- Measurement technology for mechatronic students (4 units per week, ST)
- Electronics 3 for sensor system technicians (4 units per week, WT)

Vietnamese–German University (VGU), Ho Chi Minh City (Vietnam)

Hefer, Bernd
- Physical chemistry (4 units per week, WT)

BADEN-WÜRTTEMBERG COOPERATIVE STATE UNIVERSITY (DHBW), KARLSRUHE

Engineering Department, Mechanical Engineering Course

Becker, Wolfgang
- Waves and optics (4 units per week, WT)

Kauffmann, Axel
- Technical mechanics and mechanics of materials I (3 units per week, WT + ST)
- Technical mechanics II (3 units per week, WT + ST)
- Technical mechanics III (2 units per week, WT)
- Material sciences: plastics (2 units per week, WT)
- Plastics processing (3 units per week, ST)
- Laboratory for plastics processing (2 units per week, ST)
- Product lifecycle management (2 units per week, ST)

Reinhard, Stefan
- Laboratory for plastics processing (5 units per week, ST)
- Material sciences: plastics (2.5 units per week, WT)
- Lectures on strength of materials/production machines (2 units per week, WT)

Mechatronics Course

Bader, Bernd
- New materials (33 units / year)

Safety Engineering Course

Gräbe, Gudrun
- Basics of environmental technology (3 units per week, WT)

BADEN-WÜRTTEMBERG COOPERATIVE STATE UNIVERSITY (DHBW), MANNHEIM

Mechanical Engineering Course

Bader, Bernd
- Properties and processing of elastomers (55 units / year)
- Construction with plastics (33 units / year, WT)

HECTOR SCHOOL OF ENGINEERING AND MANAGEMENT

Henning, Frank
- Automotive lightweighting and processing of composite materials (15 units / year, WT)

TECHNICAL UNIVERSITY NUREMBERG

Applied Chemistry and Process Engineering Department

Küttinger, Michael
- Electrochemical process technology (12 units – lectures and practical work, ST)

Process Engineering Department

Herrmann, Michael
- Lecture on X-ray diffraction (double-unit, WT)

Teipel, Ulrich
- Mechanical process engineering (6 units per week, ST and 4 units per week, WT)
- Particle technology (4 units per week, WT)
- Particle engineering (4 units per week, ST)

HELMUT-SCHMIDT UNIVERSITY – UNIVERSITY OF THE FEDERAL ARMED FORCES HAMBURG

Electrical Engineering Department

Pinkwart, Karsten
- Electrochemical energy storage devices and convertors (2 units per week, WS)

ASSOCIATED INSTITUTE OF OSTFALIA UNIVERSITY OF APPLIED SCIENCES

Trainings- und Weiterbildungszentrum Wolfenbüttel

Cremers, Carsten
- Fuel cell technology (block lecture, 6 double units, ST)

Tübke, Jens
- Battery technology (block lecture, 6 double units, ST)

UNIVERSITY OF WESTERN ONTARIO, CANADA

Faculty of Mechanical Engineering, Material Science

Henning, Frank
- Lightweight design of vehicles (2 units per week / WT)
- Composite manufacturing (2 units per week / WT)

THEOPRAX-TEAM

Accredited teaching engagement for teacher training events in the German federal states of Rheinland-Pfalz, Hessen and Nordrhein-Westfalen on behalf of the German Federal Ministry of Economics and Technology.

Krause, Dörthe
- Training events for teachers at the Pädagogische Hochschule Upper Austria, Institute for Training and School Development II, Linz (2 full days WT + 2 full days ST)

UNIVERSITY OF WEST BOHEMIA IN PILSEN, CZECH REPUBLIC

Mechanical Engineering Department

Kolarik, Vladislav
- X-ray diffractometry as an in-situ method (guest lecture, one 2 hour session, WT)

PUBLIC BODY MEMBERSHIP

Armbrust, Torsten
- Member of the European Working Group on Non-Lethal Weapons (EWG-NLW)

Böhnlein-Mauß, Jutta
- Member of the Working Group IPT-REACH of the Federal Office of the Bundeswehr for Equipment, Information Technology and In-Service Support Bundeswehr
- Member of the Working Group "Interior Ballistics" of the Bundeswehr Technical Center for Weapons and Ammunition

Bohn, Manfred
- Member of the German Chemical Society (GDCh)
- Member of the Bunsen Society for Physical Chemistry (DBG)
- Member of the German Society for Thermal Analysis (GEFTA)
- NATO AC326 /SG1-CNG
- Member of the International Steering Committee of the International Pyrotechnics Seminar USA (IPS-USA Seminars)
- Member of the Steering Committee of the International Pyrotechnics Seminar (IPS)
- Organizing committee member of KISHEM, Korea (South)
- Scientific committee member of the NTREM, Pardubice, Czech Republic
- Member of the Committee of the HFCS-EM (Heat Flow Calorimetry Symposium on Energetic Materials)
- Member of the Committee of International NC Symposium
- Member of the International Advisory Board of the Polymer Degradation Discussion Group (PDDG)

Boskovic, Dusan
- DIN NA 055-03-13 AA, Technical Committee for "Microprocessing Technology"

Bücheler, David
- Member of the AVK Working Group SMC/BMC
- Member of the Steering Committee of the European Alliance for SMC BMC

Cäsar, Joachim
- DKE 131 "Environmental Simulation"
- DKE 212 "IP Protection Categories"
- Member of the German Engineers' Union VDI e. V.
- Deputy Chair of the Working Group "Effects on Products" in the Air Quality Control Commission (AQCC)
- Member of the Society for Environmental Simulation (GUS) e. V.
- Deputy Director of the Working Group "Particles – Properties and Effects" of the Society for Environmental Simulation
- Various Working Groups of the Society for Environmental Simulation (GUS)
- DAkkS Consulting Expert on Environmental Simulation

Cremers, Carsten
- Member of the NATO STO Exploratory Team SET-ET-097 „Integration of Energy Sources into a NATO Tactical Power Grid"
- Appointed member of the Joint Technical Committee on Fuel Cells of the Society for Energy and Environment (GEU) of the German Engineers' Union (VDI) and the Power Engineering Society (ETG) of the Association for Electrical, Electronic & Information Technologies (VDE)
- Member of the industrial network of the Working Group "Fuel Cells" in the National Federation of Machinery and Plant Construction (VDMA)
- Member of the Technical Group "Applied Electrochemistry" of the German Chemical Society (GDCh)
- Member of the Electrochemical Society ECS

Diemert, Jan
- Founding Member and Board Member of the European Composites, Plastics & Polymer Processing Platform (ECP4)
- Member of the Polymer Processing Society (PPS)

Elsner, Peter
- Chair of the Advisory Board of the Karlsruhe University of Applied Sciences, Technology and Economy
- Member of the Central Committee of the Scientific and Technical Council of the Fraunhofer-Gesellschaft
- Member of the Presidential Council of the Fraunhofer-Gesellschaft
- Chairman of the Fraunhofer Group for Materials
- Deputy spokesman of the Fraunhofer Building Innovation Alliance
- Spokesman of the Scientific Working Group Plastics, WAK
- Member of the National Academy of Science and Engineering, acatech

Eyerer, Peter
- Executive Board of the TheoPrax Foundation
- Member of Jury VIP+, Funding Program of the Federal Ministry of Education and Research, Berlin; Project Executive Agency VDI/VDE-IT
- Consulting Expert at KMU-NETC, Funding Program of the Federal Ministry of Education and Research, Berlin; Project Executive Agency VDI/VDE-IT, Berlin
- President of the "Offene Jugendwerkstatt" (youth workshop), Karlsruhe

Fischer, Peter
- Consulting Expert for the Carl Zeiss Foundation (Carl-Zeiss-Stiftung)
- Consulting Expert for the Hans and Walter Thirring Award of the Austrian Academy of Sciences
- Member of the Working Group "Valve World Conference Düsseldorf"

Fischer, Thomas
- Member of the Working Group "Interior Ballistics" of the-Bundeswehr Technical Center for Weapons and Ammunition
- Member of the Working Group "External Ballistics" of the Bundeswehr Technical Center for Weapons and Ammunition
- Member of the Task Group "Interior Ballistics Simulation"
- Member of the Working Group IPT-REACH of the Federal Office of the Bundeswehr for Equipment, Information Technology and In-Service Support Bundeswehr

