Fraunhofer
IKTS

FRAUNHOFER INSTITUTE FOR CERAMIC TECHNOLOGIES AND SYSTEMS IKTS

ANNUAL REPORT 2016 2017

25 YEARS FRAUNHOFER IKTS

ANNUAL REPORT 2016/2017

Fraunhofer Institute for
Ceramic Technologies and Systems IKTS
Winterbergstrasse 28, 01277 Dresden-Gruna, Germany
Phone +49 351 2553-7700
Fax +49 351 2553-7600

Michael-Faraday-Strasse 1, 07629 Hermsdorf, Germany
Phone +49 36601 9301-0
Fax +49 36601 9301-3921

Maria-Reiche-Strasse 2, 01109 Dresden-Klotzsche, Germany
Phone +49 351 88815-501
Fax +49 351 88815-509

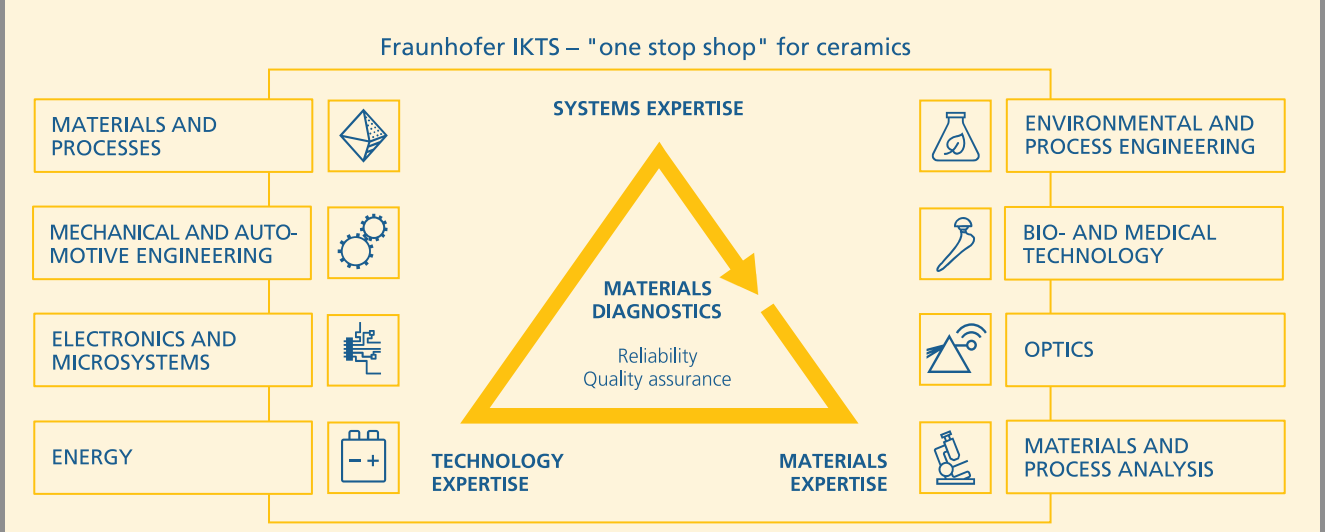
info@ikts.fraunhofer.de
www.ikts.fraunhofer.de

FOREWORD

Dear partners and friends of IKTS,

The year 2016 was another very successful and eventful year. With an order volume amounting to 19 million euros from projects with industry partners, all sites saw a significant increase in income from industry. At the Dresden-Gruna site, we were able to reach the 11 million euros mark for the first time ever. An impressive volume of 18.6 million euros was also generated from publicly funded projects completed in cooperation with industry partners. We have thereby once again demonstrated our relevance as a research partner for industry and will continue to pursue our mission as a Fraunhofer Institute with clear focus on applied research. With a total budget of approx. 54 million euros, we were also able to invest in initial research and equipment (approx. 3 million euros). The support of the Länder of Saxony and Thuringia and the federal government is especially appreciated. We are now optimally equipped to maintain our role as a competent partner for future collaborative efforts with industry.

The development of the non-destructive testing and materials diagnostics site at Dresden-Klotzsche was particularly pleasing. We were able to reach the break-even point in the reporting period and finished the year in the black. The topic of test technologies extending over the entire product life cycle of ceramics and other materials and systems holds an abundance of possibilities for process and product innovation. We will work on extending this topic and integrating it into our core area of structural and functional ceramics with the aim of creating synergetic effects. We will remain true to our strategy of covering all aspects of advanced ceramics as well as the value chain and are always open to suggestions for new topics and other input.

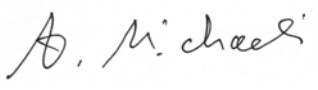


We are well prepared for the coming year and will continue to evolve the eight business divisions described in this report. The field of energy and environmental technology will continue to be a core focal point, with main emphasis being placed on storage technology for mobile and stationary applications. Our work on mobile applications will concentrate on Li-ion batteries and will revolve around solid-state batteries as a main topic. The topic of "range extenders" is another target for expansion and will involve fuel cells as well as internal combustion engines. $Na/NiCl_2$ battery research will be the primary focus in the area of stationary storage systems. In this field, we were able to acquire a new project through the Fraunhofer Future Foundation, enabling us to advance to the system development stage. With regard to batteries, we will focus on materials development and preparation as well as on new process technologies and will employ such strategies as additive manufacturing, which we also hope to further in other areas as new shaping method.

Another goal is the expansion of the topic of ceramics for water and hydrogen technologies. Both our ceramic membranes and our fuel cell systems operated in "reverse mode" as solid oxide electrolysis cells (SOECs) will be used. The combination of these technologies in conjunction with our environmental process technologies allows us to close recycling loops (energy, water, and recovery of valuables). This can also be beneficially applied to agriculture. We are currently planning on launching a research cluster with partner institutes of the Fraunhofer-Gesellschaft.

Additional highlights and trends from our business divisions can be found in this report. I hope you find them interesting and inspirational. As always, I invite you to take advantage of our comprehensive well-equipped facilities base and the outstanding IKTS team. We look forward to working with you.

Sincerely,



Alexander Michaelis

April 2017

TABLE OF CONTENTS

FRAUNHOFER IKTS IN PROFILE

PORTRAIT

The Fraunhofer Institute for Ceramic Technologies and Systems IKTS covers the field of advanced ceramics from basic preliminary research through to the entire range of applications. Superbly equipped laboratories and technical facilities covering 30,000 m^2 of useable space have been set up for this purpose at the sites in Dresden and Hermsdorf.

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

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

Among our unique areas of expertise, we offer:

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

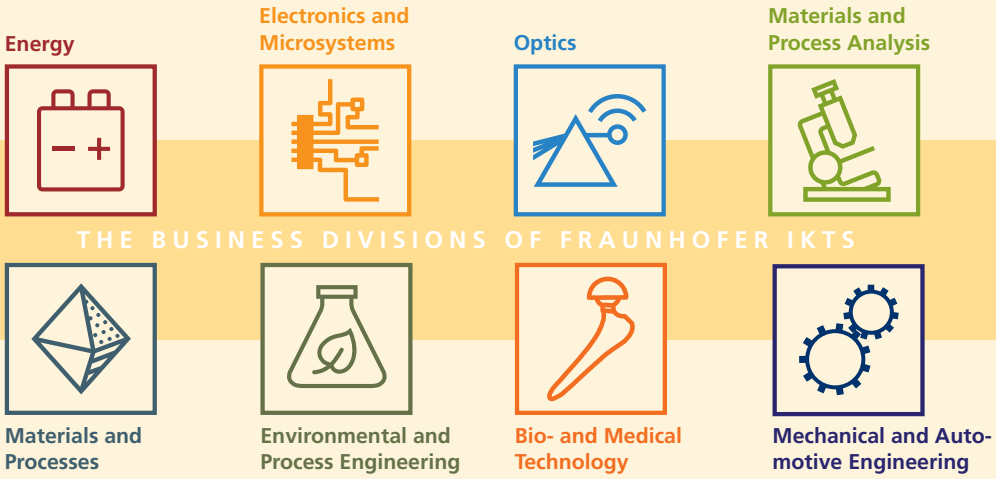
For any class of ceramic materials, we have access to all the standard processes of raw materials preparation, forming, heat treatment and finish processing. Where it makes sense, the institute can even conduct phase synthesis. In functional ceramics, we hold a particular core competency in paste and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

Multi-scale development

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

Synergies between materials and technologies

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



Competent analysis and quality assessment

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

Network creator

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

Standardized management for sustainable quality assurance

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

CORE COMPETENCIES OF FRAUNHOFER IKTS

MATERIALS AND SEMI-FINISHED PARTS

STRUCTURAL CERAMICS

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

FUNCTIONAL CERAMICS

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

ENVIRONMENTAL AND PROCESS ENGINEERING

Substrates
- Granulates
- Plates
- Tubes
- Capillaries
- Hollow fibers
- Honeycombs
- Foams

Membranes and filters
- Oxides, non-oxides
- Zeolites, carbon
- MOF, ZIF, composites
- Ion and mixed conductors

Catalysts
- Oxides
- Metals, CNT

RAW MATERIAL AND PROCESS ANALYSIS, MATERIALS DIAGNOSTICS, NON-DESTRUCTIVE EVALUATION

Analysis and evaluation of raw materials
- Analysis of particles, suspensions and granulates
- Chemical analysis

In-process characterization in ceramic technology
- Characterization
- Process simulation and design
- Quality management

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

Process design, process monitoring

TECHNOLOGY

Powder technology

Shaping

Heat treatment and sintering

Final machining

Precursor technology

Fiber technology

Additive manufacturing

Pilot production and upscaling

Coating technology

Joining technology

Thick-film technology

Multilayer
- HTCC, LTCC

Aerosol and inkjet-printing

Thin-film technology

Electrochemical machining

Galvanics

Materials separation
- Filtration, pervaporation
- Vapor permeation
- Gas separation
- Membrane extraction
- Membrane distillation
- Electromembrane processes

Catalysis

Biomass technology
- Preparation
- Conversion

Photocatalysis

Chemical process engineering

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

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

COMPONENTS AND SYSTEMS

Component design

Prototype production

Wear-resistant components

Tools

Optical components

Heating systems

Medical device technology and implants

Filters

System definition and plant development

Modeling and simulation

Design and prototype production

Validation/ CE marking

Test stand construction

Support in field tests

Samples and prototypes
- Membranes, filters
- Membrane modules
- Membrane plants

Filtration tests
- Laboratory, pilot, field
- Piloting

Modeling and simulation
- Materials transport
- Heat transport
- Reaction

Reactor development

Plant design

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

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

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

FRAUNHOFER IKTS IN FIGURES

Budget and revenues

The overall budget of Fraunhofer IKTS in 2016 was 53.7 million euros, just short of the previous year's level. All three cost centers contributed to a balanced budget. Business revenues amounted to 19.6 million euros, 3.3 million euros more than in the previous year. The total share yielded from direct industry projects for the institute as a whole was 38.7 %, 5.3 % more than in 2015. Particularly, the Hermsdorf site contributed once again to this success with a volume of 5.4 million euros and a share of 43.1 %. The share of revenues generated through EU projects increased by 160,000 euros to 2.8 %. The majority of these projects (86 %) were housed in Dresden. Over 3 million euros were utilized for new investments at the sites.

Personnel development

The employee count at IKTS remained at the 2015 level. Changes in personnel capacity requirements were accommodated through redistribution of resources among the various sites. A 6 % increase in technical personnel was offset by the lower number of doctoral students and apprentices due to the successful completion of the respective programs by the outgoing employees. New hires of apprentices are planned for 2017. One focus will be the definition of professional careers for scientists and non-scientists.

Expansion of the research basis

Within the classic working field of IKTS, the area of additive manufacturing is expanded further. The extended equipment basis enables processing of oxide and non-oxide ceramics.

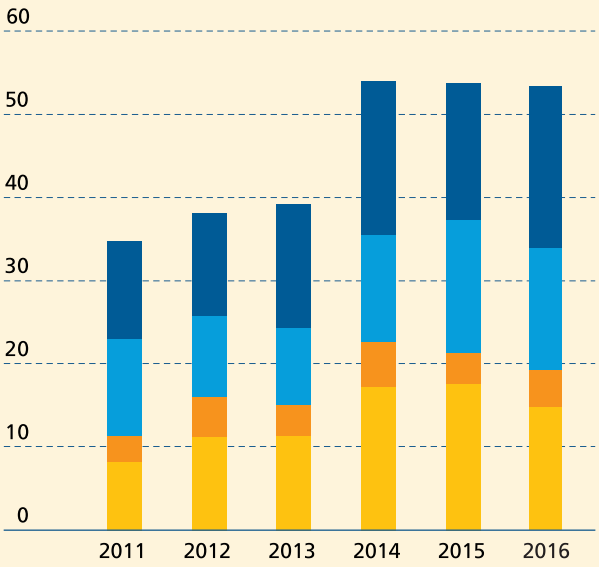
Integration of non-destructive test methods remains a strategic objective for 2017. Significant success has been achieved in the processing of various glass materials via powder-technological routes.

Development of the sintering technology at the Hermsdorf site yielded further improvements in manufacturing of membrane modules. This core area was strengthened through extensive investment in additional equipment.

As an activity operated by Fraunhofer IZI and Fraunhofer IKTS, the Bio-Nanotechnology Application Lab (BNAL) in Leipzig provided greater input to the other sites through the concentrated work of the Attract group. With the biological and medical know-how of Fraunhofer IZI combined with the expertise in developing new ceramic materials and innovative measurement methods of Fraunhofer IKTS, the lab is capable of handling a variety of international projects.

1

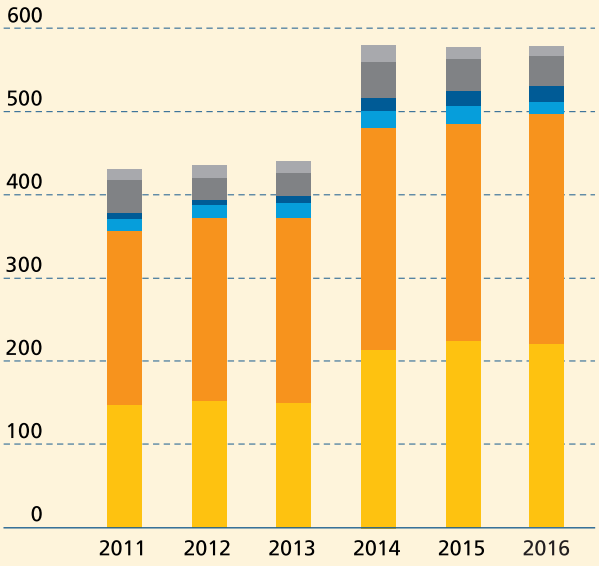
Revenue (in million euros) of Fraunhofer IKTS for the budget years 2011–2016



	2011	2012	2013	2014	2015	2016
Industrial revenue	11.9	12.6	14.4	18.6	16.3	19.6
Public-sector revenue	11.8	9.8	9.4	12.9	16.4	14.8
EU and other revenue	3.2	5.0	4.2	5.5	3.6	4.4
Institutional support	8.5	11.5	11.6	17.2	17.8	14.8
=	**35.3**	**38.9**	**39.6**	**54.2**	**54.1**	**53.6**

Personnel developments at Fraunhofer IKTS

Number of employees 2011–2016, full-time equivalents, personnel structure on December 31 of each year



	2011	2012	2013	2014	2015	2016
Apprentices	13	16	14	19	15	11
Student workers, trainees, undergraduate students	40	27	28	44	38	36
Part-time and contract workers	6	5	8	16	18	19
PhD candidates	14	15	19	20	21	15
Employees with university degrees and technicians	211	221	223	267	260	276
Scientists	147	154	150	214	223	220
=	**431**	**438**	**442**	**580**	**575**	**577**

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

ORGANIZATIONAL CHART

Institute Director	Prof. Dr. habil. Alexander Michaelis
Deputy Institute Director / Head of Administration	Dr. Michael Zins
Deputy Institute Director / Marketing and Strategy	Prof. Dr. Michael Stelter
Deputy Institute Director	Dr. Ingolf Voigt
Deputy Institute Director	Dr. Christian Wunderlich

Materials

Nonoxide Ceramics
Dipl.-Krist. Jörg Adler
- Nitride Ceramics and Structural Ceramics with Electrical Function
- Carbid Ceramics and Filter Ceramics

Oxide Ceramics
Dr. Sabine Begand
- Materials Synthesis and Development
- Pilot Manufacturing of High-Purity Ceramics
- Oxide and Polymerceramic Composites*

Processes and Components
Dr. Hagen Klemm
- Powder Technology
- Shaping
- Component Development
- Finishing
- Process Technology and Silicate Ceramics

* certified according to DIN EN ISO 13485

Sintering and Characterization / Non-Destructive Testing
Dr. habil. Mathias Herrmann
- Thermal Analysis and Thermal Physics*
- Heat Treatment
- Ceramography and Phase Analysis

Environmental and Process Engineering

Nanoporous Membranes
Dr. Hannes Richter
- Zeolithe Membranes and Nano-Composites
- Carbon-Based Membranes
- Membrane Prototypes

High-Temperature Separation and Catalysis
Dr. Ralf Kriegel
- High-Temperature Membranes and Storages
- High-Temperature Separation
- Catalysis and Materials Synthesis

Biomass Technologies and Membrane Process Engineering
Dr. Burkhardt Faßauer
- Biomass Conversion and Water Technology
- Mixing Processes and Reactor Optimization
- Membrane Process Technology and Modeling
- Technical Electrolysis and Geothermal Energy

Chemical Engineering and Electrochemistry
PD Dr. Matthias Jahn
- Modeling and Simulation
- Process Systems Engineering
- Electrochemistry

Sites of Fraunhofer IKTS
Headquarters Dresden-Gruna, Saxony
Site Dresden-Klotzsche, Saxony
Site Hermsdorf, Thuringia
Project Group Berlin

Application Center
Battery Technology, Pleißa, Saxony
Bioenergy, Pöhl, Saxony
Bio-Nanotechnology Application Lab BNAL, Leipzig, Saxony
Membrane Technology, Schmalkalden, Thuringia
Tape Casting Center, Hermsdorf, Thuringia

Technische Universität Dresden	
ifWW – Inorganic-Nonmetallic Materials	Prof. Dr. habil. Alexander Michaelis
IAVT – Electronic Packaging Laboratory	Jun.-Prof. Henning Heuer
DCN – Dresden Center for Nanoanalysis	Prof. Dr. habil. Ehrenfried Zschech
Friedrich-Schiller University Jena	
Technical Environmental Chemistry	Prof. Dr. Michael Stelter
Iowa State University	
Aerospace Engineering	Prof. Dr. habil. Norbert Meyendorf

- Powder and Suspension Characterization*
- Quality Assurance Laboratory* and Mechanics Laboratory
- Chemical and Structural Analysis
- Hardmetals and Cermets
- Accredited Test Lab*

* accredited according to DIN EN ISO/IEC 17025

Energy Systems / Bio- and Medical Technology

Materials and Components

Dr. Mihails Kusnezoff

- Joining Technology
- High-Temperature Electrochemistry and Catalysis
- Ceramic Energy Converters
- Materials MCFC

System Integration and Technology Transfer

Dr. Roland Weidl

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

Bio- and Nanotechnology

Dr. Jörg Opitz

- Biological, immunological and optical Nanosensors
- Acoustical Diagnostics

Electronics and Microsystems Engineering

Smart Materials and Systems

Dr. Holger Neubert

- Multifunctional Materials and Components
- Applied Material Mechanics and Solid-State Transducers
- Systems for Condition Monitoring

Hybrid Microsystems

Dr. Uwe Partsch

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

Testing of Electronics and Optical Methods

Dr. Mike Röllig

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

Systems for Testing and Analysis

Jun.-Prof. Henning Heuer

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

Microelectronic Materials and Nanoanalysis

Prof. Dr. habil. Ehrenfried Zschech

- Micro- and Nanoanalysis
- Materials and Reliability for Microelectronics

Project Group Berlin

Dipl.-Ing. R. Schallert

BOARD OF TRUSTEES

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

Dr. A. Beck
Saxon State Ministry for Science and the Arts, Dresden
Head of Department "Bund-Länder-Research Institutes"

Dipl.-Ing. R. Fetter
Thuringian Ministry for Economy, Science and the Digital Society, Erfurt
Department "Institutional Research"

Dr. habil. M. Gude
Thuringian Ministry for the Environment, Energy and Nature Conservation, Erfurt
Head of Department "Energy and Climate"

Dr. P. Heilmann
arXes-tolina GmbH, Berlin
Manager

A. Heller
Landrat of the Saale-Holzland-Region, Eisenberg

Dr. W. Köck
Plansee SE, Reutte
Executive Director

A. Krey
State Development Corporation of Thuringia (LEG), Erfurt
Manager

Dr. R. Lenk
CeramTec GmbH, Plochingen
Head of Service Center Development

Dr. C. Lesniak
3M Technical Ceramics, branch of 3M Deutschland GmbH, Kempten
Senior Laboratory Manager

Dr. H. H. Matthias
TRIDELTA GmbH, Hermsdorf
Managing Director

Dr. R. Metzler
Rauschert GmbH, Judenbach-Heinersdorf
Managing Director

P. G. Nothnagel
Saxony Economic Development Corporation, Dresden
Managing Director

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

Dr.-Ing. W. Rossner
former Siemens AG, München

Dr. K.-H. Stegemann
X-FAB Dresden GmbH & Co. KG
Division Manager Solar Cell and Module, Manager Business Development

Dr. D. Stenkamp
TÜV Nord AG, Hannover
Board of Management

MR C. Zimmer-Conrad
State Minister for Economic Affairs, Labour and Transportation, Dresden
Head of Department "Innovation Policy, Technology Funding"

THE FRAUNHOFER-GESELLSCHAFT

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

At present, the Fraunhofer-Gesellschaft maintains 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 % of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 % 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.

Fraunhofer locations in Germany

RETROSPECTIVE


1


2

EVENTS AND HIGHLIGHTS

January 28, 2016

Competitive advantage through industry 4.0 – innovative processes and process integration for manufacturing

More than 50 guests were welcomed by HERMOS Systems GmbH, Fraunhofer IKTS, and Bechtle AG to the Industry Night in Dresden-Klotzsche. Through presentations and laboratory tours, participants were introduced to concepts and possibilities for implementing Industry 4.0 in their own companies. The three event organizers, who combined their competencies in this field, presented a wide range of trend-setting solutions for optimization of the entire value chain. Through integration of innovative automation technology, smart sensors, and customized IT, customers now receive tailored system solutions from a single source.

April 28, 2016

Girls'Day – future prospects for girls

Girls and technology go together – at Fraunhofer! With this as a guiding theme, Fraunhofer IKTS presented itself as a training provider to interested girls at the Dresden-Klotzsche site. Participants were invited to try out some of the typical tasks performed by a physics lab technician. Girls performed bending tests on various materials, prepared samples for metallography, and examined metal microstructures under the microscope. The Germany-wide Girls'Day is intended to interest girls in grades 5 and above in vocational training and studies in IT, the trades, natural sciences, and technology.

April 30, 2016

Memorandum of understanding signed for collaboration on additive manufacturing of ceramics

In the presence of Saxon Minister President Stanislaw Tillich, the Institute Director of Fraunhofer IKTS and the Director of the Singapore Center for 3D Printing at the Nanyang Technological University signed a memorandum of understanding on joint research and development work as well as exchange of skilled workers between Saxony and Singapore. The partners hope to

3

4

revolutionize the use of ceramic materials in industry by realizing advanced ceramic components with additive manufacturing. Also known as "3D printing", additive manufacturing is the computer-controlled buildup of geometrically complex parts layer by layer that cannot be made using conventional methods. With it, customized implants, everyday objects, and even jewelry can be manufactured at a low cost.

May 2, 2016

Fraunhofer IKTS opens new Tape Casting Competence Center in Hermsdorf

Europe's most modern Tape Casting Competence Center opened in Hermsdorf, Germany in the presence of Thuringian Minister of Economic Affairs, Science, and Digital Society Wolfgang Tiefensee. The laboratory complex offers diverse processes for tape preparation and deposition as well as technologies for tape drying and post-processing. Tapes made of ceramics and other functional materials form the basis for numerous products found in daily life and industry. These tapes are used in such applications as ceramic microsystems technology (LTCC, HTCC), battery technologies, filtration, and gas separation. The Thuringian Ministry of Economic Affairs, Science, and Digital Society (TMWWDG), the Fraunhofer-Gesellschaft, and Fraunhofer IKTS contributed a total of about one million euros towards the construction and equipment of the new center.

May 25, 2016

Fraunhofer workshop on "Ceramic technologies for power generation and energy storage" in São Paolo, Brazil

Brazil is currently one of the least CO_2-intensive industrialized nations in the world, with 45 % of its energy needs coming from renewable sources. At the same time, the country is expanding its natural oil and gas production. At the first Fraunhofer workshop, scientists from Fraunhofer IKTS and 40 local experts from science and industry discussed progressive energy technologies for decentralized power generation as well as the potential of gas separation membranes, high-temperature fuel cells, and stationary batteries.

June 1–2, 2016

Industry Day "Characterization of mechanical properties at high temperatures"

Determining material parameters at high temperature is considerably more difficult and complex than at room temperature. During the Industry Day with 30 participants, recent developments in the fields of measurement technology and high-temperature measurement methods were presented by means of application examples. At the accompanying industrial exhibition, manufacturers and service providers were on hand to provide information on application trends and state-of-the-art equipment.

1 *Girls investigate the behavior of different materials in bending tests on Girls'Day.*

2 *Thuringian Minister of Economic Affairs Wolfgang Tiefensee (center), Dr. Ingolf Voigt (left) and Beate Capraro (right) open the Tape Casting Competence Center at Fraunhofer IKTS in Hermsdorf.*

3 *Signing of the MoU between Fraunhofer IKTS and Singapore Center for 3D Printing in the presence of Saxon Minister President Stanislaw Tillich.*

4 *Participants of the Fraunhofer workshop on innovative energy technologies in São Paolo.*

1

2

June 10, 2016

Dresden's Researchers' Night

Nearly 2000 interested visitors strolled through Fraunhofer IKTS and 12 high-performance ceramics stations during Dresden's Researchers' Night. Visitors were invited to learn about 3D printing of ceramics, filter membranes, ceramic implants, and fuel cells through exhibits and experiments, and a laboratory tour gave them a firsthand impression of our research on environment-related topics. Children were able to build a battery out of household items, try out screen printing, and test their knowledge in a quiz. With a total of 700 events and around 35,000 visitors, this was the biggest Dresden's Researchers' Night ever.

June 29, 2016

SMWA innovation tour is guest at Fraunhofer IKTS

On June 29, 2016, Saxon Minister of Economic Affairs Martin Dulig visited Fraunhofer IKTS as part of his SMWA summer tour on "innovation and the future". In a laboratory talk with experts, he learned about ceramic technologies for sustainable energy generation and storage. Besides fuel cell technologies for energy generation, the ceramic cerenergy® battery and technologies for alternative use and storage of surplus power (power-to-X, biogas pellets, oxygen generator) were discussed.

July 4, 2016

Science exhibition at Dresden's Neumarkt ("New Market")

From July 4, 2016, to October 3, 2016, a science exhibition organized by the DRESDEN concept network invited passersby at the Neumarkt in Dresden to discover the many facets of the local research landscape. The latest research highlights were presented on large display panels. Visitors could find the answers to questions, such as how often an axolotl could regenerate its legs, how books that were falling apart could become computer-compatible, and what "tactile Internet" actually means. Fraunhofer IKTS and partners presented solutions for power generation, energy storage, and energy efficiency.

August 17, 2016

"Die Sendung mit der Maus" filmed at Fraunhofer IKTS

How is an automotive catalytic converter made and how does it work? A film team from the "Sendung mit der Maus" pursued these questions during a visit to Fraunhofer IKTS in Hermsdorf and filmed the entire process chain for producing a honeycomb catalytic converter, through which exhaust gas flows. Through chemical reactions with the washcoat, pollutants, such as carbon monoxide, are converted to harmless substances, such as carbon dioxide and water. The episode aired on October 29, 2016.

October 1–3, 2016

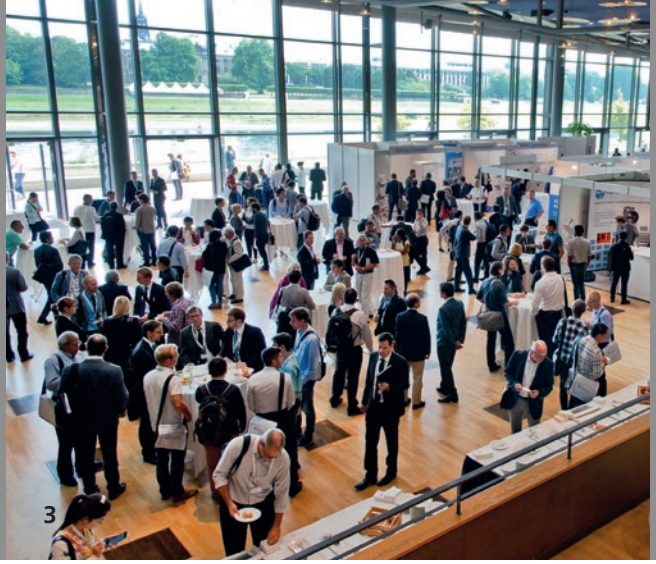
German Unity Day

The central celebrations for the 2016 German Unity Day were held in the German state of Saxony. The Neumarkt ("New Market") in Dresden was transformed into a Saxon science park, at which research institutions and initiatives demonstrated how versatile, value-adding, and exciting research could be by means of exhibits and experiments. At a group pavilion, the Fraunhofer Institutes presented highlights from biological research, materials science, and production technologies as well as nano- and microelectronics. Fraunhofer IKTS showed a thermoelectric generator for generating power from waste heat. In two presentations, the potential of advanced ceramics in the conversion to renewable energies and in personalized medicine was described.

August 21–25, 2016

ICC6 | 6th International Congress on Ceramics

More than 650 ceramics experts from 47 countries gathered at the 6th International Congress on Ceramics (ICC6) in Dres-



den to discuss the latest innovations and scientific findings in the field of advanced ceramics. "From Lab to Fab" was the theme of the approximately 400 talks in 16 parallel symposia addressing the latest research results as well as their manifold possibilities for application in industrial practice. A trade show in which 20 companies and institutions took part and a poster presentation with 120 contributions took place alongside ICC6. This was the first time that the conference was held in Germany, organized by Fraunhofer IKTS and Deutsche Keramische Gesellschaft e. V. (DKG) on behalf of the International Ceramic Federation (ICF).

November 24–25, 2016

Anodizing – oxide layers from hard to smart

Anodic oxide layers can be much more than just means of efficient corrosion protection. Participants of the symposium discussed the latest developments and trends in anodization for the medical, automotive, aerospace, energy, facade protection, and environmental engineering industries. The main themes included functionalized surfaces, nanofiltration membranes, and plasmaelectrolytic processes. 50 participants followed the invitation to Dresden.

January 10, 2017

Pearls of research – future-oriented research in seven minutes

Ten researchers from the Fraunhofer-Gesellschaft and the Max Planck Society presented trendsetting technologies and concepts to German Chancellor Dr. Angela Merkel, Prof. Johanna Wanka (Federal Minister of Education and Research), and Dr. Rainer Sontowski (State Secretary at the Federal Ministry for Economic Affairs and Energy). The idea for this event arose out of the Innovation Dialog held at the German Chancellery to provide a platform for the Federal Government to receive independent expert advice on questions concerning innovation policy with the participation of high-ranking representatives from business, science, and society. Dr. Mareike Wolter from Fraunhofer IKTS presented "EMBATT", an innovative battery concept for electric vehicles with which a range of 1000 kilometers is possible.

January 17–18, 2017

Ceramics Vision 2017

At the tenth "Ceramics Vision" symposium, 110 participants discussed new ceramics developments and application trends in energy and environmental technology, medical engineering, and micro- and nanotechnology in Hermsdorf, Thuringia. The presented application areas ranged from energy generation and storage, conditioning of industrial waste water, increasing the efficiency of combustion processes, and sensor systems to ceramic dental components. The potential of additive manufacturing and of ceramic fibers and composite materials for the development of novel high-tech products was also pointed out.

1 *Prof. Michael Stelter informs Saxon Minister of Economic Affairs Martin Dulig about energy technologies developed by Fraunhofer IKTS.*
2 *Saxon Minister of Science and the Arts Dr. Eva-Maria Stange visits the IKTS booth on German Unity Day.*
3 *ICC6 congress at Dresden International Congress Center.*
4 *Dr. Mareike Wolter presents the EMBATT battery for electric vehicles to Dr. Angela Merkel, Prof. Johanna Wanka and Dr. Rainer Sontowski (Copyright: Ausserhofer/MPG).*

1

2

"Ceramics Vision 2017" was especially dedicated to Dr. Bärbel Voigtsberger and her visionary contributions to Fraunhofer IKTS, the ceramics location of Hermsdorf, and Deutsche Keramische Gesellschaft e. V. (DKG). Voigtsberger was awarded the Fraunhofer Medal for her life's work.

Awards

April 14, 2016

NAThüringen permanent membership granted to Fraunhofer IKTS in Hermsdorf

On April 14, 2016, Fraunhofer IKTS was awarded a permanent membership from the NAThüringen (sustainability agreement of Thuringia) in the Thuringian State Parliament. NAThüringen is a voluntary agreement between the Thuringian State Government and the Thuringian business community in which the participants commit to meeting defined sustainability targets. The aim is to promote the sustainable economic growth of the State of Thuringia. In 2016, the total number of participating companies was 450. Fraunhofer IKTS in Hermsdorf has been participating in NAThüringen every year since 2005, therefore being one of NAThüringen's first members.

May 11, 2016

Biogas Innovation Award for development of biogas pellets

In the past, straw utilization in biogas plants was considered to be difficult due to floating layers and an unfavorable mass-to-volume ratio. The straw biogas pellets developed at Fraunhofer IKTS guarantee a considerably higher biogas yield with improved handling and good transportability. For this successful development work, performed within the scope of the BMWi-funded research project "EFFIGEST," Björn Schwarz received the 10,000-euro Biogas Innovation Award of the German Agricultural Sector for 2016 in the "Science" category.

July 13, 2016

2016 3D InCities Award for Fraunhofer 3D Integration Cluster

The Fraunhofer 3D Integration Cluster was recognized with the 2016 3D InCities Award in the category of "Research institute of the year." This international award recognizes the outstanding research performed in 3D packaging technologies by the cluster of Fraunhofer Institutes that includes IKTS, IZM, ENAS, EAS, and IPMS.

September 30, 2016

2016 KGCCI Innovation Award for Fraunhofer IKTS cooperation with iBULe Photonics

The Korean company iBULe Photonics received the KGCCI Innovation Award of the Korean-German Chamber of Commerce and Industry in the category of "Innovation in business" for the commercial ultrasonic testing of specialty materials. Fraunhofer IKTS developed the sensors used for testing in close cooperation with InfraTec GmbH.

October 24, 2016

Prof. Michaelis named Fellow of the American Ceramic Society

The American Ceramic Society (ACerS) named Fraunhofer IKTS Director Prof. Alexander Michaelis "Fellow of the Society" for his long commitment and outstanding contributions to applied research and development of advanced ceramics.

October 31, 2016

IEC 1906 Award for technical standards for use of nanomaterials

For his instrumental role in the formulation of technical standards for use of nanomaterials in nano-based electrochemical storage systems, Dr. Mihails Kusnezoff was honored with the

IEC 1906 Award of the German Commission for Electrical, Electronic, and Information Technologies of DIN and VDE (DKE). Within the framework of this initiative, three standards pertaining to key characteristics of nanoproduction were developed and implemented in a technical standard (IEC/TS).

November 15, 2016

Dr. Klaus Seppeler Foundation Prize for master's thesis

Tobias Liebmann received this year's Dr. Klaus Seppeler Foundation Prize from the Society for Corrosion Protection (GfKORR) for his master's thesis on wrought aluminum alloys. These extremely strong alloys are used as lightweight construction materials, e.g., in aircraft fuselages. By means of anodization, metals can be protected against corrosion or prepared with alloys for subsequent bonding or painting. With the newly gained knowledge, it is now possible to apply anodization processes more precisely and generate suitable parameters for optimum corrosion protection of materials.

November 16, 2016

Dissertation on ceramic thermoelectric materials recognized

For his dissertation on ceramic thermoelectric materials, Dr. Bing Feng received the Junior Prize of the German Thermoelectric Society (DTG). The ceramic nano-TEG materials developed over the course of the dissertation work are efficient and inexpensive. They have the potential to enable economically attractive use of waste heat in industrial processes and hence reduce the environmental impact of technological processes.

January 23, 2017

ACerS Best Paper Award for publication on particulate filters

The Best Paper Award (1st prize) of the Engineering Ceramics Division of the American Ceramic Society (ACerS) in 2016 went to Jörg Adler and Dr. Uwe Petasch from Fraunhofer IKTS for their research on optimization of engine exhaust particulate filters. The talk presented at the International Conference on Advanced Ceramics & Composites in Daytona Beach, Florida, showed how optimally adjusted membrane coatings could improve the efficiency of particulate filters.

1 *Prof. Alfred Gossner, member of the Fraunhofer executive board, presents the Fraunhofer medal to Dr. Bärbel Voigtsberger at Ceramics Vision 2017.*

2 *Awarding of the "NAThüringen" permanent membership to Dr. Ingolf Voigt and Dr. Jürgen Böer.*

3 *ACerS president Dr. Mrityunjay Singh names Prof. Alexander Michaelis "Fellow of the Society".*

4 *IEC 1906 Awards presentation, f.l.t.r.: Michael Teigeler (CEO of DKE), Dr. Mihails Kusnezoff (Fraunhofer IKTS) and Dr. Bernhard Thies (spokesperson of DKE executive board) (Source: DKE).*

1


2

TRADE FAIR REVIEW 2016 – SCIENCE TO MARKET

Pioneering ceramic technologies for energy storage and converters, personalized medicine and energy-efficient materials separation processes: research highlights from Fraunhofer IKTS were presented at 41 German and international trade shows in 2016.

The lowest-cost battery in the world, currently being developed at Fraunhofer IKTS in Hermsdorf, was presented at the **Energy Storage** in Dusseldorf. With cerenergy®, researchers have developed an inexpensive, maintenance-free high-temperature rechargeable battery that can also be used for stationary storage of large amounts of energy from wind power plants, solar parks, and fuel cells. Through the combination of easily available raw materials, such as clay or table salt, and state-of-the-art ceramic processes, system costs can be brought down to less than 300 euros per kWh. At **Hannover Messe**, the entire energy value chain was shown according to the trade fair's theme "Integrated Energy – the energy system of the future". In this context, Fraunhofer IKTS presented ceramic thermoelectric generators (TEGs), that can be economically manufactured and be applied at operating temperatures of up to 1000 °C. At the world's largest industrial event in the state capital of Lower Saxony, a new development from the field of condition monitoring was premiered. Fraunhofer IKTS showed its novel sensor ring for the permanent monitoring of offshore wind turbines. This is especially challenging for the divers who periodically check the particularly vulnerable welds at the anchors. With the new sensor collar, this hitherto tedious and lengthy underwater process can be completed in a few minutes. For the measurement, the diver couples a handheld unit to the collar via an interface and starts the examination with the push of a button. Ultrasonic waves are used for detection of cracks and other defects.

For years, 3D printers have been used for converting digitized datasets to plastically formable metal or plastic parts. Fraunhofer IKTS has now paved the way for biocompatible high-performance ceramics. At **MedTec** in Stuttgart, Germany and **AMX** in Lucerne, Switzerland, the future of personalized medicine was revealed. With different and partially combined additive methods, bone implants, dental prostheses, or surgical instruments can be manufactured with minimal resource consumption and no tools or limitations on design. 3D printing in particular can also be used for hardmetals with maximum design freedom as well as a quality comparable to that achieved using conventional methods. At **WorldPM** in Hamburg, Germany, visitors could gain an impression of the possibilities this opens up for toolmaking.

In the area of membrane process technology, the activities of Fraunhofer IKTS also played an important role in the trade fair participations in 2016. Canada is second only to Saudi Arabia in terms of oil reserves. The oil is bound in sand and has been extracted in a water-intensive process since the turn of the millennium. At **IFAT** in Munich, Germany, IKTS researchers informed about a method for increasing the cost-effectiveness and sustainability of the process by utilizing the waste water with nanofiltration membranes for additional process steps. Because of their resistance to organic constituents and oils, their desalination properties, and their thermal stability, these membranes are ideal for efficient oil treatment.

European 3D Summit
Grenoble, January 18–20

nano tech
Tokyo, January 27–29.

Photonics West
San Francisco, February 16–18

FC Expo
Tokyo, March 2–4

Battery Japan
Tokyo, March 2–4

Essener Tagung
Essen, March 2–4

JEC World Composites
Paris, March 8–10

Energy Storage
Dusseldorf, March 15–17

Electronica China
Shanghai, March 15–17

Thür. Trinkwassertagung
Jena, April 6–7

MedTec Europe
Stuttgart, April 12–14

Wind & Maritim
Rostock, April 13–14

ThEGA-Forum
Weimar, April 18

Powtech
Nuremberg, April 19–21

Hannover Messe
Hannover, April 25–29

Biogas Innovation Congress
Osnabrück, April 26–27

Control
Stuttgart, April 26–29

Printed Electronics
Berlin, April 27–28

ACHEMAsia
Beijing, May 9–12

PCIM Europe
Nuremberg, May 10–12

Sensor+Test
Nuremberg, May 10–12

Innovationsforum Spreu-Stroh
Chemnitz, May 19–20

IFAT
Munich, May 30 – June 3

Umweltwoche
Berlin, June 7–8

Cancer Diagnostics
Rome, June 13–15

WCNDT
Munich, June 13–17

Actuator
Bremen, June 13–15

Rapidtech
Erfurt, June 21–23

EFCF
Lucerne, July 5–8

ICC6
Dresden, August 21–25

Ostthür. Kooperationsbörse
Dornburg, September 15

AM Expo
Lucerne, September 20–21

Innotrans
Berlin, September 20–23

WorldPM
Hamburg, October 9–13

World Cancer Congress
Paris, October 31 – November 3

FAD Conference
Dresden, November 3–4

Electronica
Munich, November 8–11

Thüringer Unternehmertag
Erfurt, November 9

MEDICA
Dusseldorf, November 13–17

Formnext
Frankfurt a.M., November 15–18

Thüringen Erneuer!bar
Weimar, November 17

ADeKo Conference
Dresden, November 17–18

Hagener Symposium
Hagen, November 24–25

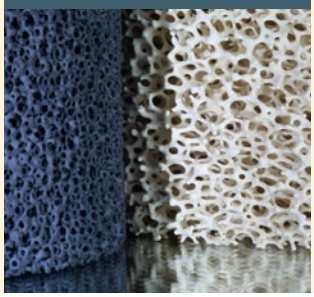
Composites
Stuttgart, November 29 – December 1

ThEEN-Innovationsdialog
Erfurt, November 30

1 *Dr. Matthias Schulz presents cerenergy® battery in Hannover.*
2 *Dr. Holger Neubert informs Fraunhofer president Prof. Reimund Neugebauer about systems for condition monitoring.*
3 *Dr. Sylvia Gebhardt shows piezoceramic components at Actuator trade fair.*
4 *Stefan Rothe explains IKTS fuel cell technology at the European Fuel Cell Forum in Lucerne.*

HIGHLIGHTS FROM OUR BUSINESS DIVISIONS

Materials and Processes

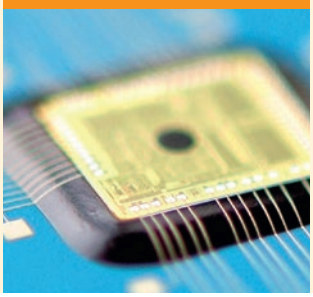


The "Materials and Processes" business division provides a central point of contact for all matters related to development, manufacturing, and qualification of high-performance ceramics for a wide range of applications. A wealth of experience has been accumulated in all relevant materials and technologies, for which requirement-related functional solutions are developed. The scope of activities encompasses the entire process chain, making this division crucial to all other business divisions.

Mechanical and Automotive Engineering

High-performance ceramics are key components in mechanical and automotive engineering. Due to their outstanding properties, they are often the only available options. The "Mechanical and Automotive Engineering" business division offers high-performance ceramic, hard metal, and cermet wear parts and tools as well as parts for specific loading conditions. A new core area comprising test systems for monitoring components and production facilities based on optical, elastodynamic, and magnetic effects has also been established.

Electronics and Microsystems

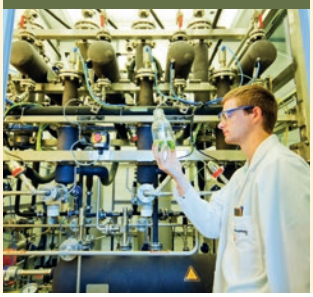


The "Electronics and Microsystems" business division offers manufacturers and users unique access to materials, technologies, and know-how to help them develop robust, high-performance electronic components. Focus is on sensors and sensor systems as well as power electronic components and "smart" multifunctional systems. With the help of innovative test methods and systems, Fraunhofer IKTS provides support along the entire value-added chain – from materials to integration of complex electronic systems.

Energy

Ceramic materials and technologies form the basis for improved and fundamentally new applications in energy technology. To that end, Fraunhofer IKTS develops, builds, and tests innovative components, modules, and complete systems, focusing mainly on ceramic solid-state ionic conductors. Applications range from electrochemical energy storage systems and fuel cells, solar cells, energy harvesting modules, and thermal energy systems to solutions for biofuels and chemical fuels.

Environmental and Process Engineering

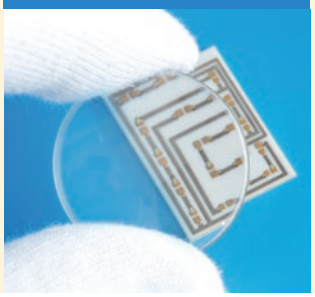


Fraunhofer IKTS develops innovative materials, technologies, and systems for safe, efficient, environmentally, and climate-friendly conversion of energy and substances. Focus is on processes involving conventional and biological energy sources as well as strategies and processes for water and air purification and treatment, and for recovery of valuable raw materials from waste. New reactor designs for the chemical industry are made possible by ceramic technologies.

Bio- and Medical Technology

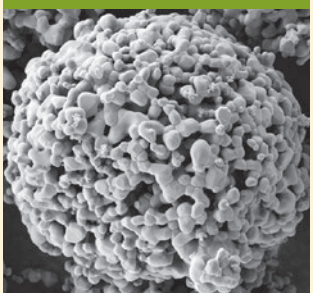
Fraunhofer IKTS makes use of the outstanding properties of ceramic materials to develop dental and endoprosthetic implants and surgical instruments. In well-equipped, certified laboratories, the interactions between biological and synthetic materials are investigated and applied towards the development of improved materials, analytics, and diagnostics. In part unique optical, acoustic, and bioelectrical techniques are available for this purpose.

Optics

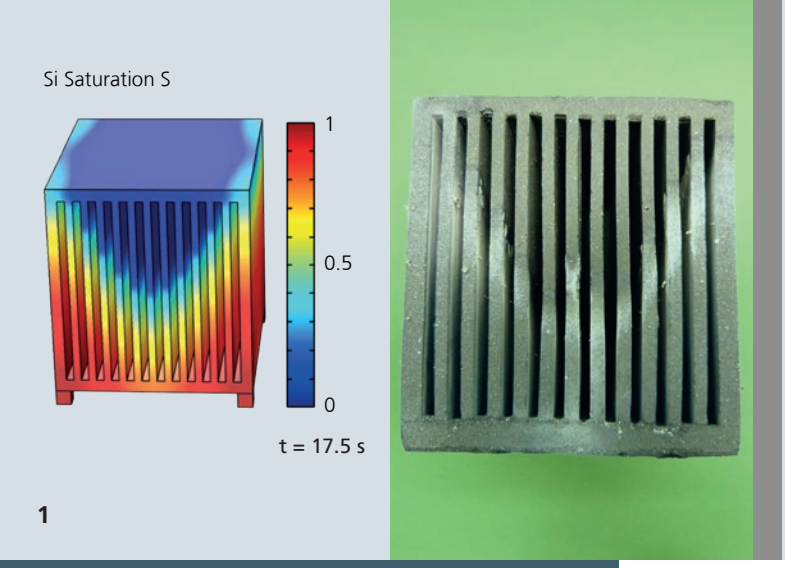


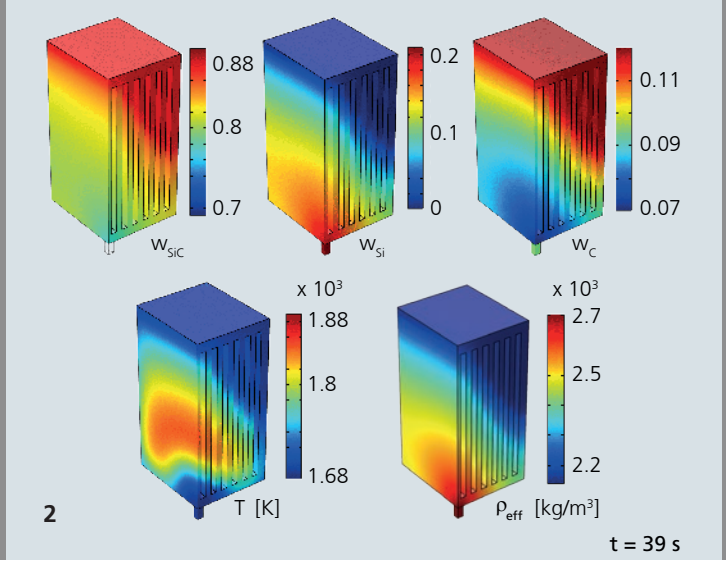
Fraunhofer IKTS develops ceramic materials and components for photonics, lighting applications, and ballistic protection. Phase synthesis combined with materials and technology expertise yields innovative luminescent materials, active optoceramics, optical and decorative elements, and transparent ceramics for defense applications. Optical technologies are also used in measurement and diagnostic systems in medicine, life sciences, and industry.

