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FRAUNHOFER INSTITUTE FOR APPLIED POLYMER RESEARCH IAP

ANNUAL REPORT

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ANNUALREPORT
20**19**

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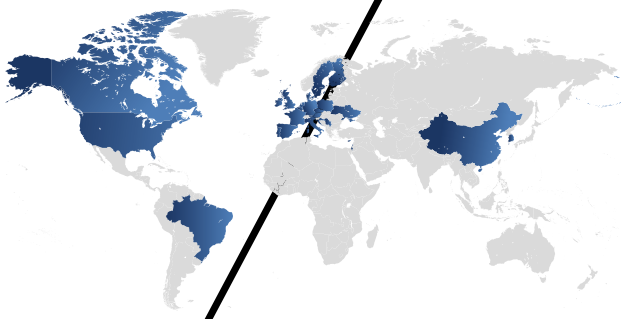

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PREFACE

Dear Reader,

for the Fraunhofer-Gesellschaft, 2019 was the year of its 70th anniversary. Just in time with this anniversary year, the Fraunhofer IAP was able to report a preliminary record year in which both economic revenues and the operating budget were again increased compared to the previous year. The Institute continues to be characterized by a stable mix of basic and applied research.

Numerous factors have contributed to this growth, which I will only mention briefly: In March 2019, the successful interim evaluation of the Fraunhofer High-Performance Center "Functional Integration" was completed and it has now entered the second funding phase. Till the end of 2020, this will concentrate on demonstrator projects which will be developed on base of the results of phase one, and on the expansion of the collaboration with the anchor University of Potsdam, with which joint projects have already been launched. The aim is to quickly transfer university results to application and to let successful demonstrator projects result in spin-offs.

The Fraunhofer IAP is also expanding the networking of its activities with other universities within and outside the state of Brandenburg (including Wildau, Cottbus, Hamburg). The most recent example is the joint appointment of Professor Holger Seidlitz in August 2019 to the professorship "Polymer-based Lightweight Construction", which is located in the Faculty of Mechanical Engineering, Electrical and Energy Systems at the Brandenburg Technical University Cottbus - Senftenberg (BTU - CS). Professor Seidlitz is also head of the research division "Polymer Materials and Composite PYCO" at the Fraunhofer IAP. Together with the BTU - CS, the Fraunhofer IAP also pushes the project "Land-Innovation-Lausitz" within the framework of the "WIR" program ("Change through Innovation in the Region") for the design of post-mining landscapes. This contribution is only one of many made by the Fraunhofer IAP to structural change in the region Lausitz.

Outside the state of Brandenburg we were able to celebrate a further step in expanding and intensifying our cooperation with the University of Hamburg by approving an Attract group for Dr. Neus Feliu Torres at Fraunhofer CAN.

These are just a few highlights from 2019, and you will notice that this year not only the introduction but also the annual report itself is shorter and more concise.

I wish you an informative lecture and, on behalf of the employees of Fraunhofer IAP, I would like to thank all customers, collaboration partners and friends of the Institute for the trusting and successful collaboration in 2019.

Sincerely,

Professor Alexander Böker

FRAUNHOFER IAP
AT A GLANCE

The Fraunhofer IAP in Potsdam-Golm, Germany, offers a broad range of research on polymers. We work on biobased and synthetic polymers that meet the growing demands of our partners. The end products are becoming more durable and stable, more acid and heat resistant, easier to care for, healthier, more environmentally-friendly, more cost-effective … as well as easier and more energy efficient to manufacture.

We develop innovative and sustainable materials, processes and products that are specifically tailored to the needs of each application. We also create conditions which ensure that the developed methods not only work on a laboratory scale, but also under production conditions. //

Locations of the Fraunhofer IAP

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Our locations
https://s.fhg.de/phq

Pilot Plant Center PAZ

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06258 Schkopau

Center for Applied Nanotechnology CAN

Grindelallee 117
20146 Hamburg

Polymeric Materials and Composites PYCO

Kantstraße 55
14513 Teltow

Technikum 1
Freiheitstraße 124 - 126
Technikum 2
Schmiedestraße 5
15745 Wildau

BTU Cottbus - Senftenberg
Panta Rhei hall
Konrad-Wachsmann-Allee 17
03046 Cottbus

Processing Pilot Plant for Biopolymers

Schipkauer Straße 1
BASF A754
01987 Schwarzheide

Biopolymers Senftenberg

BTU Cottbus - Senftenberg
Campus Senftenberg
Universitätsplatz 1
01968 Senftenberg

OUR KNOW-HOW

SERVICES

synthesis and modification of polymers, material development, polymer processing, scale-up up to ton scale, process optimization, technology and process development, surface analysis, structural characterization, material testing, utilization of biogenic residues, biotechnology, consulting

APPLICATION FIELDS

plastics industry, lightweigth construction, aerospace, automotive, electronics, optics, security technology, energy technology, textile industry, packaging, environmental and waste water technology, paper, construction and paint industry, medicine, pharmacy, cosmetics, biotechnology

MATERIALS

(bio)plastics, fiber-reinforced composites, elastomers, thermoplastics, thermosets, lightweight materials, resins, rubber, optical and photosensitive functional materials, quantum dots, chromogenic polymers, rare earth doped nanoparticles, precious metal nanoparticels, polymeric surfaces, functional colloids, polymer dispersions, hydrogels, surfactants, additives, shape memory polymers, biomedical materials, functional proteins, protein-based materials

PRODUCTS

fibers, biobased carbon fibers, films, non-wovens, prepregs, printed electronics, flexible OLEDs, flexible organic solar cells, sensors, actuators, polymer electronic components, thickener systems, (nanoscale) electrocatalysts, nanoparticle-based ink systems, microcapsules, membranes, artificial cornea, implants, drug delivery, cosmetics, artificial blood vessels (3D printing), biosensors