Gettwert, Volker
- Member of the Technical Group "Construction Chemistry" of the German Chemical Society (GDCh)

Gräbe, Gudrun
- Member of the Water Chemistry Society (professional group of the GDCh)

Henning, Frank
- Director of SAMPE Deutschland e. V.
- Member of the Federation of Reinforced Plastics (AVK)
- SPE Composites Division (Board of Directors, European Liaison)
- Adjunct Research Professor in the Department of Mechanical and Materials Engineering, Faculty of Engineering of the University of Western Ontario, Canada
- Deputy Chairman of the Executive Board of the Center for Lightweight Construction Baden-Württemberg (LBZ-BW)
- Member of the Advisory Board to the Federal Agency for Lightweight Construction BW

Herrmann, Michael
- Member of the German Crystallography Society (DGK)
- Member of the German Society for Thermal Analysis (GEFTA)

Hübner, Christof
- Elected member of the Scientific and Technical Council of the Fraunhofer-Gesellschaft
- Representative of the Fraunhofer ICT in the Fraunhofer Nanotechnology Alliance

Joppich, Tobias
- Representative of the Fraunhofer ICT in the Lightweight onstruction Center in Baden-Württemberg (LBZ-BW e. V.); assistance to the managing board
- Representative of the Fraunhofer ICT in the Lightweight Construction Agency Baden-Württemberg
- Deputy member of the Working Group "EATC – European Alliance for Thermoplastic Composites" of the German Federation of Reinforced Plastics (AVK e. V.)

Juez-Lorenzo, Mar
- Member of the German Society for Electron Microscopy (DGE)
- Member of the European Microscopy Society (EMS)

Kauffmann, Axel
- Member of the Fraunhofer Building Innovation Alliance

Knapp, Sebastian
- Member of the International Pyrotechnic Society
- Member of the German Physical Society (Deutsche Physikalische Gemeinschaft)

Kolarik, Vladislav
- Member of the German Society for Corrosion Protection (GfKORR) and of the Research Group on Corrosion Protection at High Temperatures (within the GfKORR)
- Session Chairman on "Coatings for Use at High Temperatures", International Conference on Metallurgical Coatings and Thin Films, San Diego, USA
- Member of the International Advisory Committee of the International Conference on Microscopy of Oxidation

Krause, Dörthe
- Member of the Working Group "Entrepreneurial Spirit" of the Federal Ministry of Economics and Technology, Berlin
- Executive Board Member of the Federal Association "Lernort Labor e. V."
- Executive Board Member of the TheoPrax Foundation

Löbbecke, Stefan
- ProcessNet, including Technical Groups for Microprocessing Technology, Reaction Technology, Process Analytics; Working Committee on Reaction Technology for Processes with Complex Safety Issues; Working Group for Metal-Organic Frameworks (Founding Member)
- Member of the German Chemical Society (GDCh), including Working Group "Process Analysis"
- Member of the German Catalysis Society (GECatS)

Müller, Torsten
- Member of the American Helicopter Society (AHS)

Neutz, Jochen
- Deputy Chairman European Working Group Non-Lethal Weapons (EWG-NLW)
- Mitglied der Projektgruppe »Non-lethal Capabilities« der European Defence Agency (EDA)
- Vorsitzender des Programmausschusses AIRBAG 2000 plus

Noack, Jens
- International Electrotechnical Commission IEC 61427-2
- JWG 82 "Secondary Cells and Batteries for Renewable Energy Storage and Smart Grid Structures"
- International Electrotechnical Commission IEC TC 21 / TC 105 JWG 7 »Flow Batteries«
- German Commission for Electrical, Electronic and Information Technologies (DKE), Working Group 371.0.6 "Flow Batteries"

Parrisius, Martina
- Member of the Expert Advisory Board Neue Oberstufe Berlin

Pinkwart, Karsten
- Fraunhofer Electrochemistry Network (Coordinator)
- Executive Board Member of the Association of Electrochemical Research Institutes (AGEF)
- Member of the Working Group "Energy Technology" of the German Society for Defense Technology (DWT)
- Director of the Working Group "Batteries" of the Society for Environmental Simulation (GUS)
- Member of the Working Group "Electrochemical Processes" of DECHEMA / ProcessNet
- Member of the Technical Group "Applied Electrochemistry" and "Chemistry and Energy" of the German Chemical Society (GDCh)

Reichert, Thomas
- Managing Director of the Society for Environmental Simulation (GUS) e. V.
- President of the European Federation of Clean Air and Environmental Protection Associations EFCA
- President of the Confederation of European Environmental Engineering Societies (CEEES)
- Member of the Technical Advisory Board of the Clean Air Commission, Board III on Environmental Quality, in the German Engineers' Union (VDI) and the DIN (German Institute for Standardisation)
- Chairman of the Working Group "Effects on Materials and Environmental Simulation" of the Clean Air Commission at the VDI and DIN
- Chairman of the European Weathering Symposia (EWS)
- Chairman of the CEEES Technical Advisory Board for "Climatic and Air Pollution Effects on Materials and Equipment"
- Chairman of the Organizing Committee for the Ultrafine Particles Symposia (UFP)
- DIN Standardization Committee on Plastics, NA 054-01-04, Resistance Against Environmental Influences

Roeseling, Dirk
- Member of the Liquid Explosive Study Group (ECAC)
- Member of the Trace Explosive Study Group (ECAC)
- Member of the EDS Cabin Baggage Explosive Study Group (ECAC) (formerly ACBS)
- Member of the Vapor Trace Explosive Study Group (ECAC)
- Member of the EDS Hold Baggage Explosive Study Group (ECAC)

Schnürer, Frank
- Deputy Member of the Advisory Board of the Civil Security Coordination Office (KoSi)
- Member of the European Expert Committee DEWSL (Detection of Explosives & Weapons at Secure Locations) within the ERNCIP (European Reference Network for Critical Infrastructure Protection) Initiative

Stier, Christian
- Member of the AVK Working Group for Fiber Analysis
- Working Group for Masonry Recycling (Association of research institutions and multiple industrial associations for construction material)
- Molecular Sorting Platform (Exchange and Acquisition Platform within the FhG)

Teipel, Ulrich
- Appointed member of the ProcessNet Technical Committee on Comminution and Classification
- President of the Working Group on Particles – Properties and Effects within the Society for Environmental Simulation (GUS)
- Appointed member of the ProcessNet Technical Committee on Crystallization
- Consulting Expert of the German Federation of Industrial Research Associations (AiF) and the German Research Foundation (DFG)
- Editor Board of the journal "Chemical Engineering & Technology"
- Guest editor of the journal "Chemical Engineering & Technology", thematic area of particle technology
- Director of the Working Group for the Influence on Products, in the Commission on Air Pollution Prevention of VDI and DIN (KRdL)
- Liaison lecturer of the DFG at the Technical University Nuremberg
- Member of the German-Russian Raw Materials Forum
- Member of the Working Group "Limits of development/ sustainability" of the Intern. Seminar on Planetary Emergencies at the World Federation of Scientists / Erice Member of the Scientific Committee of the "PARTEC 2016"
- Appointed member of the ProcessNet Technical Group "Raw Materials"
- Appointed member of the Council of Science and Humanities

Thoma, Bernd
- Member of the Working Group "Euro-RTM-Group" of the Federation of Reinforced Plastics (AVK)

Tübke, Jens
- Spokesman of the Fraunhofer Battery Alliance
- Member of the Working Group "National Platform for Electromobility" (NPE)
- Member of the Technical Advisory Board of the Forum Electromobility e. V.
- Deputy Director of the fokus.energie e. V.
- Chair of the MEET Scientific Advisory Board – Münster Electrochemical Energy Technology
- Member of the Advisory Board of "Battery Research Germany" of the Federal Ministry for Education and Research (BMBF)
- Member of Electrochemical Society, Battery Division
- Member of the Technical Group for Applied Electrochemistry of the German Chemical Society (GDCh)
- Member of the Society for Chemical Engineering and Biotechnology (DECHEMA e. V.)