Materials and Process Analysis



Fraunhofer IKTS offers a wide range of test, characterization, and analysis methods for materials properties and production processes. As a reliable, multiply accredited, and audited service provider, Fraunhofer IKTS assists in the investigation of fundamental aspects of materials science, application-specific issues, and measurement-related developments. Characteristic parameters are not only determined but also interpreted within the context of the respective application to uncover any potential for optimization.





SIMULATION TOOL FOR THE OPTIMIZED MANUFACTURING OF CERAMIC MODULES

Dr. Wieland Beckert, Dr. Steffen Kunze, Dipl.-Krist. Jörg Adler

Reaction bonding is a well-known and widely used technology for manufacturing of high-quality engineering ceramic components, especially liquid silicon-infiltrated silicon carbide (SiSiC) components. In this process, a porous compacted preform (C-SiC) is infiltrated with molten silicon and converted through a reaction (Si[liquid] + C → SiC). Ceramic structure formation takes place not in the usual way via a sintering process, but instead in a nearly shrinkage-free manner via chemical reactions in which secondary binder phases are formed between the primary particles. The process is complex and error-prone (non-uniform filling, crack formation). Process control is usually purely empirical in practice because of the lack of standard modeling tools for the process.

A simulation platform for modeling of the process of reactive melt infiltration and reaction bonding in ceramic components was developed as part of a Fraunhofer-internal SMB-oriented research (MEF) project. The model was validated with a prototype. The model describes the fluid, heat, and substance transformation processes – extension to the induced thermomechanical stresses is planned. Modeling is based on a homogenized continuum description of the porous structure: the flow description utilizes a porous two-phase fluid approach (melt + inert gas/vacuum) with capillary pressure as the driving force for melt infiltration. Transport of thermal energy by convection, heat conduction, and radiation as well as any occurring substance transformations and heats of reaction are balanced. The model accounts for changes in the structural parameters (permeability, porosity, etc.) occurring during the process as a result of saturation and substance transformation by applying common correlations (van Genuchten approach, etc.) and simple models (reaction capillary model). A key priority was to keep the number of parameters to a minimum. The model was implemented using the COMSOL multiphysics finite element code and enables the analysis of 3D components.

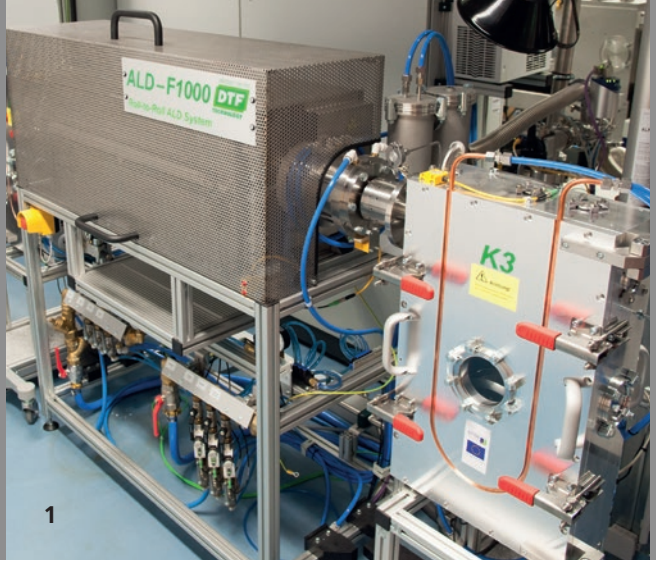
The model allows the propagation of the infiltration, reaction, and temperature fronts in the component over time to be mapped and hence provides the possibility of analyzing various effects, such as the positioning of the melt supply wicks, the preform structural parameters (composition, pore distribution, etc.) and the process control parameters, as well as providing information on quantities (temperature, composition) inside the part that are difficult to access experimentally in-situ. The objective of the analysis is to optimize the process in order to avoid the formation of weld lines and high thermal gradients in critical zones of the component as a way of improving component quality and reducing the risk of failure.

A SiSiC heat exchanger segment was manufactured and analyzed as a practical technology demonstrator. The results widely confirmed the model predictions, for example, for the filling front propagation. The model can be applied to a variety of component geometries and may be adapted to alternate material systems.

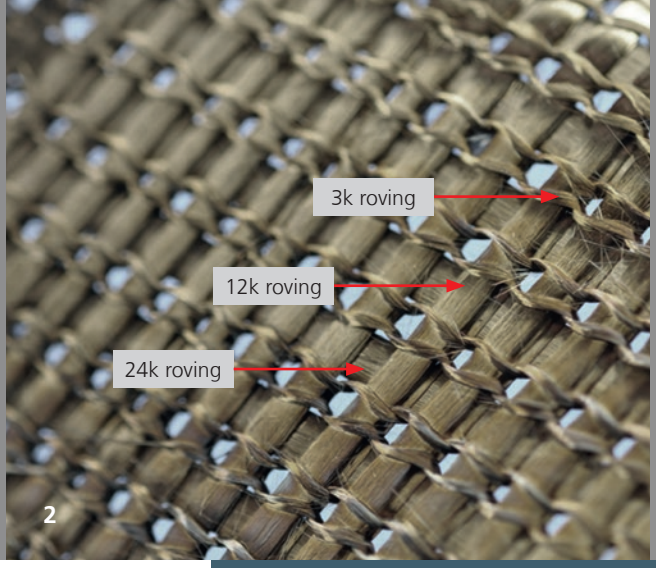
1 *Example model results for various quantities.*

2 *Comparison of the infiltration saturation of model prediction and actual component (partially filled).*

Contact Wieland Beckert • Phone +49 351 2553-7632 • wieland.beckert@ikts.fraunhofer.de



1



2

FUNCTIONAL THIN FILMS BY ATOMIC LAYER DEPOSITION (ALD)

Dr. Jonas Sundqvist, Dipl.-Phys. Mario Krug, Dr. Mandy Höhn

ALD Lab Saxony

Atomic layer deposition (ALD) is currently the fastest growing thin-film deposition technology, boasting an annual equipment and precursor market volume in excess of USD two billion. Over the last decade Dresden has become a hotbed for ALD. In spring 2016, ALD Lab Saxony was founded as a division of Cool Silicon e. V. within Silicon Saxony e. V. It combines several universities and research institutes from Saxony and forms the largest German ALD cluster. Fraunhofer IKTS is one of the founding members of ALD Lab Saxony. Members from ALD Lab Saxony took part in the ALD conference 2016 in Dublin, Ireland, as chairs and attendees, presenting a total of 18 contributions (posters and talks).

CVD and ALD deposition techniques present diverse possibilities for accommodating the heightened interest in thin and ultrathin conformal coatings for numerous applications seen today. Fraunhofer IKTS possesses capabilities for coating fiber materials and textile preforms with protective layers by ALD and CVD. Besides offering barrier and protective layers, Fraunhofer IKTS has a strong focus on ALD applications in the field of energy harvesting and storage systems. Ultrathin conformal coatings made of advanced multicomponent layers and nanolaminates are offered for backside passivation in photovoltaic devices and as lifetime enhancement layers in Li-ion batteries. Coating of powders is performed by ALD and CVD with a rotating drum technology.

Established ALD processes at Fraunhofer IKTS

Coating	Precursor	Temp. [°C]	Application
SiO_2	SAM24	60–400	Optics, electronics, PV, barrier, fibers, powder
Al_2O_3	TMA		
ZnO	DEZ		
TiO_2	TTIP		
HfO_2	TEMAHf		
TiN	$TiCl_4$	300–600	Barrier

Core competencies in ALD processing at Fraunhofer IKTS:

- Continuous roll-to-roll ALD of endless fibers and rovings
- Batch ALD for textile preforms
- ALD on particles and powders
- ALD barrier technology for displays, flexible electronics, and packaging
- Protective layers for tool applications
- Backside passivation for Si photovoltaics

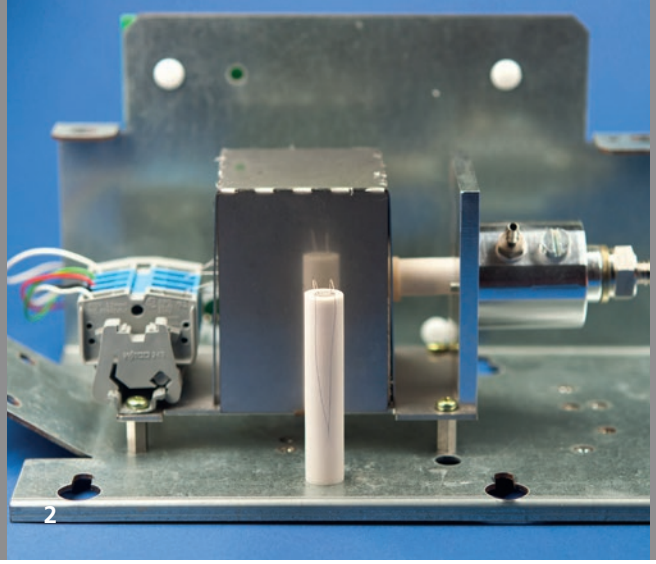
ALX ALD Lab Saxony

cool silicon energy efficiency innovations from silicon saxony

1 *Roll-to-roll ALD/CVD coating device.*

2 *ALD-coated textile preform made of carbon fibers with three different types of rovings for special components in high-performance applications.*

Contact Jonas Sundqvist • Phone +49 351 2553-7693 • jonas.sundqvist@ikts.fraunhofer.de



INTERCONNECT TECHNOLOGIES FOR CERAMIC-BASED SENSORS

Dr. Jochen Schilm, Dr. Mihails Kusnezoff, Dr. Uwe Partsch

In industrial processes and plants, measurement of various parameters and quantities at high temperatures in corrosive environments by means of sensors is necessary for optimal process control. Sensors based on ceramic materials are becoming increasingly important because of their ability to be used at very high temperatures in aggressive liquid as well as gaseous environments.

In addition to ceramic sensors for measurement of temperature and chemical parameters, especially the measure of pressure, force, flow, and position sensors, occupying about one-third of the market volume for sensors, are being increasingly targeted as a market for ceramic materials. Integration of ceramic sensors represents a challenge due to the need for a hermetically sealed, thermally stable, corrosion-resistant, and low-stress metal-ceramic composite designs for the implementation of ready-to-use standard housings and connections for end users.

In order to meet these challenging joining tasks, Fraunhofer IKTS can develop and adapt the compositions of solder glasses to properties, such as softening behavior, coefficient of thermal expansion, corrosion stability, and compatibility with ceramic and metal joining partners. Furthermore, the processing of glass frits to form powders with defined properties and their transfer to ready-to-use slurries, pastes, and cast tapes offer flexible technological solutions.

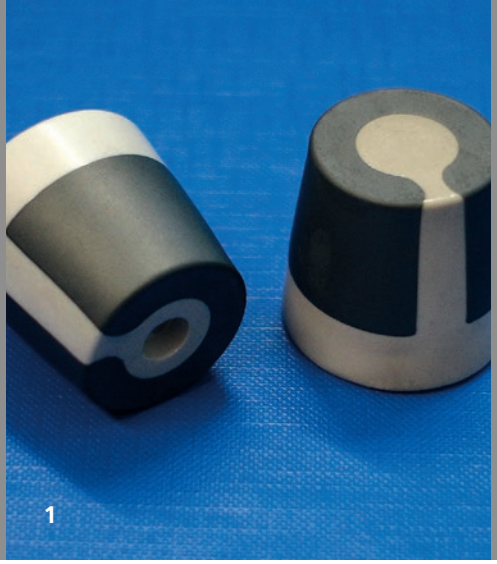
Active metal brazing (AMB) technology based on metal alloys provides reliable and thermally stable metal-to-ceramic joints. Joining processes using active metal brazes have been developed at Fraunhofer IKTS not only for sensor applications but also for thermoelectric modules, fuel cells (SOFCs), high-temperature batteries (ZEBRA) and structural ceramic components. With simulation-assisted component design, ceramic-compatible joints can be realized.

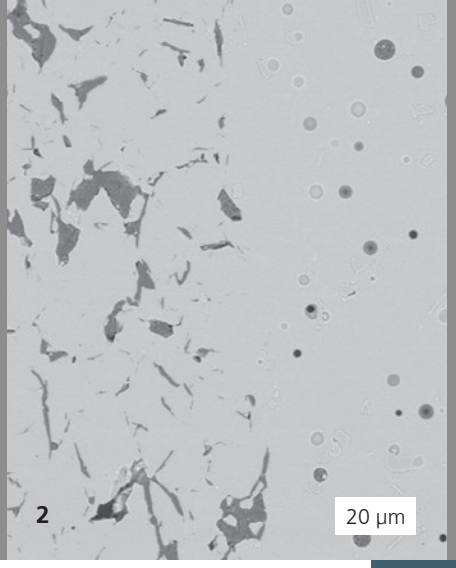
These joining technologies can be combined to yield adjusted multistage joining processes for process capability, reliable thermal loading of components, and thermomechanical stress-free integration of ceramic sensor elements into ceramic as well as metal housings and connections.

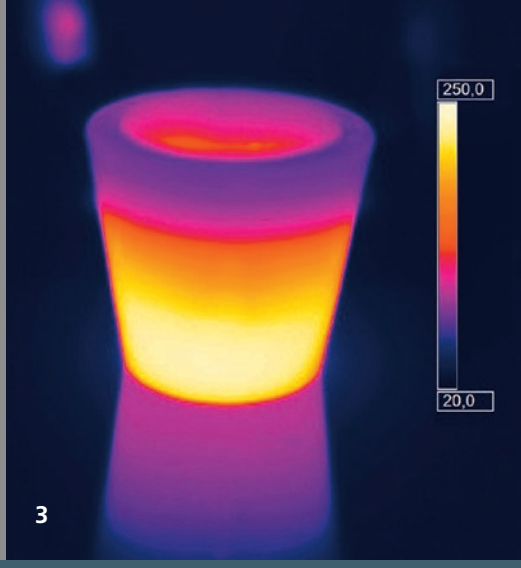
Selected examples illustrate the possibilities for different sensor types. Glass-ceramic solders from SOFC technology were adapted to join ZrO_2-based oxygen sensors (400 °C to 800 °C) (Figure 2). Miniaturized semiconductor technology-based MEMS sensor elements bonded to ceramic bodies with low-melting glass solders enable the measurement of pressure and acceleration in attitude sensors up to 160 °C. LTCC-based pressure sensors were integrated into standard steel threaded and bayonet connections for measurements up to 250 bar at 300 °C via a three-stage joining process using brazes, active filler metals, and glass solders (Figure 1). Glass solders with optimized corrosion resistance extend the application ranges of capacitive pressure sensors made of Al_2O_3 ceramics in extremely corrosive liquid media to 150 °C and 180 bar.

1 *LTCC pressure sensor integrated in a stainless steel adapter via a multistage joining process.*
2 *O_2 sensor joined to ceramic body with a glass-ceramic solder.*

Contact Jochen Schilm • Phone +49 351 2553-7824 • jochen.schilm@ikts.fraunhofer.de







NOVEL GLASS HEATING ELEMENTS BY TWO-COMPONENT INJECTION MOLDING

Dr. Tassilo Moritz, Dr. Jochen Schilm, Dipl.-Ing. Anne Mannschatz, Dipl.-Ing. Axel Müller-Köhn, Dr. Axel Rost

Glass powder injection molding offers an alternative, powder-based route to conventional glass component manufacturing, which mainly starts from a molten glass. It allows for large-scale production of glass components with complex geometries, microstructured surfaces, and sharp edges without any additional costly grinding or etching steps. The final product properties are attained by debinding and sintering, as is the case for ceramic components. As a special advantage of the powder-based shaping route, additional functionalization of the glass component can be achieved through addition of secondary phases, such as pigments or graphite powder in particle form. For instance, an electrically conductive glass component that can be used as a heating element owing to its ohmic resistance has been attained by the addition of graphite powder.

One special variant of powder injection molding originating from two-color injection molding of polymers is the so-called two-component injection molding process, which was recently developed at Fraunhofer IKTS for producing ceramic components with a combination of properties, such as electrical conductivity and electrical insulation or hardness and ductility as well as stainless steel–zirconia compounds. Now this shaping method has been used for combining electrically conductive and electrically insulating sintered glasses. For successful combination of the two glasses in a subsequent co-firing process, comparable thermal expansion coefficients and comparable shrinking behavior were necessary requirements.

In the present case, two commercially available glass powders (8330 and 8250, SCHOTT AG) were mixed with graphite (KS 15, Imerys) to yield distinct electrical conductivity. Shrinkage of the electrically insulating glass component was adjusted by adding alumina powder. As an outcome of the project, electrically heatable glass nozzles and crucibles were manufactured.

Acknowledgments

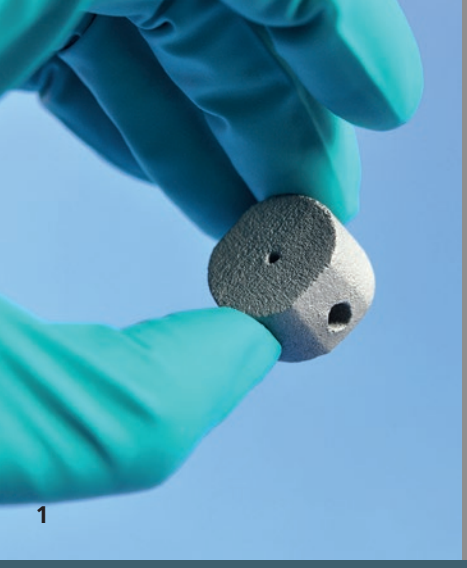
Financial support from the German Federation of Industrial Research Associations (AiF) is gratefully acknowledged (Industrial Collective Research (IGF) project no. 17755 BR).

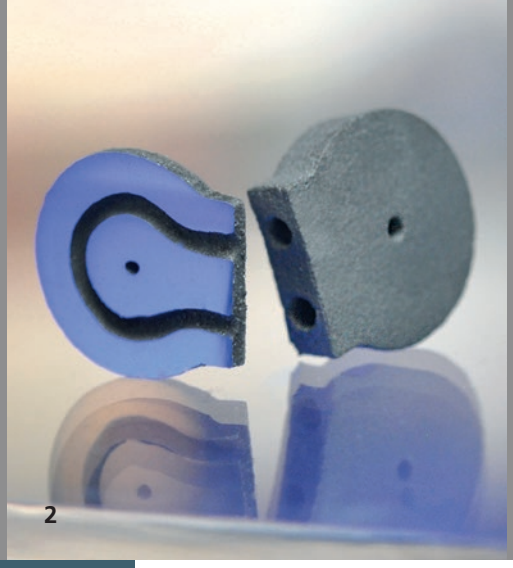
1 *Two-component injection molding module.*
2 *SEM image of a sintered microstructure.*
3 *Thermo-camera image of a heating test.*

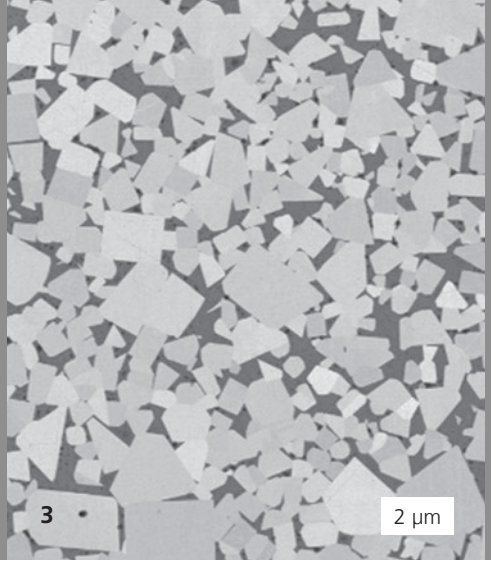
Forschungsnetzwerk Mittelstand AiF

Bundesministerium für Wirtschaft und Energie

Contact Tassilo Moritz • Phone +49 351 2553-7747 • tassilo.moritz@ikts.fraunhofer.de







3D PRINTING OF HARDMETALS

Dr. Johannes Pötschke, Dr. Hans-Jürgen Richter, Dr. Tassilo Moritz

Additive manufacturing of hardmetal tools

With a more sophisticated tool design, it is possible to achieve a higher tool productivity and optimize the associated processes. In traditional tool manufacturing, complex geometries, such as helical or U-shaped cooling channels inside components or surfaces with undercuts, can often only be implemented at high costs, if at all.

The powder-based 3D printing method (also known as "binder jetting") allows highly complex hardmetal parts to be manufactured. In the additive manufacturing method employed, optimally adapted starting powders or granules are deposited layer by layer and locally wetted and bonded by an organic binder applied with a printing head. The manufactured green parts then undergo binder burnout and sintering under conventional conditions. The sintered parts show a microstructure typical for hardmetals with a density of virtually 100 % and a homogeneous cobalt binder distribution. The material properties of the 3D-printed parts are comparable to those of hardmetal tools made via conventional shaping routes (e.g., uniaxial dry pressing).

In addition to novel geometries, rapid manufacturing of green parts in only one step and without the costly manufacturing of pressing tools or metal injection molding tools is now possible. This is especially relevant for prototypes and small batches.

Hardmetal green parts can be developed both via the powder-based method and using the suspension-based thermoplastic 3D printing (T3DP) method.

Material properties

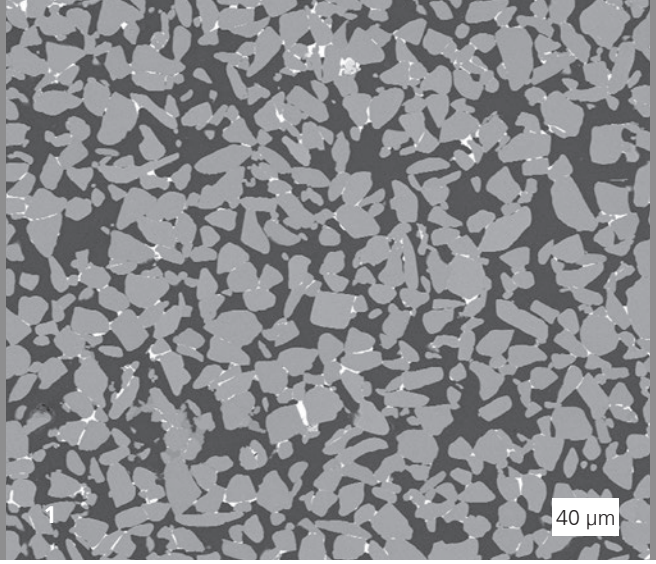
Composition	WC-12 Co wt. %
Density	14.28 g/cm³
	99.8 %
Closed porosity	< 0.06 vol. %
Hardness	HV10: 1170
	HV50: 1160
Magnetic saturation	22.3 µTm³kg⁻¹
	92 % theor. mS
Coercive force	8 kA/m
Average grain size	Medium

Services offered

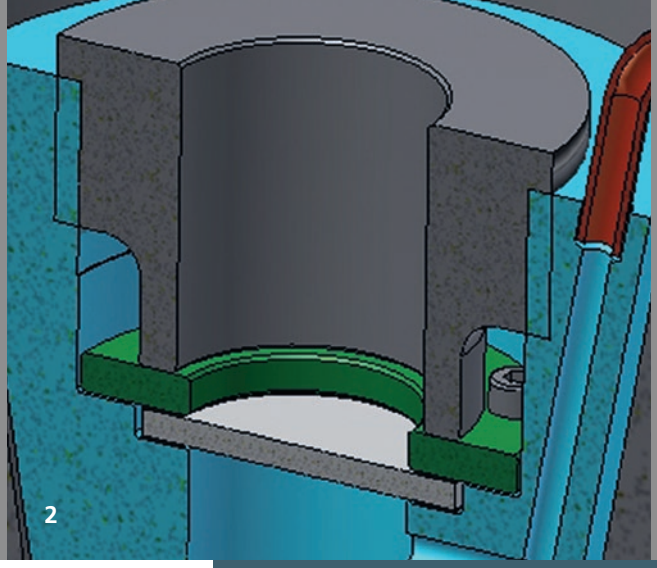
- Product-specific development of powder- and suspension-based 3D printing for WC-Co hardmetals
- Adaptation of processes to other compositions and materials systems
- Manufacturing of prototype parts made of hardmetals according to customer requirements

1 *Hardmetal drawing die with helical cooling channel.*
2 *Hardmetal drawing die with U-shaped cooling channel.*
3 *Microstructure of a 3D-printed WC-12Co hardmetal (FESEM).*

Contact Johannes Pötschke • Phone +49 351 2553-7641 • johannes.poetschke@ikts.fraunhofer.de



1



2

POROUS CERAMICS USED AS DIAPHRAGMS IN LIGHT METAL MELTS

Dipl.-Ing. Heike Heymer, Dipl.-Krist. Jörg Adler

For a number of applications in smelting, diaphragms are used, e.g., to enable pressure compensation in hollow cavities in components while preventing filling of the cavities with the molten material.

A current example is use in hollow rollers in hot-dip finishing plants, where the rollers turn and guide flat steel bands through a molten bath of a liquid zinc- or aluminum-based alloy. Hollow rollers show a lower mass moment of inertia, enabling higher band speed, less roller wear, and higher steel band surface quality. However, they are also subject to a risk of excess pressure building up in the inner space due to gas expansion during or after dipping of the roller into the melt bath. Undesired deformation or, in the worst case, bursting can result.

In a joint cooperation with an industrial partner, Fraunhofer IKTS has been developing a new gas-permeable ceramic for appliances in metallurgy and the metal processing industry to solve the instability problem in hollow rollers. A small disk made of this ceramic is inserted into the hollow journal of the roller, releasing the expanding gas from the roller into the melt. The ceramic is hardly wetted by the melt and pores are small enough to allow gas to permeate but prevent intrusion of the melt, even at high melt pressures. With the help of this porous ceramic, gas can be discharged quickly and overpressure in key functional components can be prevented.

In this application, the ceramic withstands the melt pressure exerted by aluminum and zinc at 680 °C and 480 °C, respectively, at a bath height of 2.5 m. The impermeability of the ceramic for the molten metal reliably prevents penetration of the molten metal into the component and guarantees controlled gas release and pressure reduction. The ceramic is also heat-resistant up to 1200 °C in air and resistant to corrosion by light metal melts. Therefore, the proven principle can be applied to other alloys after preliminary testing.

Additionally, a steel mounting device for securing and sealing of the porous ceramics in the hollow roller was developed. The porous ceramic disk can also serve as an active safety device that acts as a rupture disk in case of an extreme pressure increase, preventing deformation or even bursting of the hollow roller by guiding the gas into the environment.

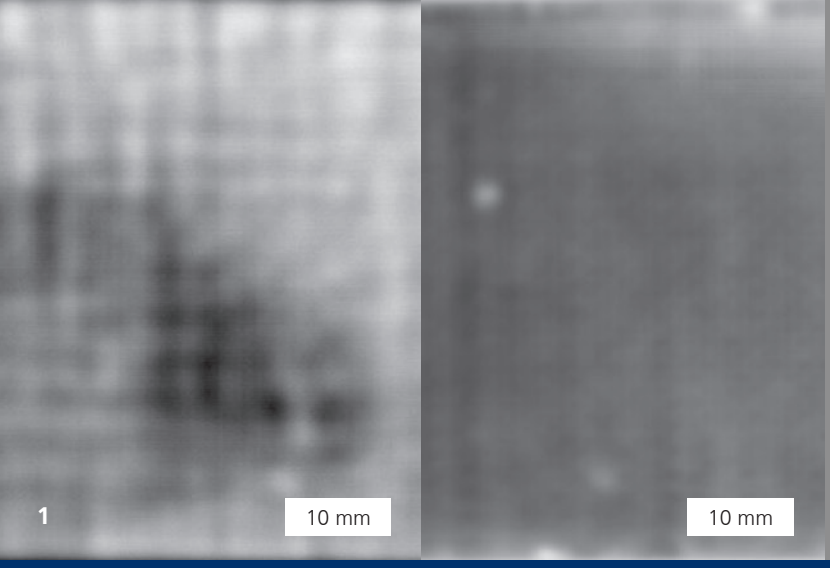
The innovative porous ceramic has already been successfully tested in lab and industrial environments.

Services offered

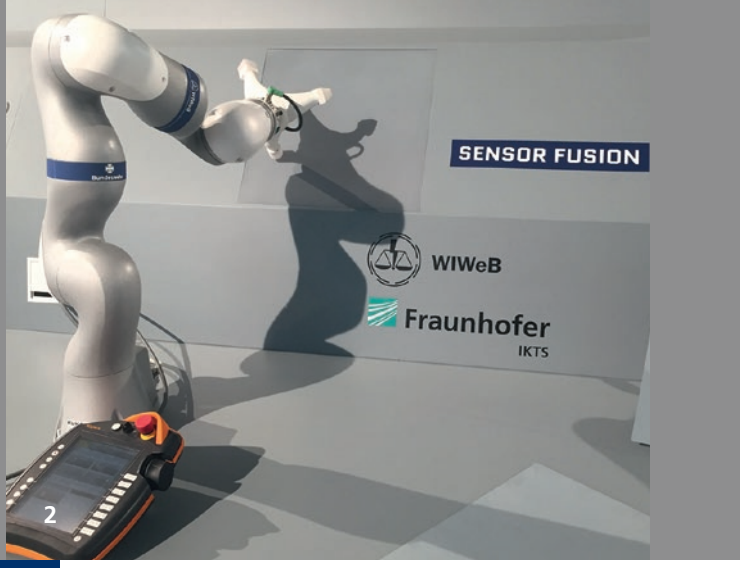
- Development of materials and technologies for manufacturing and application of porous ceramics in contact with molten metal alloys

1 *Porous SiC ceramic used as a diaphragm in aluminum and zinc alloy melts.*
2 *Device for sealing the porous ceramic disk in a steel fixture.*

Contact Jörg Adler • Phone +49 351 2553-7515 • joerg.adler@ikts.fraunhofer.de



1



2

CHARACTERIZATION OF CERAMIC MATRIX COMPOSITES USING EDDY CURRENT TECHNIQUES

Jun.-Prof. Henning Heuer, M. Sc. Susanne Hillmann, M. Sc. Martin Schulze

Ceramic matrix composites (CMCs) combine the advantages of carbon fiber composites (high strength in the fiber direction and simultaneously low weight) with the positive properties of ceramics (high temperature and corrosion resistance and high strength). This qualifies the materials for use in harsh environments, such as high-temperature, corrosive, or very high mechanical loading conditions. Therefore, the primary application for these composites is for highly stressed components, for example, in airplane engines. The obstacles to introduction of CMC technology are similar to those that complicated the introduction of carbon fiber composites. The component behavior over the life cycle of the components and the relevant damage mechanisms are unknown. In addition, non-destructive test methods have not yet become established for these materials.

The suitability of the high-frequency eddy current technology for CMCs is being evaluated in preliminary studies. This work draws on the extensive and lengthy experience of the project team in eddy current testing of pure carbon fiber composites. The test method was evaluated by means of CMC samples from different stages of the manufacturing process.

With the eddy current technique, the surface of a test object is scanned with a special probe. In the process, a small and very localized electromagnetic field is coupled with the material and variations in the electrical and capacitive properties of the material are recorded. In this way, the test object can be investigated down to a depth of a few millimeters below the surface. The scan can be performed on flat specimens using a simple 2D scan desk or on freeform components using an inspection robot. Both test systems were developed by Fraunhofer IKTS and are ready for application in industrial environments.

Within the scope of an internal study, the high-frequency eddy current technique was found to be capable of yielding the following characteristics of CMC materials:

- Orientations of individual fiber layers
- Local fiber density distributions
- Inclusions of air (pores) or impurities (depending on the included material)
- Notches, scratches, and cracks
- Local variations in homogeneity of the infiltrate
- Uninfiltrated or poorly infiltrated areas

These results demonstrate the suitability of the high-frequency eddy current technique for use in non-destructive quality control of ceramic matrix composites.

1 *Eddy current scans of two CMC samples: (left) exhibiting defective infiltration and (right) with point-shaped inclusions.*
2 *3D scanner including sensors for eddy current, ultrasound and FTIR at WIWEB.*

Contact Henning Heuer • Phone +49 351 88815-630 • henning.heuer@ikts.fraunhofer.de

1

2

MINIATURIZED SYSTEM FOR INTELLIGENT SIGNAL PROCESSING IN MECHANICAL ENGINEERING

Dr. Constanze Tschöpe, Dr. Frank Duckhorn, Dipl.-Ing. (FH) Christian Richter, Dipl.-Ing. (FH) Matthias Eiselt, Dipl.-Ing. (FH) Peter Blüthgen

Intelligent signal processing is needed in mechanical engineering for in-line quality control, life cycle analysis of wear parts, and structural health monitoring. Fraunhofer IKTS has developed a miniaturized system for intelligent signal processing within the scope of the joint project "MiSIS" funded by the German Federal Ministry of Education and Research (BMBF). The heart of the system is a base module containing a digital signal processor (DSP) and a field-programmable gate array (FPGA), along with the required memory, power supply, and peripheral interfaces. Taking the form of a mini PCI express card (30 x 50.95 mm), the module can be operated in various systems, for instance, in many laptops. Complex and real-time critical algorithms for acoustic pattern recognition using deep neural networks (DNNs) or hidden Markov models (HMMs) can be realized by the combination of DSP and FPGA. The base module can be connected to various signal acquisition and signal output modules via flat ribbon cables. The system is thus capable of audio and ultrasonic signal processing as well as processing of other signal sources. Partner company SINUS Messtechnik GmbH has developed a signal acquisition module for high-quality processing of audio signals in the audible range (up to 24 kHz) with up to four independent channels. With these two modules, the system performance was demonstrated, e.g., in the automated detection of defects in glass bottles in cooperation with the Communications Engineering Group at Brandenburg University of Technology Cottbus-Senftenberg. For this reason, the complete feature analysis (windowing, Fourier analysis, and temporal and spectral smoothing by filter matrices) and the classification algorithms (density calculation for hidden Markov models, search in finite state machines) were implemented in the base module. By embedding these CPU-intensive algorithms on the FPGA, it was possible to decrease the computing time significantly, thereby also enabling the feature analysis and classification techniques to be used at higher-frequency signals. Fraunhofer IKTS also successfully uses intelligent signal processing and acoustic pattern recognition for in-line quality control of gears, estimation of remaining useful life time of valves, early fault detection in rollers and bearings in spinning frames, structural health monitoring of airplane materials, and automatic softness testing of tissue products during production. The technology is very well suited to testing of machine components or as test units in production plants.

Calculating time in relation to signal length

Algorithm	DSP	FPGA
Feature analysis	9.4 %	1.1 %
Density calculation	59 %	34 %
Search	32 %	3.1 %

The German Federal Ministry of Education and Research (BMBF) and project management VDI/VDE Innovation + Technik GmbH are gratefully acknowledged for their financial support (FKZ 16ES0297) and joint partners for their collaboration.

Bundesministerium für Bildung und Forschung

VDI|VDE|IT

1 *Integration in measurement system.*
2 *Base module of miniaturized system for intelligent signal processing.*

Contact Constanze Tschöpe • Phone +49 351 88815-522 • constanze.tschoepe@ikts.fraunhofer.de

1

MINIATURIZED SENSOR SYSTEM FOR PACKAGING MACHINES

Dipl.-Ing. Uwe Lieske, Dipl.-Ing. (FH) Thomas Klesse, Dipl.-Ing. (FH) Jörn Augustin, Dr. Lars Schubert

Motivation

How can you determine the mechanical stresses that a product is subjected to during automated packaging? Producers and users of packaging machines have to answer this question in order to optimize packaging processes for high throughputs or to avoid defective goods through early detection of load changes.

Scientists at Fraunhofer IKTS have developed a miniaturized sensor system to address this problem. It is introduced into the customer's packaging process with a wrapper that simulates the product. During the packaging run, the sensor system records the relevant data, which can be immediately forwarded to the machine manufacturer. This enables fast response times and rapid supply of replacement parts, which in turn leads to an increase in machine availability.

Furthermore, the sensor system can identify areas on the machine in which stresses on the products are high. Based on this information, the machine design can be optimized, for example, to achieve more gentle product handling with a simultaneous increase in throughput. The effects of the design changes are then immediately checked by the miniature sensor system.

System layout

The miniaturized sensor system is designed modularly, is encapsulated, and can be realized with dimensions of as low as 12 x 12 x 12 mm or 12 x 24 x 6 mm. This makes it suitable for a wide range of applications. It is integrated into the product to be packaged and can easily be segregated from the regular products after packaging via electromagnetic locating. During the packaging run, accelerations of up to ±2000 m/s² are recorded in three axes at sampling frequencies of up to 10 kHz and angular velocities of up to 4000 °/s at frequencies of up to 1 kHz.

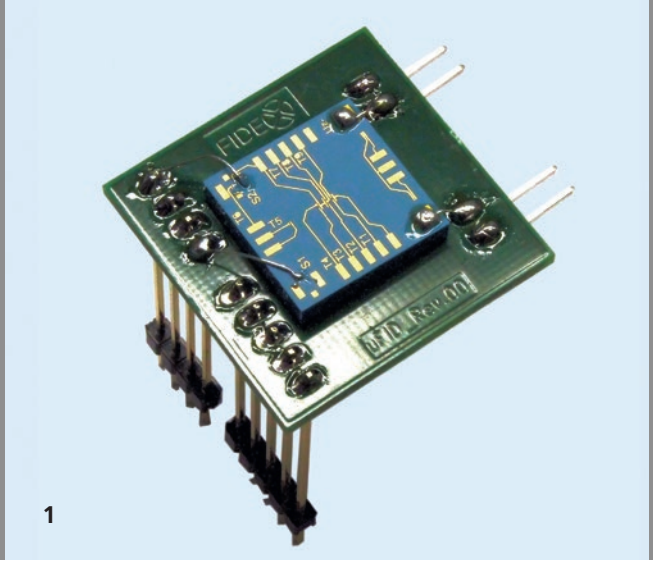
The sensor system has a data storage system for the saving of several measurement series. Configuration is accomplished via a PC interface prior to measurement. The measurement itself is started wirelessly by integrated Hall sensors using an external magnetic field. A rechargeable battery ensures a long sensor module service life.

With the developed sensor system as a starting point, individual customer preferences such, as wireless data communications or power supply, can be realized.

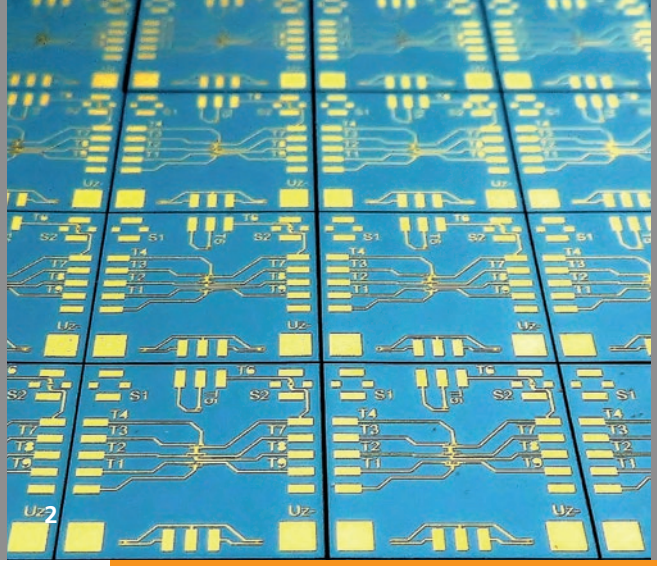
Further miniaturization of the system is planned for the future so that the production and value-adding process can also be monitored in industrial semi-finished products.

1 *Miniaturized sensor system in size comparison.*

Contact Lars Schubert • Phone +49 351 88815-533 • lars.schubert@ikts.fraunhofer.de



1



2

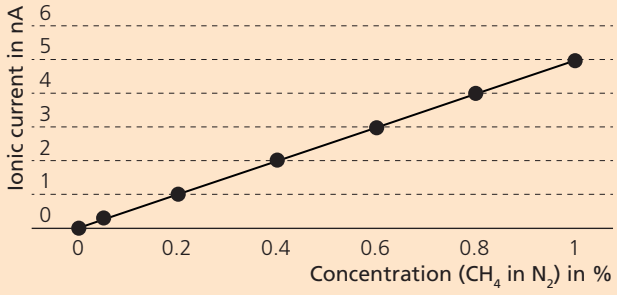
MINIATURIZED DETECTOR IN CERAMIC LTCC TECHNOLOGY FOR EARLY WARNING SYSTEMS

Dr. Steffen Ziesche, Dipl.-Ing. Christian Lenz, Dipl.-Ing. Adrian Goldberg

There is a growing trend toward comprehensive decentralized monitoring and recording of environmental, process, and status information. This requires sensor systems with reduced consumption of operating materials, high robustness, and low maintenance requirements. Fraunhofer IKTS investigates and develops microsystem applications utilizing LTCC and HTCC ceramic multilayer technologies. These technologies enable precise integration of micrometer-scale functional structures into monolithic ceramic housings. The microsystems thus created are characterized by high chemical and thermal robustness as well as a high functional density and can be fabricated at low cost in large quantities.

Within the scope of the BMBF-funded research project "FIDEX" (#13N13271), Fraunhofer IKTS is developing an early warning system for municipal sewer networks in cooperation with partners from industry and research as well as operators. This system provides a higher level of protection to the general public and the infrastructure against the formation of explosive atmospheres in the sewer system. The core of this system is made up of a miniaturized flame ionization detector (FID) used to determine the total hydrocarbon concentration in the sewer atmosphere. The low detection limit combined with the low cross-sensitivity of the FID enables monitoring of hydrocarbon concentrations far below the lower explosion limit (LEL). Thus, the operator can take adequate countermeasures early enough to avoid catastrophe. Utilizing LTCC technology enables all fluidic and electrical structures of the FID to be integrated into a (15 by 15) mm² ceramic chip. The required combustion gases (H_2 and O_2) are supplied via buried channels in a combustion chamber and are ignited by means of an electrical discharge. The resultant hydrogen flame ionizes the hydrocarbons in the sample gas. An electric field collects the ions and generates an ionic current proportional to the hydrocarbon concentration. Due to the locally concentrated mixture of combustion gases and the small dimensions of the fluidic structures, only low combustion gas flows (10 ml/min H_2) are required for continuous operation of the system. This property additionally qualifies the detector for use in portable or autonomous sensor concepts extending to field gas chromatography.

Ionic current measured as a function of the methane (CH_4) concentration in the sample gas

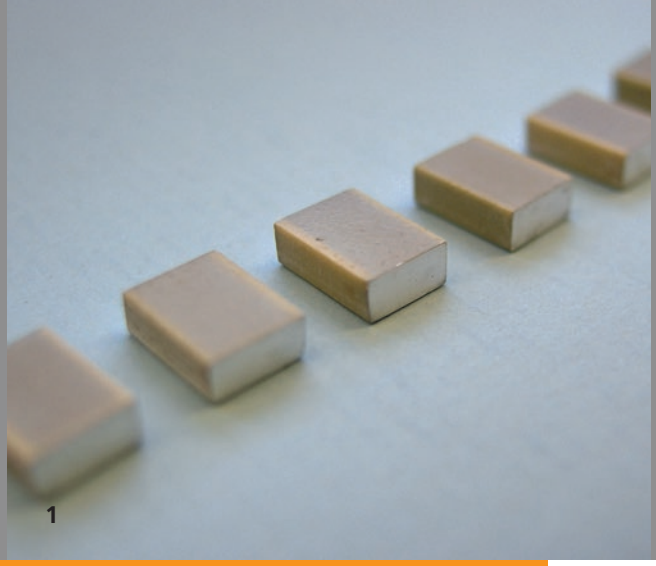


FIDEX

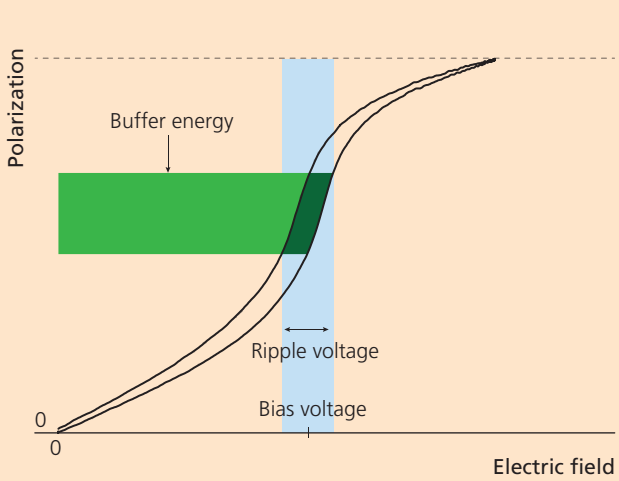
Bundesministerium für Bildung und Forschung

1 *Ceramic FID mounted on measurement board.*
2 *Fabrication of the ceramic FID on a multipanel.*

Contact Steffen Ziesche • Phone +49 351 2553-7875 • steffen.ziesche@ikts.fraunhofer.de



1



2

ANTIFERROELECTRIC CAPACITORS FOR POWER ELECTRONICS

Dr. Sylvia Gebhardt, Dipl.-Chem. Christian Molin, Dipl.-Ing. Uwe Keitel, Dr. Holger Neubert

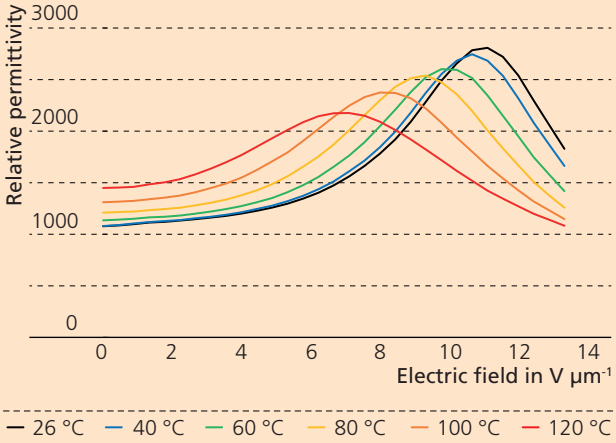
For high-density power electronic systems with miniaturized system size and high efficiency, capacitors with increased capacitance density under high electric fields and elevated temperatures are needed. Only capacitors meeting these requirements will be able to be used for the design and manufacture of future power switches with wide-band-gap semiconductors. An expanding market for engine control systems and DC/DC converters for electromobility and regenerative energies is the main factor driving the requirements for these components.

Conventional polymer-based film capacitors and multilayer ceramic capacitors (MLCCs) are restricted in terms of thermal stability and capacitance density or show a strong decrease in capacitance when higher voltages are applied. Antiferroelectric materials offer high permittivities, which even increase with increasing bias voltage. They allow for the development of capacitors with high capacitance density at high DC bias, high current handling capabilities, and stable operation at elevated temperatures.

Multilayer ceramic capacitors based on the material system lead lanthanum zirconate titanate (PLZT) with higher permittivities at higher electric field strengths than exhibited by conventional capacitors are being developed at Fraunhofer IKTS. This is accomplished through synthesis of PLZT materials with suitably adjusted phase compositions and targeted doping to yield higher energy densities. The powder can be produced on a kg scale, allowing for batch production of MLCCs.

Using this technology, multilayer ceramic capacitors with up to 50 ceramic and AgPd inner electrode layers have been manufactured. After sintering, the ceramic layer thickness is 45 µm and the AgPd inner electrode thickness is 2 µm. The MLCCs show a very high relative permittivity of $\varepsilon_{r,max}$ = 2800 at a switching field of E_{bias} = 11.1 kV/mm and a ripple voltage of $U_{p\text{-}p}$ = 20 V at room temperature. Excellent values are also obtained at higher temperatures. The material system offers room for improvement in the capacitance and switching field values, which in turn will allow for development of MLCCs with significantly higher energy densities in the future.