OUR COMPETENCES AND APPLICATIONS

COMPETENCES

SYNTHESIS AND MODIFICATION
OF (BIO)POLYMERS

PRINTING- AND
THIN FILM TECHNOLOGIES

FUNCTIONALIZATION OF SURFACES

PROCESS DEVELOPMENT
AND SCALE-UP TO TON SCALE

BIOTECHNOLOGY AND MICROBIOLOGY

CHARACTERIZATION OF MATERIALS

ANALYSIS OF POLYMERS AND
PARTICULATE SYSTEMS

NANOTECHNOLOGY AND SELF-ASSEMBLY

PROCESSING FROM SOLUTION AND MELT

APPLICATION FIELDS

ENVIRONMENT AND SUSTAINABILITY

ENERGY AND LIGHT

LIGHTWEIGHT CONSTRUCTION AND MOBILITY

MEDICINE AND DIAGNOSTICS

COSMETICS AND HYGIENE

CHEMISTRY AND MATERIALS

Find out more about this topic:
https://s.fhg.de/u7q

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https://s.fhg.de/5eJ

RESEARCH DIVISIONS OF THE FRAUNHOFER IAP

Biobased carbon fibers for lightweight cars, organic light-emitting diodes for flexible displays or artificial corneas as implants – the seven research divisions of the Fraunhofer IAP develop bio-based and synthetic polymers as well as methods for their production, functionalization and processing.

Our institute also offers a wide spectrum of research and development services for diverse polymer applications. Due to the good networking of our variously positioned divisions with each other, a fluent and dynamic implementation of all wishes and needs of our customers is guaranteed. Furthermore, we create the conditions for processes to operate not only on a laboratory scale but also under production conditions. //

For more information please visit:
https://s.fhg.de/yyf

Research Division
BIOPOLYMERS

In the research division **BIOPOLYMERS** we develop sustainable materials based on renewable raw materials, such as cellulose, lignin, starch or thermoplastics like polylactic acid (PLA). Using our experience gained over decades, we develop more effective processes, improved and new materials for existing and new innovative applications together with our partners from the pulp and paper industry, the polymer processing industry and with manufacturers of end products.

HIGHLIGHTS 2019
biobased carbon fibers, biobased coffee capsules, biobased crosslinker-free coatings with high resistance

Prof. Dr. Johannes Ganster
Division Director

For more information please visit:
https://s.fhg.de/6JD

Research Division

FUNCTIONAL POLYMER SYSTEMS

Materials with special optical and electrical properties as well as processes, technologies and concepts for customer-specific applications are developed in the research division **FUNCTIONAL POLYMER SYSTEMs**. The spectrum ranges from the development of materials with semiconducting properties to chromogenic, phototropic materials, devices which emitting light, convert sunlight into electrical power or react to mechanical pressure or temperature. We use new digital printing processes, for example to produce OLEDs or solar cells at low cost.

HIGHLIGHT 2019
QD color filters for microLEDs, artificial elastic materials for human bodies, materials for battery systems

Dr. Armin Wedel
Division Director

For more information please visit:
https://s.fhg.de/y8c

Research Division

SYNTHESIS AND POLYMER TECHNOLOGY

The competences of the research division **SYNTHESIS AND POLYMER TECHNOLOGY** cover the entire value chain from polymer synthesis and process development to analysis and characterization. The basis for this is a balanced mix of competencies in our departments Polymer Synthesis, Shape Memory Polymers, Microencapsulation and Polysaccharide Chemistry as well as Membranes and Functional Films. One focus of our activities is the substance-oriented and technology-driven research from laboratory to pilot plant scale.

HIGHLIGHT 2019
10 years Technology Platform Microencapsulation

Dr. Thorsten Pretsch
Division Director

For more information please visit:
https://s.fhg.de/ns3

Research Division

LIFE SCIENCE AND BIOPROCESSES

In the research division **LIFE SCIENCE AND BIOPROCESSES**, we use proven mechanisms of nature to extend the functional spectrum of polymers. We focus on the integration of new biological functions in polymer materials. Our interdisciplinarily skilled employees develop processes, materials and key substances for biotechnology, the chemical industry, textiles, medical devices, pharmaceuticals and cosmetics as well as for environmental and nanotechnologies.

HIGHLIGHTS 2019
Eye Lash Booster, BioPol – biologization of polymer materials, enzyme immobilization for biocatalysis

Prof. Dr. Alexander Böker
Division Director (acting)

For more information please visit:
https://s.fhg.de/s4k

Research Division

PILOT PLANT CENTER PAZ

The **FRAUNHOFER PILOT PLANT CENTER FOR POLYMER SYNTHESIS AND PROCESSING PAZ** in Schkopau is a a joint initiative of the Fraunhofer Institutes IAP and IMWS. The main fields of activity in polymer synthesis are, in addition to scale transfer and the provision of sample quantities, the development and optimization of polymer synthesis processes.

HIGHLIGHTS 2019
Pilot testing of complex customer-specific processes, projects in the area of synthetic rubber

Prof. Dr.-Ing. Michael Bartke
Division Director

For more information please visit:
https://s.fhg.de/f2g

Research Division

POLYMER MATERIALS AND COMPOSITES PYCO

Starting from the development of special polymers and fiber composite semi-finished products, through the design of prototypes, to the implementation of production processes suitable for large-scale production, we provide all important lightweight construction competencies of the value-added chain from monomers to energy-efficient high-performance components under one roof at the research division **POLYMERIC MATERIALS AND COMPOSITES PYCO**. Such bundling effects represent an absolutely unique selling proposition in the German research landscape.

HIGHLIGHTS 2019
High technologies for lightweight construction, smart blades

Prof. Dr.-Ing. Holger Seidlitz
Division Director

For more information please visit:
https://s.fhg.de/ij4

Research Division

CENTER FOR APPLIED NANOTECHNOLOGY CAN

The research focus at the **CENTER OF APPLIED NANOTECHNOLOGY CAN** is the development of innovative, industrially applicable production processes for tailor-made composite materials made of nanoparticles, which are used in displays, lighting, infrared sensors, as safety markings and in medical diagnostics. We are also developing fuel cells with highly efficient nanocatalysts, polymers for cosmetic applications and nanocapsules for the targeted medical release of active ingredients.