Urban, Helfried
- Honorary professor at the Karlsruhe University of Applied Sciences

Weiser, Volker
- Member of the Combustion Institute
- Member of the German Fire Protection Association
- Member of International Pyrotechnic Society
- Representative in the Fraunhofer Space Alliance

Weidenmann Kay
- Member of the Selection Committee of the German Academic Scholarship Foundation (Studienstiftung des deutschen Volkes e. V.)
- Consulting Expert of the German Research Foundation (Deutsche Forschungsgemeinschaft)
- Member of the DGM Technical Committees "Metal Matrix Composites" and "Hybrid Materials"
- Founding member of the Karl Drais Gesellschaft zur Förderung der Wissenschaften e. V.

Wurster, Sebastian
- Member of the Working Group for Interior Ballistics
- Member of the Working Group "External Ballistics" of the Bundeswehr Technical Center for Weapons and Ammunition
- Member of the Task Group "Interior Ballistics Simulation"

EVENTS AND PARTICIPATION IN TRADE FAIRS AND EXHIBITIONS

EVENTS

February 17-18, 2016
Material Efficiency and Innovations
Evangelical Academy (Evangelische Akademie),
Tutzing, Germany

March 22-24, 2016
45th Annual conference of the German Society for Environmental Simulation GUS "Assessment, Simulation and Evaluation of Environmental Influences"
Festhalle, Stutensee-Blankenloch, Germany

April 28, 2016
Girls' Day
Fraunhofer ICT, Pfinztal, Germany

June 8-9, 2016
Functional Integrated Plastic Components FIPCO
Karlsruhe, Germany

June 28-29, 2016
1st National Conference "Armed Forces and Energy Consumption – Potentials and Perspectives"
Stadthalle Bad Godesberg, Bonn, Germany

June 28, 2016
17th Defense Engineering Day
Fraunhofer ICT, Pfinztal, Germany

Juen 28 – July 1, 2016
47th International Annual Conference of the Fraunhofer ICT: »Synthesis, Characterization, Processing«
Congress Centre, Karlsruhe, Germany

September 24, 2016
Open Day
Fraunhofer ICT, Pfinztal, Germany

October 12, 2016
Meeting of the Advisory Board
Fraunhofer ICT, Pfinztal, Germany

November 16-17, 2016
Workshop: Propellants and Explosives / Energy Storage Devices
Fraunhofer ICT, Pfinztal, Germany

November 28-30, 2016
Airbag 2016 – 13th International Symposium and Accompanying Exhibition on Sophisticated Car Safety Systems
Kongresszentrum Rosengarten, Mannheim, Germany

PARTICIPATION IN TRADE FAIRS AND EXHIBITIONS

February 23-25, 2016
"Applied Research for Defense and Security in Germany – Shaping the Future through Research and Technology" (conference with exhibition of the German Association for Defense Technology (DWT))
Bonn, Germany

March 2-4, 2016
Fuel Cell Expo and Battery Japan
Tokyo, Japan

March 8-10, 2016
JEC Composites Paris
Paris, France

March 9-10, 2016
VDI Conference "Polymers in the Automobile Industry"
Mannheim, Germany

March 15-17, 2016
Energy Storage
Düsseldorf, Germany

March 24-27, 2016
expoMED Eurasia
Istanbul, Türkei

May 3-4, 2016
AKM forum "Storage and Application" (conference of the German Association for Defense Technology)
Diedersdorf, Germany

May 10-13, 2016
Analytica – 25th International Trade Fair for Laboratory technology, Analysis, Biotechnology and analytica conference
Munich, Germany

May 10-12, 2016
Sensor + Test – The Measurement Fair
Nuremberg, Germany

June 1-4, 2016
ILA Berlin – Innovation and Leadership in Aerospace
Berlin, Germany

June 7-9, 2016
IFBF – The International Flow Battery Forum
Karlsruhe, Germany

October 10-12, 2016
World of Energy Solutions – Battery & Storage
Stuttgart, Germany

October 19-26, 2016
K2016 – Trade Fair for Plastics and Rubber
Düsseldorf, Germany

PUBLICATIONS

Abert M., Pinkwart K.
Worauf es bei Lithium-Ionen-Batterien für Medizingeräte ankommt.
In: DeviceMed, 12 (2016), Nr. 3, S. 28-29, ISSN 1860-9414,
http://files.vogel.de/vogelonline/vogelonline/issues/dmd/2016/003.pdf

Apel S., Haupt O.J., Krause D., Parrisius M.
Von der Idee zur Innovation – Wegweiser zur Projektarbeit in Schülerlaboren und Schulen mit Partnern aus der Wirtschaft.
Pfinztal, 2016, 83 S., ISBN 978-3-946 709-01-5

Barkanov E., Akishin P., Emmerich R., Graf M.
Numerical simulation of advanced pultrusion processes with microwave heating.
ECCOMAS Congress 2016 – VII European Congress on Computational Methods in Applied Sciences and Engineering, Crete Island, Greece, June 5-10, 2016

Baumgärtner S.
Strahlungsinduziertes Vakuumkonsolidieren – Ein schneller und effizienter Prozess zum porenfreien Faserverbundhalbzeug.
SAMPE-Symposium 2016, Erlangen/Fürth, Germany

Baumgärtner S., John J., Henning F., Huber T., Hangs B.
Effizient zum maßgeschneiderten Organoblech. Wirtschaftliche CFK-Herstellung im Vakuum mit Infrarotstrahlung
In: Kunststoffe 10/2016, S. 180-184, Carl Hanser Verlag, München

Baumgärtner S., John J., Henning F., Huber T., Hangs B.
The efficient route to tailored organo sheets. Producing CFRP efficiently in a vacuum using infrared radiation.
In: Kunststoffe international 10/2016, pp. 123-127, Carl Hanser Verlag, Munich

Beck B., Huber T.
Gewickelte Faserverbundstrukturen zur lokalen Verstärkung von Thermoplast-Bauteilen.
SKZ Tagung »Polypropylen im Automobilbau«, 2016

Behnisch F., Rosenberg P., Thoma B., Henning F.
Manufacturing of CFRP with epoxy and polyurethane systems in HP-RTM process and investigation of the matrix influence on the laminate properties.
In: Proceedings of the 32nd International Conference of the Polymer Processing Society, July 25-29, 2016, Lyon, France

Bergmann B., Diemert J.
InnoREX – European project reveals impact of microwave and ultrasound energy on polymerisation of PLA via reactive extrusion.
In: Proceedings of the 32nd International Conference of the Polymer Processing Society, July 25-29, 2016, Lyon, France

Bergmann B., Mikonsaari I., Guschin V., Weiss P., Baumann S.
Mittendrin statt nur dabei – Echtzeitüberwachung von Polymeren während der Extrusion für effektivere Compoundierung.
In: Kunststoffe 7/2016, S. 72-75, Carl Hanser Verlag, München

Bergmann B., Mikonsaari I., Guschin V., Weiss P., Baumann S.
Measuring where it counts – real-time monitoring of polymers during extrusion for more effective compounding.
In: Kunststoffe international 6-7/2016, pp. 59-62, Carl Hanser Verlag, Munich

Bermejo Sanz J., Roussel Garcia R., Kolarik V., Juez-Lorenzo M.
Influence of the slurry thickness and heat treatment parameters on the formation of aluminium diffusion coatings.
9th International Symposium on High-Temperature Corrosion and Protection of Materials HTCPM 9, Oxidation of Metals, May 10-15, 2016, Les Embiez, France

Blanco-Villalba J., Valente R., Vlasveld D., Mikonsaari I., Hübner C.
Effect of the fluid flow on the distribution of carbon nanotubes during the injection moulding of polymer nanocomposites.
9th International Conference on Broadband Dielectric Spectroscopy and its Applications (BDS), September 11-16, 2016, Pisa, Italy

Böhm D., Weinert M., Gettwert V.
Evaluation of the efficiency and environmental impact of fire suppressants for forest fire fighting.
In: ForestFire2016 – International Conference on Forest Fires and WUI Fires, Book of Abstracts, May 25-27, 2016, Aix-en-Provence, France,
ISBN 979-10-94074-05-3

Böhm D., Weinert M., Gettwert V., Stegmüller S.
Investigation and evaluation of flame retardants for forest fire fighting within the framework of the European project AF3.
In: ForestFire2016 – International Conference on Forest Fires and WUI Fires, Book of Abstracts, May 25-27, 2016, Aix-en-Provence, France,
ISBN 979-10-94074-05-3