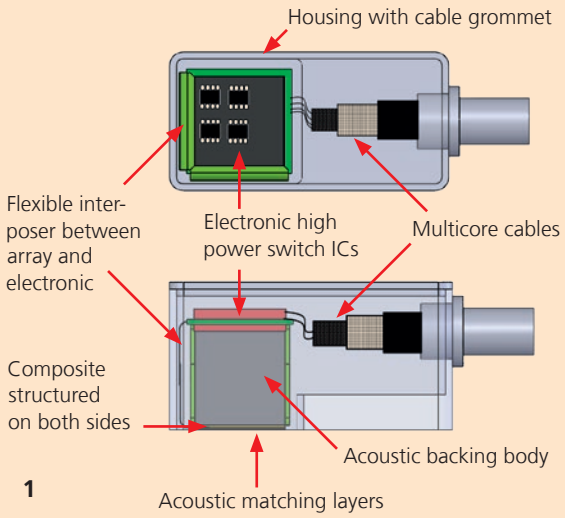
Relative permittivity of antiferroelectric MLCC as a function of bias field and temperature



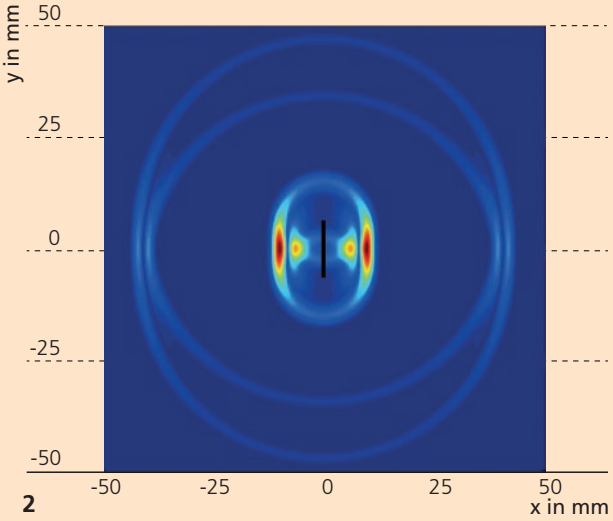
1 *Multilayer ceramic capacitors based on antiferroelectric materials.*

2 *Ferroelectric polarization curve for an antiferroelectric material.*

Contact Sylvia Gebhardt • Phone +49 351 2553-7694 • sylvia.gebhardt@ikts.fraunhofer.de



1



2

BIPLANAR ARRAYS FOR NEW APPLICATIONS IN ULTRASONIC TESTING

Dipl.-Ing. Raffael Hipp, Dr. Thomas Herzog, Dipl.-Ing. Susan Walter, Dr. Dieter Joneit, Dr. Frank Schubert, Jun.-Prof. Henning Heuer

Different transducers are used for different applications in ultrasonic non-destructive testing, based on single- or multichannel techniques. Single-element (monolithic) probes have a fixed focus that depends on the design. If greater flexibility is needed, phased array probes with multiple elements are used. With appropriately delayed excitation of the individual elements, the wave front can be swept and focused on any point in the test object. A distinction is drawn between linear arrays, which focus in a plane perpendicular to the active aperture axis, and matrix arrays, which are able to focus inside the whole volume covered by the probe.

Biplane phased arrays combine the low costs of a relatively simple probe design with the flexibility of conventional matrix arrays.

Biplane array design

A biplane array consists of a piezoelectric layer with a conventional line electrode structure on the top and a second line electrode structure rotated by 90° on the bottom side of the piezo layer.

Modeling of the sound field

For calculation of the sound field of a biplane array, the excitation by a strip element and a quadratic crossing element must be considered. With these basic sound fields, all other configurations can be obtained by the superposition principle. The numerical CEFIT-PSS technique, a hybrid method developed at IKTS for simulation of spatiotemporal wave fields, including all relevant physical wave effects, was used for the calculations.

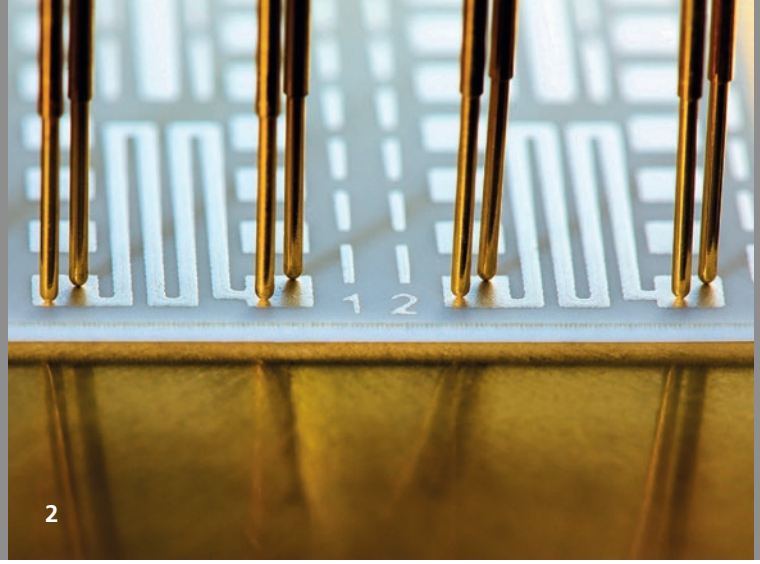
Principle of operation of a biplane array

In conventional operation mode, the biplane array offers the possibility of sweeping and focusing the ultrasonic beam in two planes. A 3D mode in which selected electrode strips on the top and bottom of the piezo layer are excited is also possible. For this, the electrical activation of the electrodes can be dynamically varied.

Compared with a fully electrically connected matrix array, the biplane array requires significantly fewer elements, i.e., only N or at most 2N independent channels instead of N x N channels. This aspect significantly lowers the technical requirements that must be met by the ultrasonic hardware and hence the manufacturing costs for a complete matrix UT system.

1 *Design of a biplane array.*
2 *Sound field of a biplane strip element in the x-y plane (24 mm).*

Contact Henning Heuer • Phone +49 351 88815-630 • henning.heuer@ikts.fraunhofer.de

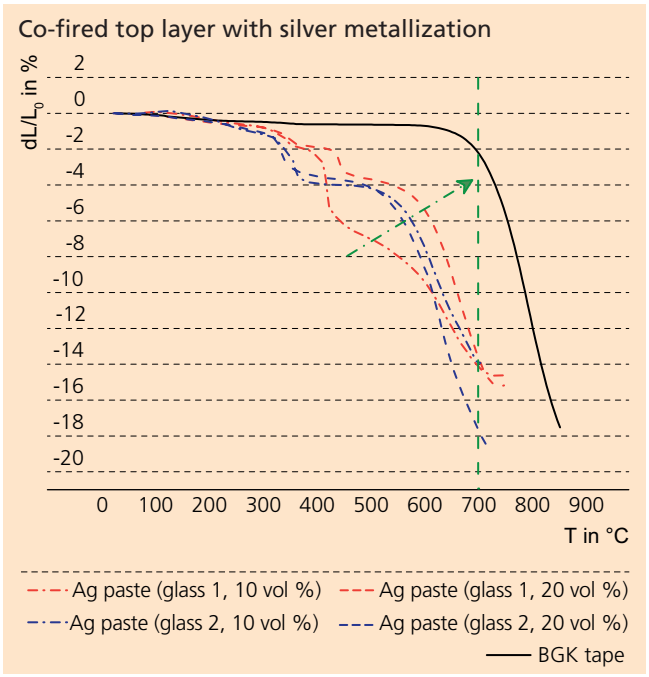


FORM-STABLE LTCC MODULES THANKS TO IKTS-SILVER PASTES

Dipl.-Ing. Markus Pohl, Dr. Rena Gradmann, Dipl.-Chem. Beate Capraro, Dr. Markus Eberstein

LTCC technology on the basis of ceramic tapes provides a wealth of design possibilities for integrating active and passive components into complexly shaped 3D architectures by lamination of planar substrates and bonding. A major limitation in LTCC processing is the well-known substrate warping effect often induced by silver metallization. It is strongly dependent on the specific LTCC composition and silver paste in use but frequently occurs as a result of unconstrained sintering of LTCC substrates with silver metallization. The mechanisms/causes of warpage include constrained tape shrinkage due to the sintered paste, Ag diffusion out of the paste, the crystallization thereby promoted, and thermal expansion mismatch. In order to avoid this deformation, LTCC manufacturers apply constrained sintering technology either by use of sacrificial tapes or by pressure-assisted sintering, which is time-consuming and expensive. Fraunhofer IKTS has developed silver pastes that suppress the warpage mechanisms observed and described by numerous authors. Exemplarily for the Fraunhofer IKTS anodically bondable tape "BGK tape", silver pastes were analyzed in terms of their material chemistry and sintering kinetics and were adapted to the sintering behavior of the tape material. To that end, the chemical composition and the amount of the glass phase in the paste were varied systematically. Silver diffusion was detected and evaluated by SEM and EDX on polished cross sections of sintered samples. Based on the results, the glass composition and amount were specifically adapted to the anodically bondable tape. Silver inner layers, top layers, and via metallizations can now be applied to the LTCC without the substrate showing any warpage after unconstrained sintering in air. The obtained know-how also allows the adaption of screen-printing pastes to other tape compositions.

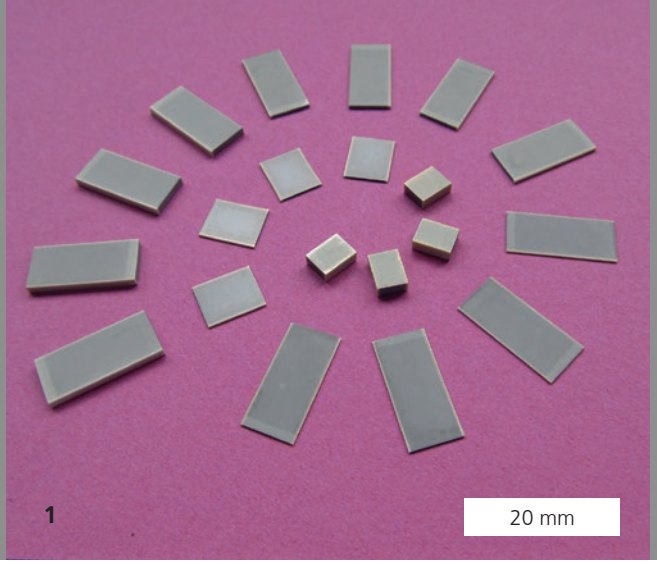
Silver pastes for screen printing on anodically bondable LTCCs are available. Paste compositions can be adapted to the characteristic sintering behavior of the tape to minimize warpage.



The best results are observed for Ag pastes with a shifted maximum densification temperature (T > 700 °C). Co-firing was optimized to suppress the Ag diffusion almost completely with a combined temperature profile (TP3) comprising slow binder burnout and a silver co-firing step at high heating and cooling rates.

1 *Doctor blade pilot plant.*
2 *Resistivity measurement.*

Contact Markus Pohl • Phone +49 351 2553-7928 • markus.pohl@ikts.fraunhofer.de



1

2

PREPARATION OF ELECTROCALORIC COOLING ELEMENTS USING MULTILAYER TECHNOLOGY

Dipl.-Chem. Christian Molin, Dr. Peter Neumeister, Dr. Holger Neubert, Dr. Sylvia Gebhardt

For the realization of active cooling elements, especially in power electronics but also for environmentally friendly air-conditioning and cooling systems, application of the electrocaloric effect is of great interest. This approach utilizes the property of certain ferroelectric ceramics to heat up or cool down considerably due to changes in an external electric field.

As part of the DFG Priority Programme (SPP) "Ferroic Cooling", Fraunhofer IKTS focuses on the development of electrocaloric materials and components that exhibit high temperature and entropy changes and low dielectric losses during cooling. Targeted materials selection and synthesis are important aspects of the work. Other aims are development of a suitable technology for preparation of the cooling elements and identification of optimized element geometries and operating conditions.

Ferroelectrics exhibit a high electrocaloric effect in the vicinity of the ferroelectric-to-paraelectric phase transition during application and withdrawal of high electric fields. Therefore, materials synthesis is performed with emphasis on adjustment of the phase transition temperature to application needs. Furthermore, reduction of dielectric losses and enhancement of the dielectric strength of the cooling elements are accomplished by addition of appropriate dopants and proper processing. Ceramic multilayer technology offers the possibility of manufacturing large-scale components with high cooling capacity at low operating voltage.

For room-temperature cooling tasks, the lead magnesium niobate-lead titanate (PMN-PT) system is adjusted by modification of its stoichiometric composition and targeted doping.

For the production of multilayer elements, ceramic layers are prepared by tape casting. Electrode structures are then applied to the layers in a screen printing process. The resultant single layers are stacked to the required cooling element height, isostatically laminated, and separated by laser cutting. Cooling elements of different sizes and thicknesses can thus be prepared to accommodate specific application needs.

The sintered cooling elements are distinguished by small individual layer thicknesses of 20–90 microns, which lead to higher dielectric strengths in comparison to bulk ceramics. At present, it is possible to achieve an electrocaloric temperature change of 2.7 K through application of an external electric field of 16 kV/mm to a multilayer component 18 mm long, 8 mm wide, and 1 mm thick.

Future work will focus on development of multilayer components for specific system designs.

Ferroic Cooling
A DFG PRIORITY PROGRAMME

1 *Sintered multilayer structures with different geometries.*
2 *FESEM images of PMN-PT multilayer structures with layer thicknesses of 39 µm (left) and 86 µm (right).*

Contact Sylvia Gebhardt • Phone +49 351 2553-7694 • sylvia.gebhardt@ikts.fraunhofer.de

TAPE CASTING COMPETENCE CENTER IN HERMSDORF

Dipl.-Chem. Beate Capraro, Dr. Uwe Partsch

The technique of tape casting and coating is a highly productive method for producing large, flexible tapes of functional materials very efficiently and cost-effectively in roll-to-roll processes. Fraunhofer IKTS has been a leader in research and development in this area for decades.

The Tape Casting Competence Center at Fraunhofer IKTS in Hermsdorf has five tape casting machines for realizing different layer formation processes and drying methods. Three casting machines operate according to the classic doctor blade method and differ in terms of drying channel length, casting speed, and drying principle (convection, contact, UV, or IR). With the battery and the triple slot die coaters, the casting portfolio has been extended to include slot die casting.

The battery coater developed within the "VALIBAT" project according to Fraunhofer IKTS specifications implements an innovative, modular, and ecological casting concept and is used for performing coating tasks in the area of Li-ion battery research. After the layer has been applied by means of a slot die, the cast electrode is dried in a non-contact manner through levitation and can then be compacted in a calender integrated in the system. The solvents contained in the slurry are disposed of after the drying process by means of thermal postcombustion, with the energy generated during the combustion being returned to the machine for drying the layers.

The triple slot die coater enables multiple layers to be produced in one process step using the triple slot die. This makes it possible to cast different functional tapes or functionally graded tapes directly in a "wet in wet" process.

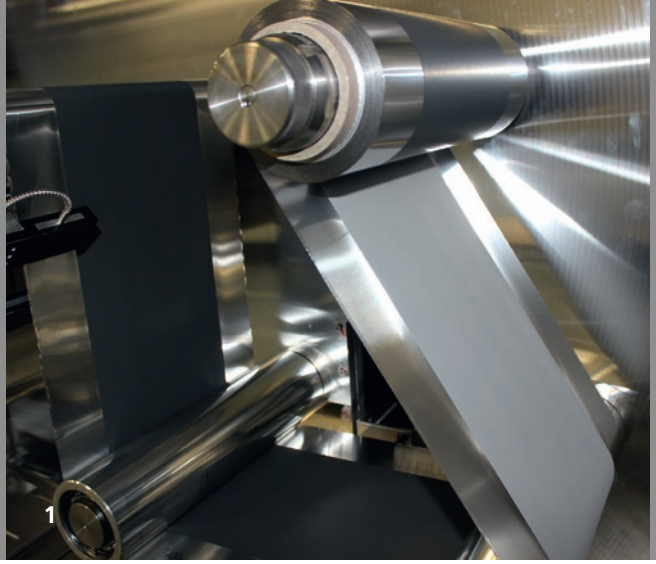
In addition to coating on carrier tapes, direct casting onto a steel strip is possible. Both systems can easily be converted to the classic doctor blade process.

The Tape Casting Competence Center processes both aqueous and organic tape casting slurry systems. Established organic materials, such as polyvinyl butyral, as well as innovative systems are used in the tapes. The solids contained in the tapes can have densities up to 19 g/cm^3 in extreme cases and have an average grain size of d_{50} = 200 nm to d_{50} = 30 µm. Tape casting slurries with viscosities in the range of 100–30,000 mPas can be processed on the casting machines.

Applications for the tapes from the new center range from classic ceramic microsystem technologies (LTCC and HTCC) and the current strategic field of battery research to filtration, gas separation, and a variety of special tapes.

1 *Triple slot die coater.*
2 *ValiBat coater.*

Contact Beate Capraro • Phone +49 36601 9301-1022 • beate.capraro@ikts.fraunhofer.de



DEVELOPMENT OF HIGH-ENERGY ELECTRODES FOR BIPOLAR LITHIUM-ION BATTERIES

Dr. Mareike Wolter, Dr. Marco Fritsch, Dipl.-Ing. Stefan Börner, Dr. Kristian Nikolowski

Fraunhofer IKTS has been cooperating with partners from industry and research in the development of large-format bipolar batteries (EMBATT concept) for several years now. Focus is on both materials development and targeted process modifications to address manufacturing-related challenges.

The bipolar construction of lithium-ion vehicle batteries can potentially enable a significant reduction in system complexity and thus an increase in the energy density and the range of electric vehicles. Optimization of the energy density starts with the electrode development. High surface loading with active material is important for increasing the proportion of storage material in the cell. At the same time, the mechanical workability and the necessary flexibility of the electrode tape have to be maintained.

Thick lithium titanate (LTO)-based electrodes made using water-based processes and LTO-LFP bipolar electrodes have recently been developed and characterized. The first LTO electrodes produced showed very stable behavior for discharging up to approx. 1 C and reached the specific capacity (> 150 mAh/g) expected for LTO. For more detailed investigation of the rate capability, additional tests were carried out and electrodes with a layer thickness of up to 102 µm (calendered) were analyzed.

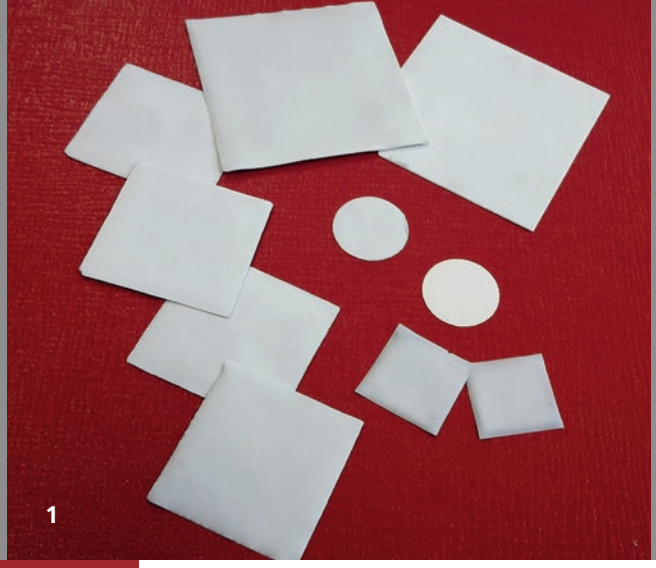
The specific challenges of water-based manufacturing of LTO electrodes mainly result from the fact that the aqueous LTO slurries have a high pH of 11.2–11.8. It has been shown that the alkaline pH is an intrinsic property of the active material and is not only due to the presence of synthesis contaminants. The high pH places high demands on the stability of the binder components for the aqueous LTO anodes and leads to corrosion of the aluminum collector foil during the coating process. In particular, pH values above 8.5 result in the formation of aluminum hydroxide and hydrogen ($2Al + 6H_2O = 2Al(OH)_3 + 3H_2\uparrow$). In the first aqueous LTO casting experiments, pore and crack formation as well as aluminum pitting corrosion was observed during electrode drying. As a result, the mixing process was adapted in such a way that the LTO slurry preparation was completely carried out at a pH of approx. 11, the normal pH for LTO. The pH of the slurry was shifted to the neutral range just before the casting process. In this way, stable electrodes with the described electrochemical properties could be realized.

This process has now been transferred to the pilot scale at the Battery Technology Application Center in Pleissa. The LTO anodes in combination with the aqueous lithium-iron-phosphate (LFP) electrodes already being manufactured at the center form the first bipolar electrodes produced on a pilot scale for the further development of the EMBATT bipolar battery.

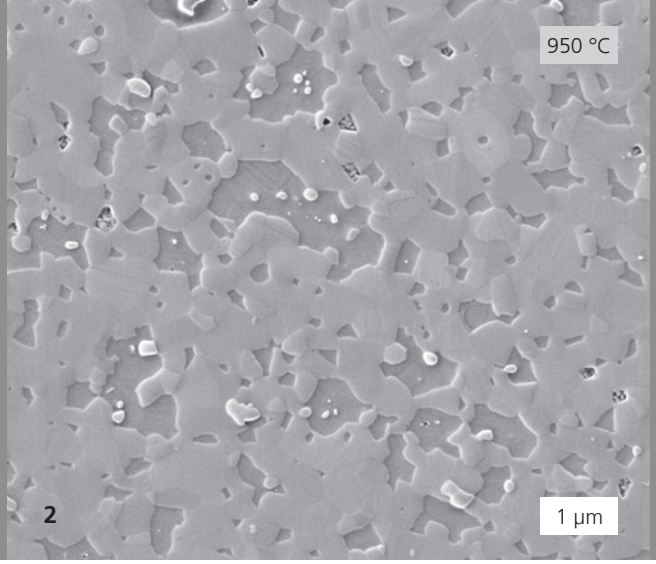
1 *Manufacturing of LTO-LFP bipolar electrodes on a pilot scale.*
2 *LTO electrode with thickness of 138 µm (as-coated).*

Europa fördert Sachsen
EFRE
Europäischer Fonds für regionale Entwicklung
Gefördert aus Mitteln der Europäischen Union und des Freistaates Sachsen.

Contact Mareike Wolter • Phone +49 351 2553-7971 • mareike.wolter@ikts.fraunhofer.de



1



2

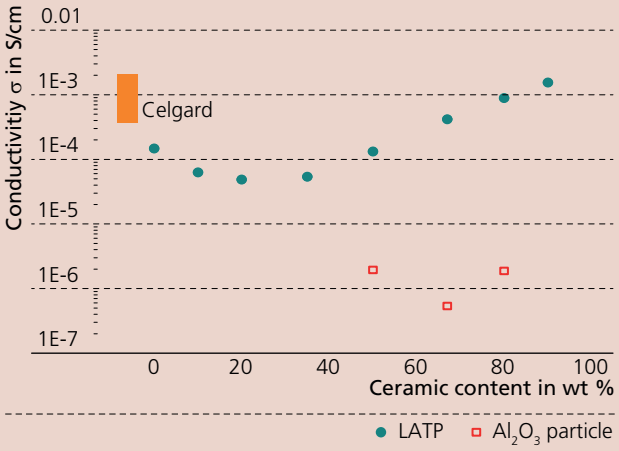
ENERGY

NEW MATERIALS FOR LITHIUM-ION-CONDUCTING SOLID-STATE ELECTROLYTES

Dr. Axel Rost, Dr. Katja Wätzig, Dipl.-Ing. Dörte Wagner, Dr. Jochen Schilm, Dr. Mihails Kusnezoff

The energy supply requirements of mobile consumer devices, stationary energy storage devices, and electromobility are driving the development of efficient accumulators. Li-ion batteries only attain incremental improvements in power density, operating voltage, and charging and discharging rates. It should be possible to surpass these limits with new battery concepts, such as lithium-sulfur cells or all solid-state batteries. The separators between the anode and cathode compartments are important elements of all battery concepts and affect performance, service life, and operational reliability. Depending on the particular type of battery, they must have either mandatory or optional Li-ion conductivity and must provide a barrier to electron transport in order to enable or improve the functionality of the single cell. Polymer separators in combination with liquid electrolytes will not be able to meet future requirements for thermal and chemical stability and cannot reliably prevent the formation of lithium dendrites inside batteries, which in turn significantly impairs the battery service life. Ceramic materials, for example, in the system $Li_{1+x}Al_xTi_{2-x}(PO_4)_3$ (LATP), with Li-ion conductivities of up to $4 \cdot 10^{-4}$ S cm^{-1} at 25 °C and high thermal as well as mechanical stability are suitable as solid electrolytes and separators. Preparation of these materials as powders with the desired particle size distributions can be realized by melting a glass frit with subsequent grinding, solidphase synthesis, or the sol-gel process. The selected production route and the stoichiometric composition of the material influence the achievable particle shapes/sizes and sintering activities of the powders. As can be seen in the diagram right, application of Li^+-conducting powders as fillers in porous, polymer-bound films allows for hybrid-type separators with significantly higher conductivities than are achieved with non-conducting ceramic fillers (e.g., Al_2O_3). New battery concepts, such as all solid-state batteries, require densely sintered layers acting simultaneously as separators and solid electrolytes to ensure the separation of the anode and the cathode as well as the ionic conductivity. Suitable powder properties and sintering conditions resulting in grain sizes < 2 µm are decisive for defect-free microstructures (Figure 2). A tape casting process that enables the production of planar substrates with thicknesses of less than 150 µm and ionic conductivities of up to $2 \cdot 10^{-4}$ S cm^{-1} at 25 °C (Figure 1) has been developed.

Comparison of conductivities of hybrid-type polymer-ceramic separators and a polymer separator (Celgard) measured in LP40 electrolyte with stainless steel blocking electrodes



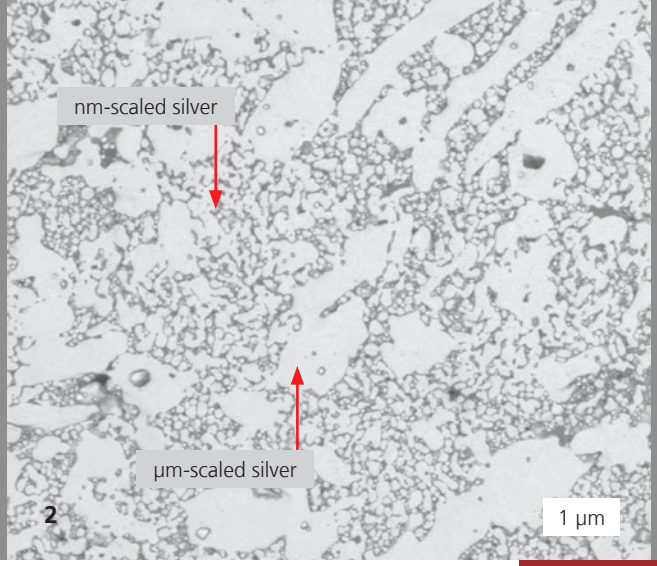
BamoSa

Bundesministerium für Bildung und Forschung

1 *Tape-cast and sintered ceramic solid electrolytes.*
2 *Fine-grained, dense microstructure of an LATP solid electrolyte.*

Contact Jochen Schilm • Phone +49 351 2553-7824 • jochen.schilm@ikts.fraunhofer.de

1



2

LOW-TEMPERATURE METALLIZATION PASTES FOR HETEROJUNCTION SOLAR CELLS

Dipl.-Chem. Stefan Körner, Dr. Markus Eberstein, Dr. Uwe Partsch

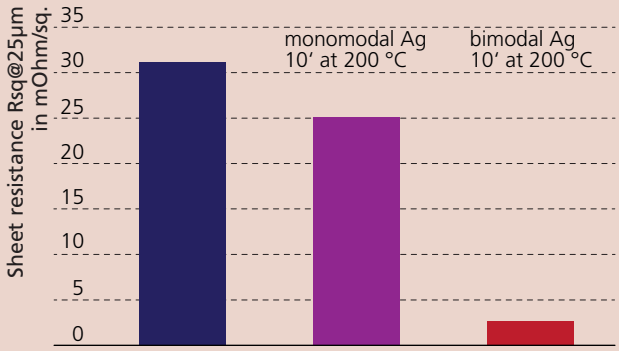
A promising cell concept for environmentally friendly, efficient generation of solar power in Germany is the heterojunction solar cell (Figure 1). This concept is predicted to gain market shares of up to 10 % with stabilized cell efficiencies of 24 % by the year 2026 [1].

In this solar cell, the doped semiconductor layers of the emitter and the passivation layer are generated by vaporization of amorphous silicon. The amorphous Si layers only survive a maximum temperature of 200 °C. Thus, silver pastes capable of being cured at 200 °C were developed for front-side metallization (Figure 1). These pastes are based on solvent-polymer combinations (so-called binders), which can be cured thermally and filled with functional phases. Silver is the most commonly used metal for front-side metallization of solar cells.

Due to the low process temperature, the conductivity of the polymer-silver composites is usually generated not through sintering, but rather via percolation paths created by the metal particles. For a minimum layer resistance, high solids contents in the pastes are necessary. This is accomplished through binder systems with suitably adapted compositions and rheologies. With a monomodal silver powder, sheet resistances of 25 mΩ/sq in the cured layer are obtained (middle column in diagram below).

A further increase in conductivity of the polymer conductive phase can be achieved through use of bimodal silver powder mixtures in which nanosilver is added to the conventional silver. Thanks to the unique properties of nanoparticles, the tap density of the metal phase can be increased and sinter necks can be created to form conduction paths, in addition to the

Sheet resistance as a function of paste composition for cured polymer conductor layers



percolation paths (Figure 2). The sintering activity of the nanoparticles depends on both the particle size and the surfactants used in the preparation of the nanoparticles. The surfactants additionally influence the dispersibility of the nanoparticles in the binder vehicle. This affects the solids content and, with it, the resistance of the cured layer. With an optimized surfactant chemistry, sheet resistances of 2.7 mΩ/sq can be reached.

The authors gratefully acknowledge the BMBF for the funding of the MWT+ project (03SF0420B).

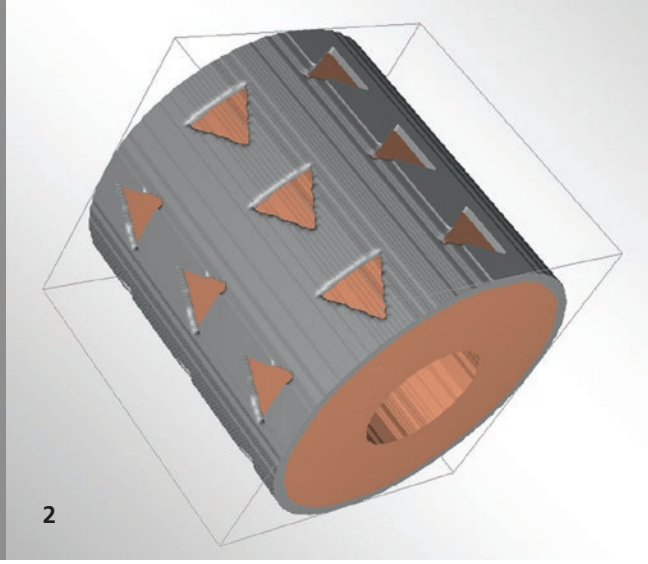
[1] International Technology Roadmap for Photovoltaic (ITRPV), 7th edition, 2016, version 2, pp. 30–32.

Bundesministerium für Bildung und Forschung

1 *Heterojunction solar cell.*
2 *Cross section through a conductor layer.*

Contact Uwe Partsch • Phone +49 351 2553-7696 • uwe.partsch@ikts.fraunhofer.de

1



2

CERAMIC COMPONENTS FOR THERMOCHEMICAL HEAT STORAGE

Dr. Daniela Haase, Dipl.-Ing. Heike Heymer, Dipl.-Krist. Jörg Adler

Thermochemical heat storage is a promising alternative to sensible or latent storage technologies based on water tanks. The heat is stored by means of a chemical potential, which enables high thermal energy storage densities and low energy storage losses, and can be retrieved at any time. Unlike with hot water tanks, insulation to prevent heat loss over time is not required. Typical materials for thermomechanical heat storage are silica gel and zeolites in the form of pellets, which offer a relatively low price and a high energy density. One disadvantage of these highly porous adsorbents, especially in packed beds, is their poor heat conductivity, which leads to a high loss in performance during charging and discharging and the need for complicated heat exchanger structures. Fraunhofer IKTS has extensive capabilities in modification and processing of highly porous ceramics and has applied them in different projects for the development of materials and components for heat storage applications. Within the scope of a Fraunhofer project, cylindrical pellets were covered with a good thermal conductor, such as copper or aluminum. These metal-covered pellets showed a thermal conductivity that was five times higher than that of conventional pellets and thus allowed for faster charging and discharging cycles. A different technological approach, taken within the BMWi project "MoGeSoWa", was the development of heat storage bricks enabling a higher heat storage system filling degree and better contact with the heat exchanger than was achievable with packed beds. The network-like permeation of the bricks improved the accessibility of the adsorbate to the inner volume of the adsorbent. Another subject of this BMWi project was the development of so-called composite adsorbents. These materials consist of a mesoporous support structure that is impregnated by an inorganic salt. In contact with water, the salt forms different hydrate phases and thereby releases heat. The advantage of these materials is the comparatively low loading temperature (~ 90 °C). Typical support structures are silica gel, attapulgite, and carbons of large surface area. Investigations within this research field were concentrated on the generation of support structures with a high specific surface area and a tailored pore structure.

Services offered

- Development of ceramic materials for heat storage applications
- Development of composite materials for sorbent and catalytic applications
- Development of manufacturing methods for industrial production of developed composites
- Application tests
- Manufacturing and analysis of test samples and small batches

Acknowledgments

The authors gratefully acknowledge BMWi for the funding of the project "MoGeSoWa" (project number: 03ESP259E).

Bundesministerium für Wirtschaft und Energie

1 *Compact heat storage brick made of zeolite (65x50x50 mm).*
2 *Metal-covered pellet for high heat conductivity in packed beds (model).*

Contact Daniela Haase • Phone +49 351 2553-7748 • daniela.haase@ikts.fraunhofer.de

PROCESS FOR CONTROLLED SCALE DEPOSITION FROM GEOTHERMAL BRINE

Dipl.-Chem. Hans-Jürgen Friedrich, Dipl.-Ing. (FH) Daniel Zschornack, Hans-Jürgen Rott

Despite their virtually inexhaustible potential, geothermal energy resources have only reached a niche status in Germany up to now. Among the reasons for this are the high risks involved in the search for suitable geological structures at great depths and the unresolved technical problems in application due to scaling and corrosion.

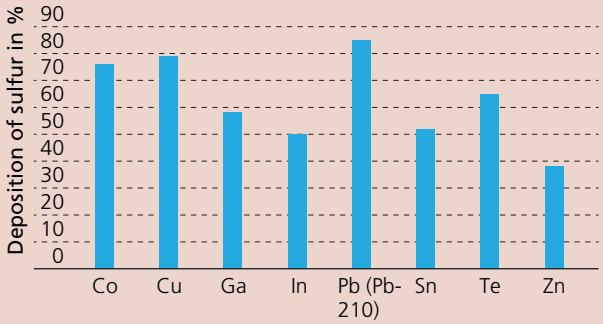
Scaling describes the deposition of mineral and metal incrustations on material surfaces to the detriment of plant economics and safety. Geothermal water and brine extracted from great depths often contain a wide range of naturally occurring chemical elements. Of these, the toxic heavy metals and metalloids As, Pb, Cd, and Tl as well as the naturally occurring radioactive isotopes and chemical elements Pb-210, Po-210, and radium isotopes are considered to be especially critical. Both the handling of these substances and the disposal of residues containing them are extremely problematic. On the other hand, water occurring at such great depths can have relatively high contents of rare and strategic metals in easily recoverable form. For a large number of these chemical elements, electrochemical deposition is possible even under the conditions (e.g., high temperatures and pressures) prevailing in geothermal systems.

In light of this, a process and a prototype setup (Figure 1) for in-situ electrochemical deposition of undesired substances were developed and field-tested within the framework of a project (FKZ 0325696) funded by BMWi (German Federal Ministry for Economic Affairs and Energy). Initial test results under conditions of practice showed that the metals could be deposited in the form of compact metal foils (Figure 2). High amounts of lead, thallium, and arsenic as well as polonium-210 and radium isotopes were accumulated. Use of a porous, or packed-bed, cathode in a flow-through reactor with separate anode and cathode chambers was found to be especially effective, allowing for separation of more than 90 % of the scale- forming substances present in the geothermal water.

Investigations on a geothermal brine from the research borehole at Groß Schönebeck revealed the potential for recovery of a series of rare metals, including gallium, indium, tellurium, copper as well as other metals.

A patent application for the process and the setup has been filed.

Deposition of rare metals and strategic metals from geothermal brines



1 *Electrodeposition unit in installed condition.*

2 *Controlled in-situ deposition of scales containing Pb, As and/or Tl.*

Contact Hans-Jürgen Friedrich • Phone +49 351 88815-720 • hans-juergen.friedrich@ikts.fraunhofer.de

WATER, ENERGY, AND FERTILIZER FROM FOOD INDUSTRY RESIDUES

Dipl.-Ing. André Wufka, Dr. Burkhardt Faßauer, Dr. Frank Weile (Sachsenmilch Leppersdorf GmbH), Dr. Christiane Münch (Sachsenmilch Leppersdorf GmbH), Hartmut Georgi (Consultant)

Sachsenmilch Leppersdorf GmbH, one of the biggest and most innovative dairy companies in Germany, uses residues from whey utilization (molasses) in an established process for the production of bioethanol. After alcoholic fermentation and distillation, a valuable residue known as wet distiller grain, characterized by a high content of organic ingredients, such as organic acids, and very high concentrations of mono- and di-valent salts, remains. Up to now, this residual material has been evaporated in an energy-intensive process and disposed of in a cost-intensive manner due to the lack of utilization routes.

Efforts were made to develop a process solution for the comprehensive material and energetic utilization of this residue and to produce water of drinking water quality for use as a fresh water equivalent in production processes. After two years of development work, a closed process chain for the complete recycling of this residual material was successfully developed and operation on a pilot scale was demonstrated.

The wet distiller grain was processed in several successive process steps. First, the organic components were converted to energy-rich biogas by anaerobic fermentation. For this purpose, a high-performance fermentation reactor following the expanded granular sludge bed (EGSB) principle was operated and all process engineering aspects were optimized. In extensive continuous fermentation experiments, an extremely stable, high COD (chemical oxygen demand) degradation rate of over 95 % and high methane contents of more than 62 % in the produced biogas were found. In the subsequent process stage, the inorganic nutrients ammonium (NH_4^+) and phosphate (PO_4^{3-}) released by degradation of the organic matter were removed by selective addition of various reaction chemicals, mainly magnesium salts in the form of struvite (magnesium ammonium phosphate). Most of the NH_4^+ and PO_4^{3-} could be removed and converted to a slow- release fertilizer with good availability. After wet-chemical precipitation, a clear phase was produced by means of nanofiltration (NF) for the remaining processing steps. Robust ceramic NF membranes with a cut-off of 450 g/mol were used to ensure a high retention of particulate matter, macromolecules, and in some cases higher-valent salts (hardening agents). After a subsequent oxidation step and the elimination of monovalent salts by means of reverse osmosis, water meeting the high quality requirements of the German Drinking Water Ordinance (TrinkwV) was obtained.

Sachsenmilch Leppersdorf GmbH plans to integrate the developed process chain for wet distiller grain treatment into the running production process. Transfer of this innovative process approach to other industries is possible.

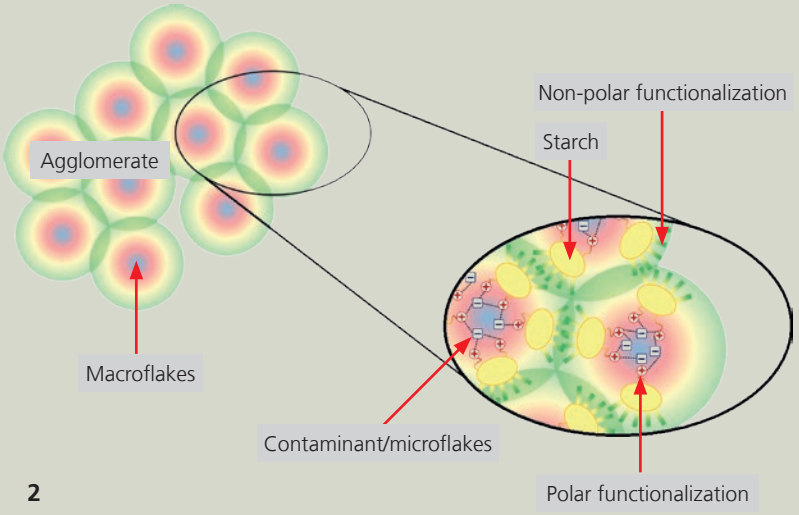
Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

1 *Granulated biomass pellets for the degradation of organic matter and the production of biogas.*

2 *Produced and dried magnesium ammonium phosphate (struvite).*

Contact André Wufka • Phone +49 351 2553-7790 • andre.wufka@ikts.fraunhofer.de

1



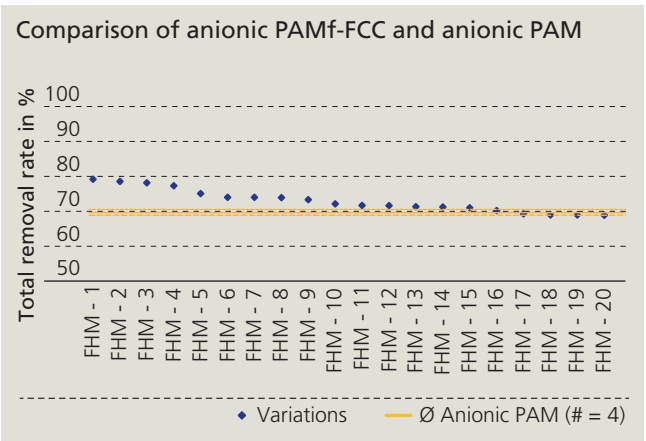
2

ENVIRONMENTALLY FRIENDLY FLOCCULANTS FOR WATER TREATMENT

Dipl.-Chem. Erik Schulze, Dr. Burkhardt Faßauer

Flocculants (FCC) are currently made of synthetic polyacrylamide (PAM) and are used in water treatment as conditioning agents, e.g., for dewatering or precipitation. The sludge thereby produced contains important nutrients, such as phosphate and ammonium and is widely employed as a nutrient-rich fertilizer in the agricultural industry for sustaining the ecological nutrient cycles in the environment. This is being deterred by disputes regarding the environmental compatibility of PAM-FCC and the starting material, acrylamide, used to produce them. The corresponding restrictions on the land application of conditioned sludge are prescribed in the planned amendment of the Fertilizers Regulation controlling and restricting the use of synthetic flocculants. From this arises the need for alternative, sustainable products that can replace synthetic PAM-FCC, which had global revenues of nearly USD 9 billion in 2015. Drawing on lengthy experience in the field of sludge conditioning and to address the need for feasible alternatives, the "Biomass Conversion and Water Technology" working group has developed bifunctional PAM-free FCC (PAMf-FCC) consisting primarily of starch. These have a very high biodegradability and can have cationic or anionic character. PAMf-FCC exhibit starch molecules with both polar and non-polar functionality. This facilitates binding of contaminants to form macroflakes as well as coagulation to form large agglomerates for easy sedimentation and/or filtration (Figure 1).

Cationic PAMf-FCC proved to be equivalent to synthetic flocculants in flocculation of fermentation products and excess sludge from a municipal waste water treatment plant and, in a comparison with commercially available natural products, showed much better results in flocculation, settling behavior (Figure 2), and dewatering of the produced sludge. Due to legal restrictions, the main application for anionic flocculants lies in drinking water production. For the purposes of assessing the performance of anionic PAMf-FCC, flocculation was transferred to a laboratory-scale drinking water plant. The anionic PAM currently used for treatment served as a benchmark. The parameters of turbidity, discoloration, and SAC_{254} were determined and compared. In each case, the total removal rate was calculated from the removal rates for the individual parameters. Here, too, the results obtained for bifunctional PAMf-FCC were at least equivalent, and for the most part superior, to those yielded for the synthetic PAM.



1 *Flocculated surplus sludge (I – commercial cationic starch; II – cationic PAMf-FCC).*

2 *Schematic diagram of flocculation with PAMf-FCC.*

Contact Burkhardt Faßauer • Phone +49 351 2553-7667 • burkhardt.fassauer@ikts.fraunhofer.de

CARBON MODIFICATIONS FOR MEMBRANE APPLICATIONS

Dr. Norman Reger-Wagner, Dr. Adrian Simon, Dipl.-Ing. (FH) Susanne Kämnitz, Dr. Hannes Richter

Membranes are becoming more and more important for industrial separation processes. Selectivity and permeance are critical properties for the use of a membrane. These two parameters are mainly influenced by the quality of the membrane, especially the amount of defects in the membrane. Carbon itself is a promising membrane material and can be used to close defects in membranes made of other materials. For both of these reasons, carbon is an interesting material for research on membrane applications.

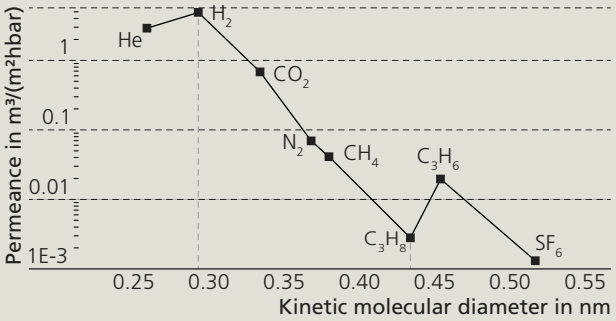
Synthesis of carbon membranes on different kinds of porous support materials has been successfully performed at Fraunhofer IKTS for more than ten years now. The corresponding coating processes are based on chemical vapor deposition or on liquid-precursor processes followed by pyrolysis. This also allows for the modification of zeolite membranes.

Due to its structural properties, nanoporous carbon is well suited to liquid and gas separation. Depending on the synthesis parameters, different structural properties can be obtained. Hence, these membranes can be adapted to different kinds of separation processes with considerable selectivities.

Examples are:

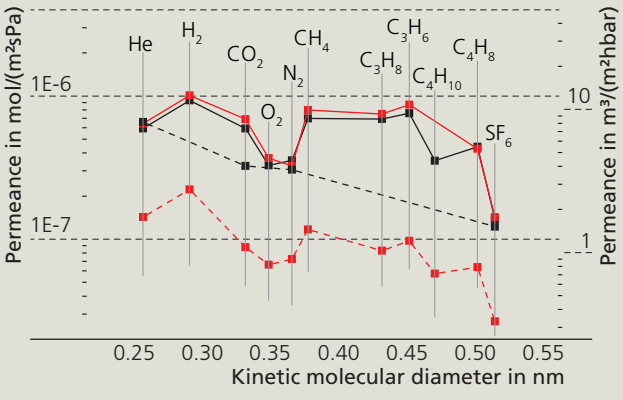
- Separation of H_2 from mixtures with propane at 300 °C and 10 bar with J_{H2} = 5 m³(m²hbar), $PS_{H2/C3H8}$ = 300
- Treatment of biogas and separation in gas streams of 94 % CH_4 and 91 % CO_2
- Drying of hot gases (300 °C, 10 bar, N_2, CH_4, CO_2, H_2) and shifting of chemical equilibria by H_2O separation

Carbon membranes for gas separation



Optimal permselectivity H_2/C_3H_8 = 1800

Single gas measures on C-modified zeolite membranes



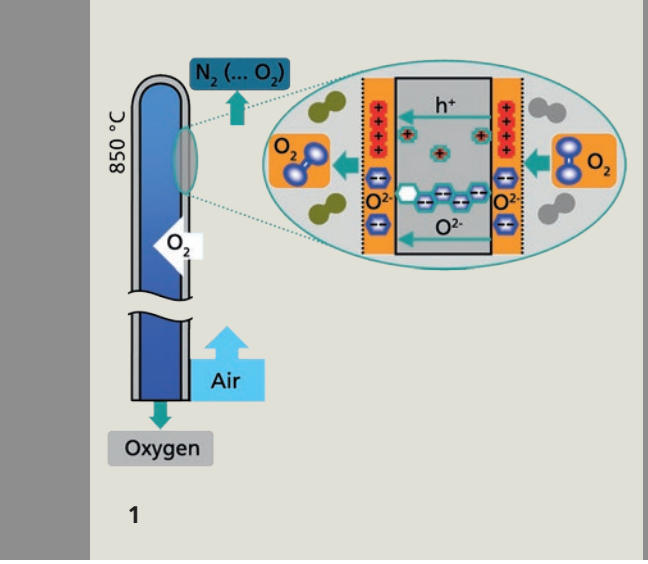
ZC0037 – as prepared
ZC0038 – as prepared
ZC0037 – post-treated at 750 °C for 15 min with C_2H_2
ZC0038 – post-treated at 750 °C for 45 min with C_2H_2

EFRE
EUROPA FÜR THÜRINGEN
EUROPÄISCHER FONDS FÜR REGIONALE ENTWICKLUNG

1 *Coated and uncoated single-channel tubes.*

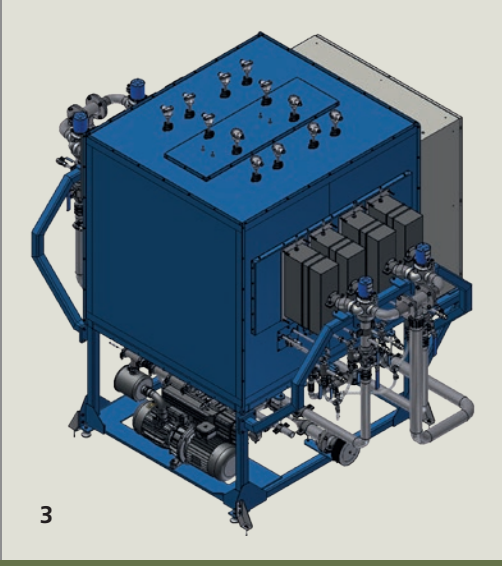
2 *Fully automated device for gas permeation measurements.*

 Contact Norman Reger-Wagner • Phone +49 36601 9301-5025 • norman.reger-wagner@ikts.fraunhofer.de



1


2


3

MORE EFFICIENT O_2 PRODUCTION USING CERAMIC MEMBRANES

Dr. Ralf Kriegel

The global production of oxygen (O_2) currently amounts to approx. 530 million metric tons per year, corresponding to revenues of 34 billion euros per year. More than 90 % of the O_2 is produced by cryogenic air separation units (cryo ASUs) and must normally be delivered to the customer. For local O_2 production, pressure swing adsorption (PSA) or vacuum-PSA (VPSA) is typically used. The purity of the oxygen is usually restricted, or higher purity can only be attained with higher energy consumption. For a high O_2 demand, the price is dominated by the energy requirements, whereas the costs of logistics and transportation dominate the price for low amounts.