HIGHLIGHTS 2019
ROHS-conform fluorescent quantum dots, projects on MS drug, new group on innovative tumor diagnostics

Prof. Dr. Horst Weller
Division Director

For more information please visit:
https://s.fhg.de/i35

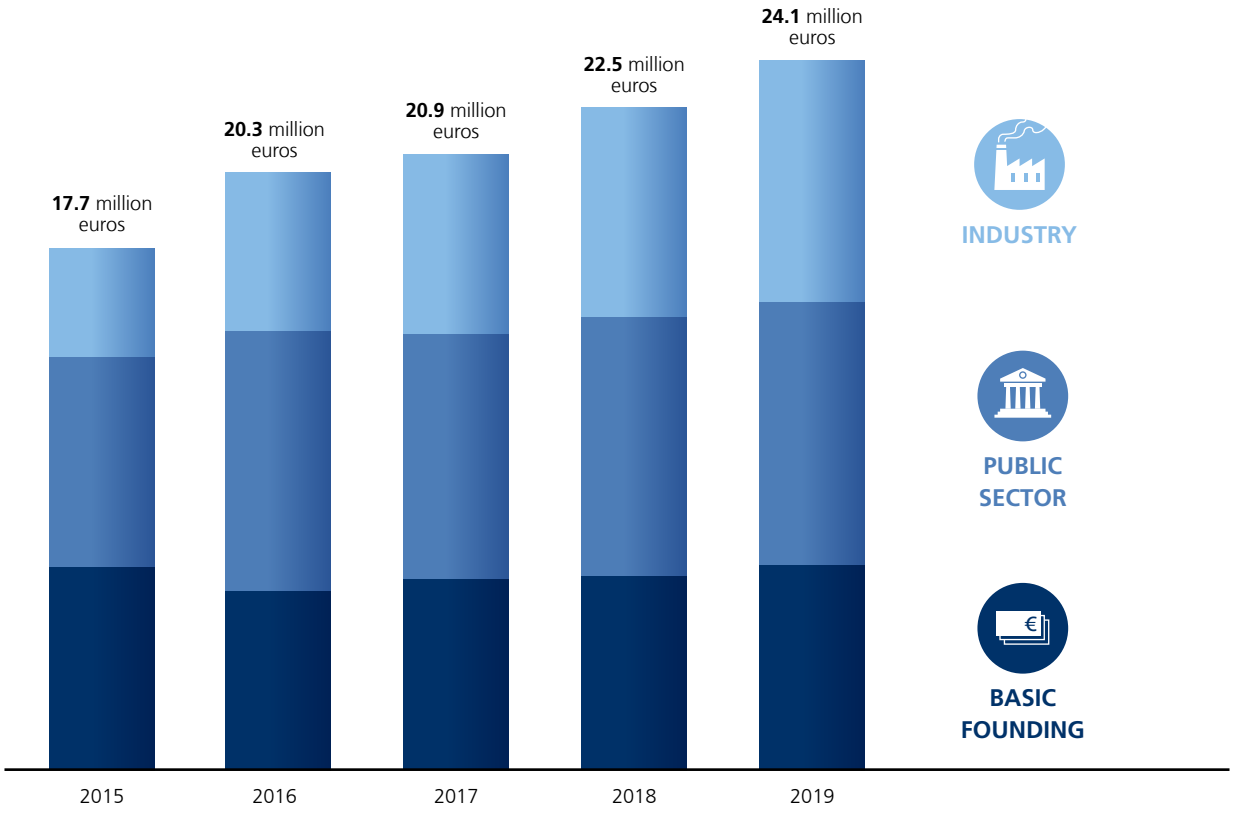
THE INSTITUTE IN FIGURES

OPERATING BUDGET

The operating budget for 2019 was approximately 24.1 million euro. External income amounted to 17.2 million euro, 46.1 percent of this was income from industry.

INVESTMENT BUDGET

In 2019 investments amounted to 2.4 million euro. 850,000 euro of this was for replacement investments of obsolete equipment, such as gas chromatograph, scattered light detector, material testing machine or DMA.



257

people were employed at the Fraunhofer IAP, 232 of them as permanent staff and 25 as junior staff at the end of 2019.

110 Scientific staff

95 Technical staff

17 Administration/scientific and technical services

10 Strategy and Marketing

21 Ph. D. students

4 Apprentices

117

Bachelor and master students, student and scientific assistants, trainees, guest scientists from Germany and abroad were also employed at Fraunhofer IAP in 2019.

ADVISORY BOARD 2019

The advisory board advises and supports the Fraunhofer-Gesellschaft as well as the institute´s directory. The following persons were members of the advisory board of the Fraunhofer IAP in 2019.

Prof. Dr. Thomas Müller-Kirschbaum
Chairman of the advisory board
Henkel AG & Co. KGaA, Düsseldorf

Prof. Dr. Herwig Buchholz
Merck KGaA, Darmstadt

Dr. Stefan Dreher
BASF SE, Ludwigshafen am Rhein

Ministerial Conductor Carsten Feller
Brandenburgian Ministry of Science, Research and Culture, Potsdam

Dekan Prof. Dr. Heinrich Graener
Universität Hamburg, Hamburg

State Councillor Dr. Eva Gümbel
Free and Hanseatic City of Hamburg, Hamburg

Prof. Dr.-Ing. Hans-Peter Heim
University of Kassel, Kassel

Dr. Claudia Herok
Brandenburgian Ministry of Science, Research and Culture, Potsdam

Dr. Steffen Kammradt
WFBB, Economic Development Agency, Potsdam

Prof. Dr.-Ing. habil. Dr. phil. Sabine Kunst
President of the Humboldt-Universität zu Berlin, Berlin

Prof. Dr. Christine Lang
BELANO medical AG, Hennigsdorf

Prof. i. R. Dr. Michael W. Linscheid
Humboldt-Universität zu Berlin, Berlin

Dr. Henning Mallwitz
Bode Chemie GmbH, Hamburg

Prof. Dr.-Ing. Friedhelm Pracht
Alfred Pracht Lichttechnik GmbH, Dautphetal-Buchenau