Bohn M.A., Seyidoglu T., Mußbach G.
Characterisation and modelling of the curing reaction of HTPB with isocyanates by reaction heat determined by heat flow microcalorimetry and by volume shrinkage determined with a pressure curing cell.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany,
pp. 38-1 to 38-35

Bohn M.A., Mußbach G., Kronis G.
Data interpretation and comparison of DMA results from HTPB-IPDI bonded composite elastomer samples used in an international Round Robin Test and from further formulations.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, p. 131-1

Bücheler D., Henning F.
Hybrid resin improves position and alignment of continuously reinforced prepreg during compression co-molding with sheet molding compound.
In: Proceedings of the 17th European Conference on Composite Materials ECCM16, June 26-30, 2016, Munich, Germany

Bücheler D., Kaiser A., Henning F.
Using thermogravimetric analysis to determine carbon fiber weight percentage of fiber-reinforced plastics.
In: Composites Part B: Engineering, Volume 106, December 2016, pp. 218-223

Chairopoulou M.A., Teipel U.
Struktur-Partikel aus biogenen Rohstoffen.
In: Teipel U., Reller A. (Hrsg.) Rohstoffeffizienz und Rohstoffinnovationen. Band 4, Fraunhofer-Verlag, Stuttgart, 2016, S. 359-365

Chairopoulou M.A., Hariskos I., Posten C., Teipel U.
Biogenic particles from microalgae.
In: Proceedings of the International Conference of Particle Technology PARTEC 2016, Nuremberg, Germany, April 19-21, 2016, p. 263

Cremers C., Rau M.S., Niedergesäß A., Pinkwart K., Tübke J.
Effect of model fuel impurities for reformed jet fuels on the hydrogen oxidation at platinum based catalyst under HT-PEMFC conditions.
In: ECS Transactions 75 (2016), Nr. 14, pp. 919-929, ISSN 1938-5862, http://dx.doi.org/10.1149/07514.0919ecst

DeLuca L.T., Palmucci I., Franzin A., Weiser V., Gettwert V., Niklas N., Sjöblom M.
New energetic ingredience for solid rocket propulsion.
In: Journal of Solid Rocket Technology 39 (6), 2016, pp. 765-774

Dörr D., Joppich T., Schirmaier F., Kärger L., Henning F.
Forming simulation of thermoplastic UD-Tapes.
SAMPE Symposium 2016, Erlangen/Fürth, Germany

Dörr D., Joppich T., Schirmaier F., Mosthaf T., Kärger L., Henning F.
A method for validation of Finite Element forming simulation on basis of a pointwise comparison of distance and curvature.
ESAFORM Conference Nantes, 2016, AIP publishing

Dörr D., Joppich T., Schirmaier F., Kärger L., Henning F.
Determination of the sensitivity of material properties on wrinkling behavior of UD-Tape laminates during forming by means of Finite Element forming simulation.
In: Proceedings of the 17th European Conference on Composite Materials ECCM16, June 26-30, 2016, Munich, Germany

Dresel A., Teipel U.
Dispergierung und Eigenschaften von Carbon Nanotubes.
In: Chemie Ingenieur Technik 88 (2016) 7, S. 857-863

Dresel A., Teipel U.
Infuence of the wetting behavior and surface energy on the dispersibility of multi-wall carbon nanotubes.
In: Colloids and Surface A: Physicochem. Eng. Aspects 489 (2016), pp. 57-66

Dürkoop A., Gräbe G., Brandstetter C.P., Rentsch L. (Hrsg.)
Innovative Technologien für Ressourceneffizienz – Strategische Metalle und Mineralien. Ergebnisse der Fördermaßnahme r³.
Fraunhofer ICT, Pfinztal, 440 S., erschienen beim Fraunhofer Verlag, Stuttgart, ISBN 978-3-8396-1102-9, 2016

Eisenlauer M., Teipel U.
Aufbereitung lignocellulosehaltiger nachwachsender Rohstoffe.
In: Teipel U., Reller A. (Hrsg) Rohstoffeffizienz und Rohstoffinnovationen. Band 4, Fraunhofer Verlag, Stuttgart, 2016, S. 329-335

Eisenlauer M., Teipel U.
Comminution of lignocellulos biomass.
In: Proceedings of the International Conference of Particle Technology PARTEC 2016, Nuremberg, Germany, April 19-21, 2016, pp. 276-277

Eisenlauer M., Teipel U.
Feinzerkleinerung lignocellulosehaltiger Rohstoffe.
In: Chemie Ingenieur Technik 88 (2016) 9, S. 1236

Eisenlauer M., Teipel U.
Zerkleinerung holzartiger nachwachsender Rohstoffe.
In: Chemie Ingenieur Technik 88 (2016) 7, S. 948-957

Elskamp F., Kruggel-Emden H., Hennig M., Teipel U.
Applicability of phenomenological screening models in representinbg dynmic processes during DEM screening simulations.
In: Proceedings of the International Conference of Particle Technology PARTEC 2016, Nuremberg, Germany, April 19-21, 2016, pp. 58

Elskamp F., Kruggel-Emden H., Hennig M., Teipel U.
Discrete element investigation of process models for batch screening under altered operational conditions.
In: Powder Technology 301 (2016), pp. 78-95

Emmerich R.
Schnelle Prozesse – Mikrowellen in der Verfahrenstechnik.
In: Jahresmagazin Kunststofftechnik (2016), Magazin des Wissenschaftlichen Arbeitskreises der Universitäts-Professoren der Kunststofftechnik WAK, S. 28-34

Gerber P., Happ A.
Influence of charge size on enhanced blast explosives.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, p. 126-1

Gettwert V.
Entwicklung von neuen signaturarmen und umweltfreundlichen Composite-Festtreibstoffen für taktische Raketenantriebe.
Angewandte Forschung für Verteidigung und Sicherheit in Deutschland – Zukunft durch Forschung und Technologie gestalten, 23.-25. Februar 2016, Bonn

Gettwert V., Fischer S., Deimling L., Weiser V.
Druck- und temperaturabhängige Brennkammerversuche mit ADN/GAP Festtreibstoffen.
Workshop Treib- und Explosivstoffe/Energiespeicher, Fraunhofer ICT, Pfinztal, 16.-17. November 2016

Gettwert V., Rapp F.
Dämmschichtbildende Beschichtungen als Flammschutz für polymerbasierte Werkstoffe.
4. Sitzung des Arbeitskreises »Flammschutz« FGK, 18. Februar 2016, Darmstadt

Graf M., Baumgärtner S.
Fiberforge tailored fiberplacement – flexible and economical process for the mass production of hybrid lightweight composites.
2nd International Composites Congress (ICC), AVK, Düsseldorf, Germany, 2016

Gromov A., Gromov A.M., Popemlo E., Sergienko A., Sabinskaya O., Raab B., Teipel U.
Formation of calcium in the products of iron – aluminum termite combustion in air.
In: Russian Journal of Physical Chemistry A, 90 (2016) 10, pp. 2104-2106

Gromov A., Teipel U.
Oxide particles production by low-voltage/low-current cathode plasma electrolysis.
In: Proceedings of the International Conference of Particle Technology PARTEC 2016, Nuremberg, Germany, April 19-21, 2016, p. 162

Gromov A., Korotkikh A., Il'in A., DeLuca L. T., Arkhipov V., Monogarov K., Teipel U.
Nanometals: Synthese and application in energetic systems.
In: Zarko, Gromov (Eds) Energetic Nanomaterials, Elsevier, Amsterdam, 2016, Chapter 3, pp. 47-63, ISBN 978-0-12-802710-3

Gromov A., Teipel U.
The probable mechanisam of foreign metals formations in particles formed by plasma elecrolysis of water solutions.
In: Teipel U., Reller A. (Hrsg) Rohstoffeffizienz und Rohstoffinnovationen. Band 4, Fraunhofer Verlag, Stuttgart, 2016, pp. 309-310

Hafner S., Keicher T.
Poly(epichlorohydrin-co-1,2-epoxyhexane) – a promising precursor for an energetic azido polymer for castcure processing.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 129-1 to 129-10