On-site O_2 production using ceramic membranes is a competitive option. The process is based on the coupled conductivity of the membrane materials for oxide ions and electronic charge carriers (electrons or holes) at high temperatures. For this reason, these membranes are called MIEC membranes (mixed ionic electronic conductor). Because only oxide ions can occupy the vacancies inside the crystal lattice, pure O_2 is always generated. The total energy requirements of the process consist of the heat needed to maintain the operating temperature and the energy needed for gas compression. The vacuum process developed by Fraunhofer IKTS requires approximately 0.2 kWh/Nm³ O_2 for the vacuum pump and approximately 0.25 kWh/Nm³ O_2 for heating and was already piloted up to a scale of 10 Nm³/h O_2. The table on the right-hand side shows a comparison of this process with the established processes.

The established processes require the energy completely in the form of electricity. In contrast, MIEC membrane plants can be heated by the combustion of gas or by waste heat from high-temperature processes. With the price of thermal energy produced by gas combustion typically amounting to just 25 to 33 % of the price of electricity, MIEC membrane plants heated by gas combustion or waste heat represent a significant cost-cutting potential. Additionally, CO_2 emissions are lower for O_2 production in MIEC membrane plants because much more CO_2 per kWh is generated in the production of electricity than in the combustion of gas. MIEC membrane plants can thus also be used beneficially in processes in which the established O_2 production methods are no longer feasible.

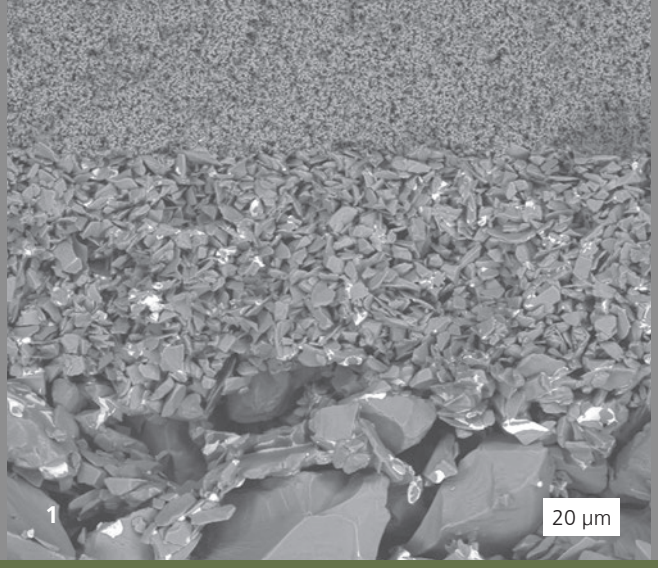
Process comparison in terms of energy costs and CO_2 emissions for the production of 1 Nm³ O_2

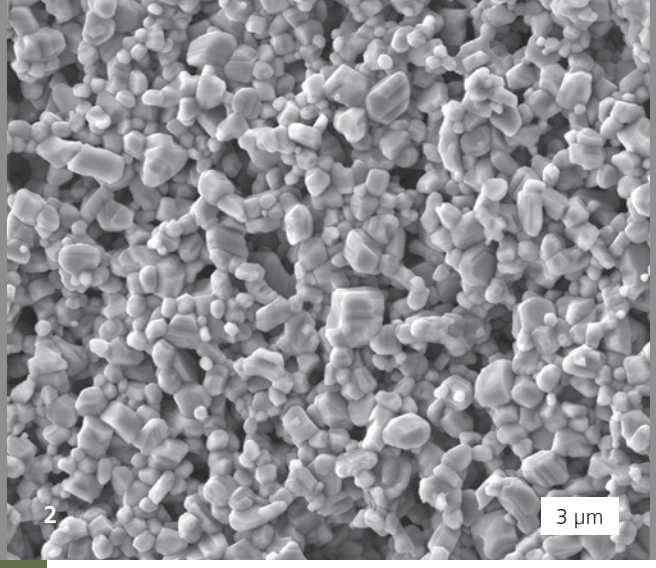
Process	kWh_{el} [a]	kWh_{th} [b]	€-Ct.	g CO_2
Cryo ASU	> 0.38		4.1[a]	290[c]
PSA	> 0.90[d]		9.0	540
Vacuum-PSA	> 0.36[d]		3.6	216
MIEC membrane plants according to heating method				
a) Electric	> 0.45		4.5	270
b) Gas	> 0.20	0.25	2.6	185
c) Waste heat	> 0.20		2.0	120

[a] 10 Ct/kWh_{el}, 600 g CO_2/kWh_{el}; [b] 2.5 Ct/kWh_{th}, 260 g CO_2/kWh_{th}; [c] incl. transport; [d] < 95 vol % O_2

1 *Schematic diagram showing the working principle of MIEC membrane separation.*
2 *BSCF capillaries for O_2 production.*
3 *CAD drawing of a device producing 10 Nm³ O_2/h.*

Contact Ralf Kriegel • Phone +49 36601 9301-4870 • ralf.kriegel@ikts.fraunhofer.de





EFFICIENT AND COST-EFFECTIVE SIC MEMBRANES FOR LIQUID FILTRATION

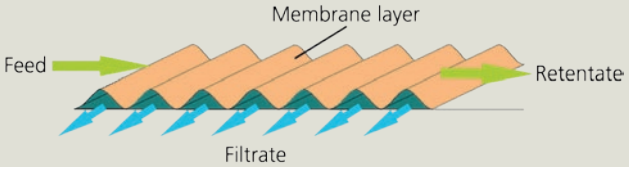
Dipl.-Krist. Jörg Adler, Dipl.-Ing. Heike Heymer, Dr. Hans-Jürgen Richter

Membrane filters made of oxide ceramics (e.g., Al_2O_3) are the state of the art for microfiltration (MF) and ultrafiltration (UF). Silicon carbide (SiC) ceramic membranes have recently been gaining popularity for liquid filtration, especially for treatment of oil-water mixtures, or "produced water", from the oil and gas production. A higher flow has been named as a significant benefit of SiC membranes and confirmed by potential users, giving rise to a new market. In principle, there are three types of materials used for porous SiC ceramics: RSiC, LPS-SiC, and silicate-bonded (glass-bonded) SiC. These three materials have different chemical and physical properties, such as chemical stability and abrasive wear resistance and differ significantly in terms of production costs.

Fraunhofer IKTS's longstanding expertise in the area of particle and liquid filtration, different SiC materials, and membrane development has yielded a variety of advancements and innovations in materials adaptation, membrane design, and production and application engineering.

Over the last two years, Fraunhofer IKTS has been working intensively on LPS-SiC microfiltration membranes. Two different variations of extruded substrates with different pore sizes (D_{50} of 3 and 12 µm) and approx. 45 % open porosity were produced. A homogeneous, porous membrane with an average pore diameter of 400 nm was successfully deposited on top of an intermediate layer with a pore size of 1.5 µm and an open porosity of 45 % (Figures 1 and 2). For mass applications, such as drinking water filtration and treatment of waste water (e.g., gray water or water from biogas plants), glass-bonded SiC flat membranes were developed, manufactured, and tested at Fraunhofer IKTS in the last 15 years. These membranes were made by tape casting technology with casting, structuring, and laminating of a wave structure (see below). These wave structures were combined into stacks in a housing. Unlike in pure SiC filters, the chemical stability is only given for a pH of 2–9 because of the glass bonding. The advantage lies in the very low production costs of about 110–170 euros/m² filter area (installed in the stack) using an established manufacturing method for > 5000 m² filter area/year at Fraunhofer IKTS. This cost advantage is generated through co-casting of the substrate and the intermediate layer and the possibility of fast co-firing of all layers at low temperatures in air.

Setup of a flat membrane made of glass-bonded SiC by tape casting

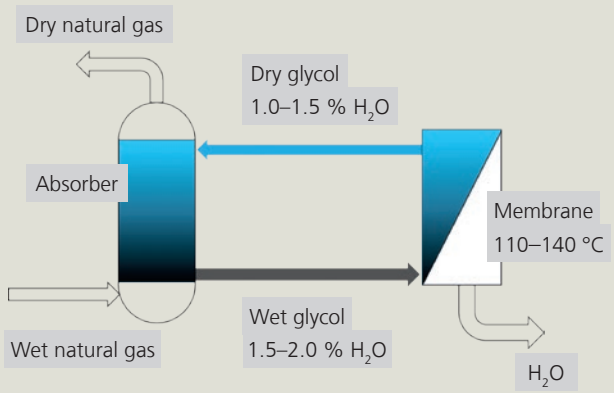


Services offered

- Design, dimensioning, development, and optimization of SiC filter materials and filtration systems for liquid filtration and exhaust after-treatment
- Application-based characterization of filter properties

1 *Cross section of an LPS-SiC filter (multilayer structure).*
2 *Surface of a filtration layer in an LPS-SiC filter.*

Contact Jörg Adler • Phone +49 351 2553-7515 • joerg.adler@ikts.fraunhofer.de



1

2

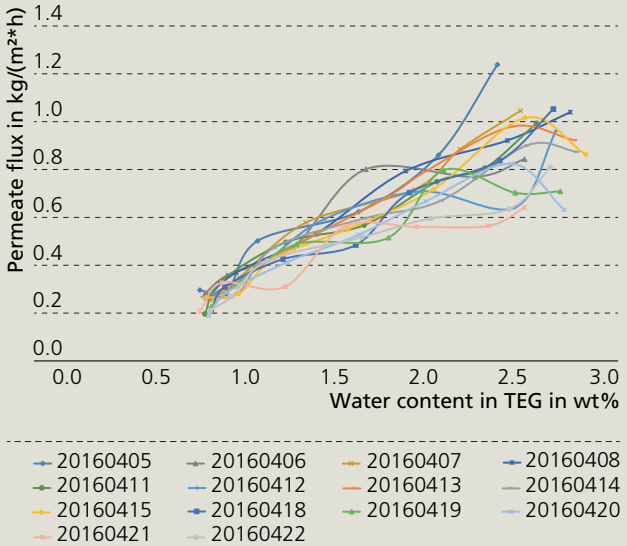
INDIRECT NATURAL GAS DRYING WITH HYDROPHILIC ZEOLITE MEMBRANES

Dipl.-Ing. Jan-Thomas Kühnert, Dr. Marcus Weyd, Dr. Hannes Richter

Natural gas has to be buffered in underground storage facilities to accommodate seasonal fluctuations in demand. During storage, natural gas absorbs humidity. When gas is extracted from the storage site and pumped into pipelines to consumers, it has to be dried again in order to avoid condensation. Normally, this drying process takes place by an absorption process using triethylene glycol (TEG). The TEG operates in a water vapor loading range of 0.5 to 2 wt %. After water absorption the TEG has to be regenerated. This is conventionally done by distillation at temperatures of 190 to 205 °C. The high regeneration temperatures cause thermal degradation of the TEG. Hence, the TEG has to be changed regularly.

These high regeneration temperatures can be avoided through use of a hydrophilic zeolite membrane that was developed for drying of organic solvents. The membranes show convincing separation properties in ethanol dewatering by pervaporation or vapor permeation. The permeate, which is drawn off of the membrane in vapor form with a low ethanol content, is returned to the distillation column. In the drying of the TEG, the permeate must be free of TEG because otherwise it would remain in the ceramic membrane substrate and accumulate there due to its low vapor pressure. Transport of water vapor would be greatly hindered by the clogged pores. Within the scope of the project, iterative optimization of the individual steps in the membrane synthesis process yielded a considerable improvement in membrane quality. Selected membranes show largely TEG-free permeates in long-term tests. Large-scale testing is now being carried out in a pilot plant with a membrane area of 20 m² (225 membranes) for drying of TEG from the underground storage site in Stassfurt.

Long term test for the drying of TEG with zeolite NaA-membranes



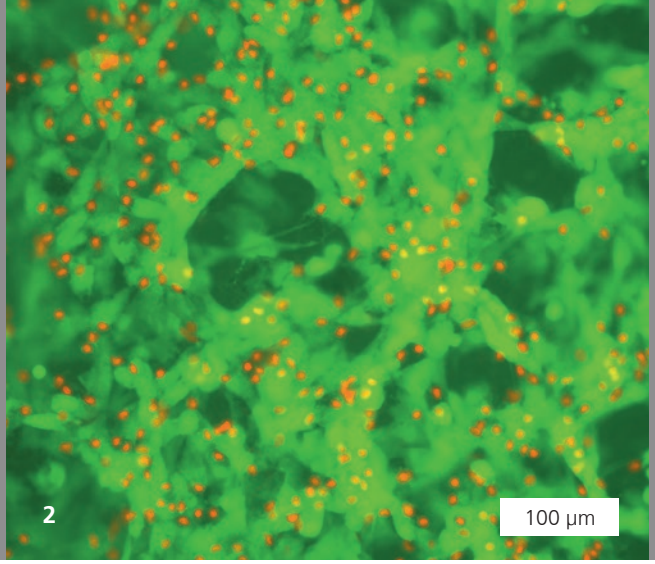
We gratefully acknowledge the BMWi for the financial support of the "MEMTEG" project (03ET1101c) and the partners innogy SE, VNG Gasspeicher GmbH as well as DBI-GUT GmbH for the successful cooperation.

1 *Process schema of indirect natural gas drying.*

2 *"MEMTEG" membrane plant.*

Bundesministerium für Wirtschaft und Energie

Contact Jan-Thomas Kühnert • Phone +49 36601 9301-2619 • jan-thomas.kuehnert@ikts.fraunhofer.de



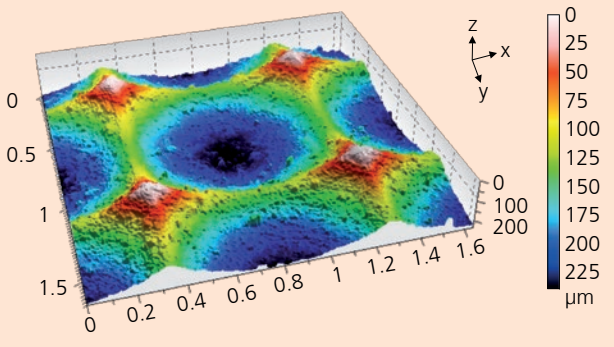
INDIVIDUALLY STRUCTURED DENTAL IMPLANTS

Dipl.-Chem. Martina Johannes, Dipl.-Ing. Olaf Sandkuhl

Use of dental implants is on the rise in dentistry. In Germany, around 1.1 million implants are applied per year, with titanium implants representing today's gold standard. However, there is also a concomitant increase in the occurrence of complications, such as periimplantitis (inflammation of the soft tissues surrounding an implant). Zirconia offers the advantages of good biocompatibility for people with allergies, outstanding soft tissue properties, low plaque accumulation rates, and excellent red-white aesthetics. Macro-/microstructuring of the ceramic surface is accomplished not via additive and/or subtractive processes, but rather directly during shaping of the ceramic by slip casting. For this purpose, a CAD/CAM process chain was developed and the first prototypes were manufactured.

For producing the green body, slurries with 3 and 2 mol % yttria-stabilized zirconia, were prepared. With these slurries, the macro-/microstructure was able to be transferred by slip casting to the surface of the dental implant (Figure 1). The topography of the sintered ceramic surface was investigated by means of white light interference microscopy. The results were in good agreement with the CAD data for the structure. The Ra value of the microstructure was 4.5 µm. The ceramics were sintered at ≤ 1400 °C.

3D map of the topography of a structural element



Characteristic material properties

YSZ	3 mol %	2 mol %
4-point bending strength	985 MPa	1140 MPa
Weibull parameter	m 14.5	m 20.8
Fracture toughness HV10	$MPa\sqrt{m}$	$MPa\sqrt{m}$
According to Shetty	6.1±0.6	14.2±1.5
According to Niihara	5.1±0.5	12.1±1.2

The characteristic properties of the materials clearly indicate that by reducing the amount of yttria-stabilized zirconia, it was possible to double the fracture toughness and improve the strength. Results of preliminary cell tests showed that cell colonization on the macro-/microstructured ceramic surface was completed within 24 h.

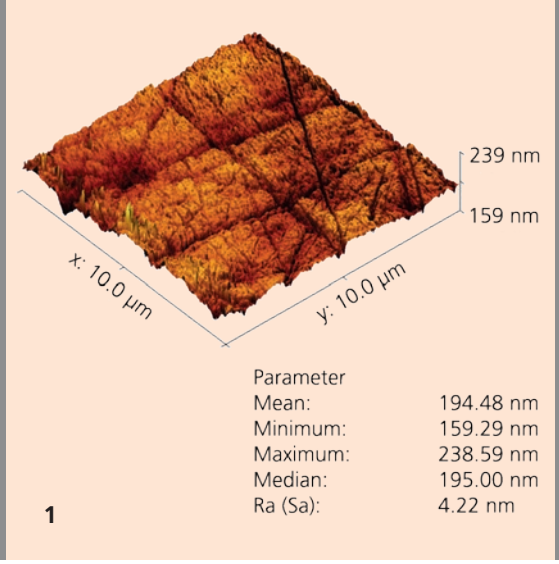
The authors gratefully acknowledge the funding from the project sponsor of the Federal Ministry for Economic Affairs and Energy (BMWi), ZIM (Central Innovation Program for SMBs) cooperation projects (KF 2087357SK4).

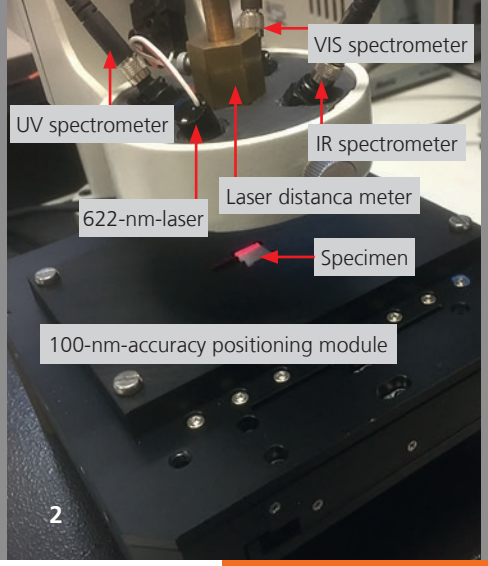
1 *Blanks made of YSZ (slip casting).*

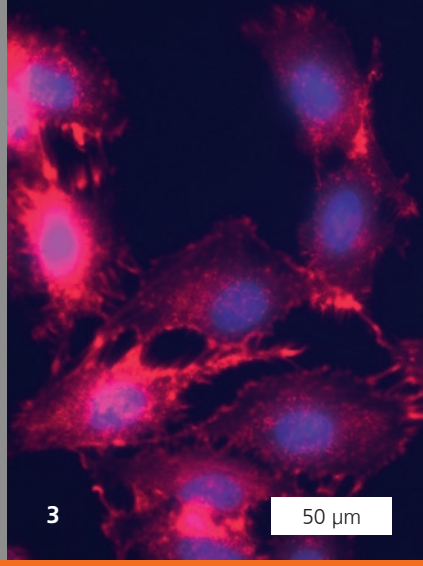
2 *Cell colonization after 24 h.*

Bundesministerium für Wirtschaft und Energie

Contact Martina Johannes • Phone +49 36601 9301-4960 • martina.johannes@ikts.fraunhofer.de







BIOINTERFACE STUDIES IN BIOCERAMICS: IMPROVEMENT OF EXISTING METHODS

Dr. Juliane Pasold, Dipl.-Biol. Katharina Wegner, M.Sc. Katherine Wiley, Dipl.-Chem. Martina Johannes, Dr. Holger Lausch, Dr. Malgorzata Kopycinska-Müller, Dipl.-Ing. Elisabeth Preuße

Ceramic materials are quickly establishing themselves as biomaterials in implantology. Up to now, the properties of biomedical materials have been evaluated in in-vitro studies by

- cultivation of cells on the substrate and/or
- incubation of materials in a physiological fluid (e.g., blood)

Numerous factors, including the material surface, protein adsorption, and different cell and tissue types, influence the interactions at the "biointerface", or the boundary between the biological system and the material surface. The biocompatibility of a material is currently evaluated through in-vitro tests based on ISO standards, such as ISO 10993.

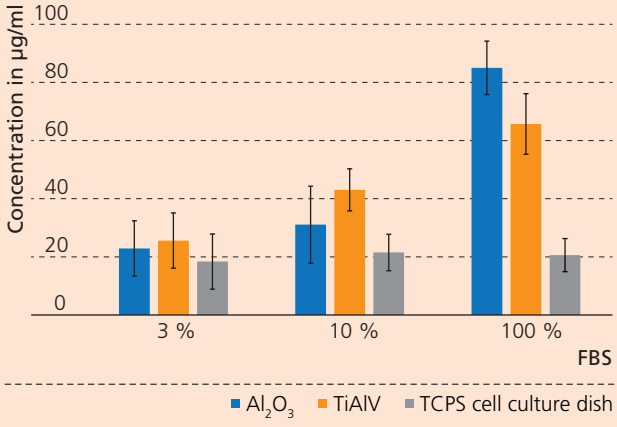
There are only a few standard test methods available for investigating the interactions between the material and blood because of the high degree of complexity of and variations in patient-specific blood response. Contact of the biomaterial with blood leads to activation of blood coagulation and inflammatory responses. The first phase (primary adhesion of blood proteins) is essential for initiation of an immune response and is the focus of the research performed in the ATTRACT group at Fraunhofer IKTS. The aims are to improve standard laboratory methods and to establish new nanoscale-resolution technologies (e.g., AFM) as standard test methods for enabling detailed analysis of protein adsorption on bioceramic and other material surfaces in the future.

Methods

Protein detection and quantitation:

- Raman spectroscopy, atomic force microscopy (AFM), fluorescence microscopy, confocal microscopy, ellipsometry
- Multispectral, nanoscale raster analysis
- Colorimetric assays for protein quantitation, e.g., based on bicinchoninic acid (BCA assay)

BCA assay for determining amount of protein (fetal bovine serum, or "FBS") bound to various surfaces



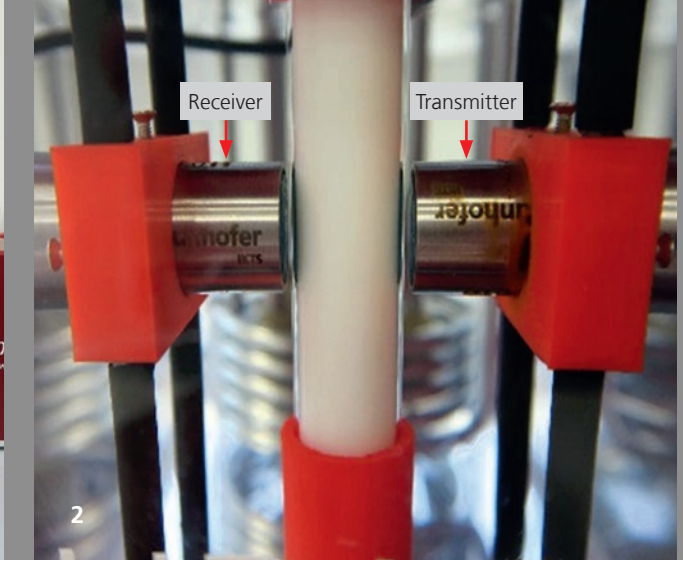
Imaging methods for specific cell types:

- Fluorescent dyes
  - Specific cytoskeletal proteins: cell adhesion and morphology
  - Live/dead dyes: cell vitality and growth
- Material-protein-cell interactions via AFM and SEM

1 *AFM measurement made on polished Al_2O_3 coated with BSA.*
2 *Raster measuring device.*
3 *Bone cells (MG-63) following one hour of incubation on a polished (FBS) protein-coated Al_2O_3 surface (red = F-actin, blue = cell nuclei).*

Contact Juliane Pasold • Phone +49 341 35536-3411 • juliane.pasold@ikts.fraunhofer.de

1



2

ACOUSTIC AND INDUCTIVE ELECTRICAL IMPEDANCE SPECTROSCOPY

Jun.-Prof. Henning Heuer, Dr. Dieter Joneit, M. Sc. Martin Schulze, Dipl.-Ing. (FH) Matthias Pooch, Dipl.-Ing. (FH) Michael Iwanow, Dr. Michael Szardenings, Dr. Claire Fabian, Sören Pietsch, M. Sc. Fu Jipeng

Impedance is the resistance of a material to the propagation of a wave. A wave can be of mechanical (e.g., ultrasound) or electromagnetic nature. The impedance is referred to as the acoustic impedance in the first case and the electrical impedance in the latter case. The impedance contains a significant amount of valuable information for describing the state of a medium. By investigating the acoustic impedance, which is influenced by the density, Young's modulus, and attenuation effects, it is possible to analyze changes in material properties, such as particle or cell size, weight, viscosity, or molecular chain lengths. Electrical impedance spectroscopy responds to changes in electrical conductivity and dielectric properties, such as ionic concentration, displacement of charges, and polarization effects. With a spectroscopic approach employing both methods, i.e., measurement of both the electrical and the acoustic impedance over a wide frequency range, influences, e.g., resulting from resonance effects can be measured.

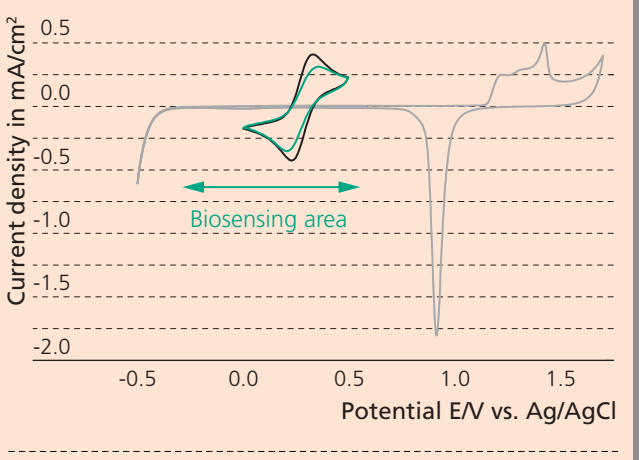
For performing acoustic impedance measurements, a broadband ultrasonic spectrometer with transmission of an ultrasonic wave through a test tube via two sensors (Figure 1) was developed at Fraunhofer IKTS on the basis of the PCUS® system platform. In the past, electrical impedance measurements required direct electrode contact between the probe and the material to be investigated or a capacitive approach with an open capacitor structure. Both approaches require direct contact between the medium and the sensor, whereas the sensor range (measurable sample volume) is low. The impedance measurement technique developed at Fraunhofer IKTS and based on the EddyCus® high-frequency eddy current technique also developed at the institute overcomes this obstacle. For the measurement, coils with alternating current flowing through them (Figure 2) are used, with no direct contact with the sensor being required.

In cooperation with the Fraunhofer Institute for Cell Therapy and Immunology IZI in Leipzig, applications for long-term evaluation of biochemical processes were investigated. With the technique, changes in blood cells can be observed through a container wall in a non-contact manner. In the future, the range of applications will be expanded to include long-term monitoring of polymer materials and ceramics.

1 *Prototyp for the acoustic impedance spectroscopy of fluids developed at Fraunhofer IKTS.*
2 *Alternating current induction coils.*

Contact Henning Heuer • Phone +49 351 88815-630 • henning.heuer@ikts.fraunhofer.de

1



2

SENSORS: CERAMIC-BASED MICROCHIPS FOR BIOANALYTICS

Dr. Lotta Römhildt, Dipl.-Ing. (FH) Uta Gierth, Thomas Täubrich, Birgit Manhica, Dr. Uwe Partsch, Dr. Michael Schneider, Dr. Jörg Opitz

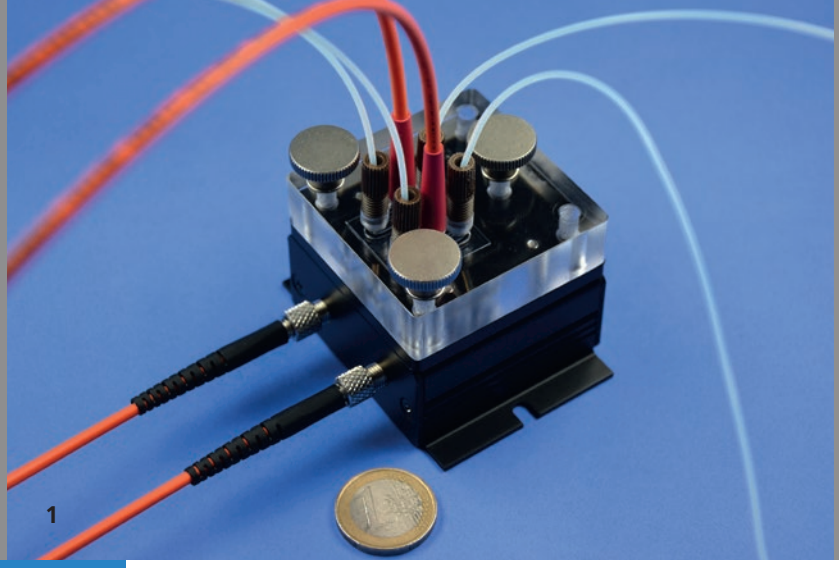
Fraunhofer IKTS develops concepts for ceramic-based biosensors as well as the required materials and processes for manufacturing and characterization of them. Because of their excellent stability and reliability, high-performance ceramics are taking on an increasingly important role in electronics. Ceramic microelectromechanical systems (MEMS) in the medical sector, specific channel structures for the complex handling of fluids and gases, even under extreme conditions, and integrated functional ceramic microelements are characterized by higher sensitivity and multiselectivity. Especially in biosensors, ceramic materials offer the unique properties of long-term stability, biocompatibility, and the combination of electrical and insulating properties.

Immobilization of biomolecules represents a substantial challenge for the development of biosensors because stability, functionality, and specificity of the biocomponents should not be affected. In an initial step, IKTS scientists focus on the long-term stability of the physicochemical components under cyclic loading and the general possibility of biochemical functionalization. Different substrate materials for low-temperature co-fired ceramics (LTCC) and gold pastes are selected for the chip production to ensure optimal conditions for biosensor applications; this is a prerequisite for ceramic multilayer technology, which potentially allows for 3D structuring and system integration and at the same time a hermetic barrier as well as economical large-scale manufacturing. Use of these chips in electrochemical biosensors places special demands on the surface quality of the gold electrodes and hence the ceramic substrates. For this reason, the surface roughness was optimized and could be reduced by 30 to 50 %, depending on the given LTCC. In tests in acid media under cyclic conditions (cyclic voltammetry), suitable combinations ensuring good adhesion and long-term stability of the gold contacts as well as minimal dissolution and degradation were identified. Except for capacitive currents, no reaction is visible in a wide electrochemical window bounded by redox peaks. Within these stationary regions, even small signals corresponding to biorecognition on the functionalized sensor surface are detectable under certain circumstances.

The sensor design is simultaneously being optimized by means of surface plasmon resonance spectroscopy (SPR). This shows that the protein detection signal measured with aptamer-functionalized gold surfaces is clearly dependent on concentration. The results are reproducible and specific compared with the control surface. Repeated regeneration of biochemical functionalization is possible with only a slight decrease in signal height. With this modification, LTCC sensors can be used in in-vitro diagnostics or biotechnology.

1 *Different LTCC sensor chips with printed gold electrodes.*
2 *Cyclic voltammetry of an LTCC sensor chip.*

Contact Lotta Römhildt • Phone +49 351 88815-662 • lotta.roemhildt@ikts.fraunhofer.de



1

OPTICAL DETECTION OF ANTHROPOGENIC TRACE SUBSTANCES IN WATER TREATMENT PLANTS

Dipl.-Phys. Roland Wuchrer, Dipl.-Ing. Nadja Steinke, Dr. Thomas Härtling

One of the pressing challenges facing modern industrialized societies is the ever-increasing concentration of complex trace substances of anthropogenic origin in the environment. Typical trace substances include pesticides, antibiotics, and hormones. The effect of this trend on human health is not yet fully understood. However, experts agree that the excessive amounts of these substances currently seen in drinking and environmental water will have negative long-term effects. Up to now, the chemical analysis of these complex organic substances has been extremely laborious and only random sampling has been possible. Furthermore, highly sensitive detection systems are required for reliably detecting the low concentrations.

With the "ANTHROPLAS" project, Fraunhofer IKTS and partners from industry aim to supplement the currently used detection methods with an online technique. To that end, an analytical tool for anthropogenic trace substances for field operation in water treatment plants is currently being developed and will be tested under real application conditions within the scope of the project, which is funded by the Federal Ministry of Education and Research (BMBF).

The chemical sensor system to be used for this is based on an advanced version of the successful and well-accepted surface plasmon resonance (SPR) spectroscopy technique. This spectroscopy method is implemented at Fraunhofer IKTS in a way that enables the setup of a robust and miniaturized sensor system for on-site targeted control of the water treatment process, e.g., ozonization. Hence, the project contributes to a safe, efficient and cost-effective water treatment process.

A key point of departure from conventional SPR sensor systems is the use of nanostructured metal sensor substrates to allow simple optical interrogation. These metal structures facilitate the detection of anthropogenic trace substances via specific molecular binding processes at their surfaces. The thus-modified optical properties of the sensor substrates are continuously interrogated with an optoelectronic detection system. A change in the optical features, for example, the transmission signal, indicates the presence of a trace substance.

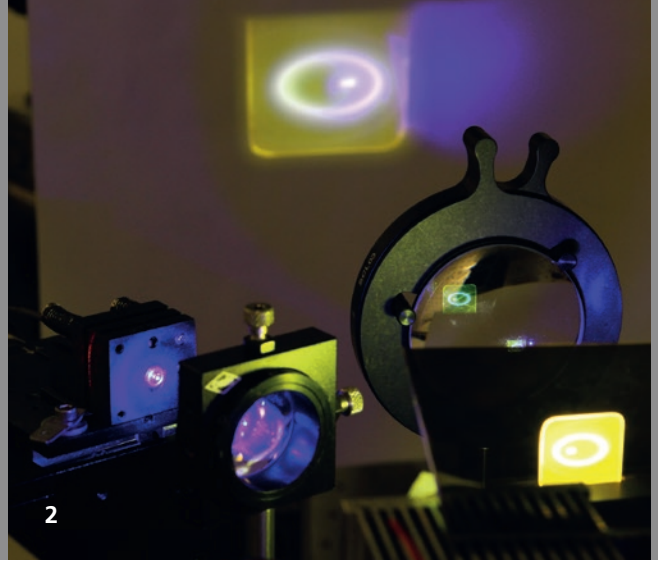
Figure 1 shows the current state of development of the sensor system. A central prerequisite for a reliable detection process is the optimization of the entire hardware used in terms of robustness and durability in field applications. As a lead substance, the concentration of diclofenac, a painkiller molecule, is monitored with a concentration resolution in the submicrogram-per-liter range. The online analytical system will be implemented and tested at a municipal water treatment plant in the Dresden region within the scope of the project.

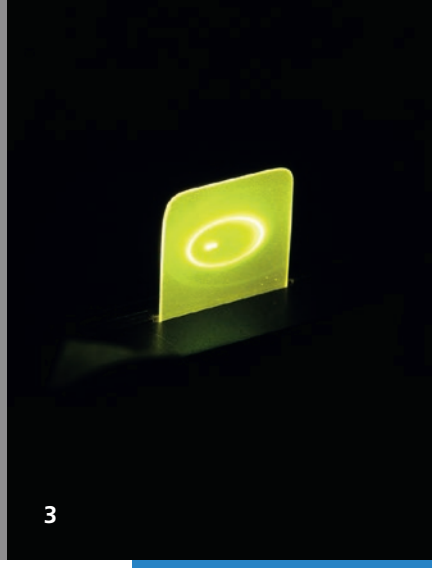
1 *Sensor unit for detection of diclofenac in treated water.*

Bundesministerium für Bildung und Forschung

Contact Thomas Härtling • Phone +49 351 88815-550 • thomas.haertling@ikts.fraunhofer.de

1


2


3

SCALE-UP AND OPTIMIZATION OF CERAMIC PHOSPHORS FOR SPECIAL APPLICATIONS

Dr. Isabel Kinski, Dr. Manfred Fries, Dr. Michael Arnold

With the current surge in interest in light-converting ceramics for the high-power lighting segment, optimization and adjustment of cerium-doped $Y_3Al_5O_{12}$ (YAG:Ce) ceramic phosphors are more important than ever. Applications in this area currently draw on both excitation possibilities for blue light of wavelength 450 nm: laser- and LED-based systems. At Fraunhofer IKTS, scale-up of the process to 4-inch ceramic phosphor wafers is being addressed in the Fraunhofer project "HeraKLED", which stands for "Hermetically sealed luminescent ceramics for LEDs". The aim is to enable use of ceramic light converter disks in LED-excited packages as hermetic sealing in wafer-to-wafer technology. For scale-up, the binder-free granules that had been optimized for transparent 2-cm disks were adjusted with respect to binder content and processed in a spray drying process. Uniaxial pressing was performed alone or in combination with CIP at pressures of 100–350 MPa to generate defect-free green bodies with a diameter of 130 mm. Optimization of sintering conditions yielded crack- and nearly distortion-free disks (Figure 1).

For laser-based applications, the 4-inch YAG:Ce disks are optimized for high-power illumination in cinema and flight simulation projectors and the smaller disks for headlight systems. In order to enable new functionalities for adaptive illumination, research on the combination of laser headlights with MEMS scanning mirror technology is performed with partners.

The YAG:Ce phosphor ceramic has to be optimized for each different application in consideration of several aspects, i.e., if the excitation is performed by laser or LED, if the ceramic phosphor is in transmission or reflection geometry, if sharp image edges are required, or if the resulting white light beam should be formed and therefore the ceramic structured.

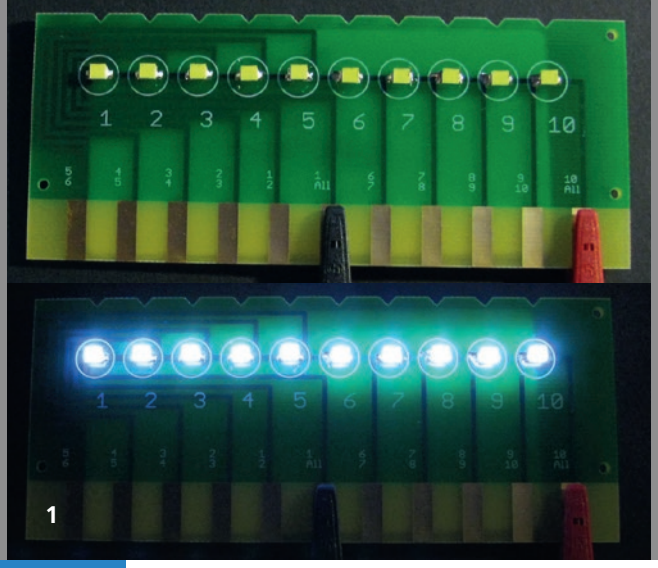
For all applications, adjustment of the scattering parameters for the intended use is crucial. At Fraunhofer IKTS, different approaches for incorporation of scattering into the ceramic are considered and compared against a transparent defect- and scattering-free YAG:Ce standard for determination of the influence of the scattering centers. Parameters, such as pore content and size, introduction of secondary phases, or dispersion of a YAG:Ce powder in a transparent ceramic matrix are investigated and compared with the aim of obtaining optimum results for various applications (see article by Ludwig and Barth).

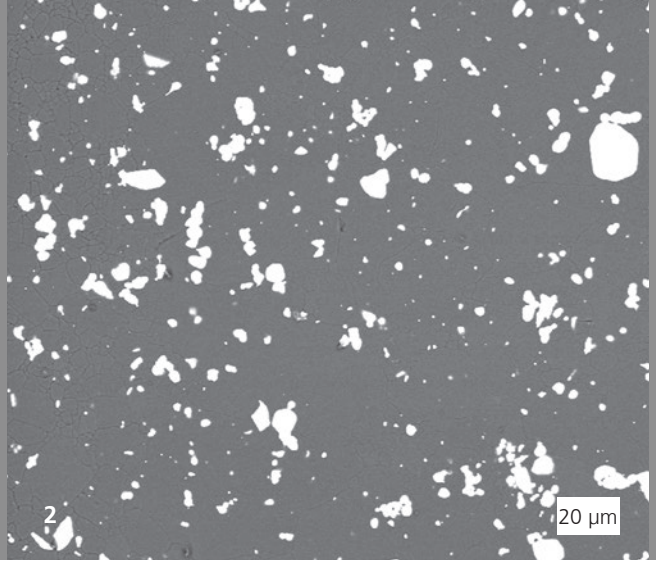
Acknowledgments

Gabriele Eberhardt from LDT GmbH as well as Dr. Ulrich Hofmann and Dr. Thomas von Wantoch from Fraunhofer ISIT are gratefully acknowledged for their cooperation.

1 *4-inch YAG:Ce ceramic phosphor with a low number of light scattering centers.*
2 *Experimental setup with fiber-coupled laser light.*
3 *Laser-excited Lissajous figure projected by a MEMS mirror.*

Contact Isabel Kinski • Phone +49 36601 9301-3931 • isabel.kinski@ikts.fraunhofer.de





OPTICS

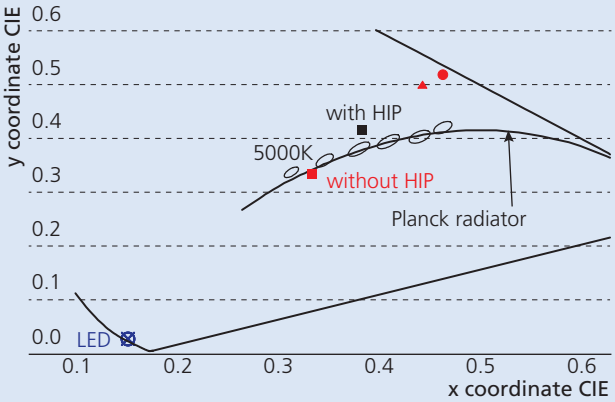
LUMINESCENT MATERIAL-BASED COMPOSITES FOR LIGHTING TECHNOLOGY

Dr. Stefan Barth, Dipl.-Ing. Henry Ludwig, Dipl.-Ing. Uta Oberbach

Light-emitting diodes (LEDs) with high power densities are currently revolutionizing nearly all areas of lighting technology due to their outstanding performance characteristics, such as light output and service life. Unlike conventional incandescent or halogen light bulbs, LEDs can only emit colored light over a very narrow range of wavelengths because of their underlying excitation mechanisms. For color perception reasons, general lighting applications normally use white light, which has a spectral composition largely approximating that of a thermal radiator to achieve good color rendering properties. The colored light of an LED must hence be converted to white light. Suitable converter phosphors that, due to electron excitation processes, absorb light at short wavelengths and emit the incoming energy in the form of light at longer wavelengths are used for this. For reproduction of all of the colors in the visible light spectrum, blue light is converted to white light with a yellow phosphor or a phosphor mixture. The phosphor is incorporated into a transparent binder matrix made of silicone or siloxane resin, applied as a paste to the LED chip, and thermally cured. With increasing LED power density, especially in the case of high-power LEDs, the phosphor and the organic binder matrix are subjected to increasingly high thermal and UV radiation loads, which affect both service life and quantum yield of the converter. With innovative converter materials in which the phosphor is either embedded in a transparent ceramic carrier material with high thermal and UV stability or applied to glasses or transparent ceramic substrates via a ceramic thick-film process, these disadvantages can be avoided and the stability and service life of these white light converters significantly improved.

Both through the implementation of luminescent YAG:Ce^{3+} materials in a transparent spinel matrix and with the help of glass-ceramic YAG:Ce^{3+} thick films, translucent converter disks that can be combined with a blue LED to achieve the white light curve in the CIE diagram can be fabricated. The outstanding thermomechanical properties of these converter disks predestine them for use in high-power LEDs.

CIE chromaticity coordinates of translucent converter disks as a function of coating thickness, finishing, and hot isostatic pressing (HIP)

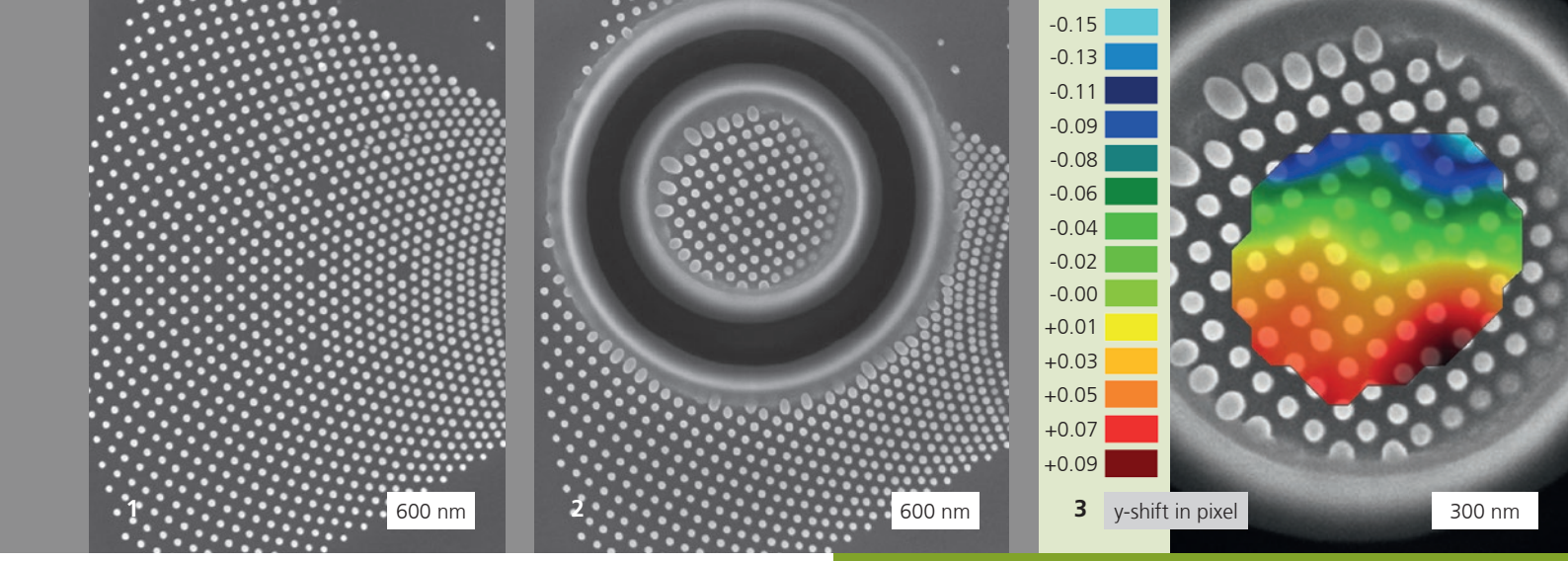


Composite dish + blue LED (500 mA): ● % (d = 0.85 mm) ▲ % (d = 0.5 mm, ground) ■ % (d = 0.2 mm, ground)

EFRE
EUROPA FÜR THÜRINGEN
EUROPÄISCHER FONDS FÜR REGIONALE ENTWICKLUNG

1 *Thick film-based white light converter chips on a diode array with no current applied (top) and with current applied (bottom).*
2 *Microstructure of the spinel-YAG:Ce^{3+} composite ceramic.*

Contact Stefan Barth • Phone +49 36601 9301-1868 • stefan.barth@ikts.fraunhofer.de



MEASUREMENT OF THE MICRO-STRESS STATE IN 3D ELECTRONICS USING THE FIB-DAC METHOD

Dr. Rüdiger Rosenkranz, Dr. André Clausner, Prof. Dr. Ehrenfried Zschech

The determination of stresses adjacent to copper through-silicon vias (TSVs) is a very important task in cutting-edge microelectronics. These copper contacts, with diameters of 5–10 µm, are placed inside silicon chips and are used to interconnect different chip levels in stacked 3D microelectronics. Due to the higher coefficient of thermal expansion, copper displays a stronger volume shrinkage than silicon, and during cooling down from the annealing temperature of 350 °C to room temperature, high mechanical stresses are induced in the silicon around the TSVs. This can cause reliability problems and change the electrical parameters of the transistors in the vicinity of the TSVs.