Dr. Felix Reiche
hesco Kunststoffverarbeitung GmbH, Luckenwalde

Dr. Günther Schneider
Beiersdorf AG, Hamburg

Dr.-Ing. Andreas Schütte
FNR, Fachagentur Nachwachsende Rohstoffe e. V., Gülzow

Prof. Dr. Ulrich Schwaneberg
RWTH Aachen University, Aachen

Prof. Dr. Robert Seckler
Vice President for Research and Junior Academics of the Universtiy of Potsdam, Potsdam

Prof. Dr.-Ing. Manfred H. Wagner
Technische Universität Berlin, Berlin

Dr. Arik Willner
Deutsches Elektronen-Synchrotron DESY, Hamburg

Dr. Bernd Wohlmann
Teijin Carbon Europe GmbH, Wuppertal

GUEST MEMBERS

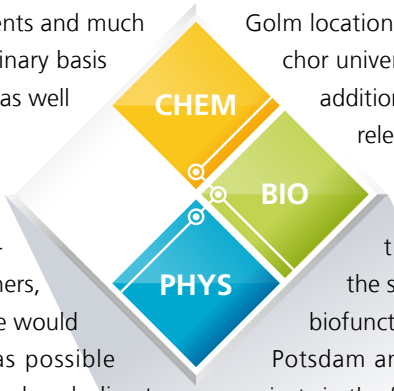
Prof. Dr. Christiane Hipp
President of Brandenburg University of Technology Cottbus - Senftenberg, Cottbus - Senftenberg

Dr. Stefan Hofschen
Bundesdruckerei GmbH, Berlin

Prof. Dr. Ulrike Tippe
President of the Technical University of Applied Sciences Wildau, Wildau

HIGH-PERFORMANCE CENTER
FUNCTIONAL INTEGRATION

In the High-Performance Center "Integration of Biological and Physical-Chemical Material Functions", we give plastics and other materials intelligent features. For this purpose, we combine them with biological molecules, sensors, solar cells, light and heat elements and much more. We collaborate on an interdisciplinary basis with partners from science and industry as well as with strong networks in the region.



The High-Performance Center regards itself as a central contact point for scientists, companies, potential research partners, public institutions and social actors. "We would like to support the scientists as far as possible throughout the entire project phase and seek direct contact with the teams," emphasizes Tahani Adnan – head of the High-Performance Center's office. Together with her colleagues, Cornelia Grasme at Fraunhofer IAP and Dr. Katharina Kasack at Fraunhofer IZI-BB, not only individual support services are provided but also new transfer formats are used. With the introduced event format of "transfer sprints" the team promotes the exchange of scientists among each other and with the actors at the Golm location and the University of Potsdam, the anchor university of the High-Performance Center. In addition, the format is used to provide transfer-relevant competences and transfer tools.

Within the framework of the "Innovative Universities", the establishment of the second Joint Labs "BioF" on the topic of biofunctional surfaces with the University of Potsdam and the collaboration in various projects in the field of lightweight construction and in micro- and optoelectronics with the BTU Cottbus - Senftenberg and the TH Wildau is being promoted via the joint InnoHub 13 initiative. //


TARGETS
sustainable and efficient products
economic strengthening of the region
SECTIONS
medicine, lightweight construction, architecture, textiles, consumer products
…

INNOVATIVE UNIVERSITIES

TECHNOLOGY TRANSFER IN A DIFFERENT WAY

The "Innovation Hub 13 – fast track to transfer" of the TH Wildau and the BTU Cottbus - Senftenberg is an instrument of the federal-state initiative "Innovative Hochschule". Together with Leibniz IRS, Fraunhofer IMW and the research division Polymer Materials and Composites PYCO of Fraunhofer IAP, the interdisciplinary transfer scout team is developing a regional innovation system for the sustainable strengthening of knowledge and technology transfer (WTT) for the region of Southern Brandenburg.

Addressed are the topics "Life Sciences", "Digital integration" and "Lightweight construction". We support businesses in the analysis of technology trends and future markets and advise them in the development of business models. The initiation and support of innovation projects at the interface between business and science often provides a successful basis. In addition to their overview of corporate structures and competencies of universities and research institutions, transfer scouts need sound knowledge of the KTT funding instruments of the federal and state governments.

The thematic complex of lightweight construction with polymers, which also implies the various sub-disciplines of plastics processing for the implementation of the most cost-optimized lightweight construction methods, is located in the Innovation Hub 13 project at the PYCO research division and is supervised by transfer scout Dr. Stefan Kamlage. The joint appointments with the BTU of Prof. Dr.-Ing. Holger Seidlitz (polymer-based lightweight design) and with the Technical University of Applied Sciences Wildau of Prof. Dr. Christian Dreyer (fiber composite material technologies) also enable the advantageous interlocking of application-oriented basic and product-oriented application research.

The results of the initiated collaboration projects were presented at various specialist events in 2019. For example, on the first day of additive manufacturing at the BTU in Cottbus. Among others, Dr.-Ing. Theresa Förster and Professor Christian Dreyer presented the results at the Hanover fair 2019 in lectures that pointed out the high potential for saving energy and resources in polymer-based lightweight construction. Dr. Stefan Kamlage outlined his experiences with WTT to representatives from politics, industry and science. Further platforms were the working group meetings of the VDI regional association, in particular the working group "Plastics and Lightweight Construction Technologies", which brings together many players from the target region at the BTU in Cottbus. With his help, the network was further expanded and further WTT projects were initiated to increase the innovative capacity. //

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Federal Ministry of Education and Research
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Innovative Hochschule

INNOVATIVE UNIVERSITY POTSDAM – INNO-UP

Since January 2018, the Fraunhofer IAP has been involved in the project of the BMBF's and the Joint Science Conference "Innovative University" funding initiative as a direct partner of the University of Potsdam. The overall "Inno-UP" project has the goal to expand the University and Innovation Campus of Potsdam-Golm by three new dimensions which are represented by so called "Campuses". Within the framework of the *Education Campus*, the research and use of digital forms of learning will be intensified. The sub-project *Society Campus* aims at strengthening the interfaces between science and civil society.