Hangs B., Link T., Henning F.
Process parameter dependent spring-in and warpage of locally reinforced UD-tape laminates and V-shaped profiles.
17th European Conference on Composite Materials ESCM, Munich, Germany, 2016

Hariskos I., Chairopoulou M., Posten C., Teipel U., Vucak M.
Characterization of biogenic Calcite particles from microalgae – Coccoliths as a potential raw material for industrial application.
In: Ecological Engineering and Environment Protection 2 (2016), pp. 36-41

Hariskos I., Chairopoulou M., Vucak M., Posten C., Teipel U.
Produktion und Charakterisierung von mikrostrukturierten Calcitpartikeln aus der Kalkalge Emiliania Huxleyi.
In: Chemie Ingenieur Technik 88 (2016) 7, S. 897-902

Heil M., Baumann S., Krause H.
Fast heating of selective adsorber beads for large volume application.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 122-1 to 122-10

Hennig M., Elskamp F., Kruggel-Emden H., Teipel U.
Dynamic behavior of screening processes.
In: Proceedings of the International Conference of Particle Technology PARTEC 2016, Nuremberg, Germany, April 19-21, 2016, pp. 301-302

Hennig M., Teipel U.
Siebklassierung von mineralischen Rohstoffen.
In: Teipel U., Reller A. (Hrsg) Rohstoffeffizienz und Rohstoffinnovationen. Band 4, Fraunhofer Verlag, Stuttgart, 2016, S. 353-358

Henning M., Teipel U.
Stationäre Siebklassierung.
In: Chemie Ingenieur Technik 88 (2016) 7, S. 911-918

Hennig M., Elskamp F., Teipel U., Kruggel-Emden H.
Experimentelle Siebklassierung und deren Abbildung in der DEM.
In: Chemie Ingenieur Technik 88 (2016) 9, S. 1363

Heintz T., Herrmann M., Leisinger K., Reinhard W.
Particle properties and crystal structure of ADN-prills.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – Juli 1, 2016, Karlsruhe, Germany, pp. 108-1 to 108-12

Herrmann M., Kempa P.B., Fietzek H., Altenburg T., Polyzoidis A., Piscopo C.G., Löbbecke S.
Characterization of metal-organic frameworks using X-ray diffraction.
In: Chemie Ingenieur Technik 88 (2016) 7, pp. 967-970

Herrmann M., Förter-Barth U., Fietzek H., Böhnlein-Mauß J., Kaiser M.
Temperature and spatially resolved investigation of the microstructure of gun propellants by means of X-ray diffraction.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 104-1 to 104-14

Herrmannsdörfer D., Herrmann M., Heintz T.
Advanced approaches to the CL-20/HMX cocrystal.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 123-1 to 123-14

Hitscherich M., Cremers C., Stolten D., Pinkwart K., Tübke J.
Development study of an air independent fuel cell system for an autonomous underwater vehicle (AUV).
In: ECS Transactions 14 (2016), No. 75, pp. 491-501, ISSN 1938-5862, http://dx.doi.org/10.1149/07514.0491ecst

Hovsepian P.E., Ehiasarian A.P., Purandare Y.P., Biswas B., Pérez F.J., Lasanta M.I., de Miguel M.T., Illana A., Juez-Lorenzo M., Muelas R., Agüero A.
Performance of HIPIMS deposited CrN/NbN nanostructured coatings exposed to 650 °C in pure steam environment.
Journal of Materials Chemistry and Physics, Volume 179, August 15, 2016, pp. 110-119

Hürttlen J., Weiser V., Schaller U., Imiolek A.
Aktuelle Arbeiten zu Treibstoffen auf Basis ionischer Liquide.
Treffen der Nationale Arbeitsgruppe Gelantriebe, DLR – Institut für Raumfahrtantriebe, Lampoldshausen, 23.-24. November 2016

Imiolek A., Sachsenheimer K., Raab A., Weiser V.
Synthese von nanostrukturierten Silizium und Bor nach dem SPCS Prinzip.
Workshop Treib- und Explosivstoffe / Energiespeicher, Fraunhofer ICT, Pfinztal-Berghausen, 16.-17. November 2016

Imiolek A., Weiser V., Hürttlen J., Schaller U., Lity A., Kelzenberg S.
Fortführung der Arbeiten zu monergolen und hypergolen Treibstoffen.
Treffen der Nationale Arbeitsgruppe Gelantriebe, Bayern-Chemie, Aschau am Inn, 19-20. April 2016

Imiolek A., Becker W., Sachsenheimer K., Weiser V.
In-situ characterization of curing reaction of gap and isocyanates by near infrared spectroscopy.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 119-1 to 119-11

Imiolek A., Seyidoglu T., Bohn M. A., Weiser V.
Influence of aging on the burning behavior of ferrocene-type catalyzed composite rocket propellants.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 117-1 to 117-3

Joppich T., Doerr D., van der Meulen L., Link T., Hangs B., Henning F.
Layup and process dependent wrinkling behavior of PPS/CF UD tape-laminates during non-isothermal press forming into a complex component.
ESAFORM Conference Nantes, AIP Publishing, 2016

Juez-Lorenzo M., Kolarik V., Kuchenreuther-Hummel V., Pötschke M., Schimanke D.
Oxidation of La-Sr-Mn coated interconnector alloys for steam electrolysis under pressure in pure oxygen and in pure steam.
9th International Symposium on High-Temperature Corrosion and Protection of Materials HTCPM 9 – Oxidation of Metals, May 15-20, 2016, Les Embiez, France

Jung M., Fischer S., Gettwert, V.
Expanding foam without secundary foaming.
Poster, 2nd International Conference on the Chemistry of Construction Materials (ICCCM), October 10-12, 2016, München

Jurzinsky T., Kintzel .B, Bär R., Cremers C., Pinkwart K., Tübke J.
Methanol oxidation on Ru- or Ni-modified Pd-electrocatalysts in alkaline media: A comparative differential electrochemical mass spectrometry study.
In: ECS Transactions, 75 (2016), No. 14, pp. 983-995, ISSN 1938-5862, http://dx.doi.org/10.1149/07514.0983ecst

Jurzinsky T., Kintzel B., Bär R., Cremers C., Tübke J.
Methanol oxidation on PdRh/C electrocatalyst in alkaline media: Temperature and methanol concentration dependencies.
Journal of Electroanalytical Chemistry, Volume 776, September 2016, pp. 49-52

Jurzinsky T., Cremers C., Pinkwart K., Tübke J.
On the influence of Ag on Pd-based electrocatalyst for methanol oxidation in alkaline media: A comparative differential electrochemical mass spectrometry study.
Electrochimica Acta, 199 (2016), pp. 270-279, ISSN 0013-4686, http://dx.doi.org/10.1016/j.electacta.2016.01.172

Jurzinsky T., Kammerer P., Cremers C., Pinkwart K., Tübke J.
Investigation of ruthenium promoted palladium catalysts for methanol electrooxidation in alkaline media.
In: Journal of Power Sources 303 (2016), pp. 182-193, ISSN 0378-7753, http://dx.doi.org/10.1016/j.jpowsour.2015.11.004

Kaiser M., Ditz B., Dörich M., Bohn M.A.
Characterization of several HTPB binder samples by NMR, GPC and OH number.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, p. 55-1

Karcher M., Chaloupka A., Henning F., Schmölzer S., Moukhina E.
Bestimmung der Aushärtekinetik eines 2-stufig aushärtenden Epoxidharzes zur Herstellung von Hochleistungsfaserverbunden.
Zeitschrift Kunststofftechnik – Journal of plastics technology 2016, Nr. 2, S. 80-111, ISSN 1864-2217

Karcher M., Huber T., Thoma B., Weidenmann K.
Hand in Hand zu Serienlösungen. Composites: Forscher-Team automatisiert Prozesskette für HP-RTM.
Industrieanzeiger (2016) 04.16, S. 56-59

Karcher M., Chaloupka A., Henning F., Schmölzer S., Moukhina E.
Bestimmung der Aushärtekinetik eines 2-stufig aushärtenden Epoxidharzes zur Herstellung von Hochleistungsfaserverbunden / Determination of curing kinetics of a two-stage curing epoxy resin for high performance composites.
Zeitschrift für Kunststofftechnik 12 (2016) 2, S. 81-111