These effects can be controlled through measurement of the micro-stress state in 3D electronic structures. The FIB-DAC method was implemented for this. The name "FIB-DAC" stands for "Digital Auto Correlation" of scanning electron microscope images before and after material removal with the "Focused Ion Beam" technique. In detail, the following steps are performed:

Step 1: A stable high-contrast pattern with no translational symmetry is created on top of the region of interest (ROI) by deposition of platinum micro dots.

Step 2: An initial high-quality micrograph of the ROI (Figure 1) is taken with a scanning electron microscope.

Step 3: All material around the ROI is removed through milling of a circular slit with a focused ion beam; relaxation of the in-plane stresses results in small amounts of expansion/contraction (depending on the previous stress state) in the ROI.

Step 4: A second high-quality micrograph of the ROI is taken (Figure 2).

Step 5: The resulting strain field is calculated with subpixel accuracy using image correlation software (Figure 3).

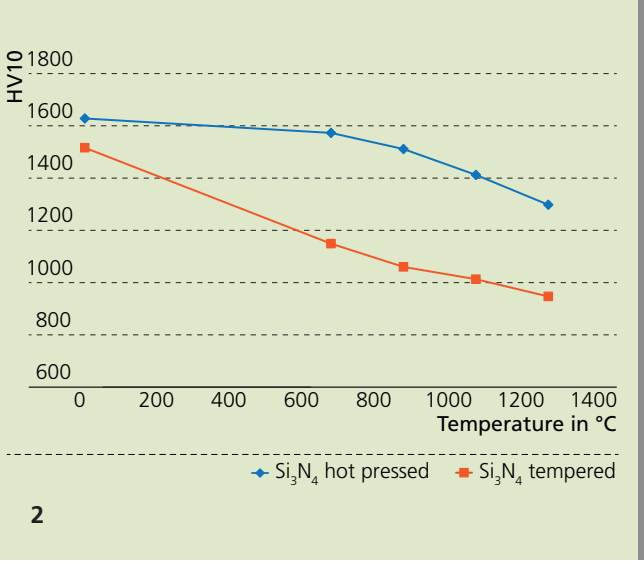
Step 6: The stresses are calculated from the strains using either numerical or analytical solutions of the local geometry.

The authors gratefully acknowledge the European Union for the funding in the context of the project "iSTRESS", grant agreement no: 604646.

1 *SEM image of the high-contrast pattern on top of the ROI.*
2 *SEM image of the ROI after FIB milling.*
3 *Displacement field calculated with image correlation software using pre- and post-FIB SEM images.*

Contact Rüdiger Rosenkranz • Phone +49 351 88815-529 • ruediger.rosenkranz@ikts.fraunhofer.de

1



2

DETERMINATION OF MECHANICAL PROPERTIES AT MAXIMUM APPLICATION TEMPERATURES

Dipl.-Ing. Clemens Steinborn

Fraunhofer IKTS develops ceramic materials for hot gas path components of gas turbines. High efficiency can be attained due to the high thermal stability of ceramic materials. For evaluation of material reliability, test methods with which key material parameters (strength, oxidation resistance, and corrosion resistance) can be determined precisely up to the highest application temperatures are needed.

The mechanical material properties were determined within the scope of various development projects through extensive strength tests under bending and compression loads. Measurement of fracture toughness on samples prepared with defects of defined geometry served toward evaluation of the crack sensitivity of the materials.

Test machines equipped with different furnaces for measurements in air up to 1600 °C or in a vacuum chamber up to 1400 °C for materials of low oxidation resistance are available. Young's modulus, which is required for component design, can be determined up to high temperatures through in-situ measurement of sample deformation by ceramic tipes. High-temperature creep testing is performed at a constant bending stress. The failure mechanism is then studied in detail in terms of fracture behavior, dynamic fatigue, and creep for evaluation of the fatigue limit and adaptation of the microstructure to the given requirements. For meaningful strength data for materials showing a statistical scatter in strength to be obtained, a large number of individual tests (30) and calculation of the Weibull modulus are required.

For applications such as cutting tools or special seals for valves in power plants, the service life of a material is strongly influenced by its wear resistance and hardness. Testing of hardness at room temperature is insufficient for evaluation of wear resistance at higher temperatures due to the additional effects of frictional heat or direct contact with hot media. This problem has been solved by a hot hardness tester developed at Fraunhofer IKTS to measure Vickers hardness up to 1500 °C (high vacuum). This tool is very useful in the development of materials with high wear resistance for applications with combined thermal and abrasive stress. Thanks to a high load range down to small test loads (HV0.2 to HV30), local characterization, for example, hardness line scans of graded materials or wear-resistant coatings, is possible. Flexible temperature control in combination with in-situ hardness testing is useful for optimization of thermal treatments.

Services offered

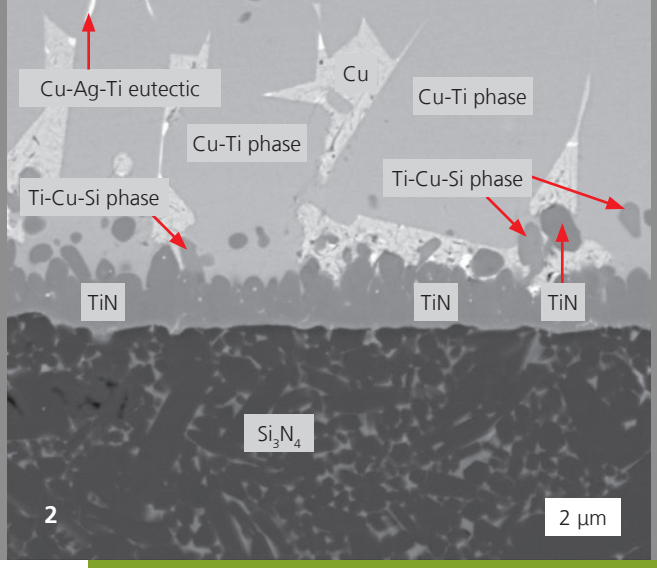
- Measurement of strength, fracture toughness, and Young's modulus between 20 and 1600 °C
- Measurement of Vickers hardness between 20 and 1500 °C
- Mechanical tests according to customer requirements

1 *Furnace and four-point bending setup (inset: materials of different creep resistance after creep test).*

2 *High-temperature Vickers hardness of Si_3N_4 ceramics with different grain sizes.*

Contact Clemens Steinborn • Phone +49 351 2553-7647 • clemens.steinborn@ikts.fraunhofer.de

1



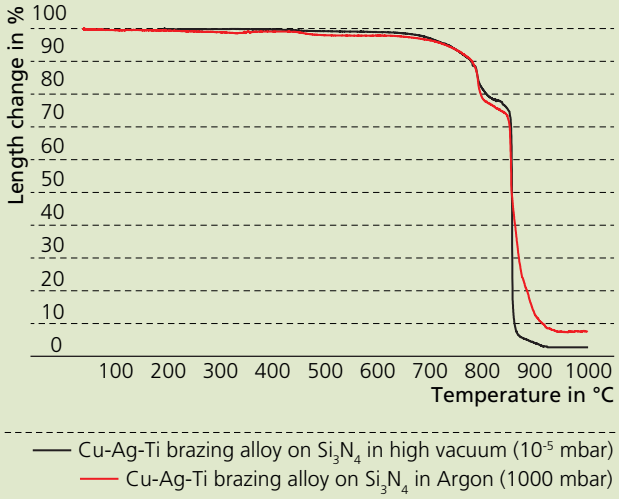
2

OPTICAL DILATOMETRY IN HIGH-PURITY ATMOSPHERES

Dr. Tim Gestrich, Dr. Arno Kaiser

Optical dilatometers measure dimensional changes in samples as a function of temperature and time. Along with hot-stage microscopes, they have a wide range of applications in materials and process development. For example, they can be used in the investigation of sintering processes and thermal expansion behavior, especially of anisotropic or fragile materials as well as samples with complex geometries. Wetting and spreading behavior on different substrates can be determined through optical measurement of the contact angle and determination of the surface tension up to high temperatures as well as measurement of the viscous properties of glasses. In addition, investigation of contact corrosion between metal and glass melts, slags, and molten ashes in contact with ceramic and metal materials is possible. Characterization of infiltration, for example, of metal melts into ceramic materials is another important possibility. Standard optical dilatometers and hot-stage microscopes are designed for measurements in air or atmospheres with relatively high oxygen concentrations. Within the framework of an AiF-ZIM project funded by the Federal Ministry for Economic Affairs and Energy (BMWi), Fraunhofer IKTS and Linseis Messgeräte GmbH have developed an optical dilatometer working in a high vacuum (approx. $5*10^{-5}$ mbar) with oxygen concentrations of about 0.5 ppm in dynamic atmospheres (normal pressure, approx. 5 L/h argon) for the analysis of processes under high vacuum or in high-purity atmospheres at temperatures of up to 1600 °C. A typical application for optical dilatometry is the characterization of processes occurring during joining of ceramic-ceramic and metal-ceramic materials by active metal brazing. With the newly developed optical dilatometer, investigations on melting and wetting behavior of brazing alloys containing braze components (e.g., titanium) of high oxygen affinity on ceramic substrates could be realized. In standard hot-stage microscopes, surface oxidation occurs because of the residual oxygen present, thereby hindering the wetting of the substrate by the brazing alloy or causing falsified experimental results to be obtained. With the new experimental possibilities, a major contribution to a fundamental understanding as well as the development and optimization of joining processes can be made.

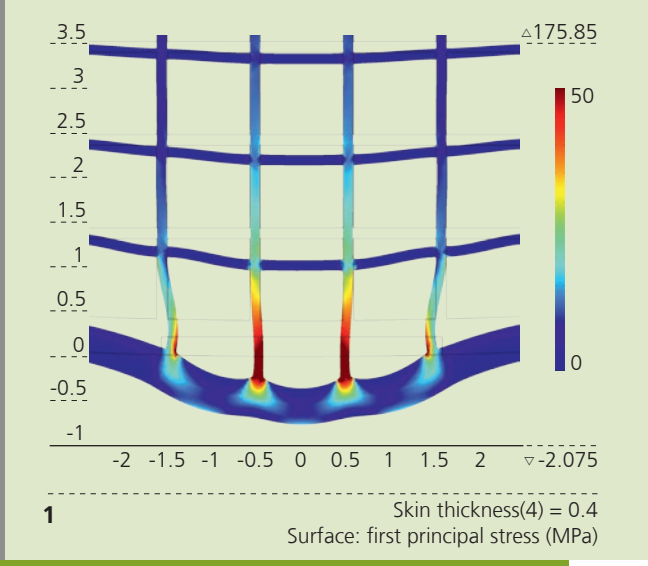
Change in height of a brazing alloy during melting and wetting of Si_3N_4



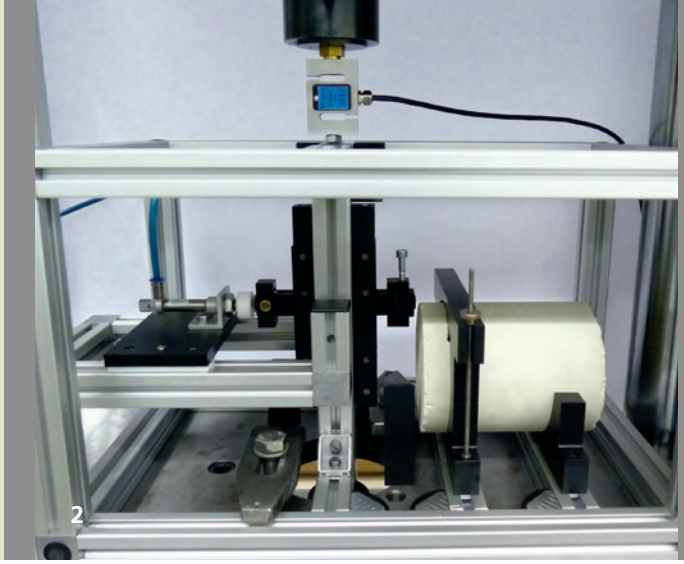
Bundesministerium für Wirtschaft und Energie

1 *Wetting of a Si_3N_4 substrate by an Ag-Cu-Ti brazing alloy.*
2 *Microstructure of the contact zone between an Ag-Cu-Ti brazing alloy and a Si_3N_4 substrate.*

Contact Tim Gestrich • Phone +49 351 2553-7814 • tim.gestrich@ikts.fraunhofer.de



1


2

COMPONENT-SPECIFIC TEST METHODS

Dipl.-Math. Michael Brand, Dipl.-Ing. Roy Torke

Overview

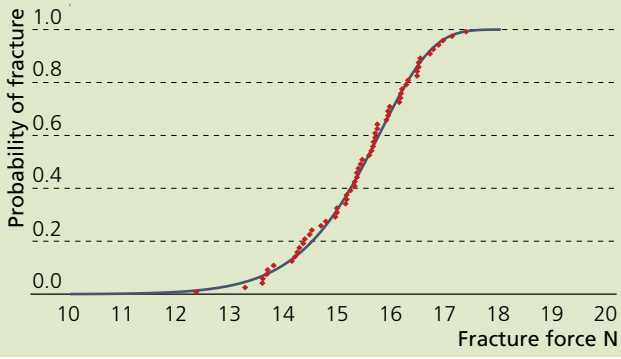
The increasing importance of ceramics as structural and functional materials requires component-specific test methods for determining the mechanical load capacity under realistic use conditions. These conditions are characterized by special geometrical as well as temporal loading scenarios and require solutions departing from the established and standardized universal procedures. For this purpose, the Laboratory for Quality and Reliability at Fraunhofer IKTS regularly develops component-specific test methods and systems. A current example is a test stand developed for UMICORE AG & CO. KG for determining edge stability in ceramic honeycombs.

Test stand for determining edge stability

In the processing of ceramics with honeycomb structures, failures that can be traced back to instabilities in the edge regions occur. Often a certain minimum edge stability is a prerequisite for further processing. The aim of the work was hence to develop a method that was suitable for simple and reproducible measurement of edge stability as well as for receiving inspections of random samples. Based on extensive preliminary examinations of samples from production as well as from inspection of the manufacturing facilities, a test system enabling simulation of the loads arising in the production process and measurement of edge stability for different ceramic honeycomb geometries was developed and validated.

For the measurement, a plunger is pressed flatly with an adjustable force against a defined edge region, the honeycomb is loaded normally until fracture of the edge occurs, and the forces occurring in the process are recorded and evaluated electronically. In this way, it is possible to determine and check the type-specific limit values for edge stability.

Distribution curve of the edge stabilities



Services offered

- Development of component-specific test methods
- Design and construction of component-specific test systems
- FEM simulations for the development of test systems
- Process evaluation with inspection of manufacturing facilities

1 *FEM simulation of the stress state in edge regions of a ceramic honeycomb.*

2 *Test stand for measurement of edge stability in ceramic honeycombs.*

Contact Michael Brand • Phone +49 36601 9301-1971 • michael.brand@ikts.fraunhofer.de

MICROPLASTICS – CHARACTERIZATION AND WEATHERING

Dipl.-Ing. Kathrin Oelschlägel, Dr. Annegret Potthoff

Microplastics – a new challenge for environment and research

Plastic particles are ubiquitous in the environment and have already been detected in water and soil. Microplastics include all polymer particles that are smaller than 5 mm in one dimension. Storms, accidents, and unprofessional or illegal disposal of plastic waste are possible pathways for entry of microplastics into the environment. The poor biodegradability of polymers leads to a long residence time in nature, where the plastics undergo different weathering and aging processes. Secondary microplastics are generated through disintegration of large plastic fragments into smaller pieces during weathering. Aging processes, such as photochemical degradation, mechanical fragmentation, or sorption of pollutants onto particle surfaces, change the chemical and physical properties of the polymers and thereby have a significant effect on the interactions occurring between microplastics and the environment.

The goal of artificial weathering of microplastics under laboratory conditions is to understand the complex natural weathering processes and their influence on material properties. Therefore, the complex processes are broken down into individual biotic and abiotic weathering steps. The natural weathering of microplastics usually starts with exposure of the material to the ultraviolet (UV) part of natural sunlight. For evaluating the influence of UV radiation on microplastics, weathering experiments with UV lamps are performed under laboratory conditions. As a first step, microplastic particles are dispersed in different media. The resulting dispersions are exposed to UV radiation for a defined period. Microplastic particles are analyzed both before and after the experiments. The chemical characterization includes the determination of chemical composition, crystal structure, crystallinity, and surface charge of the material. Initial results show that the crystallinity of polyethylene terephthalate (PET) and low-density polyethylene (LDPE) increases during UV light exposure. Additionally, physical parameters, such as density, specific surface area, and wettability, are determined. Optical methods also provide information about aging of materials. Scanning electron microscopy is used to evaluate the particle surface, whereas dynamic imaging allows for determination of particle size and shape distributions. The results of the first weathering experiments show an influence of UV light on particle size distribution.

Understanding the complex aging processes, their influence on material properties, and the resulting behavior of microplastics in the environment is the basis for a comprehensive risk assessment of a material. This complex analysis of weathering processes of polymer materials is being carried out within the framework of the EU project "Weather-Mic" in cooperation with partners from Belgium, Norway, Sweden, and Germany.

1 *Natural aging of plastic materials.*
2 *Artificial weathering of microplastics in the laboratory.*

WEATHER MIC

Contact Annegret Potthoff • Phone +49 351 2553-7761 • annegret.potthoff@ikts.fraunhofer.de

COOPERATION IN GROUPS, ALLIANCES AND NETWORKS

Membership in Fraunhofer Groups, Alliances and Networks

Scientists at Fraunhofer IKTS are active in numerous thematically oriented networks, alliances and groups. Therefore, our customers benefit from having a coordinated range of joint services available to them.

AMA Association for Sensors and Measurement

American Ceramic Society (ACerS)

Association Competence Center for Aerospace and Space Technology Saxony/ Thuringia (LRT)

Association for Manufacturing Technology and Development (GFE)

Association of Electrochemical Research Institutes (AGEF)

Association of German Engineers (VDI)

Association of the Thuringian Economy

Association of Thermal Spraying (GTS)

biosaxony

Carbon Composites (CCeV)

Ceramics Meeting Point Dresden

Competence Center for Nano Evaluation nanoeva®

Competence Network on Optical Technologies (Optonet)

Cool Silicon

DECHEMA – Society for Chemical Engineering and Biotechnology

Deutsche Glastechnische Gesellschaft (DGG)

DIN – German Institute for Standardization

Deutsche Keramische Gesellschaft (DKG / German Ceramic Society)

DKG/DGM Community Committee

DRESDEN concept

Dresden Fraunhofer Cluster Nanoanalysis

Dresdner Gesprächskreis der Wirtschaft und der Wissenschaft

Dual Career Network Central Germany

Energy Saxony

European Powder Metallurgy Association (EPMA)

European Rail Innovation Center

European Research Association for Sheet Metal Working (EFB)

European Society of Thin Films (EFDS)

Expert Group on Ceramic Injection Molding in the German Ceramic Society

Expert Group on High-Temperature Sensing Technology in the German Society for Materials Science

Fraunhofer Adaptronics Alliance

Fraunhofer Additive Manufacturing Alliance

Fraunhofer AdvanCer Alliance

Fraunhofer Battery Alliance

Fraunhofer Cluster 3D Integration

Fraunhofer Energy Alliance

Fraunhofer Group for Materials and Components – MATERIALS

Fraunhofer Group for Microelectronics

Fraunhofer Lightweight Design Alliance

Fraunhofer Nanotechnology Alliance

Fraunhofer Numerical Simulation of Products and Processes Alliance

Fraunhofer Textile Alliance

Fraunhofer Water Systems Alliance (SysWasser)

German Acoustical Society (DEGA)

German Association for Small and Medium-sized Businesses (BVMW)

German Biogas Association

German Electroplating and Surface Treatment Association (DGO)

German Energy Storage Association (BVES)

German Engineering Association (VDMA)

German Society for Materials Research (DGM)

German Society for Non-Destructive Testing (DGZfP)

German Thermoelectric Society (DTG)

Hydrogen Power Storage & Solutions East Germany

International Energy Agency (IEA) Implementing Agreement on Advanced Fuel Cells

International Zeolite Association

KMM-VIN (European Virtual Institute on Knowledge-based Multifunctional Materials AISBL)

Materials Research Network Dresden (MFD)

medways

Meeting of Refractory Experts Freiberg (MORE)

Micro-Nanotechnology Thuringia (MNT)

NanoMat – Supraregional Network for Materials Used in Nanotechnology

Nanotechnology Center of Excellence for "Ultrathin Functional Layers"

ProcessNet – an Initiative of DECHEMA and VDI-GVC

Research Association for Diesel Emission Control Technologies (FAD)

Research Association for Measurement Technology, Sensors and Medical Technology Dresden (fms)

Research Association on Welding and Allied Processes of the German Welding Society (DVS)

Silicon Saxony

smart³

SmartTex Network

Society for Corrosion Protection (GfKORR)

Thüringer Erneuerbare Energien Netzwerk e. V. (ThEEN)

Wasserwirtschaftliches Energiezentrum Dresden

WindEnergy Network Rostock

FRAUNHOFER GROUP FOR MATERIALS AND COMPONENTS – MATERIALS

Materials research and materials technology at Fraunhofer cover the entire value chain, from the development of new and the improvement of existing materials, through manufacturing technology on a quasi-industrial scale, up to the characterization of properties and assessment of service behavior. The same research scope applies to the components made from these materials and the way they function in systems. As far as materials are concerned, the Fraunhofer MATERIALS group covers the full spectrum of metals, inorganic non-metals, polymers, and materials made from renewable resources, as well as semiconductor materials. Over the last few years, hybrid materials have gained significantly in importance. With strategic forecasts the Group supports the development of future-oriented technologies and materials. With the initiative Materials Data Space© (MDS) founded in 2015, the Group is presenting a roadmap towards Industry 4.0 enabled materials. Digitalization of materials along their entire value creation chain is viewed by the Group as a key requirement for the lasting success of Industry 4.0.

Objectives of the Group:

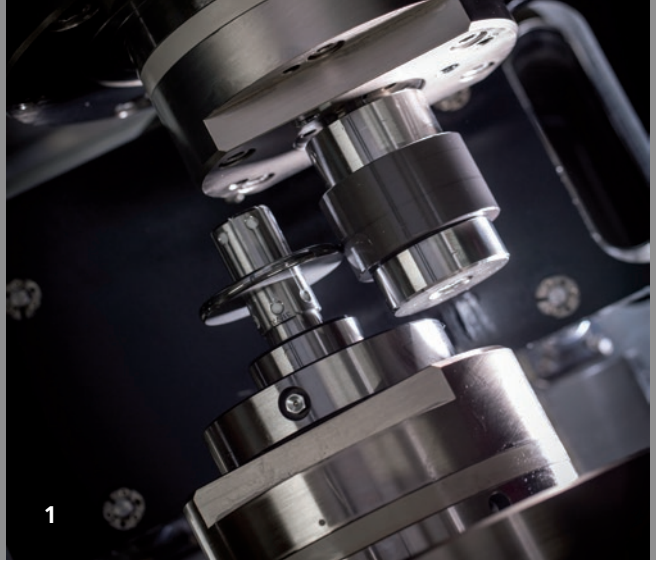
- Supporting accelerated innovation in the markets
- Promoting the success of Industry 4.0 through suitable material concepts (digital twins, Materials Data Space©)
- Increasing integration density and improving the usability properties of microelectronic devices and microsystems
- Improving the use of raw materials and improving the quality of the products manufactured from them, development of recycling concepts
- Enhancing safety and comfort and reducing resource consumption in the areas of transport, machine and plant construction, building & living
- Increasing the efficiency of systems in energy generation, energy conversion, energy storage and distribution
- Improving the biocompatibility and function of materials used in medical biotechnical devices, improving material systems for medical diagnosis, disease prevention and therapy
- Improving the protection of people, buildings and infrastructure through high-performance materials in tailored protection concepts

Members are the Fraunhofer Institutes for

- Applied Polymer Research IAP
- Building Physics IBP
- Structural Durability and System Reliability LBF
- Chemical Technology ICT
- Manufacturing Technology and Advanced Materials IFAM
- Wood Research, Wilhelm-Klauditz-Institut, WKI
- Ceramic Technologies and Systems IKTS
- High-Speed Dynamics, Ernst-Mach-Institut, EMI
- Microstructure of Materials and Systems IMWS
- Silicate Research ISC
- Solar Energy Systems ISE
- Systems and Innovations Research ISI
- Nondestructive Testing IZFP
- Wind Energy and Energy System Technology IWES
- Mechanics of Materials IWM
- Industrial Mathematics ITWM (assoc. institute)
- Interfacial Engineering and Biotechnology IGB (assoc. institute)
- Integrated Circuits IIS (assoc. institute)

Group chairman

Prof. Dr. Peter Elsner, Fraunhofer ICT
www.materials.fraunhofer.de



FRAUNHOFER ADVANCER ALLIANCE

Systems development with high-performance ceramics

The usage of high-performance ceramics allows for new applications in energy engineering, mechanical and plant engineering, and medical technology. Well-known examples are highly efficient tools and coatings, new material and manufacturing technologies for medical-technical products as well as creative solutions for energy and resource saving industrial processes. At present, AdvanCer is working in a joint project developing systems solutions and test methods for the oil and gas industry as well as for deep sea mining. It is the objective to develop new diamond-ceramic and hard metal materials as well as the appropriate manufacturing technologies. So, components may be realized which allow for the maintenance-free operation in up to 6000 m depth in the sea.

Four Fraunhofer Institutes (IKTS, IPK, ISC/HTL and IWM) have joined together to form the Fraunhofer AdvanCer Alliance. It is the aim of AdvanCer to develop individual systems solutions with advanced ceramics for industry. The research activities of the Fraunhofer Alliance extend along the entire value-added chain from modeling and simulation through application-oriented materials development, production and machining of ceramic parts to component characterization, evaluation and non- destructive testing under application conditions. Development work is conducted and supported by modeling and simulation methods.

Furthermore, AdvanCer has established a comprehensive range of training and consultancy services to support small and medi-umsized companies in solving complex tasks ranging from prototype development to technology transfer.

Fields of cooperation

- Materials development for structural and functional ceramics, fiber-reinforced ceramics, cermets and ceramic composites
- Component design and development of prototypes
- Systems integration and verification of batch-production capabilities
- Development of powder, fiber and coating technologies
- Materials, component and process simulation
- Materials and component testing
- Defect analysis, failure analysis, quality management
- Analysis of energy demand for thermal processes and to improve energy efficiency
- Increase of efficiency using ceramic components

Services offered

- Development, testing and evaluation of materials
- Prototype and small series production
- Technology development and technology transfer
- Process analysis and design
- Consulting, feasibility studies, training programs

Spokesperson of the Alliance

Dr. Michael Zins
michael.zins@ikts.fraunhofer.de
www.advancer.fraunhofer.de

1 *Test stand for the tribological testing of ceramic materials and components (Source: Dirk Mahler/Fraunhofer).*

CERAMICS MEETING POINT – CERAMIC APPLICATIONS

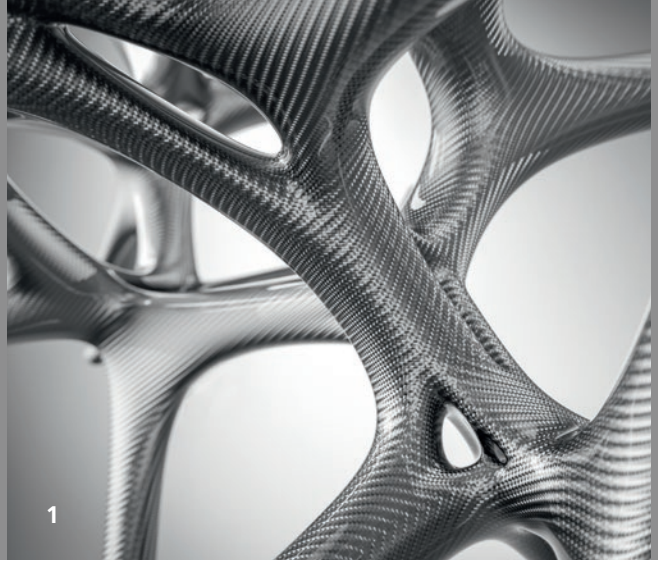
The Ceramics Meeting Point is an integral part of the public relations activities of Fraunhofer IKTS. The closed production chain from powder to component is displayed, not only from a scientific point of view but also as a mirror of technologies and capacities available in the industry. The visitor gets an impression of current focal points in research and is simultaneously informed about which manufacturers offer certain products commercially. With respective touchable models, the trust in the economic feasibility of new ideas is strengthened and the initiation of new projects facilitated.

Ceramic Applications of the Goeller Verlag, which took over the TASK GmbH business in 2015, embodies the new label of the cooperation with its currently 46 partners and members. The opportunity to see the latest research topics up to systems testing in one room and to get into contact with possible suppliers will be extended. The members of the Fraunhofer AdvanCer Alliance also benefit from this infrastructure.

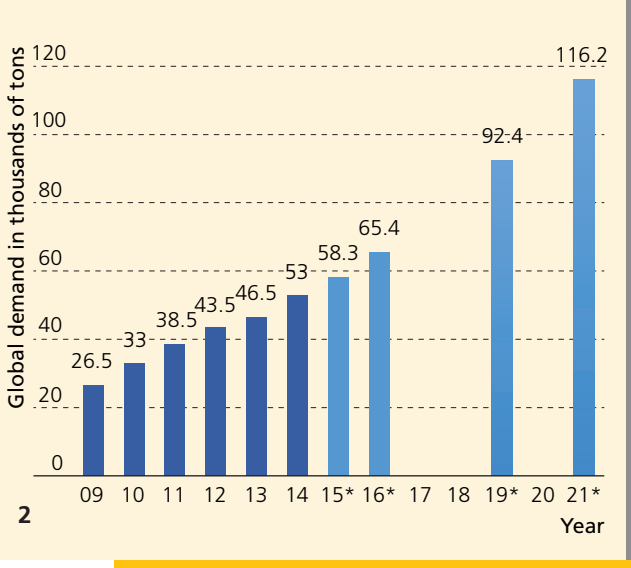
In the workshops and training courses of the Fraunhofer AdvanCer Alliance and the Deutsche Keramische Gesellschaft (DKG / German Ceramic Society), the Ceramics Meeting Point is used to present the state of the art in industry and to show the practical relevance desired by the participants. Thus, a project forum particularly for small and medium-sized companies has developed, facilitating contacts to project initiators and research institutes.

By visiting the Ceramics Meeting Point within the framework of numerous events, such as the ICC6, the number of visitors was again increased. More than 1800 visitors informed themselves about ceramic product innovations and manufacturers in 2016. The Ceramics Meeting Point was also an essential part of the DKG division 1 "Chemie-/Maschinen-/Anlagenbau" this year. Suggestions for various project proposal via the DKG were formed here.

1 *Hannover Messe 2016: Fraunhofer IKTS at the joint booth "Ceramic Applications".*



1



2

PROGNET – TESTING OF COMPOSITE MATERIALS

Project Group Berlin, located in Adlershof, was assigned the task of forming a cooperation network within the scope of the ZIM (Central Innovation Program for SMBs) by the Federal Ministry for Economic Affairs and Energy (BMWI).

Within the network, procedures and systems as well as simulation and monitoring tools are developed for ensuring the technical safety of highly reliable components manufactured with innovative materials.

Due to their outstanding properties, composite materials can be used for the efficient design of high-strength, lightweight components. For determining the structure-property relationships in these materials, methods and instruments that enable the characterization of the designed materials structure and behavior under load are called for. Both the aerospace industry and the automotive industry have identified a high demand for evaluation and testing of pure carbon fiber-reinforced composites (CFCs) and fiber-metal laminates (FMLs).

With the international trend in use of new materials that is beginning to emerge, it is safe to say that not only in Europe and the US but also in Asia in particular, a high demand for the products of the network will arise. Figure 2 depicts the predicted global need for carbon fibers. Demand is expected to rise until 2021. Similar trends are expected for other new materials. A corresponding increase in demand for tools and platforms for developing and testing components made of these materials is hence also anticipated.

The network provides its partners with funding options for a wide range of innovative technical projects. It aims to provide a sustainable improvement in the innovative and competitive capacity of partner companies and thus contribute to their growth as well as to the creation and preservation of jobs. The innovative capacity in the field of test technology generated through Prognet and the close relationships to standardization bodies for test regulations are sure to provide leverage to the solutions flowing into the network partners' various products.

Spokesperson of the cooperation network

Ralf Schallert
ralf.schallert@ikts.fraunhofer.de
www.prognet.solutions

1 *Carbon structures (© mxd - Fotolia).*
2 *Global demand for carbon fibers in thousands of metric tons for the period 2009–2021 (*estimates).*

PROGNET
Kooperationsnetzwerk

Gefördert durch:
Bundesministerium für Wirtschaft und Energie

ZIM
Zentrales Innovationsprogramm Mittelstand

CENTER FOR ENERGY AND ENVIRONMENTAL CHEMISTRY JENA (CEEC)

The Center for Energy and Environmental Chemistry Jena (CEEC) is an interfaculty center operated jointly by Fraunhofer IKTS and Friedrich-Schiller-Universität (FSU) Jena. The CEEC bundles the activities of the two research institutions in the fields of energy conversion, energy storage, and technical environmental chemistry. Focus is mainly on electrochemical energy storage systems and the materials, especially ceramics and polymers, used for them, energy converters, such as solar cells, and innovative water and waste water treatment methods. There are currently 12 professorships from FSU and 5 departments from IKTS represented at the CEEC. In addition to the new institute building in Jena, which has been in operation since 2015, laboratories and pilot-scale facilities for battery manufacturing and membrane technology are part of the center at Fraunhofer IKTS in Hermsdorf.

For IKTS, the CEEC represents a strategic cooperation platform with Friedrich-Schiller-Universität Jena, especially in the field of basic research. Numerous joint Master's and PhD theses are organized, joint events offered, research projects initiated, and large-scale equipment used via the center. The "Chemistry - Energy - Environment" Master's program, in which IKTS is particularly prominent with its research activities, is also supervised and overseen by the CEEC and is the only program of its kind offered in Germany.

One focus of the collaboration is the "Technical Environmental Chemistry" chair, which is held by Prof. Michael Stelter, Deputy Institute Director of Fraunhofer IKTS. The working group is dedicated to water treatment, water purification, and water analysis using novel, combined physical and electrochemical methods, such as ultrasound and hydrodynamic cavitation, electrochemistry, and ceramic membrane technology. The group thus functions as a bridge to the extensive work being performed at Fraunhofer IKTS in Hermsdorf and Dresden.

Additional topics addressed at the CEEC and of particular relevance to IKTS include the following:

- Materials for electrochemical reactors and batteries
- Organic active materials and membranes
- Carbon nanomaterials
- Glasses and optically active materials for photovoltaics and photochemistry
- Physical characterization

Contact

Prof. Dr. Michael Stelter
Chair Technical Environmental Chemistry
michael.stelter@uni-jena.de
www.ceec.uni-jena.de

1 *Center for Energy and Environmental Chemistry at the FSU Jena (Source: Anne Günther/FSU Jena).*

NAMES, DATES, EVENTS

Granted patents 2016

Burmeister, U.; Huber, J.; Ottmann, N.; Peterhans, S.I.; Wagner, W.; Weiser, C.
Fuel cell assembly comprising an improved catalytic burner
KR 10-1675255

Ehrt, R.; Johannes, M.
Veneering ceramic for dental restorations made of yttrium-stabilized zirconium dioxide and method for applying said veneering ceramic
CN 103 080 033 B

Ehrt, R.; Rothe, P.; Seifert, D.; Völger, K.W.
Glass-ceramic (LTCC) capable of being assembled with silicon by anodic bonding
DE 103 51 196 B4

Endler, I.
Hard-coated body and method for production thereof
EP 1 902 155 B1

Endler, I.; Höhn, M.
Coated bodies made of metal, hard metal, cermet, or ceramic, and method(s) for coating of such bodies
DE 10 2009 046 667 B4

Endler, I.; Scholz, S.
Hard-material-coated bodies composed of metal, cemented hard material, cermet or ceramic and processes for producing such bodies
US 9,309,593 B2; RU 2 588 933 C2; CN 103 987 874 B

Frankenstein, B.; Weihnacht, B.; Rieske, R.; Fischer, D.
System for monitoring the condition of rotor blades at wind turbines
US 9,239,042

Friedrich, H.-J.; Zaruba, A.
Method for recovery of noble metals
DE 10 2006 056 017 B4

Goldberg, A.; Marcinkowski, P.; Feller, C.; Wolter, M.
Electrochemical cell of an accumulator
US 9,391,348 B2

Grzesiak, A.; Weking, C.; Visotschnig, R.; Refle, O.; Kraft, T.; Schäfer, R.; Ziegler, T.; Richter, H.-J.; Heinritz, K.
Method for producing a ceramic body
DE 10 2011 117 005 B4

Gusek, C.; Eisner, F.; Hülstrung, J.; Jindra, F.; Willeke, B.-H.; Blumenau, M.; Kovac, M.; Jendrischik, G.; Peitz, A.; Schönenberg, R.; Adler, J.; Heymer, H.
Device for reducing pressure in hollow bodies in media at higher temperatures
CN 103 649 360 B; JP 5980324 B2

Han, T.; Gerich, C.; Zeh, C.; Härtling, T.; Opitz, J.; Schreiber, J.; Lee, S.; Kim, K.; Baik, J.; Kim, E.
Prostate cancer diagnosis device using fractal dimension value
EP 2 699 159; DE 60 2011 025 155

Härtling, T.; Schuster, C.
Verfahren zur Herstellung und Überprüfung von Werkstücken und Werkstück
DE 10 2014 117 519 B4

Herzog, T.; Heuer, H.; Engl, G.; Kröning, M.
Test head for testing a workpiece having an ultrasonic transducer configuration containing a plurality of ultrasonic transducers and process for producing such a test head
US 9,423,382 B2

Hutzler, T.; Krell, A.
Transparent spinel ceramics and method for the production thereof
US 9,309,156 B2

Jurk, R.; Eberstein, M.; Reinhardt, K.; Schmidt, U.
Method for determining the quality of electric conducting connections between front panel contacts and the semi-conducting layer in silicon wafers for photovoltaics
DE 10 2014 226 403 B3

Körner, S.; Eberstein, M.
Method for producing a silver-containing glass powder, and use of the glass powder
DE 10 2014 221 679 B4

Kriegel, R.; Kircheisen, R.; Ritter, K.
Method for the high-temperature-resistant bonding of oxygen-permeable oxide ceramics based on substituted earth-alkaline cobaltates by means of doping-supported diffusive reactive sintering
CN 102 574 073 B

Krüger, P.
Modular, imaging, large x-ray detector
DE 10 2007 045 799 B4

Kunz, W.; Steinborn, C.; Finaske, T.; Brückner, F.

Method for producing ceramic fibre composites
DE 10 2015 205 595 B3

Lausch, H.; Brand, M.; Andrä, W.; Werner, C.
Arrangement for non-contact defined movement of at least one magnetic body
EP 2 023 814 B1

Lausch, H.; Brand, M.; Werner, C.
Arrangement for the touchless generation of defined mechanical, electrical and magnetic impulses
EP 2 367 478 B1

Lausch, H.; Wätzig, K.; Kinski, I.
Electromagnetic radiation in the UV wavelength range emitting body, method for irradiation with this body and use of the body
DE 10 2015 102 427 B3

Luthardt, F.; Adler, J.
Method and device for continuous generation of foams
DE 10 2010 039 322 B4

Nicolai, J.; Bendjus, B.; Cikalova, U.; Schreiber, J.
Method for the contactless, destruction-free determination of inhomogeneities and/or defects on surfaces of components or samples
DE 10 2014 224 852 B4

Opitz, J.; Pohl, A.; Schreiber, J.; Quenzel, P.; Boschke, E.; Bley, T.; Pässler, S.; Vonau, W.; Mertig, M.; Lange, A.; Rohayem, J.; Lapina, V.
Method and device for detecting an analyte in a sample by means of surface-plasmon resonance (SPR) and electrochemical impedance spectroscopy (EIS)
EP 2 594 525 B1

Räthel, J.; Herrmann, M.; Weise, B.
Plunger tool for spark-plasma sintering or field activated sintering
DE 10 2011 105 413 B4

Reichel, U.; Ludwig, H.; Kemnitz, E.
Alpha-Al_2O_3- Sintering material, method for producing a high-density and very finely crystalline molded body made of said material, and use thereof
DE 10 2009 035 501 B4;
EP 2 462 080 B1

Stelter, M.; Partsch, U.; Rabbow, T.; Schöne, J.; Goldberg, A.; Wolter, M.
Contact element for contacting of an electrical power generating electrochemical cell and method for its producing
DE 10 2009 037 144 B4

Stelter, M.; Partsch, U.; Rabbow, T.; Schöne, J.; Goldberg, A.; Wolter, M.
Contact element for current consumption and current output in electrical power generating electrochemical cell
DE 10 2009 037 147 B4

Trofimenko, N.; Sauchuk, V.; Kusnezoff, M.; Lucke, K.; Michaelis, A.; Brandner, M.; Schmid, J.; Venskutonis, A.
Layer structure and use thereof to form a ceramic layer structure between an interconnect and a cathode of a high-temperature fuel cell
US 9,337,497 B2; EP 2 676 318 B1; CN 103 403 938 B; JP 600 444 8 B2

Zeh, C.; Härtling, T.
Verfahren zur Markierung von Werkstücken und Werkstück
DE 10 2015 107 744 B3

Patent applications 2016

Adler, J.; Standke, G.; Haase, D.
Zirconium oxide ceramic, cellular material from this and method for production of zirconium oxide ceramic

Cikalova, U.; Bendjus, B.; Schott, C.; Steingoewer, J.
Laseroptisches Sensorsystem zur nichtinvasiven Biomassecharakterisierung in biotechnologischen Prozessen

Friedrich, H.-J.; Hielscher, M.; Hinrichs, T.; Rott, H.-J.
Method for treatment of geothermal fluids or formation waters by continuous electrochemical separation of reducible metal-ions or metalloide-ions from the delivery stream

Gluch, J.; Kopycinska-Müller, M.; Rabe, U.; Köhler, B.
Procedure for calibration of AFM tip for quantitative determination of indentation modulus of materials on nanoscale

Goldberg, A.; Partsch, U.; Ziesche, S.
Valve from a ceramic material and method for its production

Grund, M.; Weidl, R.; Schulz, M.
Sodium ions conducting membrane based on sodium-betaaluminate system and method for its production

Härtling, T.
Verfahren zur Rückverfolgung der Temperaturhistorie von Produkten und Baugruppen

Hofacker, M.; Kiesel, L.
Extrusion method and devise for extrusion for production of a ceramic tube with sealed bottom

Joneit, D.
Auswerteverfahren für digitalisierte Schwingungspakete zur Impedanzmessung

Krüger, P.; Hillmann, S.; Brosius, D.
Application of x-ray backscattering radiography and tomography in additive manufacturing

Krüger, P.; Schulze, M.; Hillmann, S.
A method to evaluate images of fibrous tissues based on eddy current measurements

Kusnezoff, M.; Dietrich, S.
Gas-sensitive sensor-element

Meier, K.; Röllig, M.; Schingale, A.; Ochs, M.
Verbindungstechnologie für mehrlagige Leiterplatten

Rebenklau, L.; Wodtke, A.; Augsburg, K.; Irrgang, K.; Lippmann, L.; Bechtold, F.; Köhler, P.
Ring-shaped sealing element with integrated thermo-elements

Reichel, U.; Kemnitz, E.; Krahl, T.
Method for producing poly-crystalline transparent shaped parts

Richter, H.; Simon, A.; Jüttke, Y.; Schwieger, W.; Schülein, M.; Lüdke, D.; Reif, B.
Permeation membrane und method for production a permeation membrane

Scheithauer, U.; Aneziris, C.
Particle from a refractory ceramic material for influencing the damage tolerance of high temperature materials and method for its production

Scheithauer, U.; Aneziris, C.
Particle from a refractory ceramic material for influencing the crack formation in high temperature materials and method for its production

Scheunert, G.; Härtling, T.; Wuchrer, R.
Berechnungsindex-Sensor auf Basis plasmonischer Substrate für Flüssigkeiten im Automotivebereich zur Echtzeitsteuerung eines Regelkreises

Schulze, E.
Bifunctional polyacrylamide-free flocculation agents and method for its production

Schwarzer, E.; Kelemen, M.; Scheithauer, U.; Moritz, T.; Markova, D.
Ceramic suspension

Schwarzer, E.; Moritz, T.
Mouldable ceramic and/or powder-metallurgical green tapes and method for moulding this ceramic and/or powder-metallurgical green tapes

Trofimenko, N.; Kusnezoff, M.
Anode for an electrochemical cell and method for production of an electrochemical cell with such anode

Trofimenko, N.; Lucke, K.; Kusnezoff, M.
Past-like composition and method for production of three-dimensional structures or structure elements on substrate surfaces

Vogel, A.; Pippardt, U.; Hoffmann, R.; Jäger, B.
Method for dry coating of supports

Wolter, M.; Schilm, J.; Nikolowski, K.; Kusnezoff, M.
Composite-cathode layer arrangement for lithium based, solid state body batteries and method for its production

Wolter, M.; Schilm, J.; Nikolowski, K.; Kusnezoff, M.; Partsch, U.; Freytag, C.
Method for production of an electrochemical cell and an electrochemical cell produced with this method

Zeh, C.; Härtling, T.
Manufacturing method for sensing element and sensor device

Ziesche, S.; Ihle, M.; Hirsch, O.; Tuor, A.
Manufacturing method for sensing element and sensor device

Ziesche, S.; Lenz, C.; Kuipers, W.; Deilmann, M.
Device for detection of organic compounds

Books and periodical contributions

Adler, J.; Kriegel, R.; Petasch, U.; Richter, H.; Voigt, I.; Weyd, M.
Keramik für Filtrationsanwendungen
Keramische Zeitschrift 68(2016), Nr.3, p.172–178

Ahlhelm, M.
Gefrierschäume – Entwicklung von zellularen Strukturen für vielfältige Anwendungen
Stuttgart: Fraunhofer Verlag, 2016, 191 p.
(Zugl.: Clausthal, TU, Diss., 2015)
(Kompetenzen in Keramik. Schriftenreihe, 32)
ISBN 978-3-8396-0977-4

Ahlhelm, M.; Günther, P.; Scheithauer, U.; Schwarzer, E.; Günther, A.; Slawik, T.; Moritz, T.; Michaelis, A.
Innovative and novel manufacturing methods of ceramics and metal-ceramic composites for biomedical applications
Journal of the European Ceramic Society 36(2016), Nr.12, p.2883–2888

Bansal, N.P.(Ed.); Kusnezoff, M.(Ed.); Shimamura, K.(Ed.); American Ceramic Society -ACerS-, Westerville/Ohio

Advances in solid oxide fuel cells and electronic ceramics
Hoboken/NJ: Wiley, 2016, 188 p.
Ceramic engineering and science proceedings 36(2015), Nr.3
ISBN 978-1-119-21149-5;
ISBN 978-1-119-21150-1

Bardl, G.; Nocke, A.; Cherif, C.; Pooch, M.; Schulze, M.H.; Heuer, H.; Schiller, M.; Kupke, R.; Klein, M.
Automated detection of yarn orientation in 3D-draped carbon fiber fabrics and preforms from eddy current data
Composites. Part B, Engineering 96 (2016), p.312–324

Bardl, G.; Weise, D.; Nocke, A.; Cherif, C.; Pooch, M.; Schulze, M.; Heuer, H.; Schiller, M.
Automatische 3D-Drapieranalyse und Fadenrichtungsbestimmung für technische Textilien
Technische Textilien 59(2016), Nr.4, p.172–174

Berger, L.-M.; Trache, R.; Toma, F.-L.; Thiele, S.; Norpoth, J.; Janka, L.
Entwicklung wirtschaftlich effizienter Hartmetallbeschichtungslösungen für Hochtemperaturanwendungen. Teil 2: Einfluss von Wärmebehandlungen und tribologische Untersuchungen
Thermal Spray Bulletin (2016), Nr.9, p.45–53

Bierlich, S.; Reimann, T.; Barth, S.; Capraro, B.; Bartsch, H.; Müller, J.; Töpfer, J.
Integration of high-frequency M-type hexagonal ferrite inductors in LTCC multilayer modules
International Journal of Applied Ceramic Technology 13(2016), Nr.3, p.540–548

Blumenthal, P.; Molin, C.; Gebhardt, S.; Raatz, A.
Active electrocaloric demonstrator for direct comparison of PMN-PT bulk and multilayer samples
Ferroelectrics 497(2016), p.1–8

Bolelli, G.; Berger, L.-M.; Börner, T.; Koivuluoto, H.; Matikainen, V.; Lusvarghi, L.; Lyphout, C.; Markocsan, N.; Nylén, P.E.; Sassatelli, P.; Trache, R.; Vuoristo, P.
Sliding and abrasive wear behaviour of HVOF- and HVAF-sprayed Cr_3C_2-NiCr hardmetal coatings
Wear 358–359(2016), p.32–50

Cid, A.G.; Rosenkranz, R.; Zschech, E.
Optimization of the SEM working conditions: EsB detector at low voltage
Advanced Engineering Materials 18(2016), Nr.2, p.185–193

Clausner, A.; Richter, F.
Fundamental limitations at the determination of initial yield stress using nano-indentation with spherical tips
European Journal of Mechanics. A, Solids 58(2016), p.69–75

Cornelius, S.; Vinnichenko, M.
Al in ZnO – from doping to alloying. An investigation of Al electrical activation in relation to structure and charge transport limits
Thin Solid Films 605(2016), p.20–29

Eckhard, S.; Fries, M.; Antonyuk, S.; Heinrich, S.
Dependencies between internal structure and mechanical properties of spray dried granules – experimental study and DEM simulation
Advanced Powder Technology (2016), Online First, 12 p.