In addition, and this is where the Fraunhofer IAP is mainly involved, so-called "Joint Labs" (JLs) are to be developed and tested as part of the Technology Campus sub-project. These JLs aim at connecting scientists in order to stimulate transfer activities and the creation of innovative potentials. The JLs are intended as long-term innovation spaces across organizational and technical boundaries. In the course of the project, the conception and implementation of at least three JLs adressing different topics is planned. JL activities will be accompanied by supporting workshops on aspects of open collaborations, open innovation in science, co-creation and also citizen science. In the last two years, the Fraunhofer IAP, the University of Potsdam, Potsdam Transfer and the Innovation Center innoFSPEC have worked closely together to advance the conceptual design and implementation of *JL OPAT* (Optical Technologies for Process Analytics). Scientists of the Fraunhofer IAP and innoFSPEC jointly identified new issues in the processes of the Fraunhofer IAP, which were investigated using the process analytics techniques of innoFSPEC. Several industrial contacts have already been established within the JLs. The successful collaboration in the JL OPAT is to be continued and expanded in the future – especially with a focus on the acquisition of joint projects and the joint processing of collaboration requests.

Another JL project on which the Fraunhofer IAP is working together with Fraunhofer IZI-BB and the University of Potsdam is the JL Biofunctional Surfaces (BioF). Here, expertise available in the High-Performance Center "Integration of Biological and Physical-Chemical Material Functions" is utilized to focus specifically on the aspect of biofunctional surfaces. //

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https://s.fhg.de/w76

FRAUNHOFER CLUSTER OF EXCELLENCE

The Fraunhofer Cluster of Excellence is a funding program of the Fraunhofer-Gesellschaft for its Institutes to research topics with disruptive potential. The aim is to establishvirtual institutes with complementary competences and international visibility for the industry, science and society.

PROGRAMMABLE MATERIALS

The research cluster "Programmable Materials" is laying the scientific and technological foundations for materials whose internal structure allows them to fulfil the function of entire systems. This reduces the size of the system and lowers dependence on large infrastructures. The aim is to specifically combine various elements of the programmable materials to create customer-specific systems with a desired functionality.

Programmable materials are materials, material composites or surfaces whose form or function can be reversibly changed or controlled by external influences. The programming is achieved by a targeted configuration of the inner structure of the material. External stimuli such as pressure, heat or electric fields act on the material causing changes in the internal structure and thus in the material design. The programming of complex and locally different functions unlocks unique potentials for entire systems since a system's functionality can be induced by the material itself. The system can thus automatically adapt to changing conditions in the environment.

The cluster aims to fundamentally develop, characterize and implement different forms of programmability in a modular way. It will initially focus on two key aspects: programmable transport properties and programmable mechanical material properties, as well as the scaling and manufacturing associated with it. Both properties can usually only be changed to a limited degree in conventional solid materials through targeted material design and cannot be changed once the materials have been produced. Focusing on these properties therefore poses a particular scientific and technical challenge, but also offers potential for a new, disruptive and application-oriented system design.

A joint library for functions and processes will be established based on the acquired scientific and technological understanding of "Programmable Materials". This forms the sustainable technological and economic basis for the research cluster. This library will link the material mechanisms and systemic functions with the necessary process steps for manufacturing. **//**

Participating Institutes: Fraunhofer IAP, Fraunhofer IBP, Fraunhofer ICT, Fraunhofer IWM, Fraunhofer IWU

Find out more about this topic:
https://s.fhg.de/GYv

CIRCULAR PLASTICS ECONOMY

Plastic production is growing and is an important economic factor in many countries. Plastics used in industrial and consumer goods have a broad spectrum of optimized properties. In many cases they are difficult to replace. Their low weight means they are irreplaceable when it comes to resource efficient products. But too much plastic waste ends up in the environment at the end of its life cycle. While the raw material base only slowly opens up for biogenic sources.

The aim of the research cluster is to establish a virtual institute with new competencies, methods and products for the circular plastics industry. The basic idea is simple: to minimize the extraction of fossil resources, minimize end-of-life losses, and at the same time enable real recycling. But the change from today's largely linear global system to an efficient recycling economy requires systemic, technical and social innovations.

The diverse range of plastics must be optimized in terms of recyclability without sacrificing functionality. Plastic products must be designed to enable repairability and long lifetimes. At the same time, the cultural practices and value that we place on plastics must be actively reinvented.

Smart collection systems for plastic waste must be in place on a global scale and they must become significantly more efficient and better accepted. Collection, separation and recycling technologies need to be enhanced to avoid downcycling. Where the release of microplastics is unavoidable, for example due to weathering and abrasion, or not feasible for reasons of resource efficiency, it must be ensured that they can rapidly degrade in the environment. Recycling losses should be replaced exclusively by renewable – not fossil – sources.

This vision requires a "plastics revolution along the entire value chain", which can only succeed with a multi-stakeholder approach. From the beginning scientists work together with marketing experts and business development managers in a virtual institute to provide industry-relevant demonstrators. **//**

Participating Fraunhofer Institutes: Fraunhofer IAP, Fraunhofer ICT, Fraunhofer IML, Fraunhofer LBF, Fraunhofer UMSICHT

Find out more about this topic:
https://ccpe.fraunhofer.de/

HIGHLIGHTS 2019

Our polymers and developments can be found in a variety of products from a wide range of application areas. On the following pages we present some of the highlight topics from 2019. //

ENVIRONMENT
AND SUSTAINABILITY

ENERGY
AND LIGHT

LIGHTWEIGHT CONSTRUCTION
AND MOBILITY

MEDICINE
AND DIAGNOSTICS

COSMETICS
AND HYGIENE

CHEMISTRY
AND MATERIALS

BIODEGRADABLE
AGRICULTURAL FILMS

Dr.-Ing. Murat Tutuş
Membranes and Functional Films

SPONSORED BY THE
Federal Ministry of Education and Research

New biobased materials for completely degradable agricultural films are developed at the Fraunhofer IAP as partner of the BTU Cottbus - Senftenberg in the WIR! alliance "Land-Innovation-Lausitz". The films developed at the Fraunhofer IAP are supposed to be able to regulate their water and heat balance autonomously and contain further additional functions. In the WIR! alliance, which was formed within the framework of the BMBF funding line "Change through Innovation in the Region" (WIR!), innovative technologies and forms of use are being developed to adapt agriculture to climate extremes. //

SYNTHETIC RUBBER OUTPERFORMS NATURAL RUBBER

The treads of truck tyres are mainly made from the natural rubber of the rubber trees. This rubber has the best abrasion properties to date. But natural rubber is a limited raw material. In Brazil, its country of origin, the *fungus Microcyclus* ulei destroys entire plantations. If the fungus also spreads to Asia, where important cultivation areas are located today, world rubber production is threatened. Synthetically produced rubber, however, does not yet come close to the natural product in terms of abrasion behaviour and is therefore not suitable for truck tyres.