Kempa P.B., Herrmann M.
Pair distribution function analysis of ammonium nitrate – evaluation for energetic materials.
24. Jahrestagung Deutsche Gesellschaft für Kristallographie, 14.–17. März 2016, Stuttgart, Abstract in Zeitschrift für Kristallographie – Supplement 36 (2016), p. 107, 122, http://www.degruyter.com/view/serial/247761

Kirchberger C., Ciezki H.K., Hürttlen J., Schaller U., Weiser V., Caldas-Pinto P., Ramsel J., Naumann K.W.
An Overview of the German Gel Propulsion Technology Program.
Space Propulsion, 2016, Roma, May 2-5, 2016

Knapp S., Bieroth D., Kelzenberg S., Lity A., Poth H., Raab A., Roth E., Weiser V.
Analysis of CIE-color values using the example of tracer munition.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 115-1 to 115-8

Knapp S., Eickershoff B., Eißler C., Fietzek H., Günthner C., Koleczko A., Schuppler H.
Characterization of nanoparticle layers deposited by wire explosions.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 114-1 to 114-10

Knapp S., Eisenreich N., Kelzenberg S., Raab A., Roth E., Weiser V.
Modellierung in der Pyrotechnik – Datenauswertung, Modellierung und Anwendungen.
Grundlagen der Pyrotechnik, Kaiserslautern, 9.-11. November 2016

Knapp S., Eisenreich N., Kuchenreuther-Hummel V., Kelzenberg S., Koleczko A., Schuppler H.
Thermogravimetric analysis of molybdenum oxide (MoO_3) decomposition.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 113-1 to 113-7

Knapp S., Günthner C., Kelzenberg S, Roth E., Raab A., Weiser V.
Emission spectroscopy on pyrotechnic mixtures.
42nd International Pyrotechnics Society. Seminar, Grand Junction, Colorado, USA, July 10-15, 2016, p. 273

Knapp S., Koleczko A., Eisenreich N., Kelzenberg S., Raab A., Roth E., Weiser V.
Emission spectroscopy on pyrotechnic mixtures.
High Energy Materials: Demilitarization, Antiterrorism and Civil Application (HEMs-2016), 7.-9. September 2016, Tomsk, Russia

Kolarik V., Juez-Lorenzo M., Kuchenreuther-Hummel V., Pötschke, M.; Schimanke D.
Effect of pure oxygen and pure water vapour under pressure on Mn-Co-Fe coated interconnector alloys for steam electolysis (SOE).
9th International Symposium on High-Temperature Corrosion and Protection of Materials HTCPM 9 – Oxidation of Metals, May 15-20, 2016, Les Embiez, France

Kolarik V., Juez-Lorenzo M., Kuchenreuther-Hummel V., Pötschke M., Schimanke D.
Behavior of chromium barrier interconnector coatings for steam electrolysis under pressure exposed to water vapor and pure oxygen.
43rd International Conference on Metallurgical Coatings and Thin Films ICMCTF, April 25-29, 2016, San Diego, CA, USA

Kuchenreuther-Hummel V., Schneider M., Liehmann M., Neutz J.
First verification of the modified hartmann-apparatus with aluminum and magnesium particles.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 130-1 to 130-10

Mitró D., Böhnlein-Mauß J.
Dynamic mechanical analysis of nitrocellulose-plasticizer-mixtures.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 125-1 to 125-2

Mußbach G., Bohn M.A.
Consumption of atmospheric oxygen as ageing indicator of HTPB-based solid rocket propellants.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 132-1 to 132-20

Nardai M.M., Bohn M.A.
Direct simulation of pbx uniaxial tensile testing by molecular dynamics.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 124-1 to 124-11

Nardai M.M., Bohn M.A.
Cohesive zone model parameterization by molecular dynamics.
Proceedings of 19th International Seminar »New Trends in Energetic Materials«, p. 231, April 20-22, 2016, Pardubice, Czech Republic,

Nardai M.M., Bohn M.A.
Molecular dynamics simulation of cohesion within solid propellants.
Proceedings of the 42nd International Pyrotechnics Society Seminar, p. 306, July 10-15, 2016, Grand Junction, Colorado, USA

Noack J., Cognard G., Oral M., Küttinger M., Roznyatovskaya N., Pinkwart K., Tübke J.
Study of the long-term operation of a vanadium/oxygen fuel cell.
Journal of Power Sources 326 (2016), pp. 137-145, ISSN 0378-7753, http://dx.doi.org/10.1016/j.jpowsour.2016.06.121

Noack J., Wietschel L., Roznyatovskaya .N, Pinkwart K., Tübke J.
Techno-economic modeling and analysis of redox flow battery systems.
Energies 9 (2016), No. 627, 15 p., ISSN 1996-1073 http://dx.doi.org/10.3390/en9080627

Pappert S., Wehner H., Eckl W.
Potential und Grundlagen von Wärmespeichersystemen.
Konferenz Angewandte Forschung für Verteidigung und Sicherheit in Deutschland, 23.-25. Februar 2016, Bonn

Pappert S., Teicht Ch., Eckl W.
Unterbringung im Einsatz, Medienver- und -entsorgung als technisch vernetzte Systemleistung mit stationärer und mobiler Technik.
Forum mit Ausstellung, Deutsche Gesellschaft für Wehrtechnik e.V., 3.-4. Mai 2016, Schloss Diedersdorf

Pappert S., Wehner H., Eckl W.
Steigerung der Energieeffizienz von Infrastruktureinheiten durch Verwendung von Wärmespeichersystemen.
Konferenz ENERGIE – Streitkräfte und Energiebedarf, Potentiale und Perspektiven, 28.-29. Juni 2016, Stadthalle Bonn, Bad-Godesberg

Pappert S., Eckl W.
Fraunhofer-Institut für Chemische Technologie & Potential von Wärmespeichersystemen.
DWT Arbeitsgruppe F&T, 28. Juli 2016, Schwaikheim

Pappert S., Eckl W., Fischer L.
Wärmespeicher zur Steigerung der Energieeffizienz in Produktionsprozessen.
Jahrestreffen der ProcessNet-Fachgemeinschaft Prozess-, Apparate- und Anlagentechnik, Akademie Hotel Karlsruhe, 14.-15. November 2016, Karlsruhe

Pappert S.
Fraunhofer-Institut für Chemische Technologie ICT & Arbeitsgruppe Energieeffiziente Speichersysteme.
BAAIN der Bw Ref. U.3.3, 14. Dezember 2016, Koblenz-Rauenthal

Piscopo C.G., Trapani F., Polyzoidis A., Schwarzer M., Pace A., Loebbecke S.
Positive effect of the fluorine moiety on the oxygen storage capacity of UiO-66 metal-organic frameworks.
New Journal of Chemistry (2016), 40, pp. 8220-8224

Piscopo C.G., Schwarzer M., Herrmann M., Affini A., Pelagatti P., Maestri G., Maggi R., Loebbecke S.
Batch vs. flow acetalyzation of benzaldeheyde with HKUST-1: Diffusion pathways and performance comparison.
ChemCatChem (2016) 8, pp. 1293-1297, doi:10.1002/cctc.201501364

Polyzoidis A., Altenburg T., Schwarzer M., Loebbecke S., Kaskel S.
Continuous microreactor synthesis of ZIF-8 with high space-time-yield and tunable particle size.
Chemical Engineering Journal (2016), 283, pp. 971–977

Pontius H., Dörich M., Heil M.
Analyzing the migration of plasticizers in powders by imaging spectroscopy.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 120-1 to 120-10

Quaresma J., Campos J., Pimenta J., Ribeiro A., Mendes R., Gois J., Deimling L., Keicher T.
Hot spots sensitization and optical detonation measurements of emulsion explosives.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 34-1 to 34-16

Rabenecker P., Bayha T., Essig C., Pinkwart K.
Sprengstoffschnüffeln im Meer: Elektrochemische Detektion von Seeminen.
In: Hunkel P. (Hrsg) Angewandte Forschung für Verteidigung und Sicherheit in Deutschland: Zukunft durch Forschung und Technologie gestalten. Studiengesellschaft der Deutschen Gesellschaft für Wehrtechnik, Bonn, 2016, ISBN 978-3-943730-19-7, S. 903-949