Eldawud, R.; Reitzig, M.; Opitz, J.; Rojansakul, Y.; Jiang, W.; Nangia, S.; Dinu, C.Z.
Combinatorial approaches to evaluate nanodiamond uptake and induced cellular fate
Nanotechnology 27(2016), Nr.8, Art. 085107, 11 p.

Engelhardt, S.; Mietschke, M.; Molin, C.; Gebhardt, S.; Fähler, S.; Nielsch, K.; Hühne, R.
Structural and ferroelectric properties of epitaxial $BaZr_xTi_{1-x}O_3$ thin films
Journal of Physics. D. Applied Physics 49(2016), Nr.49, Art. 495303, 7 p.

Faßauer, B.
Autartec®-Systeme zur dezentralen Wasseraufbereitung
GWF. Wasser, Abwasser 157(2016), Nr.6, p.587–588

Feller, C.; Seuthe, T.; Eberstein, M.
Dickschicht-Messwiderstände mit minimiertem Temperaturkoeffizienten für Präzisionssensoren zur Bestimmung der Einspeiseleistung dezentraler Energieerzeuger
Keramische Zeitschrift 68(2016), Nr.4/5, p.238–244

Feng, Bing
Herstellung, Modifizierung und Charakterisierung von borcarbidbasierten Keramiken als Thermoelektrikum
Stuttgart: Fraunhofer Verlag, 2016, V, 145 p.
(Zugl.: Dresden, TU, Diss., 2016)
(Kompetenzen in Keramik. Schriftenreihe, 33)
ISBN 978-3-8396-1007-7

Fu, J.; Pang, R.; Jiang, L.; Jia, Y.; Sun, W.; Zhang, S.; Li, C.
A novel dichromic self-referencing optical probe SrO:Bi(3+),Eu(3+) for temperature spatially and temporally imaging
Dalton Transactions 45(2016), Nr.34, p.13317–13323

Fu, J.; Zhang, S.; Pang, R.; Jia, Y.; Sun, W.; Li, H.; Jiang, L.; Li, C.
Material and ingenious synthesis strategy for short-wavelength infrared light-emitting device
Inorganic Chemistry 55(2016), Nr.21, p.11258–11263

Fuhrmann, K.; Neumeister, P.; Eulitz, K.-G.
Optimisation methods for the determination of cyclic material parameters from strain controlled uniaxial fatigue tests
International Journal of Fatigue 83(2016), Part 2, p.93–99

Gago, R.; Vinnichenko, M.; Hübner, R.; Redondo-Cubero, A.
Bonding structure and morphology of chromium oxide films grown by pulsed-DC reactive magnetron sputter deposition
Journal of Alloys and Compounds 672(2016), p.529–535

Garitagoitia, M.A.; Moayedi, E.; Rosenkranz, R.; Clausner, A.; Pakbaz, K.; Zschech, E.
Non-destructive imaging of organosilicate glass (OSG) thin films at low voltage with the EsB detector
IEEE Transactions on Device and Materials Reliability 16(2016), Nr.4, p.461–464

Garitagoitia, M.A.; Sedighi, M.; Löffler, M.; van Dorp, W.F.; Zschech, E.
Energy-filtered backscattered imaging using low-voltage scanning electron microscopy: Characterizing blends of ZnPc-C_{60} for organic solar cells
Advanced Engineering Materials 18(2016), Nr.6, p.913–917

Gestrich, T.; Kaiser, A.; Meinl, J.; Schilm, J.; Linseis, F.; Seibt, S.; Gollner, M.
Aktivlöten von Keramik: Erhitzungsmikroskopie und komplexe thermische Analyse in hochreinen Atmosphären
Keramische Zeitschrift 68(2016), Nr.4/5, p.245–248

Gestrich, Tim
Thermische Analysen und Bestimmungen thermophysikalischer Eigenschaften von Materialien und Bauteilen
Pulvermetallurgie in Wissenschaft und Praxis 32(2016), p.339 –341

Giuntini, D.; Räthel, J.; Herrmann, M.; Michaelis, A.; Haines, C.D.; Olevsky, E.A.
Spark plasma sintering novel tooling design: Temperature uniformization during consolidation of silicon nitride powder
Journal of the Ceramic Society of Japan 124(2016), Nr.4, p.403–414

Glöß, B.; Fries, M.
A method for analysing the die filling behaviour of ceramic granules
cfi – ceramic forum international 93(2016), Nr.10, p.E38–E43

Goldstein, A.; Krell, A.
Transparent ceramics at 50: Progress made and further prospects
Journal of the American Ceramic Society 99(2016), Nr.10, p.3173–3197

Goldstein, A.; Räthel, J.; Katz, M.; Berlin, M.; Galun, E.
Transparent $MgAl_2O_4$/LiF ceramics by hot-pressing: Host-additive interaction mechanisms issue revisited
Journal of the European Ceramic Society 36(2016), Nr.7, p.1731–1742

Gommlich, A.
Entwicklung einer neuen Methode zur Ansteuerung von Ultraschall-Phased Arrays
Dresden: TUDpress, 2016, XVII, 103 p.
(Zugl.: Dresden, TU, Diss., 2016)
ISBN 978-3-95908-063-7

Gonzales-Julian, J.; Jähnert, K.; Speer, K.; Liu, L.; Räthel, J.; Knapp, M.; Ehrenberg, H.; Bram, M.; Guillon, O.
Effect of internal current flow during the sintering of zirconium diboride by field assisted sintering technology
Journal of the American Ceramic Society 99(2016), Nr.1, p.35–42

Gradmann, R.; Seuthe, T.; Vedder, C.; Eberstein, M.; Partsch, U.
Adaption of functional ceramic materials for the laser sintering process in integrated sensor applications
IMAPS Additional Conferences (Device Packaging, HiTEC, HiTEN, & CICMT). Online journal (2016), p.000011–000017

Hallmann, L.; Ulmer, P.; Lehmann, F.; Wille, S.; Polonskyi, O.; Johannes, M.; Köbel, S.; Trottenberg, T.; Bornholdt, S.; Haase, F.; Kersten, H.; Kern, M.
Effect of surface modifications on the bond strength of zirconia ceramic with resin cement resin
Dental Materials 32(2016), Nr.5, p.631–639

Härtel, A.; Scheithauer, U.; Schwarzer, E.; Weingarten, S.; Slawik, T.; Richter, H.-J.; Moritz, T.
Additive Herstellung mehrkomponentiger metallischer und keramischer Bauteile mittels thermoplastischen 3D-Druckes (T3DP)
Keramische Zeitschrift 68(2016), Nr.1, p.43–47

Hennicke, J.; Herrmann, M.; Kessel, T.; Räthel, J.
FAST/Flash eröffnet neue Perspektiven für die industrielle Anwendung des feldunterstützten Sinterns
cfi – ceramic forum international 93(2016), Nr.10, p.D12–D15

Heubner, C.
Thermisch-elektrochemische in-operando Untersuchungen zur

lokalen Wärmeentwicklung in Lithiumionenbatteriezellen
Stuttgart: Fraunhofer Verlag, 2016, XV, 161 p.
(Zugl.: Dresden, TU, Diss., 2015)
(Kompetenzen in Keramik. Schriftenreihe, 35)
ISBN 978-3-8396-1075-6

Heubner, C.; Schneider, M.; Michaelis, A.
SoC dependent kinetic parameters of insertion electrodes from Stair-Case – GITT
Journal of Electroanalytical Chemistry 767(2016), p.18–23

Heubner, C.; Schneider, M.; Michaelis, A.
Detailed study of heat generation in porous $LiCoO_2$ electrodes
Journal of Power Sources 307(2016), p.199–207

Heubner, C.; Heiden, S.; Matthey, B.; Schneider, M.; Michaelis, A.
Sodiation vs. Lithiation of $FePO_4$: A comparative kinetic study
Electrochimica Acta 216(2016), p.412–419

Hillmann, S.; Schubert, F.; Brosius, D.M.; Bor, Z.
Validation of an ultrasonic-phased array method for testing of circumferential welds at thin-walled pipes
NDT World 19(2016), Nr.3, p.30–33

Huang, J.; Löffler, M.; Möller, W.; Zschech, E.
Ga contamination in silicon by focused ion beam milling: Dynamic model simulation and atom probe tomography experiment
Microelectronics Reliability 64(2016), p.390–392

Janka, L.; Norpoth, J.; Trache, R.; Berger, L.-M.
Influence of heat treatment on the abrasive wear resistance of a Cr_3C_2-NiCr coating deposited by an ethene-fuelled HVOF spray process
Surface and Coatings Technology 291(2016), p.444–451

Jemec, A.; Kahru, A.; Potthoff, A.; Drobne, D.; Heinlaan, M.; Böhme, S.; Geppert, M.; Novak, S.; Schirmer, K.; Rekulapally, R.; Singh, S.; Aruoja, V.; Sihtmäe, M.; Juganson, K.; Käkinen, A.; Kühnel, D.
An interlaboratory comparison of nanosilver characterisation and hazard identification: Harmonising techniques for high quality data
Environment International 87(2016), p.20–32

Johnen, S.; Meißner, F.; Krug, M.; Baltz, T.; Endler, I.; Mokwa, W.; Walter, P.M.
Properties of retinal precursor cells grown on vertically aligned multiwalled carbon nanotubes generated for the modification of retinal implant-embedded microelectrode arrays
Journal of Ophthalmology (2016), Art. 2371021, 13 p.

Kappes, W.; Hentschel, D.; Oelschlägel, T.
Potential improvements of the presently applied in-service inspection of wheelset axles
International Journal of Fatigue 86(2016), p.64–76

Khazaee, M.; Majumder, A.; Baraban, L.; Cuniberti, G.; Opitz, J.; Ye, D.
Non-covalent modified multi-walled carbon nanotubes: Dispersion capabilities and interactions with bacteria
Biomedical Physics & Engineering Express 2(2016), Nr.5, Art. 055008, 8 p.

Kiebach, R.; Engelbrecht, K.L.; Kwok, K.; Molin, S.M.; Søgaard, M.; Niehoff, P.; Schulze-Küppers, F.; Kriegel, R.; Kluge, J.; Hendriksen, P.V.
Joining of ceramic $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_3$ membranes for oxygen production to high temperature alloys
Journal of Membrane Science 506(2016), p.11–21

Kim, H.S.; Han, T.-Y.; Yoo, Y.-M.
Melatonin-mediated intracellular insulin during 2-deoxy-D-glucose treatment is reduced through autophagy and EDC3 protein in insulinoma INS-1E cells
Oxidative Medicine and Cellular Longevity 2016(2016), Art. 2594703, 11 p.

Kirsten, M.; Meinl, J.; Schönfeld, K.; Michaelis, A.; Cherif, C.
Characteristics of wet-spun and thermally treated poly acrylonitrile fibers
Journal of Applied Polymer Science 133(2016), Nr.29, Art. 43698, 9 p.

Köckritz, T.; Luther, R.; Paschew, G.; Jansen, I.; Richter, A.; Jost, O.; Schönecker, A.; Beyer, E.
Full polymer dielectric elastomeric actuators (DEA) functionalised with carbon nanotubes and high-K ceramics
Micromachines 7(2016), Nr.10, Art. 172, 15 p.

Köhler, B.; Gaul, T.; Lieske, U.; Schubert, F.
Shear horizontal piezoelectric fiber patch transducers (SH-PFP) for guided elastic wave applications
NDT & E International 82(2016), p.1–12

Köhler, B.
First special issue of case study in nondestructive testing and evaluation. Editorial.
Case Studies in Nondestructive Testing and Evaluation 6(2016), Pt.B, p.1

Kopycinska-Müller, M.; Gluch, J.; Köhler, B.
Study of mechanical behavior of AFM silicon tips under mechanical load
Nanotechnology 27(2016), Nr.45, Art. 454001, 16 p.

Kopycinska-Müller, M.; Clausner, A.; Yeap, K.B.O.; Köhler, B.; Kuzeyeva, N.; Mahajan, S.; Savage, T.; Zschech, E.; Wolter, K.-J.
Mechanical characterization of porous nano-thin films by use of atomic force acoustic microscopy
Ultramicroscopy 162(2016), p.82–90

Kraatz, M.; Gall, M.; Zschech, E.; Schmeißer, D.; Ho, P.S.
A model for statistical electromigration simulation with dependence on capping layer and Cu microstructure in two dimensions
Computational Materials Science 120(2016), p.29–35

Kruse, N.; Schießer, Y.; Kämnitz, S.; Richter, H.R.; Voigt, I.; Braun, G.; Repke, J.U.
Carbon membrane gas separation of binary CO_2 mixtures at high pressure
Separation and Purification Technology 164(2016), p.132–137

Kunze, S.
Entwicklung von SiSiC-Strukturkeramiken aus Reaktionsharzbeton
Stuttgart: Fraunhofer Verlag, 2016, 115 p., XVII
(Zugl.: Dresden, TU, Diss., 2016)
(Kompetenzen in Keramik. Schriftenreihe, 34)
ISBN 978-3-8396-1029-9

Kusnezoff, M.; Trofimenko, N.; Müller, M.; Michaelis, A.
Influence of electrode design and contacting layers on performance of electrolyte supported SOFC/SOEC single cells
Materials 9(2016), Nr.11, Art. 906, 13 p.

Lenczner, M.; Yang, B.; Bontempi, A.; Teyssieux, D.; Cogan, S.D.; Janus, P.; Köhler, B.; Ratier, N.
A SThM probe optimization and its time-space multi-scale modeling
Mechatronics 40(2016), p.251–263

Li, Q.; Gluch, J.; Krüger, P.; Gall, M.; Neinhuis, C.; Zschech, E.
Pollen structure visualization using high-resolution laboratory-based hard X-ray tomography
Biochemical and Biophysical Research Communications 479(2016), Nr.2, p.272–276

Liao, Z.; Gall, M.; Ye, K.B.; Sander, C.; Clausner, A.; Mühle, U.; Gluch, J.; Standke, Y.; Rosenkranz, R.; Aubel, O.; Hauschildt, M.; Zschech, E.
TEM investigation of time-dependent dielectric breakdown mechanisms in Cu/Low-k interconnects
IEEE Transactions on Device and Materials Reliability 16(2016), Nr.4, p.455–460

Lin, H.-T.(Ed.); Hemrick, J.(Ed.); Singh, M.(Vol. Ed.); Ohji, T.(Vol. Ed.); Michaelis, A.(Vol. Ed.); American Ceramic Society -ACerS-, Westerville/Ohio:
Advanced and Refractory Ceramics for Energy Conservation and Efficiency
Hoboken, NJ: Wiley, 2016, IX, 202 p.
(Ceramic Transactions, 256)
ISBN 978-1-119-23458-6;
ISBN 978-1-119-23459-3

Lomtscher, A.; Jobst, K.; Fogel, S.; Rostalski, K.; Stempin, S.; Kraume, M.
Scale-up of mixing processes of highly concentrated suspensions using electrical resistance tomography
Flow Measurement and Instrumentation (2016), Online First, 18 p.

Majumder, A.
Functionalization and large scale assembly of carbon nanotubes
Dresden, 2016, 113 p.
(Dresden, TU, Diss., 2016)
(URN: urn:nbn:de:bsz:14-qucosa-203279)

Martin, H.-P.; Pönicke, A.; Kluge, M.; Sichert, I.; Rost, A.; Conze, S.; Wätzig, K.; Schilm, J.; Michaelis, A.
TiO_x-based thermoelectric modules: Manufacturing, properties, and operational behavior
Journal of Electronic Materials 45(2016), Nr.3, p.1570–1575

Matthews, S.; Berger, L.-M.
Long-term compositional/microstructural development of Cr_3C_2-NiCr coatings at 500 °C, 700 °C and 900 °C
International Journal of Refractory Metals and Hard Materials 59(2016), p.1–18

Meinl, J.; Kirsten, M.; Cherif, C.; Michaelis, A.
Influence of PAN-fiber stretching during thermal treatment on the stabilization reactions
American Journal of Analytical Chemistry 7(2016), Nr.3, p.282–293

Michaelis, A.(Hrsg.); Schneider, M.(Hrsg.):
Symposium Anodisieren – Oxidschichten von hart bis smart 2016: 24.–25. November 2016, Dresden, Tagungsband.
Stuttgart: Fraunhofer Verlag, 2016, 80 p.
(Schriftenreihe Angewandte Elektrochemie in der Werkstoffwissenschaft, V)
ISBN 978-3-8396-1119-7

Michaelis, A.; Stelter, M.; Klemm, H.; Voigt, I.; Kriegel, R.
Current Trends in Ceramic Technologies and Systems
Ohji, T.: Engineered Ceramics: Current Status and Future Prospects
Hoboken, NJ: Wiley, 2016, p.381–414

Mietschke, M.; Chekhonin, P.; Molin, C.; Gebhardt, S.; Fähler, S.; Nielsch, K.; Schultz, L.; Hühne, R.
Influence of the polarization anisotropy on the electrocaloric effect in epitaxial PMN-PT thin films
Journal of Applied Physics 120(2016), Nr.11, Art. 114102, 8 p.

Molin, C.; Gebhardt, S.
PMN-8PT device structures for electrocaloric cooling applications
Ferroelectrics 498(2016), p.111-119

Moritz, T.; Scheithauer, U.; Schwarzer, E.; Ahlhelm, M.
Medizinische Komponenten und Design-Artikel aus Keramik – hergestellt mit additiver Fertigungstechnik
wt Werkstattstechnik online 106(2016), Nr.7/8, p.1–2

Nakahataa, K.; Sugahara, H.; Barth, M.; Köhler, B.; Schubert, F.
Three dimensional image-based simulation of ultrasonic wave propagation in polycrystalline metal using phase-field modeling
Ultrasonics 67(2016), p.18–29

Opitz, J.; Wunderlich, C.; Bendjus, B.; Cikalova, U.; Wolf, C.; Naumann, S.; Lehmann, A.; Barth, M.; Duckhorn, F.; Köhler, B.; Tschöke, K.; Tschöpe, C.; Moritz, T.; Scheithauer, U.; Windisch, T.
Materialdiagnose und integrale Prüfverfahren für keramische Bauteile
Keramische Zeitschrift 68(2016), Nr.4/5, p.249–254

Pfeifer, T.(Ed.); Matyás, J.(Ed.); Balaya, P.(Ed.); Singh, D.(Ed.); Wei, J.(Ed.); Singh, M.(Vol. Ed.); Ohji, T.(Vol. Ed.); Michaelis, A.(Vol. Ed.); American Ceramic Society -ACerS-, Westerville/Ohio:
Ceramics for Energy Conversion, Storage, and Distribution Systems
Hoboken, NJ: Wiley, 2016, 290 p. (Ceramic Transactions, 255)
ISBN 978-1-119-23448-7;
ISBN 978-1-119-23453-1

Pingen, D.; Altıntas, C.; Schaller, M.R.; Vogt, D.
A ruthenium racemisation catalyst for the synthesis of primary amines from secondary amines
Dalton Transactions 45(2016), Nr.29, p.11765–11771

Pippardt, U.; Bernhardt, M.; Böer, J.; Kiesel, L.; Kircheisen, R.; Kriegel, R.; Voigt, I.; Weyd, M.
Herstellung von dünnen mischleitenden $Ba_{0,5}Sr_{0,5}Co_{0,8}Fe_{0,2}O_{3-\delta}$ – Membranen mit hoher Sauerstoffpermeation auf porösen rohrförmigen Trägern im Cofiring
Keramische Zeitschrift 68(2016), Nr.1, p.28–36

Pötschke, J.
Gefügeausbildung und Eigenschaften von nanoskaligen bindefreien Hartmetallen
Stuttgart: Fraunhofer Verlag, 2016, VII, 190 S.
(Zugl.: Dresden, TU, Diss., 2016)
(Kompetenzen in Keramik. Schriftenreihe, 36)
ISBN 978-3-8396-1104-3

Pötschke, J.; Höhn, S.; Richter, V.; Mayer, M.
Microstructural evolution during sintering of cermets studied using interrupted sintering experiments and novel 2D and 3D FESEM based techniques
International Journal of Refractory Metals and Hard Materials 63(2017), p.47–54

Prasad, R.M.; Jüttke, Y.; Richter, H.; Voigt, I.; Riedel, R.; Gurlo, A.
Mechanism of gas separation through amorphous silicon oxycarbide membranes
Advanced Engineering Materials 18(2016), Nr.5, p.721–727

Reichel, U.; Notni, G.; Duparré, A.; Müller, F.A.; König, S.; Herold, V.
Hochtemperatur-Stabilität optikrelevanter Eigenschaften von transparenter $MgAl_2O_4$-Spinell-Keramik
Kriegesmann, J.; Deutsche Keramische Gesellschaft e.V. (DKG): Technische Keramische Werkstoffe. Loseblattausgabe. Aktualisierte Ausgabe Ellerau: HvB Verlag, 22 p. (150. Ergänzungslieferung, Kapitel 8.6.2.1)

Reichelt, E.
Theoretische und experimentelle Untersuchungen zu Stofftransport und Druckverlust in geschütteten und strukturierten Festbetten
Stuttgart: Fraunhofer Verlag, 2016, VII, 115 p.
(Zugl.: Dresden, TU, Diss., 2016)
(Schriftenreihe Kompetenzen in Keramik und Umweltverfahrenstechnik, 3)
ISBN 978-3-8396-1037-4

Reitzig, M.; Goodband, R.; Schuster, C.; Härtling, T.
Optical electron beam dosimetry with ceramic phosphors as passive sensor material for broad dose ranges
Technisches Messen:TM 83(2016), Nr.3, p.171–179

Richter, H.-J.; Moritz, T.; Scheithauer, U.; Ahlhelm, M.; Schwarzer, E.
Additive manufacturing of ceramic components using powder bed and suspension methods
Ceramic Applications 4(2016), Nr.1, p.51–55

Rodríguez-Arteche, I.; Martínez Aznar, M.M.; Garitagoitia, M.A.
La competencia sobre planificación de investigaciones en 4° de ESO: Un estudio de caso
Revista Complutense de Educación 27(2016), Nr.1, p.329–351

Sanlialp, M.; Molin, C.; Shvartsman, V.V.; Gebhardt, S.; Lupascu, D.C.
Modified differential scanning calorimeter for direct electrocaloric measurements
IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control 63(2016), Nr.10, p.1690–1696

Schilm, J.; Goldberg, A.; Partsch, U.; Dürfeld, W.; Arndt, D.; Pönicke, A.; Michaelis, A.
Joining technologies for a temperature-stable integration of a LTCC-based pressure sensor
Journal of Sensors and Sensor Systems 5(2016), Nr.1, p.73–83

Schneider, M.; Schubert, N.; Michaelis, A.
Anodic dissolution of solid-state sintered silicon carbide at high current densities
Materials and Corrosion (2016), Online First, 6 p.

Schneider, M.; Kremmer, K.; Höhn, S.
Corrosion protection of thickness reduced plasma electrolytic layers on AZ31
Materials and Corrosion 67(2016), Nr.9, p.921–928

Schneider, M.; Lämmel, C.; Hübner, R.; Gierth, U.; Michaelis, A.
TEM investigation of barrier-like anodic oxide films on aluminum
Surface and Interface Analysis 48(2016), Nr.8, p.906–912

Sempf, K.; Boese, M.; Gnauck, P.; Höhn, S.; Herrmann, M.
Determination of local resistivity in ceramic composites by electron microscopy
Journal of the European Ceramic Society 36(2016), Nr.14, p.3531–3537

Shimamura, K.(Ed.); Kirihara, S.(Ed.); Akedo, J.(Ed.); Ohji, T.(Ed.); Naito, M.(Ed.); Singh, M.(Vol. Ed.); Ohji, T.(Vol. Ed.); Michaelis, A.(Vol. Ed.); American Ceramic Society -ACerS-, Westerville/Ohio:
Additive Manufacturing and Strategic Technologies in Advanced Ceramics
Hoboken, NJ: Wiley, 2016, X, 230 p. (Ceramic Transactions, 258)
ISBN 978-1-119-23600-9;
ISBN 978-1-119-23601-6

Slawik, T.; Günther, A.; Moritz, T.; Michaelis, A.
Co-sintering behaviour of zirconia-ferritic steel composites
AIMS Materials Science 3(2016), Nr.3, p.1160–1176

Stark, S.; Neumeister, P.; Balke, H.
A hybrid phenomenological model for ferroelectroelastic ceramics. Part II: Morphotropic PZT ceramics
Journal of the Mechanics and Physics of Solids 95(2016), p.805–826

Stark, S.; Neumeister, P.; Balke, H.
A hybrid phenomenological model for ferroelectroelastic ceramics. Part I: Single phased materials
Journal of the Mechanics and Physics of Solids 95(2016), p.774–804

Stark, S.; Neumeister, P.; Balke, H.
Some aspects of macroscopic phenomenological material models for ferroelectroelastic ceramics
International Journal of Solids and Structures 80(2016), p.359–367

Svoboda, H.
Untersuchungen zu mikroskopischen und makroskopischen Grünkörperfehlern bei der uniaxialen Pressverdichtung
Dresden, 2016, 130 p.
(Dresden, TU, Diss., 2016)

Thiele, M.; Herrmann, M.; Müller, C.; Michaelis, A.
Formation of secondary borides in liquid phase-sintered B_6O materials
Journal of the European Ceramic Society 36(2016), Nr.7, p.1549–1557

Trunec, M.; Klimke, J.; Shen, Z.-J.
Transparent alumina ceramics densified by a combinational approach of spark plasma sintering and hot isostatic pressing
Journal of the European Ceramic Society 36(2016), Nr.16, p.4333–4337

Vogt, H.; Altmann, F.; Braun, S.; Celik, Y.; Dietrich, L.; Dietz, D.; Dijk, Marius van; Dreiner, S.; Döring, R.; Gabler, F.; Goehlich, A.; Hutter, M.; Ihle, M.; Kappert, H.; Kordas, N.; Kokozinski, R.; Naumann, F.; Nowak, T.; Oppermann, H.; Partsch, U.; Petzold, M.; Roscher, F.; Rzepka, S.; Schubert, R.; Weber, C.; Wiemer, M.; Wittler, O.; Ziesche, S.
HOT-300 – a multidisciplinary technology approach targeting microelectronic systems at 300 °C operating temperature
IMAPS Additional Conferences (Device Packaging, HiTEC, HiTEN, & CICMT). Online journal (2016), Issue HiTEC, p.1–10

Wang, L.(Ed.); Imanak, N.(Ed.); Kriven, W.M.(Ed.); Fukushima, M.(Ed.); Kale, G.(Ed.); Singh, M.(Vol. Ed.); Ohji, T.(Vol. Ed.); Michaelis, A.(Vol. Ed.); American Ceramic Society -ACerS-, Westerville/Ohio:
Ceramics for Environmental Systems
Hoboken, NJ: Wiley, 2016, VII, 160 p. (Ceramic Transactions, 257)
ISBN 978-1-119-23444-9;
ISBN 978-1-119-23446-3

Wätzig, K.; Krell, A.
The effect of composition on the optical properties and hardness of transparent Al-rich $MgO{\cdot}nAl_2O_3$ spinel ceramics
Journal of the American Ceramic Society 99(2016), Nr.3, p.946–953

Wätzig, K.; Rost, A.; Langklotz, U.; Matthey, B.; Schilm, J.
An explanation of the microcrack formation in $Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_3$ ceramics
Journal of the European Ceramic Society 36(2016), Nr.8, p.1995–2001

Weil, M.; Meißner, T.; Springer, A.; Bundschuh, M.; Hübler, L.; Schulz, R.; Duis, K.
Oxidized carbo-iron causes reduced reproduction and lower tolerance of juveniles in the amphipod Hyalella azteca
Aquatic Toxicology 181(2016), p.94–103

Weiser, M.; Schulze, C.; Schneider, M.; Michaelis, A.
Platinum electrodeposition from a dinitrosulfatoplatinate(II) electrolyte
Applied Surface Science 390(2016), p.333–338

Winkin, N.; Gierth, U.; Mokwa, W.; Schneider, M.
Nanomaterial-modified flexible micro-electrode array by electrophoretic deposition of carbon nanotubes
Journal of Biochips & Tissue Chips 6(2016), Nr.1, Art. 1000115, 6 p.

Wolf, A.; Härtling, T.; Hinrichs, D.; Dorfs, D.
Synthesis of plasmonic $Cu_{2-x}Se$@ ZnS Core@Shell nanoparticles
ChemPhysChem 17(2016), Nr.5, p.717–723

Wollbrink, A.; Volgmann, K.; Koch, J.A.; Kanthasamy, K.; Tegenkamp, C.; Li, Y.; Richter, H.R.; Kämnitz, S.; Steinbach, F.; Feldhoff, A.; Caro, J.
Amorphous, turbostratic and crystalline carbon membranes with hydrogen selectivity
Carbon 106(2016), p.93–105

Wuchrer, R.; Amrehn, S.; Liu, L.; Wagner, T.; Härtling, T.
A compact readout platform for spectral-optical sensors
Journal of Sensors and Sensor Systems 5(2016), Nr.1, p.157–163

Yoo, Y.-M.; Han, T.-Y.; Kim, H.S.
Melatonin suppresses autophagy induced by clinostat in preosteoblast MC3T3-E1 cells
International Journal of Molecular Sciences 17(2016), Nr.4, Art. 526, 13 p.

Presentations and poster

Workshop Additive Manufacturing, Singapore, 14.–16.1.2016

Opitz, J.
Fraunhofer Institute for Ceramic Technologies and Sytems IKTS: Branch materials diagnostics
Presentation (author)

40th International Conference and Exhibition on Advanced Ceramics and Composites – ICACC 2016, Daytona Beach, 24.–29.1.2016

Adler, J. et al.
Effect of membranes in exhaust particulate filtration
Presentation (author)

Bienert, C. et al.
CFY-Stack Technology for SOEC applications
Presentation (author)

Gaczynski, P.; Harpf, A. et al.
High-temperature 57Fe Mössbauer study of mixed ionic-electronic conducting $(Ba_{0.5}Sr_{0.5})(Co_{0.8}Fe_{0.2})O_{3-\delta}$
Presentation (co-author)

Hennicke, J. et al.
Combining flash sintering/sinterforging with hybrid FAST/SPS technology for oxide and non-oxide materials
Presentation (author)

Hennicke, J. et al.
Enhancements on FAST sintering systems promote transfer from the lab to industrial applications
Presentation (author)

Klemm, H. et al.
Ceramic turbo charger of silicon nitride – Material development and fabrication
Presentation (author)

Klimke, J.
Gelcasting of transparent ceramics
Invited presentation (author)

Kusnezoff, M. et al.
MEA performance evaluation using different methods for area specific resistance estimation
Presentation (author)

Michaelis, A.
Smart advanced ceramic materials for energy and environmental technology
Invited presentation (author)

Moritz, T. et al.
Additive manufacturing of advanced ceramic components: What is possible today and what are the trends?
Invited presentation (author)

Schwarzer, E. et al.
Suspension-based additive manufacturing of ceramic, metal and metal-ceramic components
Presentation (author)

Wätzig, K. et al.
Lithium loss indicated formation of microcracks in LATP ceramics
Presentation (author)

Wolf, C. et al.
In-situ optical coherence tomography inspection of laser-structured polycrystalline ceramics
Presentation (author)

4th Germany-Japan Joint Workshop "Organic Electronics and Nano Materials for Energy", Tokyo, 25.1.2016

Eberstein, M. et al.
Ceramic functional inks for high definition 3D printed electronics
Presentation (author)

15th International Nanotechnology Exhibition & Conference – nano tech 2016, Tokyo, 27.–29.1.2016

Eberstein, M.
High performance thick film pastes for AlN, Si_3N_4, and warpage free LTCC
Presentation (author)

23. Seminar des Arbeitskreises "Elektrochemie in Sachsen", Dresden, 5.2.2016

Liebmann, T. et al.
Mikroelektrochemische Untersuchungen an AA2024
Presentation (author)

Schrötke, E. et al.
Verhalten von EKasic D bei hohen anodischen Stromdichten
Presentation (author)

Scientific discussion meeting of the Royal Society: Taking the temperature of phase transitions in cool materials, London, 8.–9.2.2016

Molin, C. et al.
PMN-PT multilayer ceramic devices for electrocaloric cooling applications
Poster (author)

145th TMS Annual Meeting & Exhibition – TMS 2016, Nashville, 14.–18.2.2016

Gluch, J. et al.
Novel in-situ mechanical tests within an X-ray microscope
Presentation (author)

8. DVS/GMM-Tagung: Elektronische Baugruppen und Leiterplatten, Fellbach near Stuttgart, 16.–17.2.2016

Dudek, R.; Hildebrandt, M.; Rzepka, S.; Röllig, M. et al.
Sprödbruchrisiko an keramischen Bauelementen in Abhängigkeit vom Hochtemperatur-Lotwerkstoff und der Beanspruchungsgeschwindigkeit
Presentation (co-author)

Meier, K. et al.
Zuverlässigkeitsuntersuchungen an organischen Leiterplatten mit dickem Kupferkern für leistungselektronische Anwendungen
Presentation (author)

Metais, B.; Kabakchiev, A.; Guyenot, M.; Metasch, R. et al.
Entwicklung einer Pro-aktiven Lötstellengeometrie-unaghängigen Lebensdauersimulation für bleifreie Lote
Presentation (co-author)

Metasch, R. et al.
Messverfahren zur thermomechanischen Charakterisierung von Werkstoffen der Hochtemperatur-AVT
Presentation (author)

Röllig, M. et al.
Schnelle Beanspruchungsanalyse von elektronischen Motorsteuerungen unter Vibrationslast als Unterstützung im Designprozess
Presentation (author)

Schwerz, R. et al.
Langzeitstabile und robuste Kapselung von Elektronikbaugruppen für Unterwasseranwendungen
Presentation (author)

Fraunhofer-Forschungsmanager-Prädikatsprogramm, Dresden, 17.02.2016

Michaelis, A.
Innovationsmanagement bei Fraunhofer mit Beispielen aus der Praxis
Presentation (author)

5th International Nanotechnology Conference & Exhibition – NanoIsrael, Tel Aviv, 22.–23.2.2016

Michaelis, A.
Smart ceramic materials for energy and environmental technology
Presentation (author)

Innovationsforum FerroKat, Leipzig, 23.–24.2.2016

Gaitzsch, U.; Walther, G.; Lincke, M. et al.
Entwicklung eines neuartigen energie- und rohstoffeffizienten Entschwefelungssystems für die Erzeugung von Bio-Erdgas
Presentation (author)

Reichelt, E.
Synthese höherer Alkohole an Eisenkatalysatoren
Presentation (author)

ATC Tagung, Frankfurt on the Main, 25.–26.2.2016

Reger-Wagner, N. et al.
Adsorptionsselektive Kohlenstoffmembranen auf keramischen Trägern
Poster (author)

14. Treffen des DGG-DKG Arbeitskreises "Glasig-kristalline Multifunktionswerkstoffe", Berlin, 25.–26.2.2016

Rost, A. et al.
Glaskeramiken als Werkstoffe für Festkörperbatterien
Invited presentation (author)

Fortbildungsseminar Hochtemperatur-Sensorik, Goslar, 25.–26.2.2016

Rebenklau, L. et al.
Aufbau- und Verbindungstechnik
Presentation (author)

Jahrestreffen der ProcessNet-Fachgruppen "Mechanische Flüssigkeitsabtrennung und Membrantechnik", Kassel, 2.–3.3.2016

Voigt, I.
Keramische Membranen: Anwendungsbeispiele und Zukunftspotentiale
Vortrag (Autor)

49. Essener Tagung für Wasser- und Abfallwirtschaft "Wasserwirtschaft 4.0", Essen, 2.–4.3.2016

Schulze, E.
autartec® – Technologien zur autarken Wasserver- und -entsorgung
Presentation (author)

27. Konferenz Elektronische Sprachsignalverarbeitung – ESSV 2016, Leipzig, 2.–4.3.2016

Tschöpe, C. et al.
Universal Cognitive User Interface – UCUI
Poster (author)

28. Deutsche Zeolith-Tagung, Giessen, 2.–4.3.2016

Gleichmann, K.; Fischer, G. et al.
Compact zeolithe form body free of binding agent type LTA and FAU
Poster (co-author)

Gleichmann, K.; Brandt, A.; Zimmermann, J.; Unger, B.; Richter, H.
Pades – Developoment of new technologies for zeolithe manufacturing
Poster (co-author)

Jüttke, Y. et al.
Carbon infiltration in NF membranes as model for pore blocking
Poster (author)

Lüdke, D.; Schülein, M.; Jüttke, Y. et al.
Closing of defects via infiltration and carbonization of furfuryl alcohol of supported zeolite BEA membranes
Poster (co-author)

Schülein, M.; Lüdke, D.; Richter, H. et al.
Carbon integrated zeolite membranes – A defect closing method
Poster (co-author)

Simon, A. et al.
Improvement of zeolite membranes by CVD-carbon deposition
Poster (author)

International Symposium of Innovative Ceramic Manufacturing Process Technology, Tokyo, 4.3.2016

Pfeifer, T. et al.
Portable fuel cell systems based on multilayer ceramics technology and derived design concepts
Invited presentation (author)

Conference on Electric Field Assisted Sintering and Related Phenomena Far From Equilibrium – ECI, Tomar, 6.–11.3.2016

Räthel, J. et al.
Flash sintering by the use of hybrid-heated FAST/SPS technique
Presentation (author)

80. Jahrestagung der DPG und DPG-Frühjahrstagung, Regensburg, 6.–11.3.2016

Zschech, E. et al.
Laboratory-based X-ray microscopy – Technique and applications
Presentation (author)

Phosphor Global Summit, Newport Beach, 7.–9.3.2016

Kinski, I. et al.
Development and characterization of transparent and other optically active ceramics
Presentation (author)

91. DKG Jahrestagung & Symposium Hochleistungskeramik 2016, Freiberg, 7.–9.3.2016

Abel, J.
Joining of Al_2O_3/Al_2O_3 and Si_3N_4/Si_3N_4 ceramics without using additives
Presentation (author)

Abel, J.
Micro gas turbine rotor made of silicon nitride: Approach, development and operation
Presentation (author)

Baumgärtner, C.
Phase transformation in nanoporous $LiAlO_2$
Presentation (author)

Eckhard, S.
Modification of internal granule structures via suspension formulation and process parameters
Presentation (author)

Gestrich, T. et al.
Erhitzungsmikroskopie in hochreinen Atmosphären und komplexe thermische Analyse für das Löten von Keramik und die Herstellung von Hochleistungskeramik
Presentation (author)

Gradmann, R. et al.
Adaption of ceramic thick-film materials for laser sintering in integrated sensor applications
Poster (author)

Günther, A.
Textiles in ceramic – Manufacturing and applications for structural and functional materials
Presentation (author)

Herrmann, M. et al.
Corrosion of silicon carbide bonded diamond ceramics and SiSiC-materials in aqueous solutions
Presentation (author)

Kircheisen, R. et al.
Keramische Membrankomponenten für die O_2-Erzeugung in Rauchgasen
Poster (author)

Kunz, W.
Self-healing materials as environmental barrier coatings for gas turbines
Presentation (author)

Martin, H.-P.
Herstellung von Keramikverbunden mit hochtemperaturstabilen Titanaluminiden
Presentation (author)

Müller-Köhn, A. et al.
Powder Injection Moulding (PIM) of glass composites for electrical conductive and decorative components
Presentation (author)

Opitz, J. et al.
Development of nanodiamond-based coatings for titanium alloy oxide layers
Presentation (author)

Opitz, J. et al.
Novel characterization technologies for structural ceramics
Presentation (author)

Potthoff, A.
Cr_2O_3/TiO_2-Hochleistungsschichten durch thermisches Spritzen von wässrigen Suspensionen
Presentation (author)

Reinhardt, K.
Rheological properties of thick film pastes and their effects on printing performance
Presentation (author)

Richter, H.-J.
Plastic forming of flat ceramic substrates using an extrusion and rolling process
Poster (author)

Richter, J. et al.
Ceramic membrane reactors for improvement in efficiency
Poster (author)

Scheithauer, U. et al.
New lightweight kiln furniture produced by combining tape casting and extrusion
Presentation (author)

Scheithauer, U. et al.
Suspension based additive manufacturing of ceramic and metal-ceramic components
Presentation (author)

Schmidt, R. et al.
Shrinkage controlled pastes for bulky silver and copper thick films in power electronics
Presentation (author)

Schönfeld, K. et al.
ZrC – A potential material for ultrahigh temperature heaters
Presentation (author)

Seidel, M. et al.
Characterization of the lithium ion battery high voltage cathode material $LiNi_{0.5}Mn_{1.5}O_4$ synthesized from different precursor chemistries and calcination parameters
Presentation (author)

Seuthe, T. et al.
Ceramic decals – Pre-adjusted thick film circuits and sensors for variable surfaces
Presentation (author)

Seuthe, T. et al.
Thick film measuring resistors with minimized temperature coefficients
Presentation (author)

Voigt, I. et al.
Design of micropores in inorganic membranes for efficient separation of liquids and gases
Presentation (author)

Wätzig, K. et al.
Preparation and characterization of LATP ceramics for solid electrolytes
Presentation (author)

Ziesche, S.
Mehrlagenkeramik und Keramikspritzguss – Eine technologische Kombination zur Herstellung dreidimensionaler funktioneller LTCC-Komponenten
Presentation (author)

6th International Conference on Silicon Photovoltaics – SiliconPV 2016, Chambéry, 7.–10.3.2016

Körner, S. et al.
Low temperature paste for preparation of high efficiency HJT solar cells
Presentation (author)

18. Werkstofftechnisches Kolloquium – WTK 2016, Chemnitz, 10.–11.3.2016

Berger, L.-M.
Binary WC- and Cr_3C_2-containing hardmetal compositions for thermally sprayed coatings
Presentation (author)

China Semiconductor Technology International Conference 2016 – CSTIC, Shanghai, 13.–14.3.2016

Gabler, F.; Roscher, F.; Döring, R.; Otto, A.; Ziesche, S. et al.
Materials and technologies to enable high temperature stable MEMS and electronics for smart systems used in harsh environments
Presentation (co-author)

Workshop 2 des Innovationsforums SpreuStroh: "Energetische Nutzung der Biomasse SpreuStroh", Leipzig, 14.3.2016

Schwarz, B.
Stroh – Strohpellets – Biogaspellets: Alternative Möglichkeiten zur verbesserten Biomethanproduktion
Presentation (author)

49. Jahrestreffen Deutscher Katalytiker, Weimar, 16.3.2016

Jäger, B. et al.
Wirkungsgrad-Steigerung in der alkalischen Wasser-Elektrolyse
Poster (author)

Schaller, M. et al.
Production of long-chained alcohols from syngas on iron catalysts
Poster (author)

3rd Fraunhofer Direct Digital Manufacturing Conference – DDMC 2016, Berlin, 16.–17.3.2016

Lausch, H. et al.
Multi-material approach to integrate ceramic boxed temperature-sensitive components in laser beam melted structures for bio and other applications
Presentation (author)

Schwarzer, E. et al.
Development of photo-curable ceramic suspensions usable for additive manufacturing combined with freeze foaming
Presentation (author)

Springer, P.; Schwarzer, E. et al.
Equipment, material and processes for UV-DLP-based additive manufacturing of two-component ceramic green bodies and dense structures
Presentation (co-author)

Conference on Optical Chemical Sensors and Biosensors – EUROPT(R)ODE XIII, Graz, 20.–23.3.2016

Wuchrer, R. et al.
A holistic plasmonic sensor system
Poster (author)

Smart Materials and Nondestructive Evaluation for Energy Systems – 2016, Las Vegas, 20.–24.3.2016

Hakim, I.; May, D.; Ras, M.; Meyendorf, N. et al.
Quantifying voids effecting delamination in carbon/epoxy composites: Static and fatigue fracture behavior
Presentation (co-author)

Meyendorf, N. et al.
NDE applications in microelectronic industries
Presentation (author)

Wunderlich, C.
Nondestructive cell evaluation techniques in SOFC stack manufacturing
Presentation (author)

13th Symposium for Fuel Cell and Battery Modeling and Experimental Validation – ModVal13, Lausanne, 22.–23.3.2016

Ganzer, G. et al.
New method for determining area-specific resistance of a MCFC stack
Presentation (author)

2016 MRS Spring Meeting & Exhibit, Phoenix, 28.3.–1.4.2016

Zschech, E. et al.
Micro and nano X-ray tomography of 3D IC stacks
Presentation (author)

International Exhibition and Conference for the Printed Electronics Industry – LOPEC 2016, Munich, 5.–7.4.2016

Körner, S. et al.
Printable transparent organic resistors for sensor applications
Poster (author)

Thüringer Werkstofftag 2016, Ilmenau, 6.4.2016

Jäger, B. et al.
Oberflächenaktive katalytische Mischmetalloxide zur Erhöhung des Wirkungsgrades bei der Wasserelektrolyse
Presentation (author)

Jüttke, Y. et al.
Minimization of NF-membrane pores as model for blocking
Poster (author)

Kircheisen, R. et al.
Schutzrohrkonzept zur Abwärmenutzung von Rauchgasen für Sauerstofftransportmembranen
Poster (author)

Reger-Wagner, N. et al.
Keramische Membranreaktoren zur Effizienzsteigerung in der chemischen Verfahrenstechnik
Poster (author)

Simon, A. et al.
Defect blocking of zeolite membranes by CVD-carbon deposition
Presentation (author)

Villwock, M. et al.
Studies on manufacturing SAPO-34 mixed-matrix membranes
Poster (Autor)

1. Thüringer Trinkwassertagung, Jena, 6.–7.4.2016

Voigt, I. et al.
Wasseraufbereitung mit keramischen Membranen
Presentation (author)

Weyd, M. et al.
Wasseraufbereitung durch Membranverfahren
Poster (author)

4SMARTS Symposium für Smarte Strukturen und Systeme, Darmstadt, 6.–7.4.2016

Schubert, L. et al.
Systementwicklung zur Strukturüberwachung mit geführten Wellen
Presentation (author)

6th KMM-VIN Industrial Workshop "Innovative Material Solutions for Transport Applications", Hatfield, 7.–8.4.2016

Kunz, W. et al.
Development of a silicon nitride material for a micro gas turbine impeller
Presentation (author)

DLR Bauteilekonferenz 2016 – Qualitäts- und Produktsicherung, Bonn, 12.–13.4.2016

Scheithauer, U. et al.
Additive Herstellung keramischer und metall-keramischer Bauteile
Poster (author)

Vakuumtag, Dresden, 13.4.2016

Nikolowski, K.
Untersuchungen zum Befüllprozess von Lithium-Ionen-Batterien
Presentation (author)

17th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems – EuroSimE 2016, Montpellier, 17.–20.4.2016

Lenczner, M.; Yang, B.; Cogan, S.D.; Domas, S.; Ke, D.; Couturier, R.l; Renault, D.; Köhler, B. et al.
Temperature control of an SThM micro-probe with an heat source estimator and a lock-in measurement
Presentation (co-author)

Schwerz, R. et al.
Robust and reliable encapsulation of electronics for underwater applications
Presentation (author)

Internationale Deponie- und Biogas-Fachtagung, Lübeck, 18.–19.4.2016

Kriegel, R.
Sauerstoff für die motorische Nutzung von Schwachgasen
Presentation (author)

E4Water Final Conference: Integrated Industrial Water Management: Solutions For Practice, Brussels, 19.–20.4.2016

Weyd, M. et al.
Ceramic membranes for water treatment
Poster (author)

12th International Conference and Exhibition on Ceramic Interconnect and Ceramic Microsystems Technologies – CICMT 2016, Denver, 19.–21.4.2016

Eberstein, M. et al.
Silver pastes with adjusted glass composition for warpage-free LTCC
Presentation (author)

Gradmann, R. et al.
Adaption of functional ceramic materials for the laser sintering process in integrated sensor applications
Presentation (author)

Partsch, U. et al.
LTCC-based pressure sensors for elevated operation temperatures up to 300 °C
Presentation (author)

DKG working group Keramische Membranen, Frankfurt on the Main, 20.4.2016

Richter, H. et al.
Kohlenstoff als Membranmaterial für die Gastrennung
Presentation (author)

Virtuelle Besichtigung "autartec® – vom Entwurf zur Realisierung", Geierswalde, 21.4.2016

Lincke, M. et al.
Vom Grau- und Regenwasser zum Trinkwasser
Presentation (author)

Hannover Messe 2016: Werkstoff- & Leichtbau-Forum, Hanover, 24.–29.4.2016

Berger, L.-M.
Verschleißfeste Hartmetallschichten für den Leichtbau
Presentation (author)