Biomimetic synthetic rubber with optimized abrasion behaviour (BISYKA)

In the BISYKA project, the five Fraunhofer Institutes IAP, IME, IMWS, IWM and ISC have now developed a new type of synthetic rubber for the first time that has 30 to 50 percent less abrasion than natural rubber. To this end, they used findings obtained in the study of dandelion rubber. //

Dr. Ulrich Wendler
Synthesis and Product Development

Find out more about this topic:
https://s.fhg.de/9VA

Preformed splints made of biobased and biodegradable plastic PLA simplify the treatment of bone fractures and protect the environment.

COMPOSTABLE SPLINT FOR BONE FRACTURES

A new type of splint for immobilizing fractures can be reshaped several times during treatment, for example when the swelling subsides. This is made possible by the biobased plastic polylactic acid, PLA. After use, the splint can be composted. At the *Biopolymer Congress* held on 21st and 22nd May 2019 in Halle/Saale, Germany, the product known as RECAST received the second prize in the Biopolymer Innovation Award, which is given for product innovations made from compostable plastics.

Material development with PLA – from disadvantage to advantage

The bioplastics formulation was developed at the Fraunhofer IAP for the company Nölle Kunststofftechnik GmbH in Meschede. In the immobilization concept, preformed PLA splints are heated from 55 to 65 °C and adapted to the corresponding body part for about five minutes. If corrections are necessary, the hardened splint can simply be reheated. //

Prof. Dr. Johannes Ganster
Material Development and Structural Characterization

Find out more about this topic:
https://s.fhg.de/e5y

Find out more about this topic:
https://s.fhg.de/bq2

SUSTAINABLE FOOD PACKAGING

Antimicrobial packaging for perishable foods is being developed on the basis of natural nanomaterials in the EU joint project "NanoPack". At the Fraunhofer IAP, technologies for functionalization of nanotubes are developed that are loaded with antimicrobial essential oils, such as thyme oil, and integrated into packaging films. The essential oils are released as vapour and reduce the growth of microbes both on the product surface and in the packaging room. //

Dr. Andreas Holländer
Functional Materials and Components

FRAUNHOFER CLUSTER CIRCULAR PLASTICS ECONOMY

The design of plastics so that they can be recycled, degraded quickly and without residue or not be released into the environment, is the focus of the Fraunhofer Cluster. The Fraunhofer Institutes IAP, ICT, IML, LBF and UMSICHT provide impulses for rethinking the design, production, use, disposal and recycling of plastics. //

Find out more about this topic:
https://s.fhg.de/Mc4

NEW DIVISION DIRECTOR PROF. DR.-ING. HOLGER SEIDLITZ

Since August 1st, 2019, Professor Holger Seidlitz has been head of the "Polymer Materials and Composite PYCO" research division at Fraunhofer IAP. Here, at the Teltow and Wildau sites, highly cross-linked polymers for lightweight construction are developed, which are used for example in aerospace, wind turbines and vehicle construction. Professor Holger Seidlitz took over the task from Professor Christian Dreyer, who has temporarily led the research division since 2016. At the same time Professor Seidlitz takes up the professorship "Polymer-based lightweight construction" at the Brandenburg University of Technology Cottbus - Senftenberg. //

CONSTRUCTION PROGRESS IN WILDAU

At the Wildau site, in the future, a large part of the lightweight construction expertise of the PYCO research division will be bundled. Construction work began in June 2018 with the laying of the foundation stone. The shell of the new office and laboratory building was completed in April 2019. The technical interior work is currently in full swing. The building is expected to be handed over to the user at the end of 2020. //

Status of construction on the office and laboratory building in Wildau in April 2020.

BIOBASED CARBON FIBERS

Carbon fibers are the strongest and stiffest material that can currently be produced in large-scale plants. This, together with their low weight, makes them irreplaceable, especially in lightweight construction for reinforcing plastics, for example in aircraft, vehicles or sports equipment. The demand for carbon fibers has been increasing for years. In view of current developments towards a more sustainable future, they will become even more important as a lightweight reinforcement material in wind turbines, hydrogen tanks or in the construction sector in the form of carbon concrete, among other things.

Sustainable high-performance for lightweight construction

Carbon fibers produced on the basis of renewable raw materials are currently practically unavailable on the market. At present, 95 percent of carbon fibers worldwide are based on petroleum-based polyacrylonitrile (PAN) as a precursor material. The Fraunhofer IAP has been developing bio-based precursors for many years. After conversion, their properties partly reach those of conventional PAN-based carbon fibers. The production of high-performance carbon fibers (high modulus) is also possible at the Fraunhofer IAP by using a new type of oven that can generate temperatures of up to 2900 °C. //

At 2900 °C, bio-fibers made of cellulose are graphitized at the Fraunhofer IAP.