Rabenecker P., Pinkwart K.
Elektrochemische Sensorik für Explosivstoffe im Praxiseinsatz bei Seeversuchen.
In: Bundesministerium der Verteidigung, Unterabteilung AIN II (2016) Jahresbericht Wehrwissenschaftliche Forschung 2016, Bonn

Rieger M., Wittek M., Scherer P., Schnürer F., Löbbecke S.
Investigation of metal organic frameworks as selective preconcentrator material via inverse gas-chromatography.
In: Proceedings of the 11th Future Security Security Research Conference, Berlin, September 13-14, 2016, ISBN 978-3-8396-1011-4, pp. 495-499

Rieger M., Wittek M., Schnürer F., Löbbecke S.
Evaluation of metal-organic frameworks for gas-phase preconcentration and sample enrichment by inverse gas chromatography (IGC).
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 109-1 to 109-3

Rieger M., Schnürer F., Löbbecke S.
Metal-organic frameworks in C-protective equipment – MOFSchutz (BMBF-FUNDED).
CBRNE Innovation Fair, October 11-12, 2016, Brussels

Roch A., Menrath A., Schmid B.
2-component air guide panel manufactured by co-molding and foaming using core-back technology.
Automotive Composites Conference & Exhibition (ACCE) 2016, Society of Plastics Engineers SPE, Novi/ USA

Röseling D., Schnürer F., Ulrich C., Wittek M., Krause H.
EVADEX – Methods for standardized evaluation of explosive trace detection systems
In: Proceedings of the 11th Future Security Security Research Conference, Berlin, September 13-14, 2016, ISBN 978-3-8396-1011-4, pp. 239-246

Rosenberg P., Thoma B., Henning F.
Investigation and validation of a cavity pressure controlled HP-RTM process variant (PC-RTM).
16th Annual SPE Automotive Composites Conference & Exhibition, Society of Plastics Engineers ACCE, Novi, MI, 2016

Roth E., Weiser V., Knapp S.
Untersuchung spektraler Täuschkörperwirkmassen im Strömungsprüfstand.
Workshop Treib- und Explosivstoffe/Energiespeicher.
16.-17. November 2016, Fraunhofer ICT, Pfinztal-Berghausen

Roth E., Weiser V., Raab A., Lity A.
Influence of various binders and oxidizers on the spectral emission of pyro-organic flares.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 118-1 to 118-10

Roznyatovskaya N., Herr T., Küttinger M., Fühl M., Noack J., Pinkwart K., Tübke J.
Detection of capacity imbalance in vanadium electrolyte and its electrochemical regeneration for all-vanadium redox-flow batteries.
Journal of Power Sources 302 (2016), pp. 79-83, ISSN 0378-7753, http://dx.doi.org/10.1016/j.jpowsour.2015.10.021

Roznyatovskaya N., Noack J., Fühl M., Pinkwart K., Tübke J.
Towards an all-vanadium redox-flow battery electrolyte: electrooxidation of V(III) in V(IV)/V(III).
Electrochimica Acta 211 (2016), pp. 926-932, ISSN 0013-4686, http://dx.doi.org/10.1016/j.electacta.2016.06.073

Rupp P., Wafzig F., Weidenmann A.
Influence of process parameters on the interface of carbon fiber reinforced face sheets and aluminum foam core structure of hybrid sandwich panels manufactured by the PUR spray process.
17th European Conference on Composite Materials ECCM17, Munich, Germany, June 26-30, 2016

Schaller U., Keicher T., Krause H., Schlechtriem S.
EILs – Suitable substances for future energetic applications?
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 9-1 to 9-11

Schneider A., Rapp F., Iglhaut, K., Michel A.
Vom Baum zum Schaum – Serientaugliche Partikelschäume aus Celluoseester.
Kunststoffe (2016) 5, S. 86-89, Hanser-Verlag

Schneider A., Rapp F., Iglhaut K., Michel A.
Turning Trees into Foam. Particle Foams Made from Cellulose Esters for Large-Scale Production.
Kunststoffe international (2016) 5, S. 46-49, Hanser-Verlag

Schneider S., Eppler F., Weber M., Olowojoba G., Weiss P., Hübner C., Mikonsaari I., Freude W., Koos C.
Multiscale dispersion-state characterization of nanocomposites using optical coherence tomography.
Scientific Reports 6, 31733

Schnürer F., Ulrich C., Ehlerding A., Elfving A.
Harmonized Evaluation, Certification and Testing of Security products (HECTOS) – Case Study: Explosive Trace Detection.
In: Proceedings of the 11th Future Security Security Research Conference, Berlin, September 13-14, 2016, ISBN 978-3-8396-1011-4, pp. 505-507

Schreiber A., Klahn T., Zilly A., Schuch M., Deimling L.
Test facility for investigation of impact-initiated bimetallic compounds.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 127-1 to 127-9

Schweikert W., Mendl A., Eichberger S.
Evaluation of different commercially available surface-enhanced raman spectroscopy (sers) – substrates and improved methods for detection of explosives.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, p. 121-1

Seiler E., Materna M., Teipel U.
Energetische Demontage von Kompositmaterialien am Beispiel Rotorblatt.
In: Teipel U., Reller A. (Hrsg) Rohstoffeffizienz und Rohstoffinnovationen. Fraunhofer Verlag, Stuttgart, 2016, Band 4, S. 337-342

Seiler E., Teipel U.
Recycling von Rotorblättern.
VDI-Konferenz „Recycling von Kunststoffen und Verbundwerkstoffen", 28.-29. Juni 2016, Düsseldorf

Seyidoglu T., Bohn M.A., Mußbach G.
Accelerated aging and cure kinetics of butacene® based composite propellants.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 78-1 to 78-4

Sims S., Gettwert V., Urban H., Winkel A., Kahlmeyer M., Böhm S.
Debonding by exothermic reaction due to microwave activation.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 112-1 to 112-9

Sims S., Gettwert V., Urban H., Winkler A., Kahlmeyer M., Böhm S.
Debonding using exothermic reactions.
Welding and Cutting 15 (2016), No. 3, pp. 188-192

Sims S., Gettwert V., Urban H., Winkler A., Kahlmeyer M., Böhm S.
Entkleben unter Nutzung exothermer Reaktionen.
Schweißen und Schneiden 68 (2016), Heft 1-2, S. 38-43

Sims S., Gettwert V., Urban H. et al.
Durch exotherme Reaktionen schnell Entkleben.
Adhäsion 2016, 12 (60), S. 34- 37

Sims S. et al.
X-Bond-Entkleben unter Nutzung exothermer Reaktionen.
Proceedings of the 16. Kolloquium Gemeinsame Forschung in der Klebtechnik, March 1-2, 2016, Cologne, Germany

Spötter C., Hennig M., Weber A., Teipel U.
Visualisierung von Partikelbewegungen während Klassierprozessen.
Chemie Ingenieur Technik 88 (2016) 9, p. 1363

Stier C., Forberger J.
Ergebnisse einer Befragung zum Umgang mit Porenbetonabfällen aus dem Abbruch von Gebäuden. Kurzmitteilung im CIT-Themenheft Molecular Sorting.
In: Woidasky J. (Gastherausgeber) Chemie Ingenieur Technik April 2016, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, S. 506-513, ISSN 0009-286X, 2016

Tagliabue C., Gettwert V., Bohn M., Heintz T., Keicher T., Weiser V.
ADN/AN propellants as green advanced high energy propellants for launchers.
Space Propulsion, 2016, Roma, May 2-5, 2016

Tagliabue C., Weiser V., Imiolek A., Bohn M.A., Heintz T., Gettwert V.
Burning behavior of AN/ADN propellants.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 36-1 to 36-15

Tagliabue C., Weiser V., Imiolek A., Bohn M.A., Heintz T., Gettwert V.
Characterisation of different gun propellants by long-term mass loss.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 37-1 to 37-16

Teipel U.
Partikeltechnologie.
Chemie Ingenieur Technik 88 (2016) 7, Editorial, Gastherausgeber

Teipel U., Reller A. (Hrsg.)
Rohstoffeffizienz und Rohstoffinnovationen.
Fraunhofer Verlag, Stuttgart, 2016, Band 4, 399 S.,
ISBN 978-3-8396-0980-4