7. Anwenderseminar 2D/3D-Rheologie und Stabilität von dispersen Systemen, Potsdam, 25.–27.4.2016

Meyer, A. et al.
Untersuchungen der Stabilität von metallischen Nanopartikel-Tinten mittels Zentrifugalseparationsanalyse
Invited presentation (author)

GRL-FYK Opening Ceremony & Workshop, Songdo, 25.–27.4.2016

Opitz, J.
Division bio- and medical technology at Fraunhofer IKTS
Presentation (author)

26. Workshop des Forums Inn-O-Kultur, Leipzig, 26.4.2016

Hoyer, Thomas
Anorganisch-organische Nanokompositbeschichtungen für Steine, Metalle, Kunststoffe
Presentation (author)

Kraftwerk Batterie 2016, Münster, 26.–27.4.2016

Reinke, C. et al.
Analysis of the electrolyte penetration behavior in lithium-ion battery cells by electrical measurements
Poster (author)

Wolter, M. et al.
EMBATT bipolar lithium battery concept – Approach to increase energy density for automotive application
Poster (author)

Deutsche Biotechnologietage, Leipzig, 26.–27.4.2016

Lehmann, A. et al.
Spin-Off-Vorhaben des Fraunhofer IKTS: Optische Prostatakrebsdiagnose
Presentation (author)

9. Biogas-Innovationskongress – BIOGAS 2016, Osnabrück, 26.–27.4.2016

Schwarz, B. et al.
Strohbasierte Biogaspellets als alternatives Inputsubstrat in Biogasanlagen
Presentation (author)

COST MP1105 Final Conference "Innovations in Flame Retardancy of Textiles and Related Materials", Poznan, 27.–28.4.2016

Martins, M.; Slawik, T.; Moritz, T. et al.
Ceramic tapes as fire protective coatings for CFRP composites
Presentation (co-author)

Printed Electronics Europe 2016, Berlin, 27.–28.4.2016

Fritsch, M. et al.
Synthesis and formulation of particle inks for inkjet and aerosol-jet printing methods
Presentation (author)

Fritsch, M.
Synthesis and properties of nanoinks for inkjet and aerosol-jet printing applications
Presentation (author)

Turbine Forum 2016: "Advanced Coatings for High Temperatures", Nice, 27.–29.4.2016

Schönfeld, K. et al.
Potential of ceramic matrix composites for gas turbine applications
Presentation (author)

Frühjahrestagung der Landesfachgruppe der neuen Bundesländer, Hartha, 29.4.2016

Hoyer, T.
Einkomponentige werkseitige Nanokristallithbehandlung
Presentation (author)

6th Workshop on Metallization & Interconnection for Crystalline Silicon Solar Cells, Constance, 2.–3.5.2016

Eberstein, M. et al.
High performance silver polymer pastes for SHJ cells
Presentation (author)

Körner, S. et al.
Transparent front side contact pastes for high efficiency SHJ-solar cells
Presentation (author)

Jahrestreffen Reaktionstechnik 2016 – ProcessNet, Würzburg, 2.–4.5.2016

Lomtscher, A.
Einfluss der Anwesenheit von faserigen Partikeln auf das Fließverhalten und die Strömungsgeschwindigkeiten in gerührten Systemen
Presentation (author)

Pohl, M. et al.
Konform temperierter Fluidmischer
Poster (author)

Reichelt, E. et al.
Stofftransport und Druckverlust in geschütteten und strukturierten Festbetten
Presentation (author)

Schaller, M. et al.
Synthese langkettiger Alkohole an Eisenkatalysatoren
Poster (author)

CNS Symposium 2016, Caputh, 4.5.2016

Hillmann, S. et al.
Methoden zur Messung der mechanischen Spannung und des Ermüdungszustandes an Stählen mit magnetischem Barkhausenrauschen
Invited presentation (author)

2016 Critical Materials Council Seminar – CMC, Hillsboro, 5.–6.5.2016

Sundqvist, J.
ALD/CVD material & equipment market trends
Presentation (author)

21st International Conference on Microwave, Radar and Wireless Communications – MIKON, Krakow, 9.–11.5.2016

Heuer, H. et al.
High resolution radio frequency inspection of carbon fiber composites
Presentation (author)

AchemAsia, Beijing, 9.–12.5.2016

Richter, H. et al.
Dewatering of glycol with zeolite NaA membranes for enhancement of natural gas drying
Presentation (author)

Richter, H. et al.
Enhancement of natural gas drying by dewatering of glycol with zeolite NaA membranes
Presentation (author)

Richter, H. et al.
Large scale ceramic nanofiltration membranes for water and waste water treatment
Presentation (author)

First Iranian Conference of FAST/SPS, Teheran, 10.5.2016

Räthel, J. et al.
FAST/SPS Technology – Principles and applications for ceramic materials
Presentation (co-author)

International Conference on High Temperature Electronics – HiTEC / IMAPS 2016, Albuquerque, 10.–12.5.2016

Vogt, H.; Altmann, F.; Braun, S.; Celik, Y.; Dietrich, L.; Dietz, D.; van Dijk, M.; Dreiner, S.; Döring, R.; Gabler, F.; Goehlich, A.; Hutter, M.; Ihle, M. et al.
HOT-300 – A multidisciplinary technology approach targeting microelectronic systems at 300 °C operating temperature
Presentation (co-author)

39th International Spring Seminar on Electronics Technology – ISSE 2016, Pilsen, 18.–22.5.2016

Lenz, C. et al.
Consideration of inhomogeneous shrinkages for LTCC-applications in panel-level processes
Presentation (author)

Ziesche, S. et al.
Ceramic substrate technology for wafer level packaging of MEMS
Presentation (author)

20. Leibniz-Konferenz – Recycling 2016, Lichtenwalde, 19.–20.5.2016

Voigt, I. et al.
Recycling von seltenen Metallen aus Prozesswässern der Metall-Bergbauindustrie
Presentation (author)

Abschlussveranstaltung des Innovationsforums SpreuStroh, Chemnitz, 19.–20.5.2016

Schwarz, B.
Das Biogaspellet – Energie und Dünger aus SpreuStroh
Presentation (author)

Glass & Optical Materials Division – GOMD 2016, Madison, 22.–26.5.2016

Möncke, D.; Wondraczek, L.; Brauer, D.; Brandt, J.; Ehrt, R.; Johannes, M. et al.
Structural analysis by vibrational spectroscopy (IR and Raman) in the study of bio-glasses and glass ceramics
Presentation (author)

4th Annual Seminar of ALDCoE "ALD precursors and processes", Helsinki, 23.–24.5.2016

Puurunen, R. L.; Koshtyal, Y.; Pedersen, H.; van Ommen, J. R.; Yurkevich, O.; Sundqvist, J.
Virtual project on the history of ALD: Overview and current status
Poster (co-author)

IEEE International Interconnect Technology Conference / Advanced Metallization Conference – IITC/AMC, San José, 23.–26.5.2016

Zschech, E. et al.
Novel approaches to determine thermomechanical materials data in advanced interconnect stacks
Presentation (author)

14th International Conference Reliability and Stress-Related Phenomena in Nanoelectronics – IRSP 2016, Bad Schandau, 30.5.–1.6.2016

Kteyan, A.; Mühle, U. et al.
Analysis on effect of TSV-induced stress: Measurements and simulations
Presentation (co-author)

Niese, S. et al.
Full-fiel hard X-ray microscopy and tomography for in-situ mechanical testing of BEOL structures
Presentation (author)

Zschech, E. et al.
X-ray techniques for 3D metrology and diagnostics – Status and outlook
Presentation (author)

Symposium on Design, Test, Integration and Packaging of MEMS/MOEMS – DTIP 2016, Budapest, 30.5.–2.6.2016

Ihle, M. et al.
LTCC-Packaging of a laser optical system for harsh environments
Presentation (author)

7th CIRP Conference on High Performance Cutting – HPC 2016, Chemnitz, 31.5.–2.6.2016

Bergs, T.; Richter, V.; Ottersbach, M.; Pötschke, J. et al.
Tool technologies for milling of hardmetals and ceramics
Presentation (co-author)

Biomass to Power and Heat 2016, Zittau, 1.–2.6.2016

Scheithauer, O. et al.
CLEANPELLET – Entwicklung eines Verfahrens für die Erzeugung emissionsarm verbrennbarer Gärrestpellets zu Nutzung als Brennstoff für Haus- und Kleinfeueranlagen
Presentation (author)

23. Innovationstag Mittelstand des BMWi / Partnering Event – Innovation Day, Berlin, 2.6.2016

Reichel, U.
New ceramic materials for innovative applications
Presentation (author)

DGMT Workshop IFAT 2016: Membrane Technologies for Environmental Protection, Munich, 2.6.2016

Pflieger, C. et al.
Ceramic nanofiltration membranes for organic solvent filtration of oily water and organic solvents
Presentation (author)

Cross-border Expert Talks: "Carbide-, Cermet- and Ceramic Coatings", Prague, 2.–3.6.2016

Berger, L.-M.
Hardmetal coatings – Developments and trends
Invited presentation (author)

International Conference on Powder Metallurgy & Particulate Materials – POWDERMET 2016, Boston, 5.–8.6.2016

Pötschke, J. et al.
Novel polycrystalline WC-Co based cemented carbides and their properties
Presentation (author)

XXI Physical Metallurgy and Materials Science Conference "Advanced Materials and Technologies" – AMT 2016, Rawa Mazowiecka, 5.–8.6.2016

Zschech, E.
Nano X-ray tomography – A novel technique for materials development
Presentation (author)

11th Natural Gas Conversion Symposium – NGCS 11, Tromsø, 5.–9.6.2016

Schaller, M. et al.
Production of long-chained alcohols from synthesis gas using iron catalysts
Poster (author)

90. Glastechnische Tagung der DGG, Goslar, 6.–8.6.2016

Eberstein, M. et al.
Einfluss von Glasadditiven auf das Sinterverhalten von Silberpulvern für die Metallisierung von LTCC-Substraten
Presentation (author)

Gradmann, R. et al.
Entwicklung funktioneller Glaswerkstoffe für den laserbasierten Sinterungsprozess in integrierten Sensorsystemen
Presentation (author)

11th International Conference on Brazing, High Temperature Brazing and Diffusion Bonding – LÖT 2016, Aachen, 7.–9.6.2016

Martin, H.-P. et al.
Experimental investigations of TiAl-brazes for ceramic joining
Presentation (author)

Schilm, J. et al.
Brazing of kovar to alumina and LTCC for integration of ceramic pressure sensors
Presentation (author)

16th AUTEX World Textile Conference, Ljubljana, 8.–10.6.2016

Mühle, U. et al.
Structural characterisation of carbon fibres along the fabrication process using SEM/FIB and TEM
Presentation (author)

15th International Conference on New Actuators & 9th Exhibition on Smart Actuators and Drive Systems – ACTUATOR 16, Bremen, 13.–15.6.2016

Ehle, F. et al.
An effective method for designing magnetic shape memory actuator systems
Presentation (author)

Hohlfeld, K. et al.
Tailored composite transducers based on piezoceramic fibres and pearls
Presentation (author)

Cancer Diagnostics Conference & Expo, Rome, 13.–15.6.2016

Lehmann, A. et al.
Fast evaluation of biopsy for prostate cancer diagnosis by Fraunhofer IKTS
Presentation (author)

19th World Conference on Non-Destructive Testing – WCNDT 2016, Munich, 13.–17.6.2016

Barth, M. et al.
Inspection of forged disc materials with an adapted annular array and dynamic depth focusing
Presentation (author)

Barth, M. et al.
Testing of ceramics by ultrasound microscopy and vibration analysis
Presentation (author)

Bendjus, B. et al.
Determination of biomass by laser-speckle-photometry
Poster (author)

Chapnyi, T.; Schreiber, J. et al.
Characterization of polymer-based materials using fluorescence method and fractal analysis
Presentation (co-author)

Cikalova, U. et al.
Laser speckle photometry (LSP) – Optical sensor system for monitoring of material condition and processing
Presentation (author)

Gommlich, A. et al.
On determination of focal laws for linear phased array probes as to the active and passive element size
Presentation (author)

Herzog, T. et al.
New possibilities in ultrasound phased array testing by the use
Poster (author)

Hillmann, S. et al.
Validation of an ultrasonic-phased-array-method for testing of circumferential welds at thin-walled pipes
Presentation (author)

Hipp, R.
Operation and sound field of the ultrasonic biplanar-array
Poster (author)

Hönig, U.; Holder, U.; Pietzsch, A. et al.
Definition of requirements for reference experiments to determine and evaluate various damage mechanisms in fibre composites by acoustic emission
Presentation (co-author)

Köhler, B. et al.
A novel piezoelectric fibre patch transducer for shear horizontal wave modes
Presentation (author)

Kovalenko, D.; Opitz, J.
Structural characterization by Raman spectroscopy
Presentation (co-author)

Richter, C. et al.
Ultrasonic phased array system with 128 full parallel channels (128:128) for fast and modular automated testing
Presentation (author)

Schubert, F.
Simulation of ultrasonic wave propagation in anisotropic heterogeneous welds embedded in a polycrystalline base material
Presentation (author)

Schulze, M. et al.
NDE of carbon fiber based materials and polymers by the application of high frequency eddy-current techniques
Presentation (author)

Walter, S. et al.
Comparison of ultrasonic phased array probes based on PMN-PT and PZT 1-3 composites
Presentation (author)

Sitzung der Fachgruppe "Integrierte Schaltungen" des Zentralverbandes der Deutschen Elektroindustrie, Hermsdorf, 14.6.2016

Capraro, B.
Foliengießen am Fraunhofer IKTS
Presentation (author)

4th Dresden Nanoanalysis Symposium "Materials Modeling and Characterization", Dresden, 15.6.2016

Gluch, J. et al.
Multilayer Laue lenses – Novel optics for nano X-ray tomography in a wide range of photon energy
Presentation (author)

Kutukova, K. et al.
Crack imaging in composite materials using high resolution nano-XCT
Presentation (author)

Sander, C. et al.
Advanced characterization methods for materials properties of composite BEoL stacks for multi-scale simulation
Presentation (author)

SUMMEREV 16: Characterisation of Hardmetals and Superhard Materials, Liechtenstein, 16.–17.6.2016

Pötschke, J. et al.
Novel techniques for sample preparation for electron imaging technologies
Presentation (author)

18th International Zeolite Conference, Rio de Janeiro, 19.–24.6.2016

Richter, H. et al.
Designing of zeolite particles for mixed-matrix-membrane and heat storage application
Poster (author)

Schülein, M.; Lüdke, D.; Richter, H. et al.

Carbon integrated zeolite membranes (CiZM) – A defect closing method
Poster (co-author)

Simon, A. et al.
Improvement of zeolite membranes by deposition of amorphous carbon
Poster (author)

18th International Meeting on Lithium Batteries – IMLB 2016, Chicago, 19.–24.6.2016

Reinke, C. et al.
Electrochemical approach to investigate the electrolyte wetting process of lithium-ion cells
Poster (author)

Intersolar Europe + ees Europe Conference 2016, Munich, 21.–22.6.2016

Rost, A.
Glass-ceramic solid electrolytes for lithium and sodium ion batteries
Presentation (author)

5th International Conference on Structured Catalysts and Reactors – ICOSCAR5, Donostia-San Sebastian, 22.–24.6.2016

Hübner, M.; Petasch, U. et al.
Potential of ceramic foams for DeNOx exhaust aftertreatment
Poster (co-author)

NanoTech Poland, Poznan, 22.–25.6.2016

Zschech, E. et al.
Nano X-ray tomography – A novel technique to study nanomaterials and nanostructures
Presentation (author)

17th European Conference for Composite Materials – ECCM17, Munich, 26.–30.6.2016

Krug, M. et al.
Evaluation of alumina as protective coating for carbon fibers in aluminum-based composites
Presentation (author)

9th International Conference on High Temperature Ceramic Matrix Composites and Global Forum on Advanced Materials and Technologies for Sustainable Development – HTCMC 2016, Toronto, 26.6.–1.7.2016

Klemm, H. et al.
Hot gas stability of various ceramic matrix composites
Presentation (author)

Kunz, W. et al.
Self-healing EBC material for gas turbine applications
Presentation (author)

Electroceramics XV, Limoges, 27.–29.6.2016

Molin, C. et al.
PMN-8PT thick film and multilayer ceramic devices for electrocaloric cooling applications
Presentation (author)

3. ThEEN-Treff, Hermsdorf, 29.6.2016

Capraro, B.
Folientechnik für mobile Stromspeicher
Presentation (author)

30th International Conference on Surface Modification Technologies – SMT30, Milan, 29.6.–1.7.2016

Weiser, M. et al.
Characterization of the electrolytic deposition of particle reinforced metal layers by electrochemical quartz crystal micro balance
Poster (author)

ASCO Annual Meeting – ASCO16, Chicago, 3.–7.7.2016

Lehmann, A. et al.
Fast evaluation of biopsy for prostate cancer diagnosis by Fraunhofer IKTS
Presentation (author)

AFC IA Annex 32 (Solid Oxide Fuel Cells), Lucerne, 4.7.2016

Megel, S. et al.
Update on SOFC/SOEC Technology in Germany
Presentation (author)

Kongress QS Excellence 2016, Bad Nauheim, 5.–6.7.2016

Wunderlich, C.
Innovative zerstörungsfreie in-line Methoden zur Qualitätssicherung im Umfeld von Industrie 4.0
Invited presentation (author)

12th European SOFC & SOEC Forum – EFCF 2016, Lucerne, 5.–8.7.2016

Henke, M.; Steilen, M.; Näke, R. et al.
Control strategy for a SOFC gas turbine hybrid power plant
Presentation (co-author)

Kusnezoff, M. et al.
Status of SOFC/SOEC stack and system development and commercialization activities at Fraunhofer IKTS
Presentation (author)

Megel, S. et al.
CFY-stacks: Progress in development
Poster (author)

Pfeifer, T. et al.
Development of a SOFC/battery-hybrid system for distributed power generation in India
Presentation (author)

Schilm, J. et al.
Glass ceramic sealants for CFY based SOFC
Presentation (author)

14th International Conference on Inorganic Membranes – ICIM 2016, Atlanta, 10.–13.7.2016

Hoffmann, R. et al.
Electrostatically supported spray coating to improve oxygen permeation of $(Ba_{0.5}Sr_{0.5})(Co_{0.8}Fe_{0.2})O_{3-\delta}$-capillaries
Poster (author)

Kiebach, R.; Agerstedt, K.; Hu, Q.; Hendriksen, P.V.; Engelbrecht, K.; Sogaard, M.; Pippardt, U.; Kiesel, L. et al.
Lessons learned from designing and operating a proof-of-concept module with 25 tubular oxygen transport membranes
Presentation (co-author)

Reger-Wagner, N. et al.
Reduction of defects in zeolite membranes by chemical vapor deposition technique
Presentation (author)

Simon, A. et al.
Synthesis of carbon nanotubes and carbon nanofibers on asymmetric porous ceramic substrates
Presentation (author)

Voigt, I. et al.
Efficient oxygen separation from air with MIEC-membranes
Presentation (author)

Voigt, I. et al.
NF-Membranes for the cleaning of "Recycle water" in oil sand extraction
Poster (author)

24. Seminar des "Arbeitskreises Elektrochemie in Sachsen", Chemnitz, 11.7.2016

Lämmel, C. et al.
Leckraten von Ag/AgCl-Referenzelektroden und die Verwendung in elektrochemischen Messungen
Presentation (author)

Voigt, K. et al.
Oxidbildung und Wärmeentwicklung bei stromkontrollierter Pulsanodisation von Aluminium
Presentation (author)

5th International Symposium on Graphene Devices – ISGD-5, Brisbane, 11.–14.7.2016

Liao, Z.; Dianat, A.; Gall, M. et al.
In-situ stretching graphene ribbons in the transmission electron microscope
Presentation (co-author)

IMWA Annual Conference 2016: "Mining meets Water – Conflicts and Solutions" – IMWA 2016, Leipzig, 11.–15.7.2016

Friedrich, H.-J.
Membranelektrolyseverfahren zur Behandlung von und zur Rohstoffgewinnung aus Bergbau- und Tiefenwässern
Presentation (author)

World Federation of NDE Centers Short Course – WFNDEC, Atlanta, 16.–17.7.2016

Köhler, B.
Measurement Methods #1: Visualization of sound fields: From August Toeplers Schlieren Method to laser vibrometry
Invited presentation (author)

Köhler, B.
Wavefield visualization: Applications
Invited presentation (author)

43rd Review of Progress in Quantitative Nondestructive Evaluation – QNDE 2016, Atlanta, 16.–22.7.2016

Köhler, B. et al.
Course of studies for non-destructive testing at Dresden International University
Presentation (author)

Köhler, B. et al.
Elastic wave fields generated by shear horizontal piezoelectric fiber patch (SH-PFP) transducers: Parameter study by modelling and laser vibrometric measurements
Presentation (author)

Kopycinska-Müller, M. et al.
Novel approach in mechanical characterization of thin films for nano electronics
Presentation (author)

Löffler, M.; Zschech, E. et al.
Multi-scale X-ray tomography of solder interconnects in microelectronics
Presentation (co-author)

Michaelis, A.
New NDE methods for quality assessment of advanced ceramic materials and systems
Presentation (author)

Rjelka, M.
Extraction of depth profiles of third order elastic constants in cracked media
Presentation (author)

6th International Conference on Shaping of Advanced Ceramics – Shaping VI, Montpellier, 18.–20.7.2016

Abel, J. et al.
Influence of PE type in Ceramic Injection Molding (CIM) feedstocks towards the solvent extractability of green bodies
Presentation (author)

Schwarzer, E. et al.
Application instances based on different materials made by lithography-based ceramic manufacturing (LCM)
Presentation (author)

Schwarzer, E. et al.
Thermoplastic 3D-printing (T3DP) – Update in the field of additive manufacturing of single- and multi-material components
Presentation (author)

15th Ulm Electrochemical Talks – UECT 2016, Blaubeuren, 20.–21.7.2016

Rost, A. et al.
Impedance spectroscopy on glass-ceramic solid-state electrolytes for room temperature Na-S batteries
Presentation (author)

16th International Conference on Atomic Layer Deposition – ALD 2016, Dublin, 24.–27.7.2016

Sundqvist, J.
Industry panel on atomic level processing
Presentation (author)

Suyatin, D. B.; Khan, S. A.; Sundqvist, J. et al.
Longitudinal nanowire splitting by atomic layer etching
Presentation (co-author)

Microscopy & Microanalysis Meeting – M&M 2016, Columbus/OH, 24.–28.7.2016

Gluch, J.
FIB sample preparation for X-ray microscopy and ROI target cross-sectioning
Presentation (author)

Gordon Research Conference, South Hadley, 31.7.–5.8.2016

Michaelis, A.
$(AM)^2$: Advanced Manufacturing and Additive Manufacturing
Presentation (author)

11th International Symposium on Electrochemical Micro & Nanosystem Technologies – EMNT 2016, Brussels, 17.–19.8.2016

Heubner, C. et al.
Electrochemical in situ preparation and characterization of submicron sized-$NaFePO_4$
Presentation (author)

Schneider, M. et al.
Microelectrochemical investigation of AA2024
Presentation (author)

Weiser, M. et al.
Platinum nanoparticle electrodeposition from a halogen-free electrolyte for catalytically active coatings
Presentation (author)

7th International Zeolite Membrane Meeting – IZMM 2016, Dalian, 20.–23.8.2016

Voigt, I. et al.
Scale-up manufacturing and testing of microporous membranes
Presentation (author)

6th International Congress on Ceramics – ICC6, Dresden, 21.–25.8.2016

Abel, J. et al.
Aluminum alloy tools in Ceramic Injection Molding (CIM) for testing sample series
Presentation (author)

Ahlhelm, M. et al.
Novel ceramic composites for personalized 3D structures
Presentation (author)

Beckert, W. et al.
Modelling support for development of ceramic thermo-electric applications
Presentation (author)

Chen, L. et al.
Crack detection of ceramics based on laser speckle photometry
Poster (author)

Eberstein, M. et al.
On the development of ceramic functional inks for high definition 3D printed electronics
Presentation (author)

Feng, B. et al.
Fabrication and characterization of ceramic thermoelectric modules based on boron carbide and titanium suboxide
Presentation (author)

Füssel, A. et al.
Advancement of open-celled SSiC foams for high temperature application
Presentation (author)

Gast, F.-U.; Schwinge, C.; Bohatzsch, T.; Ahlhelm, M. et al.
Testing of polymer-based ceramics as bone replacement material in additive manufacturing
Presentation (co-author)

Glöß, B. et al.
Influence of granule properties on die filling behavior
Presentation (author)

Heinig, K.-H. et al.
Ceramic-ceramic nanocomposites by melt quenching – How does it work and what are they good for?
Presentation (author)

Herrmann, M. et al.
Diamond, cBN reinforced ceramic materials: Potential wear resistant components
Presentation (author)

Hillmann, S. et al.
Current state of research of non-destructive methods for ceramic materials
Presentation (author)

Kaiser, A. et al.
Characterization of high temperature materials properties and processes by heating microscopy under high purity atmospheres and high vacuum
Presentation (author)

Kaiser, S. et al.
Development of three-dimensional catalytically active fiber structures for heterogeneous catalysis
Presentation (author)

Kentaro, I.; Richter, H.-J. et al.
Preparation of aluminium titanate-based porous ceramics using 3D printing as green process
Presentation (co-author)

Kinski, I. et al.
Characterization and development of ceramic phosphors for light-conversion
Presentation (author)

Klemm, H. et al.
Design of non-oxide ceramic matrix composites for gas turbine applications
Presentation (author)

Köhler, B.
A duality: Elastodynamic testing for ceramics and ceramics for elastodynamic based nondestructive testing
Presentation (author)

Krell, A. et al.
New horizons beyond glass-optics: Transparent ceramics with advanced optical quality
Presentation (author)

Kusnezoff, M. et al.
Status and prospectives of SOFC technology
Presentation (author)

Mannschatz, A. et al.
Conductive glass-carbon composites for heaters produced by powder injection molding (PIM)
Presentation (author)

Marcinkowski, M. et al.
Development of ceramic functional films for curing at 200 °C on planar and non-planar surfaces
Presentation (author)

Martin, H.-P. et al.
Technological options to tune electrical conductivity of titanium suboxide – An experimental approach
Presentation (author)

Mühle, U. et al.
Target preparation and characterization of interfaces in cosintered metal ceramic composites using imaging and analytical transmission electron microscopy
Presentation (author)

Nikolowski, K. et al.
Novel approach to optimize high voltage spinel materials for lithium-ion batteries via the synthesis procedure
Presentation (author)

Petasch, U. et al.
Potential of open-celled ceramic foams for DeNOx exhaust aftertreatment
Poster (author)

Pohl, M. et al.
Tailor-made silver pastes for functional LTCC applications
Presentation (author)

Räthel, J. et al.
Flash sintering by the use of hybrid heated FAST/SPS technique
Presentation (author)

Reichelt, E. et al.
Application of ceramics for the sustainable production of chemical products
Presentation (author)

Reinhardt, K. et al.
Shear tinning and thixotropic properties of thick film pastes and their effects on printing performance
Presentation (author)

Reuber, S. et al.
Ceragen fuel cells for off-grid and residential power
Presentation (author)

Rost, A. et al.
Joining of ceramic based TEG-modules
Presentation (author)

Scheithauer, U. et al.
Combination of green tape cast and extruded components for new lightweight kiln furniture
Presentation (author)

Scheithauer, U. et al.
Suspension based additive manufacturing of single- and multi-material components
Presentation (author)

Schulz, M. et al.
Stiff plastic extrusion of sodium beta alumina ceramic electrolytes
Presentation (author)

Semu, D. et al.
Open-celled ceramic foams as functional structures for multiphase chemical reactors
Poster (author)

Vinnichenko, M. et al.
Basic aspects of matrix materials stability for application in molten carbonate fuel cells
Presentation (author)

Wagner, D. et al.
Glass-ceramic solid electrolytes for room temperature sodium ion batteries
Presentation (author)

Zeh, C. et al.
Ceramic phosphors for direct part making and sensor applications
Presentation (author)

2016 Joint IEEE International Symposium on the Applications of Ferroelectrics, European Conference on Applications of Polar Dielectrics & Workshop on Piezoresponse Force Microscopy – ISAF/ECAPD/PFM, Darmstadt, 21.–25.8.2016

Gebhardt, S. et al.
Study on electrocaloric multilayer ceramics based on PMN-8PT
Presentation (author)

Günther, P. et al.
Fabrication and characterization of a 20 MHz ultrasonic transducer using soft mold process
Presentation (author)

67th Annual Meeting of the International Society of Electrochemistry, The Hague, 21.–26.8.2016

Heubner, C. et al.
Harmonics analysis for investigation of insertion electrodes
Poster (author)

Langklotz, U. et al.
Silicon-Nanowire anodes for lithium batteries synthesized from galvanic gold nanoparticles
Presentation (author)

Ponnusamy, P.; Feng, B. et al.
Effect of TiB_2 in boron rich boron carbide for TE applications
Poster (co-author)

16th Nordic Filtration Symposium, Lappeenranta, 24.–26.8.2016

Richter, H. et al.
Ceramic nanofiltration membranes
Presentation (author)

30th European Crystallographic Meeting, Basel, 28.8.–1.9.2016

Münchgesang, W.; Wagner, D. et al.
Crystal structure, microstructure and ionic conductivity of the cost-efficient sodium solid electrolyte $Na_5YSi_4O_{12}$
Presentation (co-author)

Fachtagung "Biogas aus Stroh", Heiden, 30.8.2016

Schwarz, B.
Strohbasierte Biogaspellets als alternatives Inputsubstrat in Biogasanlagen
Presentation (author)

EUROSENSORS XXX, Budapest, 4.–7.9.2016

Lenz, C. et al.
Development and characterization of a miniaturized flame ionization detector in ceramic multilayer technology for field applications
Presentation (author)

2016 Asian SOFC Symposium, Tokyo, 4.–7.9.2016

Pfeifer, T. et al.
Development of a SOFC/Battery-hybrid system for distributed power generation in India
Presentation (author)

15th European Inter-Regional Conference on Ceramics, Villeurbanne, 5.–7.9.2016

Johannes, M. et al.
Nanostructured zirconia composites with high ageing resistance
Poster (author)

ProcessNet-Jahrestagung, Aachen, 12.–15.9.2016

Koleva, V.; Richter, H. et al.
Energieeffiziente Stofftrennung in der chemischen und pharmazeutischen Industrie durch Membranverfahren
Presentation (co-author)

6th Electronics System-Integration Technology Conference – ESTC 2016, Grenoble, 13.–16.9.2016

Goldberg, A. et al.
Highly efficient and long-term stable fuel cell micro-energy systems based on ceramic multilayer technology
Presentation (author)

2. Wasseranalytisches Seminar – MWAS 2016, Mülheim on the Ruhr, 14.–15.9.2016

Oelschlägel, K. et al.
Weathering of microplastics
Poster (author)

23rd International Congress on X-ray Optics and Microanalysis – ICXOM23, Upton, 14.–18.9.2015

Niese, S. et al.
A dedicated illumination for full-field X-ray microscopy with multilayer Laue lenses
Presentation (author)

IEEE International Ultrasonics Symposium – IUS 2016, Tours, 18.–21.9.2016

Gebhardt, S. et al.
Towards fabrication of high frequency ultrasonic transducers using soft mold process
Presentation (author)

Wang, H.; Qiu, Y.; Démoré, C.; Gebhardt, S. et al.
2-D crossed-electrode transducer arrays for ultrasonic particle manipulation
Presentation (co-author)

18. Heiligenstädter Kolloquium "Technische Systeme für die Lebenswissenschaften", Heilbad Heiligenstadt, 19.–21.9.2016

Heuer, H.
Kombinierte akustische und induktiv elektrische Impedanz-Spektroskopie zur zeitlichen Beobachtung biochemischer Prozesse
Presentation (author)

27. European Symposium on the Reliability of Electron Devices, Failure Physics and Analysis – ESREF, Halle, 19.–22.9.2016

Huang, J.; Löffler, M.; Möller, W.; Zschech, E.
Ga contamination in silicon by focused ion beam milling: Dynamic model simulation and atom probe tomography experiment
Presentation (co-author)

55. Chemiefasertagung Dornbirn-MFC, Dornbirn, 20.–22.9.2016

Herfert, H.; Moritz, T.
CerMeTex – Neuartige Metallfaser-Keramik-Verbundwerkstoffe für Bauteileigenschaften auf Basis von Metallfaser- und Metallfilamentstrukturen
Presentation (author)

14th European Conference on Thermoelectrics – ECT 2016, Lisbon, 20.–23.9.2016

Feng, B. et al.
Technological options to tune electrical conductivity of titanium suboxide – An experimental approach
Presentation (author)

Rost, A. et al.
Joining of ceramic based TEG-modules
Presentation (author)

4th International Symposium on New Frontier of Advanced Si-Based Ceramics and Composites – ISASC 2016, Busan, 25.–28.9.2016

Adler, J. et al.
Silicon carbide based filter materials and concept for cost-effective flat membranes
Invited presentation (author)

Klemm, H.
High-temperature silicon nitride with Sc_2O_3 as sintering additive
Invited presentation (author)

21st International Workshop on Electromagnetic Nondestructive Evaluation – ENDE 2016, Lisbon, 25.–28.9.2016

Cikalova, U. et al.
New sensor development for Barkhausen noise technique
Presentation (author)

Cikalova, U. et al.
Spatially resolved Barkhausen noise measurement of laser cut electrical steels
Poster (author)

7th Late Summer Workshop "Microplastics in the aquatic environment", Haltern am See, 25.–28.9.2016

Oelschlägel, K. et al.
Characterization of microplastics
Poster (author)

40th International Microelectronics and Packaging IMAPS Poland 2016 Conference, Waldenburg, 25.–28.9.2016

Ziesche, S. et al.
Technological combination of multilayer ceramic technology and ceramic injection molding for the manufacturing of 3D functional ceramic components
Presentation (author)

AM CERAMICS 2016, Nuremberg, 26.–27.9.2016

Scheithauer, U. et al.
Additive Fertigung keramischer Bauteile – Neue Designmöglichkeiten und Anwendungsbeispiele
Presentation (author)

15th International Conference on Nanoimprint and Nanoprint Technology – NNT 2016, Braga, 26.–28.9.2016

Khan, S. A.; Graczyk, M.; Nilsson, N.; Kvennefors, A.; Huffmann, M.; Suyatin, D. B.; Sundqvist, J. et al.
Atomic layer etching in nanoimprint stamp technology
Poster (co-author)

2nd Graz Battery Days, Graz, 27.–28.9.2016

Nikolowski, K. et al.
Material and process development for lithium bipolar batteries
Poster (author)

Wolter, M. et al.
Application of ceramic technologies in all solid state batteries
Invited presentation (author)

Materials Science and Engineering – MSE 2016, Darmstadt, 27.–29.9.2016

Voigt, I. et al.
Carbon coatings for membrane application and catalysis
Presentation (author)

Workshop "Keramische Schaltungsträger – Eine innovative Technologie nicht nur für Satel-

litenkommunikation", Bonn, 29.9.2016

Capraro, B.
Casting und Slot – Die Technologien zur Herstellung keramischer Folien
Vortrag (Autor)

14th International Baltic Conference on Atomic Layer Deposition – BALD 2016, St. Petersburg, 2.–4.10.2016

Puurunen, R. L.; Koshtyal, Y.; Pedersen, H.; van Ommen, J. R.; Yurkevich, O.; Sundqvist, J.
On the history of ALD and the VPHA project
Presentation (co-author)

BMT 2016 "Dreiländertagung", Basel, 4.–6.10.2016

Gebhardt, S. et al.
Towards fabrication of high frequency ultrasonic transducers using soft mold process
Presentation (author)

3rd Annual InkJet Conference 2016 – TheICJ, Dusseldorf, 4.–6.10.2016

Fritsch, M.
Synthesis of particles inks for inkjet printing of microelectronic components
Presentation (author)

2nd Ceramics Osaka – Highly-functional Ceramics Expo, Osaka, 5.–7.10.2016

Wunderlich, C.
Advanced ceramics for high tech innovations: The Fraunhofer approach
Invited presentation (author)

Thermodynamik-Kolloquium 2016, Kaiserslautern, 5.–7.10.2016

Kriegel, R.
Die selbstverdichtende Verbrennung – Ein Ansatz für eine effizientere Energieproduktion
Presentation (author)

5th International Conference "Fractography of Advanced Ceramics", Smolenice, 9.–12.10.2016

Herrmann, M. et al.
Determination of defects, relevant for strength of ceramics, by non-destructive methods
Invited presentation (author)

World PM2016 Congress & Exhibition, Hamburg, 9.–13.10.2016

Günther, A. et al.
Combining metal textiles with ceramics by injection molding for novel composites with promising properties
Presentation (author)

Höhn, M. et al.
TiSiCN nanocomposite hard coatings by CVD
Presentation (author)

Lay, S.; Guyon, A.; Pötschke, J.
Grain boundary segregation in sintered materials: Effect on densification and grain growth
Poster (co-author)

Pötschke, J. et al.
Manufacturing and properties of polycrystalline WC-Co based cemented carbides
Presentation (author)

Fachtagung KMU-innovativ: IKT, Hanover, 10.–11.10.2016

von Dungern, F.; Tschöke, K.
Entwicklung einer integrierten Strukturüberwachung für Faserverbundbauteile im Automobil
Poster (author)

3rd International Conference on In-Situ and Correlative Electron Microscopy – CISCEM 2016, Saarbrücken, 11.–12.10.2016

Sempf, K. et al.
Quantifying the contrast mechanisms of a scanning electron microscope by an unique in-situ FESEM/AFM hybrid system
Presentation (author)

Workshop "Neue Materialien und Technologien für Smart Textiles", Weimar, 13.10.2016

Krug, M.
Atomlagenabscheidung (ALD) für funktionale Schichten auf textilen Strukturen
Presentation (author)

Vision 2016: Vehicle and infrastructure safety improvement in adverse conditions and night driving, Paris, 13.–14.10.2016

Hofmann, U.; von Wantoch, T.; Eberhardt, G.; Kinski, I. et al.
Dynamic shaping of the basic intensity profile of an adaptive laser headlights based on resonant MEMS scanning mirrors
Presentation (co-author)

Biomaterials for Healthcare – BioMaH, Rome, 17.–20.10.2016

Ahlhelm, M. et al.
Novel structural ceramic composites for individualized 3D-structures
Presentation (author)

Bionection – Partnering Conference for Technology Transfer in Life Sciences, Leipzig, 18.–19.10.2016

Lehmann, A. et al.
Das Fraunhofer IKTS als innovativer Partner im Bereich Bio- und Medizintechnik
Presentation (author)

Lehmann, A.
Spin-Off-Vorhaben des Fraunhofer IKTS: Optische Prostatakrebsdiagnose
Presentation (author)

r4-Innovative Technologie für Ressourceneffizienz – Bereitstellung wirtschaftsstrategischer Rohstoffe, Hanover, 20.–21.10.2016

Wufka, A.
Entwicklung von keramischen Membran-Extraktionssystemen und Adaption von elektrochemischen Verfahren zur Gewinnung metallischer Rohstoffe
Presentation and poster (author)

IMAPS Herbstkonferenz 2016, Munich, 20.–21.10.2016

Gradmann, R. et al.
Entwicklung funktioneller Glaswerkstoffe für den laserbasierten Sinterungsprozess in integrierten Sensorsystemen
Presentation (author)

Materials Science & Technology 2016 – MS&T ,16, Salt Lake City, 23.–27.10.2016

Scheithauer, U. et al.
Combination of green tape cast and extruded components for new lightweight kiln furniture
Presentation (author)

Scheithauer, U. et al.
Suspension based additive manufacturing of ceramic and metal-ceramic components
Presentation (author)

6. Innovationstage 2016, Bonn, 25.–26.10.2016

Wufka, A.
Aufbereitung von Prozesswasser aus der Bioethanolschlempe als Ersatz von Frischwasser
Presentation (author)

pades – Partikeldesign Thüringen – Symposium 2016, Neudietendorf, 25.–26.10.2016

Gleichmann, K.; Richter, H.
Zeolithpartikeldesign für die Anwendung in der Stofftrennung und Wärmespeicherung
Presentation (co-author)

Jäger, B. et al.
Oberflächenaktive Elektrokatalysatoren zur Wirkungsgraderhöhung bei der Wasserelektrolyse
Presentation (author)

Jäger, B. et al.
Synthese und Applikation katalytisch aktiver Mischoxidpartikel
Poster (author)

Ommer, M.; Hoffmann, C.; Kolditz, K.; Richter, H. et al.
Oberflächenmodifizierung von Zeolithmikropartikeln im Pulsationsreaktor (PR)
Poster (co-author)

Richter, H. et al.
Membranen und Formkörper – Mixed-Matrix-Membranen
Poster (author)

IVG-Mitgliederversammlung, Herne, 27.10.2016

Kriegel, R.
Sauerstoff für die Nutzung von Schwachgasen
Presentation (author)

GRDC Symposium, Gangnam/Seoul, 31.10.–1.11.2016

Opitz, J. et al.
Material- and process-diagnostic for industrial applications
Presentation (author)

Weidl, R.
Energy storage and power generation technologies at IKTS
Presentation (author)

Jahrestagung Forschungsvereinigung Feinmechanik, Optik und Medizintechnik F.O.M. e.V., Berlin, 2.11.2016

Reichel, U. et al.
Optokeramische Werkstoffe: Innovationspotenzial für vielfältige Anwendungen
Poster (author)

Testing, Characterisation and Filter Media 8: Conference and Exhibition, Chester, 2.–3.11.2016

Richter, H. et al.
Ceramic membranes for large scale filter application
Presentation (author)

16th Aachener Membran-Kolloquium, Aachen, 2.–3.11.2016

Weyd, M. et al.
Zeolite NaA membranes for improved glycol dewatering in natural gas drying
Presentation (author)

2. BMUB-Fachtagung "Klimaschutz durch Abwärmenutzung", Berlin, 3.11.2016

Martin, H.-P. et al.
Neue Optionen in der Abwärmenutzung mit keramischen Thermoelektrika
Presentation (author)

8th International Symposium on NDT in Aerospace, Bangalore, 3.–5.11.2016

Heuer, H.
NDT investigations on C/SiC samples from different manufactur-

ing steps
Presentation (author)

1st Workshop on rational design for improved functionalities of porous inorganic materials, Cavaillon, 7.–9.11.2016

Richter, H. et al.
Designing of ceramic membranes for separation on molecular level
Presentation (author)

FloEFD Simulation Conference 2016, Frankfurt a. Main, 8.–9.11.2016

Stahn, M.
Porous media flow – Use of FloEFD in the design process of ceramic membrane elements for cross-flow filtration
Presentation (author)

DKG-Fortbildungsseminar "Foliengieß- und Schlitzdüsen-Verfahren", Hermsdorf, 9.–10.11.2016

Capraro, B.
Casting und Slot-Die Technologien zur Herstellung keramischer Folien
Presentation (author)

Fritsch, M.
Formulierung und Aufbereitung von Foliengießschlicker
Presentation (author)

Härtel, A. et al.
Folienverbunde – Materialpaarungen, Optionen der Herstellung und Einsatzmöglichkeiten
Presentation (author)

China Intelligent Manufacturing International Conference – CIMIC 2016, Jinan, 9.–11.11.2016

Schwarz, B.
Fraunhofer Gesellschaft – Close connection between research and industry – International cooperation on the way to intelligent manufacturing
Presentation (author)

1st International Biomass Professional Forum: "Application and Development of sustainable Biomass Materials and Energy", Jinan, 10.–11.11.2016

Schwarz, B.
Möglichkeiten und Herausforderungen bei der Vergärung von Stroh
Presentation (author)

Advancer-Schulungsprogramm Hochleistungskeramik Teil III: Konstruktion, Prüfung, Freiburg, 10.–11.11.2016

Herrmann, M.
Fehlerquellen bei der Herstellung keramischer Werkstoffe
Presentation (author)

Herrmann, M.
Gefügedarstellung und Bewertung
Presentation (author)

ASME's International Mechanical Engineering Congress and Exposition – IMECE 2016, Phoenix, 11.–17.11.2016

Sukharev, V.; Kteyan, A.; Hovsepyan, H.; Choy, J.-H.; Mühle, U. et al.
Chip-package-interaction stress induced carrier mobility shift in advanced Si nodes
Presentation (co-author)

12th International Symposium on Electrochemical Machining Technology – INSECT 2016, Brussels, 17.–18.11.2016

Schneider, M. et al.
ECM of an SiC-based ceramic – Passivation and Dissolution
Presentation (author)

Schneider, M. et al.
The dissolution mechanism of tungsten carbide under ECM conditions
Presentation (author)

5. Workshop "Lithium-Schwefel-Batterien", Dresden, 21.–22.11.2016

Rost, A. et al.
Glass-ceramic solid-state electrolytes for the use in Li-S batteries
Poster (author)

Symposium Anodisieren – Oxidschichten von hart bis smart, Dresden, 24.–25.11.2016

Lämmel, C. et al.
Untersuchung wärmebedingter Beeinträchtigungen der Schichteigenschaften beim Hartanodisieren
Presentation (author)

Voigt, K. et al.
In-operando Temperaturmessung bei der plasmaelektrolytischen Oxidation von Aluminium
Presentation (author)

16. Sitzung des Arbeitskreises Biokeramik, Hermsdorf, 25.11.2016

Menzel, M.; Johannes, M.
Individualisiertes Dentalimplantat
Presentation (co-author)

2016 MRS Fall Meeting & Exhibit, Boston, 27.11.–2.12.2016

Fritsch, M. et al.
Synthesis, formulation and rapid curing of particles based inkjet and aerosol-jet printed films for electronic and sensory devices
Poster (author)

Vinnichenko, M. et al.
Millisecond laser functionalization of the structures prepared using wet chemical deposition
Presentation (author)

Der Geothermiekongress 2016, Essen, 29.11.–1.12.2016

Friedrich, H.-J. et al.
Elektrochemische Abtrennung scalingrelevanter Schwermetalle und Radionuklide aus geothermalen Tiefenwässern
Invited presentation (author)

5. Deutsch-Polnisches PhD-Seminar "Advanced Materials Science", Schmochtitz, 30.11.2016

Michaelis, A.
Advanced ceramics for disruptive innovations
Presentation (author)

DKG Herbstsymposium 2016, Erlangen, 30.11.–1.12.2016

Capraro, B. et al.
Überblick über moderne Foliengießverfahren am Fraunhofer IKTS für innovative Anwendungen
Invited presentation (author)

Eberstein, M. et al.
Rheologie als Schlüssel für Druckverhalten und Funktionseigenschaften neuer Dickschichtpasten
Presentation (author)

Karlsruher Werkstoff-Kolloquium, Karlsruhe, 6.12.2016

Michaelis, A.
Keramische Werkstoffe für die Energie und Umwelttechnologie
Presentation (author)

5. Stiftungstagung des DECHEMA-Forschungsinstituts, Frankfurt a. Main, 7.12.2016

Schneider, M.
Plasmaanodisieren als keramische Oberflächentechnologie
Presentation (author)

6. Dresdner Werkstoffsymposium, Dresden, 8.–9.12.2016

Michaelis, A.
In operando non-destructive evaluation techniques for additive manufacturing
Presentation (author)

4th Cellular Materials – CellMAT 2016, Dresden, 7.–9.12.2016

Füssel, A. et al.
Property adjustment of open-celled ceramic foams for high temperature applications assisted by numerical modelling
Presentation (author)

Haase, D. et al.
TiO_2 coatings on ceramic foams for photocatalytic applications
Presentation (author)

Walther, G.; Kieback, B.; Büttner, T.; Gaitzsch, U.; Kolvenbach, R.; Weißgärber, T.; Lincke, M.
Metal foam for applications in heterogeneous catalysis and biogas desulfurization
Presentation (co-author)

Expertenpanel "Biomaterialien", Mainz, 8.12.2016

Johannes, M. et al.
Bioinerte Oxidkeramiken für dentale und endoprothetische Anwendungen
Presentation (author)

Teaching activities of IKTS employees

Dr. Eberstein, M.
Lecture
"Dickschichttechnik"
TU Bergakademie Freiberg, Institut für Keramik, Glas- und Baustofftechnik (16.6.2016)

Dr. Fries, M.
Lecture
"Granulationsverfahren und Granulatcharakterisierung in der keramischen Industrie"
TU Bergakademie Freiberg (9.6.2016)

Dr. Fries, M.; Bales, A.; Dr. Eckhard, S.; Lenzner, K.
Practical training
"Demonstrationspraktikum Pulveraufbereitung: Technologie – Granulatcharakterisierung – Instrumentierte Pressverdichtung"
IKTS Dresden (31.5.2016, 28.6.2016)

Dr. Härtling, T.
Lecture and seminar
"Nanotechnologie und Nanoelektronik"
TU Dresden, Fakultät Elektrotechnik und Informationstechnik (SS2016)

Jun.-Prof. Heuer, H.
Lecture
"Systeme für die zerstörungsfreie Prüfung und Strukturüberwachung"
TU Dresden, Fakultät Elektrotechnik und Informationstechnik, Institut für Aufbau- und Verbindungstechnik der Elektronik IAVT (WS2016/2017)