Dr. Jens Erdmann
Material Development and Structure Characterization

Find out more about biobased carbon fibers:
https://s.fhg.de/EL9

ESJET PRINTING TECHNOLOGY AWARDED

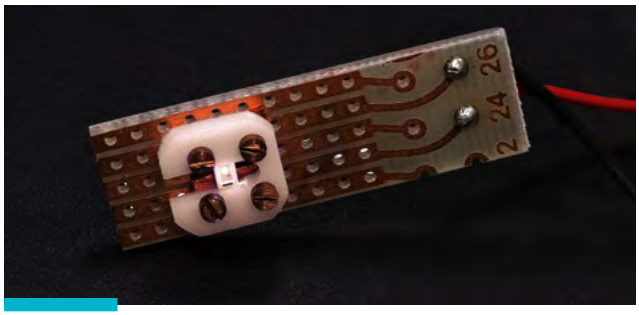
ESJET printing is a new printing technology for large-scale, solution-processed displays of the future. By means of a drop-on-demand technique a particularly high resolution down to the micrometer range can be achieved. The Fraunhofer IAP, together with its project partners imec and TNO/Holst Centre, developed this printing technology in an EU project, for which they were awarded as the Best Institute/Academic R&D Award at the IDTechEx Printed Electronics 2019. //

Find out more about this topic:
https://s.fhg.de/82t

Dr. Christine Boeffel
Functional Materials and Devices

NEW TECHNOLOGY FOR WARM WHITE LEDS

Light emitting diodes (LEDs) enable significant energy savings compared to conventional light sources. In terms of light quality, however, conventional lighting solutions are still superior to LEDs, as LEDs do not reproduce the full color spectrum. Above all, LEDs lack an efficient red phosphor to produce warmer white light. In the EuroLED project, four partners are working on the development of a nanoscale phosphor system for white LEDs based on a fundamentally new concept. With the energy-efficient generation of warm white light they want to increase acceptance of energy-saving LEDs among the population. //



Dr. Christoph Gimmler
Nanoscale Energy and Structural Materials

Find out more about this topic:
https://s.fhg.de/87c

QD COLOR FILTERS FOR MICRO LEDS

Quantum dot-based color filters for micro-LEDs are one of the most promising future technologies for displays. This technology makes displays even more brilliant, efficient and even thinner compared to displays with conventional color filters. The Fraunhofer IAP and the Korea Electronics Technology Institute (KETI) are working together in the research project "CoCoMe" on the development of printed QD color filters for microLEDs.

Dr. Youngsam Kim, president of KETI and Prof. Alexander Böker, director of the Fraunhofer IAP confirm the renewal of their collaboration.

Future technology for displays

Conventional color filters suffer from high light loss and relatively low color purity. Color filters based on quantum dots, on the other hand, are highly efficient because they do not filter light, but absorb it with much lower losses and emit it again in high purity. The aim of the project is to develop QD-based color filters for microLEDs and to realize a new technology of printing these color filters. Fraunhofer IAP and KETI have been working together for ten years. //

Dr. Armin Wedel
Functional Materials and Devices

Find out more about this topic:
https://s.fhg.de/Qpc

CONTACT LENSES
WITH MEDICINE AND SUGAR

Contact lenses that release drugs in a controlled way and ensure long contact times in the eye are being developed by the Fraunhofer IAP together with Israeli and German partners. The active ingredient is encapsulated in liposomes and bound to the inside of the contact lenses. This way, it is intended to remain in the eye for longer. In addition, the contact lens is to be made particularly compatible with the help of sugars.

Dr. Ruben R. Rosencrantz
Biofunctionalized Materials and (Glyco)Biotechnology

On the track to a marketable medical device

The Fraunhofer IAP is developing glycopolymers for this purpose. On the one hand, they are coupled on the surface of the entire contact lens in order to ensure the smooth gliding of the eyelid, and on the other hand they fix the liposomes carrying the drug to the contact lens. In order to obtain a marketable medical product, the cost-efficient production of glycopolymers is also a very important aspect. //

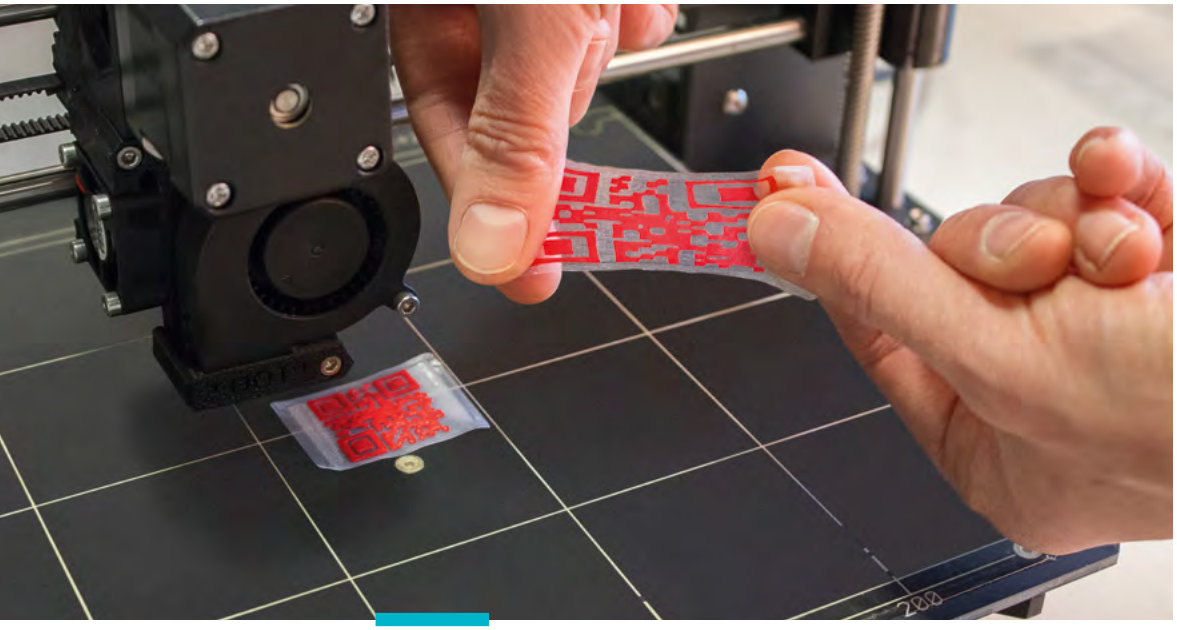
Find out more about this topic:
https://s.fhg.de/Si9

INTEGRATED SUGAR MOLECULES PROTECT CELL CULTURES

The coating of cell culture vessels with glycopolymers protects adherent cells that, for example, contain active substances for the pharmaceutical industry.

