

# RETROSPECTIVE



## 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



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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 Paulo, Brazil

Brazil is currently one of the least CO<sub>2</sub>-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 tech-

nologies 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 Paulo.*



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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"



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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

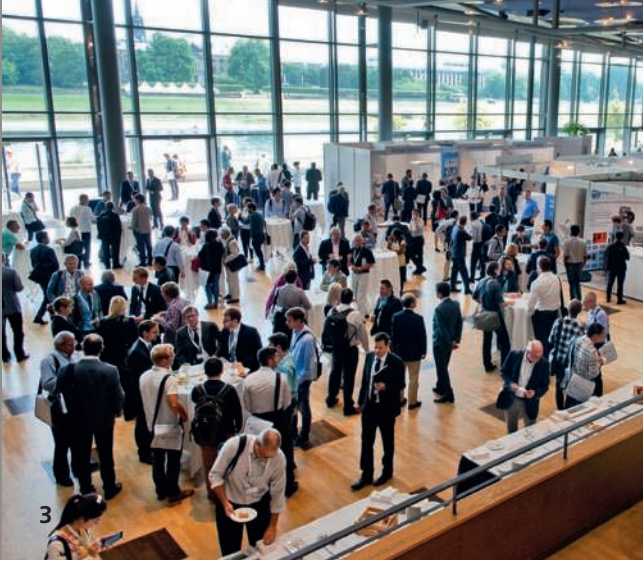
**German Unity Day**

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-



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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).



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“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



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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 (1<sup>st</sup> prize) of the Engineering Ceramics Division of the American Ceramic Society (ACerS) in 2016

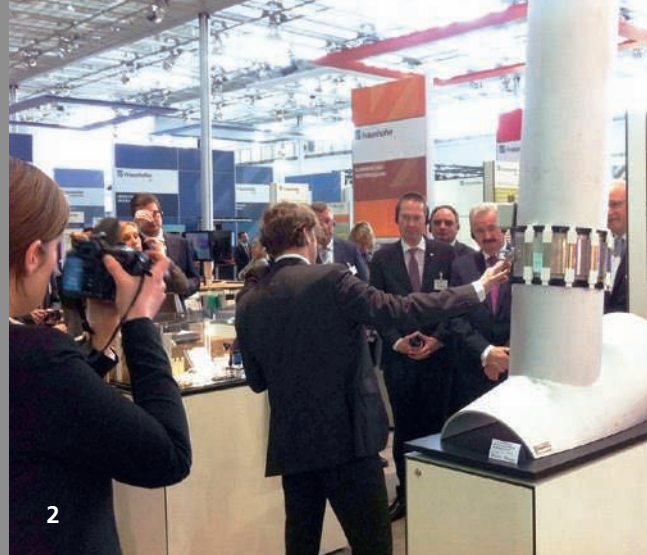
went to Jörg Adler and Dr. Uwe Petasch from Fraunhofer IKTS for their research on optimization of engine exhaust particulate filters. The talk presented at the International Conference on Advanced Ceramics & Composites in Daytona Beach, Florida, showed how optimally adjusted membrane coatings could improve 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).



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## 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*<sup>®</sup>, 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.



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**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**

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 Euro-*

*pean Fuel Cell Forum in Lucerne.*