Jun.-Prof. Heuer, H.
Lecture
"Textile Werkstoffe und Prüftechnik/ Textile Faserstoffe und Prüftechnik"
TU Dresden, Fakultät Maschinenwesen, Institut für Textilmaschinen und Textile Hochleistungswerkstofftechnik (SS2016)

Jun.-Prof. Heuer, H.
Lecture
"Zerstörungsfreie Prüfung elektronischer Baugruppen"
TU Dresden, Fakultät Elektrotechnik und Informationstechnik, Zentrum

für mikrotechnische Produktion (WS2016/2017)

Dr. Höhn, S.
Lecture
"Keramographie", im Rahmen der Lehrveranstaltung "Metallografie"
TU Dresden, Institut für Werkstoffwissenschaft (1.2.2016)

Dr. Jahn, M.
Lecture, tutorial and practical training "Brennstoffzellensysteme und Elektrolyse" im Rahmen des Studienganges "Regenerative Energiesysteme"
TU Dresden, Institut für Werkstoffwissenschaft (WS2016/2017)

Dr. Jahn, M.
Lecture
"Fischer-Tropsch-Synthese – Stand der Technik und aktuelle Entwicklungen zum Einsatz alternativer Rohstoffe" im Rahmen der Lehrveranstaltung "Mehrphasenreaktionstechnik"
TU Dresden (4.7.2016)

Dr. Kriegel, R.
Lecture
"Grundlagen analytischer Untersuchungsmethoden" im Wissenschaftlichen Kolleg des Studiengangs "Baustoffingenieurwesen"
Bauhaus-Universität Weimar (WS2016/2017)

Prof. Meyendorf, N.
Lecture and practical training
"Mikro- und Nano-NDE"
TU Dresden, Institut für Aufbau- und Verbindungstechnik der Elektronik IAVT (WS2016/2017)

Prof. Meyendorf, N.
Lecture
"NDE and SHM"
University of Dayton, UD-Fraunhofer Project Center (SS2016)

Prof. Meyendorf, N.
Lecture
"Nano characterization"
University of Dayton, UD-Fraunhofer Project Center (SS2016)

Prof. Meyendorf, N.
Complex lecture
"NDE and SHM"
University of Dayton, General Electrics Aerospace, Cincinnati (2016)

Prof. Michaelis, A.; Dr. Kusnezoff, M.; Dr. Neumeister, P.; Dr. Rebenklau, L.
Lecture
"Keramische Funktionswerkstoffe"
TU Dresden, Institut für Werkstoffwissenschaft (SS2016)

Prof. Michaelis, A.
Lecture and practical training
"Keramische Werkstoffe"
TU Dresden, Institut für Werkstoffwissenschaft (SS2016)

Prof. Michaelis, A.; Dr. Kinski, I.; Dr. Herrmann, M.; Dr. Klemm, H.; Dr. Moritz, T.; Dr. Potthoff, A.; Dr. Gestrich, T.; Dr. Kusnezoff, M.; Dr. Neumeister, P.; Dr. Partsch, U.; Dr. Langklotz, U.
Lecture
"Prozesse – Gefüge – Eigenschaften keramischer Werkstoffe"
TU Dresden, Institut für Werkstoffwissenschaft (WS2016/2017)

Dr. Moritz, T.
Lecture
"Keramikspritzgießen"
TU Bergakademie Freiberg (30.6.2016)

Dr. Moritz, T.
Lecture series
"Grundlagen der Technischen Keramik"
Kunsthochschule Halle, Burg Griebichenstein (SS2016)

Dr. Mühle, U.
Lecture
"Industrielle Halbleiterfertigung"
TU Bergakademie Freiberg, Fakultät Werkstoffwissenschaft und Werkstofftechnologie (WS2016/2017)

Dr. Mühle, U.
Lecture
"Spezielle Methoden der Mikrostrukturanalytik"
TU Bergakademie Freiberg, Fakultät Werkstoffwissenschaft und Werkstofftechnologie (SS2016)

Dr. Opitz, J.
Lecture
"Biomolekulare Nanotechnologie"
"Introduction to Nanotechnology"
TU Dresden, Max-Bergmann-Zentrum, Institut für Werkstoffwissenschaft
TU Dresden, BIOTEC (WS2016/2017)

Dipl.-Ing. Metasch, R.
Practical training in the course of the lecture
"Micro-/nanomaterials and reliability aspects"
TU Dresden, Fakultät Elektrotechnik, Institut für Aufbau- und Verbindungstechnik (WS2016/2017)

Dr. Schneider, M.
Lecture
"Rastersondenmikroskopie/AFM"
im Rahmen der Lehrveranstaltung Materialdiagnostik
TU Dresden, Institut für Werkstoffwissenschaft (6.7.2016)

Prof. Stelter, M.
Lecture
"Technische Chemie I / II"
Friedrich-Schiller-Universität Jena (SS2016; WS2016/2017)

Prof. Stelter, M.
Lecture
"Technische Umweltchemie"
Friedrich-Schiller-Universität Jena (SS2016; WS2016/2017)

Prof. Stelter, M.
Lecture
"Energiesysteme – Materialien und Design"
Friedrich-Schiller-Universität Jena (WS2016/2017)

Dr. Voigt, I.
Lecture and practical training
"Keramische Verfahrenstechnik"
Ernst-Abbe-Hochschule Jena, MA-Studiengang Werkstofftechnik (WS 2016/2017)

Dr. Voigt, I.
Lecture and practical training
"Membranen und Membranverfahrenstechnik"
Friedrich-Schiller-Universität Jena, MA-Studiengang Chemie-Energie-Umwelt (WS 2016/2017)

Dr. Weyd, M., Pflieger, C.
Lecture
"Filtration with ceramic membranes"
University of Connecticut, Storrs, USA, Seminar (3.2.2016)

Dr. Zins, M.
Lecture
"Metalle, Kunststoffe, Keramiken – Technische Keramik als Leichtbaustoff"
TU Dresden, Institut für Werkstoffwissenschaft (WS2016/2017)

Prof. Zschech, E.; Prof. Stamm, M.; Dr. Mühle, U.; Dr. Rosenkranz, R.; Dr. Kopycinska-Müller, M.
Lecture and practical training
"Physical Characterization of Organic and Organic-Inorganic Thin Films"
TU Dresden, Institut für Angewandte Photophysik (WS2016/2017)

Prof. Zschech, E.; Dr. Kopycinska-Müller, M.
Lecture
"Microscopy for Nondestructive methods classes"
Master course in English Non-Destructive Testing M. Sc. (NDT)
DIU Dresden International University (2016)

Prof. Zschech, E.; Dr. Gall, M.; Dr. Aubel, O.
Lecture
Master's Program Nanoelectronic Systems
Module "Semiconductor Industry Challenges: Market Dynamics – Technology Innovations – Yield and Reliability Engineering"
Lecture: "Reliability Engineering and Kinetics of Degradation Processes in Advanced Electronics"
TU Dresden, Fakultät Elektrotechnik und Informationstechnik, Institut für Halbleiter- und Mikrosystemtechnik (WS2016/2017)

Participation in bodies and technical committees

Bodies

Dr. Berger, L.-M.
- Editorial Board of the Journal "Surface Engineering", Maney Publishing
- Editorial Board of the Journal "Materials Performance & Characterization", ASTM International

Dr. Gall, M.
- IEEE Transactions on Device and Materials Reliability – TDMR, Editor
- IEEE International Interconnect Technology Conference – IITC, Technical Committee
- IEEE International Reliability Physics Symposium – IRPS, Technical Committee
- International Conference on Reliability and Stress-Related Phenomena – IRSP, Technical Committee
- Fraunhofer Nanotechnology Alliance
- European Society of Thin Films (EFDS)

Dr. Härtling, T.
- AMA Association for Sensors and Measurement, Representative

Dr. Kinski, I.
- American Ceramic Society – ACerS
- Deutsche Gesellschaft für Kristallographie – DGK
- Materials Research Society – MRS

Dr. Köhler, B.
- Editor-in-Chief of the Journal "Case Studies in Nondestructive Testing and Evaluation", Elsevier Verlag

Dr. Kusnezoff, M.
- Fraunhofer Energy Alliance, Representative
- SOFC Symposium of ICACC Conference Series organized by American Ceramic Society in Daytona Beach, Organizer
- VDMA Working Group High Temperature Fuel Cells, Coordinator
- European Fuel Cell Forum EFCF, Scientific Advisory Committee

Dr. Martin, H.-P.
- KMM-VIN, European Virtual Institute on Knowledge-based Multifunctional Materials

Prof. Meyendorf, N.
- Editor-in-Chief of the "Journal of Nondestructive Evaluation", Springer Verlag
- Publication series "Dresdner Beiträge zur zerstörungsfreien Prüftechnik", Wolter, K.-J. (Hrsg.); Meyendorf, N.(Hrsg.); Heuer, H.(Hrsg.), Dresden: TUDpress, Start 2010
- DGZfP – German Society for Non-Destructive Testing
- ASNT – The American Society for Nondestructive Testing
- SPIE – the international society for optics and photonics
- Joint Lab Berlin, Technical Safety
- UD-Fraunhofer Joint Research Center, Co-Director

Prof. Michaelis, A.
- Editorial Board of the "International Journal of Materials Research", Hanser Verlag

- Editorial Board of the "Journal of Ceramic Science and Technology", Göller Verlag
- Publication Series "Competencies in Ceramics", Michaelis, A. (Hrsg.), Stuttgart: Fraunhofer Verlag, Start 2006
- Publication Series "Kompetenzen in Keramik und Umweltverfahrenstechnik", Michaelis, A.(Hrsg.), Stuttgart: Fraunhofer Verlag, Start 2008
- Publication Series "Applied Electrochemistry in Material Science", Michaelis, A.(Hrsg.); Schneider, M.(Hrsg.), Stuttgart: Fraunhofer Verlag, Start 2009
- AGEF e. V. Institute at Heinrich-Heine-Universität, Arbeitsgemeinschaft Elektrochemischer Forschungsinstitutionen e. V.
- American Ceramic Society – ACerS
- Ceramic and Glass Industry Foundation (CGIF), Member Board of Trustees CGIF
- DECHEMA Society for Chemical Engineering and Biotechnology
- DECHEMA working group "Angewandte Anorganische Chemie"
- Deutscher Hochschul-Verband
- DGM German Society for Materials Research
- DKG Deutsche Keramische Gesellschaft / German Ceramic Society, Member of executive board, Chairman of the research advisory board, Director of the scientific works
- DPG Deutsche Physikalische Gesellschaft
- DRESDEN-concept e. V.
- Dresdner Gesprächskreis der Wirtschaft und der Wissenschaft e. V.
- Energy advisory council of the Wirtschaftsministeriums Sachsen
- EPMA European Powder Metallurgy Association
- Fraunhofer AdvanCer Alliance, Spokesperson
- Evaluation team "Interne Programme" of the Fraunhofer-Gesellschaft, Chairman
- GreenTec Awards, Member of the jury
- Helmholtz-Zentrum Dresden-Rossendorf
- IFW Dresden e. V.
- Materials Research Network Dresden MFD, Executive board
- Meyer Burger (Germany) AG, Supervisory board
- NOW GmbH, Beirat
- Silicon Saxony e. V.
- Solarvalley Mitteldeutschland e. V.
- "World Academy of Ceramics" WAC

Dr. Moritz, T.
- European Network of Material Research Institutes (ENMat), President

Dr. Opitz, J.
- American Ceramic Society – ACerS

Dr. Richter, H.
- International Zeolite Association
- American Ceramic Society – ACerS

Dr. Röllig, M.
- ZIM-Netzwerk "Zuverlässige Leistungselektronik", Berlin, technical council of the network management

Dr. Schneider, M.
- Publication Series "Applied Electrochemistry in Material Science", Michaelis, A.(Hrsg.); Schneider, M.(Hrsg.), Stuttgart: Fraunhofer Verlag, Start 2009
- DGO-Bezirksgruppe Sachsen der Deutschen Gesellschaft für Galvano- und Oberflächentechnik, Chairman
- GfKORR technical advisory board of the Society for Corrosion Protection, Working group "Korrosion keramischer Werkstoffe", Chairman

Dr.-Ing. Schubert, L.
- Guideline committee VDI-GPP FA628 "Strukturüberwachung und Beurteilung von Windenergieanlagen und Plattformen"

Prof. Stelter, M.
- Center for Energy and Environmental Chemistry CEEC, Jena, Member of directorate
- MNT Mikro-Nano-Technologie Thüringen e. V., Executive board
- Clusterboard, Free State of Thuringia
- RIS3 working group "Nachhaltige Energie und Ressourcenverwendung", Free State of Thuringia
- VDMA, Working group Research and innovation in medical technology

Dr. Jonas Sundqvist
- Cool Silicon e. V., Dresden, Division "ALD Lab Saxony", Division manager
- Critical Materials Council – CMC Fabs, USA, Sr. Technology Analyst CVD & ALD Materials & Conference, Co-chair
- HERALD EU Cost Action "Hooking together European research in Atomic Layer Deposition", Social media & news coordinator

Dr. Voigt, I.
- BVMW German Association for Snmall and Medium-sized Businesses
- DECHEMA Society for Chemical Engineering and Biotechnology
- DKG Deutsche Keramische Gesellschaft / German Ceramic Society, Member of executive board
- American Ceramic Society – ACerS
- DGM German Society for Materials Research
- University council of Ernst-Abbe-Hochschule Jena

Dr. Wunderlich, C.
- Fuel Cell Energy Solutions GmbH, Member of advisory board
- Energy Saxony e. V., Deputy chairman
- European Fuel Cell Forum, International board of advisors
- American Ceramic Society – ACerS

Prof. Zschech, E.
- Federation of the European Materials Societies – FEMS, Brussels, Member of executive board
- European Alliance for Materials – A4M, Brussels, Member of executive board
- The European Platform on Advanced Materials and Technologies – EUMAT, Brussels, Member of the steering board
- European Materials Characterization Council, Brussels, Member of advisory board
- CENIMAT/I3N Lisbon, Member of advisory board
- Institute of Lightweight Construction and Hybrid Systems at University Paderborn, Member of scientific advisory board
- DRESDEN-concept e. V., "Information technologies and microelectronics", Scientific committee
- Cool Silicon e. V., Dresden, Member of executive board

Dr. Zins, M.
- Fraunhofer-Allianz AdvanCer, Sprecher
- Editorial Board of the Journal "Ceramic Applications", Göller Verlag, Chairman
- American Ceramic Society – ACerS

Technical committees

Dipl.-Krist. Adler, J.
- DGM technical committee "Zellulare Werkstoffe"
- FAD Research Association for Diesel Emission Control Technologies

Dr. Berger, L.-M.
- DVS technical committee 2 "Thermisches Spritzen und Autogentechnik"
- DIN/DVS joint committee NA 092-00-14 AA "Thermisches Spritzen und thermisch gespritzte Schichten"

Dr. Böer, J.
- DKG technical committee TFA 6-1 "Charakterisierung Poröse Keramiken"

Dipl.-Math. Brand, M.
- DGZfP technical committee "Schallemissionsprüfung (SEP)"

Dr. Eberstein, M.
- DGG technical committee 1 "Physik und Chemie des Glases"
- DKG/DGG working group "Glasigkristalline Multifunktionswerkstoffe"

Dr. Faßauer, B.
- Fraunhofer Water Systems Alliance (SysWasser)
- Wasserwirtschaftliches Energiezentrum Dresden – e.qua impuls e. V.
- Professional association "Biogas"
- agra – Zentrum für Innovation, Member of innovation advisory board

Freund, S.
- Fraunhofer AdvanCer Alliance, Central office

Dr. Fries, M.
- DKG joint committee "Hochleistungskeramik", working group "Verarbeitungseigenschaften synthetischer keramischer Rohstoffe", Group manager
- DKG technical committee FA 3 "Verfahrenstechnik"
- ProcessNet technical group "Agglomerations- und Schüttguttechnik", Member of advisory board
- ProcessNet technical group "Trocknungstechnik", Member of advisory board

Dr. Gestrich, T.
- Joint committee "Pulvermetallurgie", expert group "Sintern"
- GEFTA working group "Thermophysik"

Dipl.-Ing. Gronde, B.
- Community "Thermisches Spritzen e. V."

Dr. Hentschel, D.
- DGZfP technical committee "ZfP in der Luftfahrt", Deputy manager

Dr. Herrmann, M.
- DGM technical committee "Field Assisted Sintering Technique / Spark Plasma Sintering"
- GfKORR working group "Korrosion keramischer Werkstoffe"
- DKG technical committee 6 "Material- und Prozessdiagnostik"

Dr. Kaiser, A.
- GEFTA working group "Thermophysik"
- DGM technical committee "Thermodynamik, Kinetik und Konstitution der Werkstoffe"

Dr. Kinski, I.
- DGK working group 12 "Spektroskopie"
- DGK working group "AK13 Pulverdiffraktometrie"

Dr. Klemm, H.
- DKG joint committee "Hochleistungskeramik", working group "Verstärkung keramischer Stoffe"
- DIN committee for standardization "Materialprüfung NMP 291"
- DIN committee for standardization "Materialprüfung NMP 294"
- Carbon Composites e. V., working group "Ceramic Composites"

Kunath, R.
- Working group "Spezialbibliotheken"

Dr. Kusnezoff, M.
- DIN/VDE, Department K 141, DKE German Commission, "Elektrotechnik Elektronik Informationstechnik"
- DIN/VDE, Department K 384, DKE German Commission, "Brennstoffzellen"
- DGM working group "Aufbau-

und Verbindungstechnik für Hochtemperatursensoren", AVT working group manager

Dr. Lausch, H.
- VDE/VDI Society of Microelectronics, Microsystems and Precision Engineering, GMM technical committee 4.7 "Mikro-Nano-Integration"
- VDE/DGMT/BMBF accompanying research "Intelligente Implantate", External member
- biosaxony – Verein für Biotechnologie & Life Sciences e. V.
- InfectoGnostics research campus Jena/Funding initiative "Forschungscampus – öffentlich-private Partnerschaft für Innovationen" of the BMBF
- German platform NanoBioMedizin
- BIO CITY LEIPZIG, BIO-NET LEIPZIG Technologietransfergesellschaft

Dipl.-Ing. Ludwig, H.
- DGM technical committee "Biomaterialien"

Dr. Martin, H.-P.
- DTG German Thermoelectric Society
- DVS committe for technology, working group W3 "Fügen von Metall, Keramik und Glas"

Dipl.-Ing. Metasch, R.
- ZVEI working group "Hochtemperaturelektronik"

Prof. Meyendorf, N.
- DGZfP technical committee "Materialcharakterisierung"
- DGZfP technical committee "Zustandsüberwachung"
- DGZfP technical committee "ZfP in der Luftfahrt"
- DGZfP technical committee "Hochschullehrer ZfP"
- VDI-GME division 1 "Werkstofftechnik" FA101 "Anwendungsnahe zerstörungsfreie Werkstoff- und Bauteilprüfung"
- DGZfP working group Berlin
- ASNT Miami Valley Section

Dr. Moritz, T.
- DECHEMA technical committee "Nanotechnologie"
- DKG expert group "Keramikspritzguss" CIM, Chairman of the executive board
- DKG technical committee III "Verfahrenstechnik"
- DKG "Szene Additiv"
- EPMA-Additive Manufacturing Group
- Editorial board of the cfi/Ber.DKG, Chairman
- Management Committee of COST action MP1105 "Flame-retardant Materials"

Dipl.-Phys. Mürbe, J.
- VDI regional association Dresden, working group "Granulometrie"

Dr. Petasch, U.
- FAD Research Association for Diesel Emission Control Technologies

Dr. Potthoff, A.
- DGM/DKG working group "Prozessbegleitende Prüfverfahren"
- DECHEMA/VCI working group "Responsible Production and Use of Nanomaterials"
- DIN committee for standardization NMP NA 062-08-16 AA "Chemische Oberflächenanalyse und Rastersondenmikroskopie"
- DIN committee for standardization NMP NA 062-08-17-03 UA "Gesundheits- und Umweltaspekte"
- Fraunhofer Nanotechnology Alliance
- VDI regional association Dresden, working group "Granulometrie"

Dr. Pötschke, J.
- VDI technical committee "Schneidstoffanwendung"
- EPMA working group "European Hard Materials Group"
- DGM/DKG joint committee "Pulvermetallurgie"

Dipl.-Ing. Räthel, J.
- DGM technical committee "Field Assisted Sintering Technique / Spark Plasma Sintering (FAST/SPS)"

Dr. Rebenklau, L.
- VDE/VDI Society of Microelectronics, Microsystems and Precision Engineering, GMM Technical committee 5.5 "Aufbau- und Verbindungstechnik"
- Working group "Aufbau- und Verbindungstechnik für Hochtemperatursensoren"
- DVS working group A 2.4 "Bonden im DVS"

Dr. Reichel, U.
- DGM technical committee "Field Assisted Sintering Technique / Spark Plasma Sintering (FAST/SPS)"

Dr. Richter, H.-J.
- DGM/DKG expert group "Additive Manufacturing" in the joint committee "Pulvermetallurgie"
- DGM technical committee "Additive Fertigung"
- Fraunhofer Additive Manufacturing Alliance

Dr. Rost, A.
- DKG/DGG working group "Glasig-kristalline Multifunktionswerkstoffe"
- DVS committee for technology, working group W3 "Fügen von Metall, Keramik und Glas"

Dr. Sauchuk, V.
- DGM technical committee "Werkstoffe der Energietechnik"

Dr. Schilm, J.
- DGG technical committee 1 "Physik und Chemie des Glases"
- DKG/DGG working group "Glasig-kristalline Multifunktionswerkstoffe"
- DVS committee for technology, working group W3 "Fügen von Metall, Keramik und Glas"

Dr. Schneider, M.
- GfKORR working group "Korrosion keramischer Werkstoffe", Chairman

Dr. Schubert, F.
- DGZfP technical committee "Ultraschall", subcommittee "Modellierung und Bildgebung"
- DGZfP technical committee "Ultraschall", subcommittee "Phased Array", Deputy manager
- DGZfP working group Dresden, Group manager

Dr.-Ing. Schubert, L.
- DGZfP technical committee "Zustandsüberwachung", Manager
- Technical committee "Berufs- und Ausbildungsfragen, Unterausschuss Ausbildung BC"

Dipl.-Chem. Schubert, R.
- DKG expert group "Keramikspritzguss" CIM

Dipl.-Ing. Stahn, M.
- VDI working group "Entwicklung, Konstruktion, Vertrieb"

Standke, G.
- DGM technical committee "Zellulare Werkstoffe"

Prof. Stelter, M.
- DGM technical committee "Werkstoffe der Energietechnik"
- medways e. V. (The industry association for Medical Technology and Biotechnology)
- OptoNet e. V., (Photonics network Thuringia)

Dipl.-Min. Thiele, S.
- GTS community "Thermisches Spritzen e. V."

Dr. Voigt, I.
- DECHEMA/VDI-GVC ProcessNet technical group "Produktionsintegrierte Wasser- und Abwassertechnik"
- DECHEMA/VDI-GVC ProcessNet technical group "Membrantechnik"
- DKG/DGM joint committee "Hochleistungskeramik", Chairman
- DKG/DGM joint committee "Hochleistungskeramik", working group "Keramische Membranen", Chairman

Dr. Weidl, R.
- European Society of Thin Films (EFDS)
- BVES German Energy Storage Association, working group 2 "Roadmap der Energiewende und Rolle der Energiespeicher"
- CEEC – Center for Energy and Environmental Chemistry

Dr. Weyd, M.
- DGMT German Society for Membrane Technology

Dr. Wunderlich, C.
- VDI-GEU VDI Society Energy and Environment, VDI/VDE technical committee "Brennstoffzellen"

Prof. Zschech, E.
- Cool Silicon technical committee "Materialintegration und Zuverlässigkeit", Manager
- DGM working group "Röntgentomographie", Group manager

Dr. Zins, M.
- DKG coordination group "Strukturwerkstoffe Fachausschüsse"
- DKG division 1 "Chemie-/Maschinen-/Anlagenbau", Chairman
- DKG joint committee "Pulvermetallurgie"
- Deutsche Messe AG, Advisory board "Industrial Supply"
- Messe München, Advisory board "Ceramitec"
- Institut für Prozess- und Anwendungstechnik Keramik, RWTH Aachen, Member of executive board

Committees for symposia

Dipl.-Krist. Adler, J.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Symposium "Cellular and porous ceramics", Dresden (21.–25.8.2016), Symposium organizer
- 4th International Symposium on New Frontier of Advanced Si-based Ceramics and Composites – ISASC 2016, Busan, Korea (25.–28.9.2016), International advisory committee
- 4th Cellular Materials – CellMat 2016, Dresden (7.–9.12.2016), Program committee

Capraro, B.
- DKG seminar "Foliengieß- und Schlitzdüsen-Verfahren sowie Aspekte der Folienweiterverarbeitung" at Fraunhofer IKTS, Hermsdorf (9.–10.11.2016), Organization

Dr. Eberstein, M.
- IMAPS/ACerS/DKG 12th International Conference and Exhibtion on Ceramic Interconnect and Ceramic Microsystems Technologies – CICMT 2016, Denver (19.–21.4.2016), Local organizing committee

Freund, S.
- AdvanCer-Schulungsprogramm "Einführung in die Hochleistungskeramik Teil I: Werkstoffe, Verfahren, Anwendungen", Dresden (16.–17.6.2016), Organization and moderation

Dr. Gall, M.
- IEEE International Reliability Physics Symposium – IRPS 2016, Pasadena, CA, USA, (17.–21.4.2016), Technical committee
- IEEE International Interconnect Technology Conference / Advanced Metallization Conference – IITC/AMC San Jose, CA, USA

(23.–26.5.2016), Technical committee
- 14th International Conference on Reliability and Stress-Related Phenomena in Nanoelectronics, Experiment and Simulation – IRSP, Bad Schandau, Germany (31.5.–2.6.2016), Technical committee

Dr. Gestrich, T.
- 35. Hagener Symposium Pulvermetallurgie "Zerspanung von und mit pulvermetallurgischen Werkstoffen", Hagen (24.–25.11.2016)

Dr. Herrmann, M.
- 15th Conference & Exhibition of the European Ceramic Society – ECERS2017, Budapest, Hungary (9.–13.7.2017), Organizing committee
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer

Dr. Jahn, M.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizing committee

Dr. Kinski, I.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer

Dr. Klemm, H.
- 9th International Conference on High Temperature Ceramic Matrix Composites – HTCMC 9, Symposium "Advanced thermal and environmental barrier coatings: processing, properties and applications", Toronto, Canada (26.–30.6.2016), Symposium organizer
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Conference committee, International advisory board and Symposium organizer

Dr. Köhler, B.
- 19th World Conference on Nondestructive Testing – WCNDT 2016, Munich (13.–17.6.2016), Scientific program committee "Nano-Technologies and High-Resolution NDT"

Dr. Kusnezoff, M.
- 40th International Conference and Exhibition on Advanced Ceramics and Composites – ICACC 2016, Daytona Beach (24.–29.1.2016), Session chair
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer

Dr. Martin, H.-P.
- Industrietag "Charakterisierung mechanischer Eigenschaften bei hohen Temperaturen", Dresden (1.–2.6.2016), Organizer
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizing committee

Prof. Meyendorf, N.
- SPIE Conference "Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems", Las Vegas, Nevada (21.-24.3.2016), Chair

Prof. Michaelis, A.
- 40th International Conference and Exhibition on Advanced Ceramics and Composites – ICACC 2016, Daytona Beach (24.–29.1.2016), 40th Jubilee Symposium: Engineered Ceramics – Current Status and Future Prospects
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Conference committee, Chair
- Symposium Ceramics Vision 2017, IKTS Hermsdorf (17.–18.1.2017)

Dr. Moritz, T.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Conference committee, Session organizer

Dr. Neubert, H.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizing committee

Dr. Opitz, J.
- GRL-FYK Opening Ceremony & Workshop, Session II, Seoul (26.4.2016), Session Chair
- 19th World Conference on Non-Destructive Testing – WCNDT, Munich (13.–17.6.2016), Scientific program committee
- 6th International Congress on Ceramics – ICC6, Session "Materials and process diagnosis for quality assessment/non-destructive testing", Dresden (21.–25.8.2016), Session organizer, Session chair

Dr. Partsch, U.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer

Dr. Röllig, M.
- 18th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems – EuroSimE, Dresden (2.–5.4.2017), IEEE, Chair
- 17th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems – EuroSimE, Montpellier (17.–20.4.2016), IEEE, Technical program committee

Dr. Schneider, M.
- 9th International Workshop on Impedance Spectroscopy – IWIS 2016, Chemnitz (26.–28.9.2016), Program committee
- 12th International Symposium on Electrochemical Machining Technology – INSECT 2016, Mechelen (17.–18.11.2016), Advisory board
- Symposium "Anodisieren – Oxidschichten von hart bis smart", Dresden (24.–25.11.2016), Organization committee

Dr. Schubert, F.
- 19th World Conference on Non-Destructive Testing – WCNDT 2016, Munich (13.–17.6.2016), Scientific program committee "Structural Health Monitoring"

Dr.-Ing. Schubert, L.
- 2nd user seminar of the DGZfP technical committee "Zustandsüberwachung", expert panel "Geführte Ultraschallwellen", Petershagen/Eggersdorf (26.–27.10.2016)

Dr. Sundqvist, Jonas
- Critical Materials Council Conference – CMC 2016, Hillsboro (5.–6.5.2016), Co-chair
- 16th International Conference on Atomic Layer Deposition – ALD 2016, Dublin (24.–27.7.2016) Co-chair
- 3rd International Workshop on Atomic Layer Etching – ALE 2016, Dublin (24.–27.7.2016), Scientific committee
- ALD Symposium SEMICON Europa, Grenoble (25.–27.10.2016), Co-chair
- ALD For Industry, EFDS Workshop, Dresden (17.–18.1.2017), Co-chair
- CMC Conference 2017 – Critical Materials for Semiconductor Device Manufacturing, Dallas (11.–12.5.2017), Co-chair
- EuroCVD21 / Baltic ALD15 2017, Linköping (11.–14.6.2017), Organization committee
- 17th International Conference on Atomic Layer Deposition – ALD 2017, Denver (15.–18.7.2017), Scientific committee

Dr. Voigt, I.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer

Dr. Weidl, R.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer

Dr. Wolter, M.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Conference committee, International advisory board

Dr. Wunderlich, C.
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Conference committee, International advisory board

Dr. Zins, M.
- 91th DKG Annual Conference & Symposium on High-Performance Ceramics 2016, Freiberg (7.–9.3.2016), Program committee
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizer
- Ceramitec 2016, Tag der Technischen Keramik, Munich (22.10.2016), Host

Prof. Zschech, E.
- 14th International Conference on Reliability and Stress-Related Phenomena in Nanoelectronics, Dresden (30.5.–1.6.2016), Chair
- 4th Dresden Nanoanalysis Symposium, Dresden (15.6.2016), Chair
- 6th International Congress on Ceramics – From Lab to Fab – ICC6, Dresden (21.–25.8.2016), Symposium organizing committee
- 27th European Symposium on Reliability of Electron Devices, Failure Physics and Analysis – ESREF 2016, Halle, Saale (19.–22.9.2016), Scientific committee
- 62nd IEEE International Electron Devices Meeting IEDM 2016, San Francisco, CA (3.–7.12.2016), Scientific committee

Dissertations 2016

Conze, Susan
Precursor-basierte Darstellung von Magnéli-Phasen Ti_nO_{2n-1} für die Anwendung als Thermoelektrikum
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Feng, Bing
Herstellung, Modifizierung und Charakterisierung von borcarbidbasierten Keramiken als Thermoelektrikum
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen

Gommlich, Andreas
Entwicklung einer neuen Methode zur Ansteuerung von Ultraschall-Phased Arrays
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Elektrotechnik und Informationstechnik

Heubner, Christian
Thermisch-elektrochemische in-operando Untersuchungen zur lokalen Wärmeentwicklung in Lithiumionenbatteriezellen

Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Hohlfeld, Kai
Herstellung und Charakterisierung piezokeramischer Komponenten und daraus abgeleiteter Piezokomposite
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Kunze, Steffen
Entwicklung von SiSiC-Strukturkeramiken aus Reaktionsharzbeton
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Institut für Leichtbau und Kunststofftechnik

Majumder, Anindya
Functionalization and large scale assembly of carbon nanotubes
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Oberländer, Andreas
Synthese und Charakterisierung von Galliumoxidnitriden
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Pötschke, Johannes
Gefügeausbildung und Eigenschaften von nanoskaligen binderfreien Hartmetallen
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Reichelt, Erik
Theoretische und experimentelle Untersuchungen zu Stofftransport und Druckverlust in geschütteten und strukturierten Festbetten
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Verfahrenstechnik und Umwelttechnik

Simon, Adrian
Schichten aus Kohlenstoff-Nanomaterialien auf asymmetrisch porösen keramischen Trägern und deren Erprobung für Anwendungen in Membrantechnik und Katalyse
Dissertation 2016
Fraunhofer IKTS – TU Ilmenau, Institut für Chemie und Biotechnik

Svoboda, Hermann
Untersuchungen zu mikroskopischen und makroskopischen Grünkörperfehlern bei der uniaxialen Pressverdichtung
Dissertation 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Theses 2016

Bachmann, Sebastian
Herstellung und Entwicklung von porös-geträgerten Na-β-Al_2O_3 Festkörperelektrolytschichten
Master's thesis 2016
Fraunhofer IKTS – Ernst-Abbe-Hochschule Jena, Fachbereich SciTec

Becher, Martin
Entwicklung eines automatischen Gaspermeationsmessplatzes zur Charakterisierung keramischer Membranen
Master's thesis 2016
Fraunhofer IKTS – Ernst-Abbe-Hochschule Jena, Fachbereich Maschinenbau

Blechschmidt, Paul
Automatisierte Datenerfassung und Protokollerstellung für die Charakterisierung von Ultraschallprüfköpfen
Diploma thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Elektrotechnik

Beyer, Michael
Entwicklung und Herstellung breitbandiger Ultraschallprüfköpfe
Diploma thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Elektrotechnik

Eckoldt, Moritz
Untersuchung des elektromechanischen Energiewandlungspotenzials zur autonomen Energieversorgung von Kleingeräten
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Elektrotechnik und Informationstechnik, Institut für Feinwerktechnik und Elektronik-Design

Eiselt, Matthias
FPGA Implementierung eines Suchverfahrens zur akustischen Mustererkennung
Diploma thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Elektrotechnik

Grünberg, Ivo
Experimentelle Untersuchungen zur Synthese höherer Alkohole an eisenbasierten Katalysatorsystemen
Master's thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Verfahrenstechnik und Umwelttechnik

Haufe, Eric
Bestimmung statischer magnetischer Eigenschaften von magnetischen Formgedächtnislegierungen
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Elektrotechnik und Informationstechnik, Institut für Feinwerktechnik und Elektronik-Design

Henker, Tobias
Untersuchung elektromechanischer Wandlerkonzepte für piezoelektrische Generatoren bei stochastischer Anregung
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Elektrotechnik und Informationstechnik, Institut für Feinwerktechnik und Elektronik-Design

Hönig, Ulrike
Erstellung eines Anforderungsprofils an Referenzversuche zur Ermittlung und Bewertung von unterschiedlichen Schadensmechanismen in Faserverbunden mittels Schallemissionsanalyse
Diploma thesis 2016
Fraunhofer IKTS – TU Bergakademie Freiberg, Fakultät Maschinenbau, Verfahrens- und Energietechnik

Hoppe, Domenic
Schwachstellenanalyse von Elektronikkomponenten bei der Strukturintegration in GFK-Bauteile
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Leichtbau und Kunststofftechnik

Ji, Hyunjoon
Investigation of the influence of process parameters on the electrolyte penetration process in lithium-ion battery production
Master's thesis 2016
Fraunhofer IKTS – Hochschule Offenburg, Fakultät Maschinenbau und Verfahrenstechnik (M+V)

Johne-Michaelis, Robert
Entwicklung thermoplastischer Massen für den Thermoplastischen 3D-Druck (T3DP)
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Kluge, Steven
Präparation und Charakterisierung von Membranen zur Aufkonzentrierung von 80,3 Ma-% n-Butanol aus wässrigen Gemischen in Flachmembran- und Einkanalrohrgeometrie
Bachelor's thesis 2016
Fraunhofer IKTS – Brandenburgische TU Cottbus – Senftenberg, Campus Senftenberg

Knoch, Philip
Durchführung von Vibrationsversuchen an Lotkontakten unter einer Temperaturwechsellast
Bachelor's thesis 2016
Fraunhofer IKTS – Berufsakademie Sachsen, Staatliche Studienakademie Riesa, Studienrichtung Umwelttechnik

Liebmann, Tobias
Mikroelektrochemische Untersuchungen an Aluminiumknetlegierungen
Master's thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Landbau/Umwelt/Chemie, Studiengang Chemieingenieurwesen

Liu, Yao
Entwicklung eines miniaturisierten Elektrolyseurs in keramischer Mehrlagentechnologie
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät für Elektrotechnik und Informationstechnik, Institut für Aufbau- und Verbindungstechnik der Elektronik

Merkel, Susann
Untersuchungen zur Temperaturentwicklung an technisch reinem Cobalt bei anodischen Reaktionen mit hohen Stromdichten
Bachelor's thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Landbau/Umwelt/Chemie, Bereich Chemieingenieurwesen

Nickol, Alexander
Korrosionsverhalten von Siliciumnitridwerkstoffen in wässerigen Medien
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Verfahrenstechnik und Umweltverfahrenstechnik

Parulewski, Franz
Methodenentwicklung zur Bestimmung der Langzeitstabilität von Reformierungskatalysatoren zum Einsatz in SOFC-Systemen
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Verfahrenstechnik und Umwelttechnik

Rimbach, Isabel
Untersuchungen zur Präparation defektarmer BAM-Leuchtstoffpulver mit Partikelgrößen im sub-µm Bereich
Master's thesis 2016
Fraunhofer IKTS – Ernst-Abbe-Hochschule Jena, Fachbereich SciTec, Studiengang Werkstofftechnik

Rosenberg, Markus
Synthese und Charakterisierung von Perowskiten für die elektrokatalytische Sauerstoffreduktion
Master's thesis 2016
Fraunhofer IKTS – Ernst-Abbe-Hochschule Jena, Fachbereich SciTec, Studiengang Werkstofftechnik

Sammt, Nikhil Benjamin
Infrarotspektroskopische Untersuchungen zur Wasseradsorption und -desorption an modifizierten Metalloberflächen
Bachelor's thesis 2016
Fraunhofer IKTS – Brandenburgische TU Cottbus-Senftenberg, Fakultät Umwelt und Naturwissenschaften

Sattler, Julia-Christina
Elektrochemische Untersuchung der Leistungs- und Degradationseigenschaften von Hochvoltspinell $LiNi_{0,5}Mn_{1,5}O_4$ mit unterschiedlicher spezifischer Oberfläche
Bachelor's thesis 2016
Fraunhofer IKTS – TU Braunschweig, Institut für Partikeltechnik

Schrötke, Elena
Elektrochemische Untersuchungen

zur anodischen Auflösung einer SiC-basierten Keramik
Master's thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Landbau/Umwelt/Chemie, Bereich Chemieingenieurwesen

Seeba, Jann
Synthese und Charakterisierung von Mischmetalloxiden
Master's thesis 2016
Fraunhofer IKTS – FSU Jena, Chemisch-Geowissenschaftliche Fakultät

Seiler, Tim
Entwicklung und Test von Ultraschall-Phased-Array-Prüfköpfen auf Basis von PMN-PT-Einkristall-Kompositen
Bachelor's thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Elektrotechnik

Simunkova, Lenka
Untersuchung zum Einfluss der Elektrolytzusammensetzung auf die Oberflächenqualität beim ECM von Wolframcarbid-Cobalt
Bachelor's thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Landbau/Umwelt/Chemie, Bereich Chemieingenieurwesen

Staden, Kevin von
Screening eines alternativen Verfahrens zur Herstellung von Palladium-Membranen: nasschemisches Abscheiden von Metallsalzen und Metallkomplexen auf nanoporösen Trägern mit anschließender Wärmebehandlung
Master's thesis 2016
Fraunhofer IKTS – Ernst-Abbe-Hochschule Jena, Fachbereich SciTec

Susca, Alessandro
Characterization of novel electrode materials for bipolar lithium-ion batteries
Master's thesis 2016
Fraunhofer IKTS – HTW Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Tannert, Matthias
Development and characterisation of a porous support system for Na-β''-Al_2O_3 thin layer electrolytes in high temperature batteries
Master's thesis 2016
Fraunhofer IKTS – Ernst-Abbe-Hochschule Jena, Fachbereich SciTec

Voigt, Karsten
Kinetische Untersuchungen zur plasmaelektrolytischen Oxidation von Aluminium
Master's thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Mathematik und Naturwissenschaften, Fachrichtung Chemie und Lebensmittelchemie

Werner, Daniel
Untersuchungen zur Herstellung orange/rot lumineszierender Keramiken auf Basis moderner nitridischer Luminophore bei Anregung mit einer blauen LED
Diploma thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Maschinenwesen, Institut für Werkstoffwissenschaft

Zobel, Ruben
Labortechnische Untersuchungen zum anaeroben Abbau von Reststoffen aus der Bioethanolproduktion der milchverarbeitenden Industrie
Master's thesis 2016
Fraunhofer IKTS – TU Dresden, Fakultät Umweltwissenschaften, Institut für Abfall- und Kreislaufwirtschaft

Zywietz, Immanuel
Untersuchungen zur elektrochemischen Thermodynamik von Aktivmaterialien für Lithiumionenbatterien
Bachelor's thesis 2016
Fraunhofer IKTS – BTU Cottbus-Senftenberg, Fakultät Umwelt und Naturwissenschaften

EVENTS AND TRADE FAIRS – PROSPECTS

Conferences and events

Girls'Day
April 27, 2017, Dresden, Maria-Reiche-Strasse and Hermsdorf

Researchers' Night
June 16, 2017, Dresden, Winterbergstrasse

International Symposium on Piezocomposite Applications
September 13–15, 2017, Dresden, Winterbergstrasse

Dresden Battery Days 2017
September 18–20, 2017, Dresden, Winterbergstrasse

12th ICBM – International Conference on Barkhausen Noise and Micromagnetic Testing
September 24–26, 2017, Dresden, Maria-Reiche-Strasse

Industry workshop for the EU project "cerAMfacturing"
October 24, 2017, Dresden, Winterbergstrasse

International Symposium on Electrochemical Machining Technology INSECT
November 30 – Dezember 1, 2017, Dresden, Winterbergstrasse

Please find further information at
www.ikts.fraunhofer.de/en/events.html

Seminars and workshops

AdvanCer training program:
Introduction into advanced ceramics

Part I / 2017: Materials, technologies, applications
June 22–23, 2017, Dresden

Please find further information at
www.advancer.fraunhofer.de/en.html

Trade fair participations

Hannover Messe
Hanover, April 24–28, 2017
Joint booth Fraunhofer Adaptronics Alliance, Hall 2
Individual booth, Hall 6
Joint booth Energy Saxony, Hall 27

Windforce
Bremerhaven, May 9–11, 2017

Control
Stuttgart, May 9–12, 2017

ThEGA-Forum 2017
Weimar, May 10, 2017

Printed Electronics
Berlin, May 10–11, 2017

DGZfP-Jahrestagung
Coblenz, May 22–24, 2017

Sensor+Test
Nuremberg, May 30 – June 1, 2017

EuroCVD/Baltic ALD
Linköping, June 11–14, 2017

RapidTech
Erfurt, June 20–22, 2017
Joint booth Fraunhofer Additive Manufacturing Alliance

Laser World of Photonics
Munich, June 26–29, 2017
Joint Fraunhofer booth

Powtech
Nuremberg, September 26–28, 2017

Materials Week
Dresden, September 27–29, 2017
Joint booth Materials Research Network Dresden MFD

EuroPM
Milan, October 1–4, 2017

World of Energy Solutions
Stuttgart, October 9–11, 2017
Joint booth Fraunhofer Energy Alliance

FAD Conference
Dresden, November 8–9, 2017

Compamed
Dusseldorf, November 13–16, 2017

Productronica
Munich, November 14–17, 2017

Semicon
Munich, November 14–17, 2017
Joint booth VME

Formnext
Frankfurt/Main, November 14–17, 2017
Joint booth Fraunhofer Additive Manufacturing Alliance

Hagener Symposium
Hagen, November 30 – Dezember 1, 2017

Please find further information at
www.ikts.fraunhofer.de/en/tradefairs.html

HOW TO REACH US AT FRAUNHOFER IKTS

Please find further information and direction sketches at
www.ikts.fraunhofer.de/en/contact.html

How to reach us in Dresden-Gruna

By car

- Highway A4: at the three-way highway intersection "Dresden West" exit onto Highway A17 in direction "Prag" (Prague)
- Exit at "Dresden Prohlis/Nickern" (Exit 4)
- Continue 2 km along the secondary road in direction "Zentrum" (City center)
- At the end of the secondary road (Kaufmarkt store will be on the right side), go through traffic light and continue straight ahead along Langer Weg in direction "Prohlis" (IHK)
- After 1 km, turn left onto Mügelner Strasse
- Turn right at the next traffic light onto Moränenende
- Continue under the train tracks and turn left at next traffic light onto Breitscheidstrasse
- Continue 3 km along the An der Rennbahn to Winterbergstrasse
- Fraunhofer IKTS is on the left side of the road
- Please sign in at the entrance gate

By public transport

- From Dresden main station take tram 9 (direction "Prohlis") to stop "Wasaplatz"
- Change to bus line 61 (direction "Weißig/Fernsehturm") or 85 (direction Striesen) and exit at "Grunaer Weg"

By plane

- From Airport Dresden-Klotzsche take a taxi to Winterberg-strasse 28 (distance is approximately 7 miles or 10 km)
- Or use suburban train S2 (underground train station) to stop "Haltepunkt Strehlen"
- Change to bus line 61 (direction "Weißig/Fernsehturm") or 85 (direction Striesen) and exit at "Grunaer Weg"

How to reach us in Dresden-Klotzsche

By car

- Highway A4: exit "Dresden-Flughafen" in direction Hoyerswerda along H.-Reichelt-Strasse to Grenzstrasse
- Maria-Reiche-Strasse is the first road to the right after Dörnichtweg

- From Dresden city: B97 in direction Hoyerswerda
- Grenzstrasse branches off to the left 400 m after the tram rails change from the middle of the street to the right side
- Maria-Reiche-Strasse branches off to the left after approximately 500 m

By public transport

- Take tram 7 from Dresden city to stop "Arkonastraße"
- Turn left and cross the residential area diagonally to Grenzstrasse
- Follow this road for about 10 min to the left and you will reach Maria-Reiche-Strasse

- Take suburban train S2 to "Dresden-Grenzstraße"
- Reverse for ca. 400 m
- Maria-Reiche-Strasse branches off to the right

By plane

- After arriving at airport Dresden use either bus 80 to bus stop "Grenzstraße Mitte" at the beginning of Dörnichtweg and follow Grenzstrasse for 150 m
- Or take suburban train S2 to "Dresden-Grenzstraße" and walk about 400 m further along Grenzstrasse

How to reach us in Hermsdorf

By car

- Highway A9: exit "Bad Klosterlausnitz/Hermsdorf" (Exit 23) and follow the road to Hermsdorf, go straight ahead up to the roundabout
- Turn right to Robert-Friese-Strasse
- The 4th turning to the right after the roundabout is Michael-Faraday-Strasse
- Fraunhofer IKTS is on the left side

- Highway A4: exit Hermsdorf-Ost (Exit 56a) and follow the road to Hermsdorf
- At Regensburger Strasse turn left and go straight ahead up to the roundabout
- Turn off to right at the roundabout and follow Am Globus
- After about 1km turn off left to Michael-Faraday-Strasse
- Fraunhofer IKTS is on the left side

By train

- From Hermsdorf-Klosterlausnitz main station turn right and walk in the direction of the railway bridge
- Walk straight into Keramikerstrasse (do not cross the bridge)
- Pass the porcelain factory and the Hermsdorf town house
- Turn right, pass the roundabout and walk straight into Robert-Friese-Strasse
- After 600 m turn right into Michael-Faraday-Strasse
- Find Fraunhofer IKTS after 20 m

EDITORIAL NOTES

Editorial team/layout

Press and Public Relations
Marketing
Specialist Information

Printing

ELBTAL Druckerei & Kartonagen Kahle GmbH

Photo acknowledgements

Fotograf Jürgen Lösel, Dresden
Fraunhofer IKTS
MEV Verlag

Institute address

Fraunhofer Institute for
Ceramic Technologies and Systems IKTS
Winterbergstrasse 28
01277 Dresden, Germany
Phone +49 351 2553-7700
Fax +49 351 2553-7600

Michael-Faraday-Strasse 1
07629 Hermsdorf, Germany
Phone +49 36601 9301-0
Fax +49 36601 9301-3921

Maria-Reiche-Strasse 2
01109 Dresden-Klotzsche, Germany
Phone +49 351 88815-501
Fax +49 351 88815-509

info@ikts.fraunhofer.de
www.ikts.fraunhofer.de

Contact
Press and Public Relations

Dipl.-Chem. Katrin Schwarz
Phone +49 351 2553-7720
katrin.schwarz@ikts.fraunhofer.de