Teipel U.
Modified blaine test-characterization of specific surface area by the through-flow method.
Cement International 13 (2015) 6, S. 50-58

Teipel U., Seiler E.
Recycling von polymerbasierten Kompositebauteilen.
Vortrag ProcessNet Fachgruppe Energieverfahrenstechnik, Abfallbehandlung und Wertstoffrückgewinnung, 23. Februar 2016, Frankfurt

Trapani F., Polyzoidis A., Loebbecke S., Piscopo C.G.
On the general water harvesting capability of metal-organic frameworks under well-defined climatic conditions.
Microporous and Mesoporous Materials (2016), 230, pp. 20–24

Trauth A., Bücheler D., Weidenmann K.A., Henning, F.
Mechanical properties of unidirectional continuous carbon fiber reinforced sheet molding compounds.
17th European Conference on Composite Materials (ECCM17), München, 2016

Volk R., Sevilmis N., Stier C., Bayha A.
ResourceApp – Entwicklung eines mobilen Systems zur Erfassung und Erschließung von Ressourceneffizienzpotenzialen beim Rückbau von Infrastruktur und Produkten.
In: Dürkoop A., Brandstetter C.P., Gräbe G., Rentsch L. (2016) Innovative Technologien für Ressourceneffizienz – Strategische Metalle und Mineralien: Ergebnisse der Fördermaßnahme r³; mit CD-ROM, Stuttgart, Fraunhofer Verlag, 2016, ISBN 978-3-8396-1102-9, S. 389-404

Weidenmann K.A., Baumann S., Pinter P., Elsner P.
Analysis of fiber orientation, microstructure and mechanical properties of specimens made from fiberreinforced abs manufactured by fused filament fabrication (fff).
17th European Conference on Composite Materials Munich ECCM17, Germany, June 26-30, 2016

Weinert M., Gettwert V.
Fire Protection Coatings for Wood.
Poster, 2nd International Conference on the Chemistry of Construction Materials (ICCCM), October 10-12, 2016, München

Weiser V., Hürttlen J, Schaller U., Imiolek A.
Untersuchung der Anzündvorgänge Verschiedener Energetischer Materialien. Treibladungspulver und hypergole Treibstoffe.
Workshop Treib- und Explosivstoffe / Energiespeicher, Fraunhofer ICT, Pfinztal-Berghausen, 16.-17. November 2016

Weiser V., Hürttlen J., Schaller U., Imiolek A.
Aktuelle Arbeiten zu hypergolen Treibstoffen auf Basis H_2O_2/ADN/AN/HSPO.
Treffen der Nationale Arbeitsgruppe Gelantriebe, DLR – Institut für Raumfahrtantriebe, Lampoldshausen, 23.-24. November 2016

Weiser V., Fischer S., Gettwert V., Imiolek A., Schaller U.
Influence of energetic plasticizers on ADN/nitramine/GAP-solid rocket propellants with special focus to the burning behavior.
New Energetics Workshop, May 17-18, 2016, Stockholm, Sweden

Weiser V., Franzin A., DeLuca L.T., Fischer S., Gettwert V., Kelzenberg S., Knapp S., Raab A., Roth E., Eisenreich N.
Combustion behavior of aluminum particles in ADN/GAP composite propellants.
DeLuca L.T., Shimada T., Sinditskii V.P., Calabro M. (Editors) Chemical Rocket Propulsion - A comprehensive survey of energetic materials. Springer Aerospace Technology, 2017, ISBN 978-3-319-27746-2, pp. 253-270

Weiser V., Hürttlen J., Schaller U., Imiolek A., Lity A., Kelzenberg S.
Green liquid propellant oxidizers basing on solutions of ADN and AN in commercial hydrogen peroxide for hypergolic propellants.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 116-1 to 116-10

Wilhelm I., Rieger M., Hürttlen J., Wittek M., Alépée C., Leidinger M., Sauerwald T.
Novel low-cost selective pre-concentrators based on metal organic frameworks.
EUROSENSORS 2016, Budapest, September 4-7, 2016

Wurster S.
Simulation of double base propellant combustion using the ICT-cellular-combustion-algorithm.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 107-1 to 107-11

Wurster S., Fischer T.S.
Simulation of closed vesselcombustion using the 2D ICT-cellular-combustion-algorithm.
29th International Symposium on Ballistics, May 9-13, 2016, Edingburgh, UK

Yurrita Arce P., Klahn T., Deimling L., Roussel Garcia R., Schreiber A.
Mass flow measurements on airbag inflators.
In: Proceedings of the 47th International Annual Conference of the Fraunhofer ICT "Energetic Materials – Synthesis, Characterization, Processing", June 28 – July 1, 2016, Karlsruhe, Germany, pp. 128-1 to 128-11

HOW TO REACH US

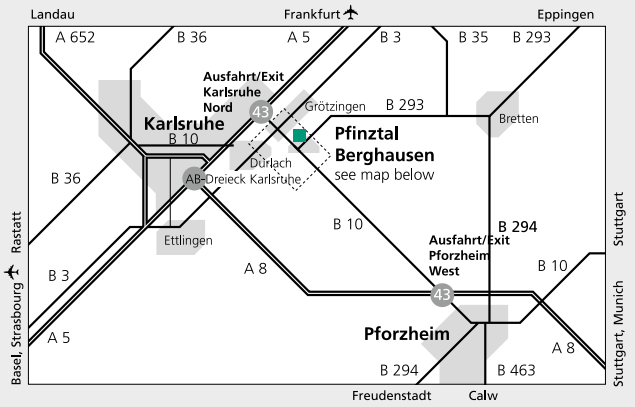
BY CAR

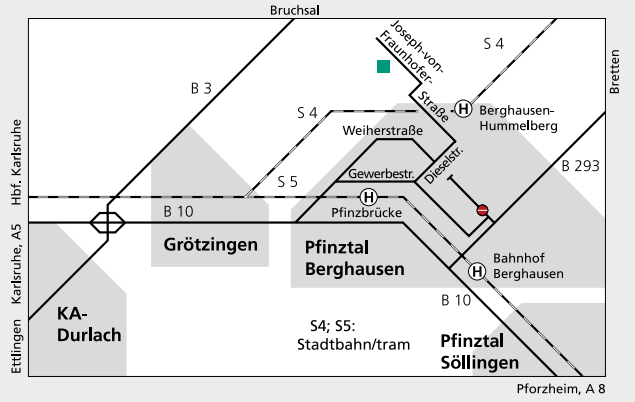
Approaching from Frankfurt/Main or Basel (CH):
Autobahn A5, exit Karlsruhe-Nord [43], follow B10 towards Pforzheim, turn left approx. 300 m after the tunnel and follow signs to the Fraunhofer ICT; follow Joseph-von-Fraunhofer-Straße approx. 1.5 km uphill to reach the institute.

Approaching from Stuttgart or Munich
Autobahn A8, exit Pforzheim-West [43], follow B10 towards Karlsruhe, drive through Pfinztal-Berghausen, turn right after the gas station at the edge of the village and then follow signs to the Fraunhofer ICT; follow Joseph-von-Fraunhofer-Straße approx. 1.5 km uphill to reach the institute.

BY TRAIN

Take the train to Karlsruhe Hauptbahnhof, change to the "Stadtbahn" (city tram) S4 which runs every 20 or 40 minutes towards Bretten/Eppingen/Heilbronn, exit at the stop Berghausen-Hummelberg. Travel time approx. 20 minutes, plus 10 minutes up the hill on foot. Please note that the S4 "Eilzug" does NOT stop at the stop "Hummelberg", and that the normal tram stops only on request (press the button near the door).





BY PLANE

- Frankfurt/Main Airport (approx. 120 km)
- Straßburg Airport (France) (approx. 100 km)
- Stuttgart Airport (approx. 80 km)
- Baden Airport Karlsruhe (approx. 40 km)

CONTACT

Fraunhofer-Institut für Chemische Technologie ICT
Joseph-von-Fraunhofer-Str. 7
76327 Pfinztal
Germany

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 69 institutes and research units. The majority of the 24,500 staff are qualified scientists and engineers, who work with an annual research budget of 2.1 billion euros. Of this sum, 1.9 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 state 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.

Figures are for January 2017.