In order to gently detach animal or plant cells from their cell culture vessels, which are used for the development of new active substances, for example, researchers at the Fraunhofer Institutes for Applied Polymer Research IAP and for Cell Therapy and Immunology, Bioanalytics and Bioprocesses IZI-BB integrate sugar molecules on the bottom of the cell culture vessels. This is one of over 20 projects of the High-Performance Center "Integration of Biological and Physical-Chemical Material Functions", which is coordinated by the two Potsdam institutes since April 2017. ***//***

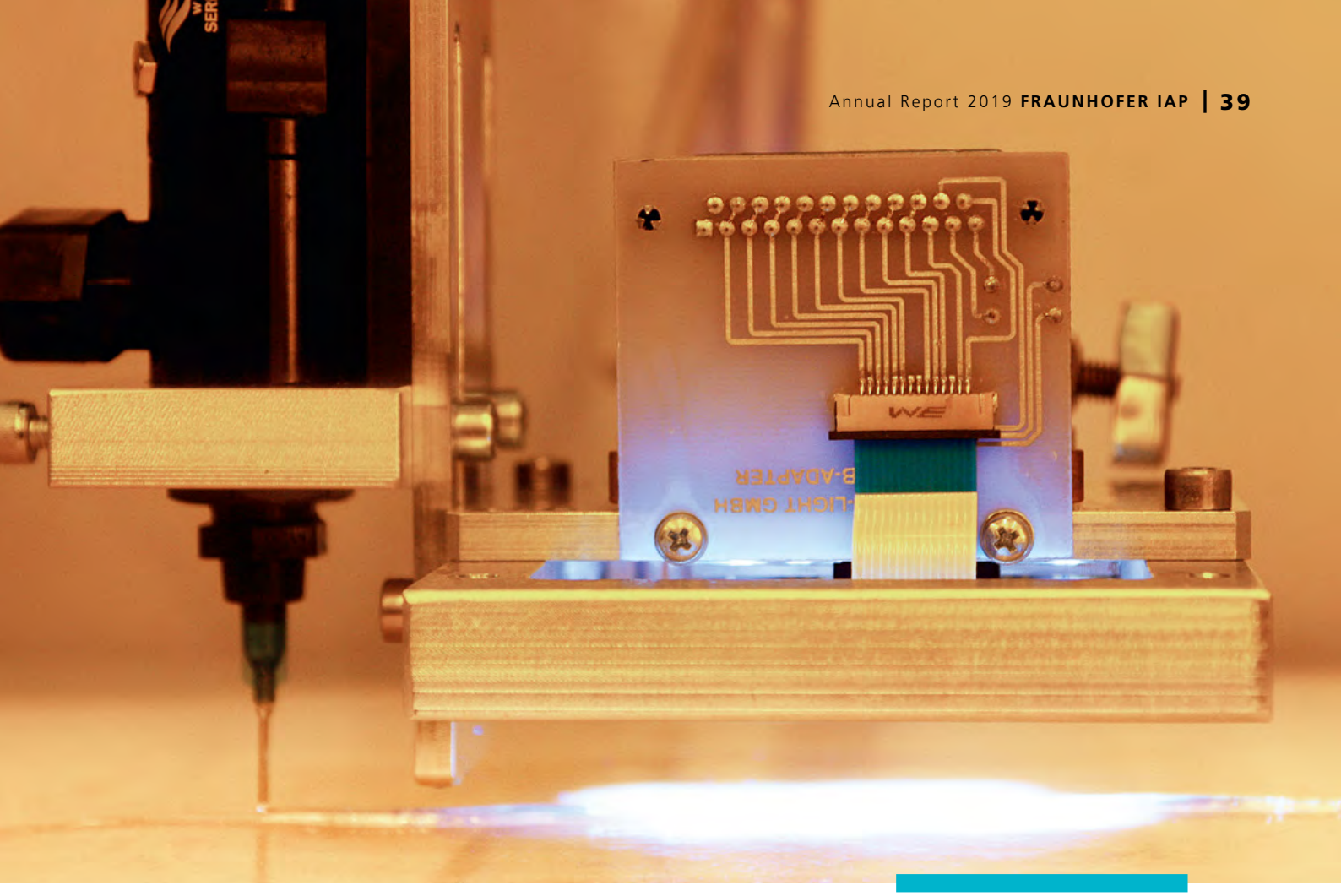
SHAPE-MEMORY
QR CODES



Dr. Thorsten Pretsch
Shape-Memory Polymers

Find out more about this topic:
https://s.fhg.de/M5J

A new process for the additive manufacturing of QR codes with shape memory properties has been developed at the Fraunhofer IAP in Potsdam. It is based on the 3D printing of shape memory polymers. The QR codes were mathematically examined at the Fraunhofer Institute for Industrial Mathematics ITWM in Kaiserslautern; the print quality and the shape memory effect are very good. Even very flat and light QR codes can be produced. This makes the technology perfect for labels, e. g. as a security device against product piracy. The high-tech polymers can be processed with commercially available 3D printers. //



3D PRINTING OF RESINS
FAST CURING WITH UV LED

A new 3D printing process, which should be clearly superior to the current processes in terms of print quality and speed as well as material homogeneity, is being developed in the research project "Belt deposited, double UV-cured materials for 3D engineering – overcoming the property limits of today's Rapid Manufacturing, BUERMa". The project with FKZ 03ZZ0145A, which is funded by the BMBF's Twenty20 Initiative, is being carried out under the leadership of the Polymer Materials

Prof. Dr. Christian Dreyer
Tailored Materials

Efficient and cost-effective

and Composites PYCO research division of the Fraunhofer IAP and involves the key partner, the Berlin-based mechanical engineering and 3D printer company Karl Rabofsky GmbH, the company Bernhardt Kunststoffverarbeitungs GmbH, the Technical University of Wildau and the Freie Universität Berlin. **//**

SPONSORED BY THE
Federal Ministry of Education and Research

Find out more about this topic:
https://s.fhg.de/yr7

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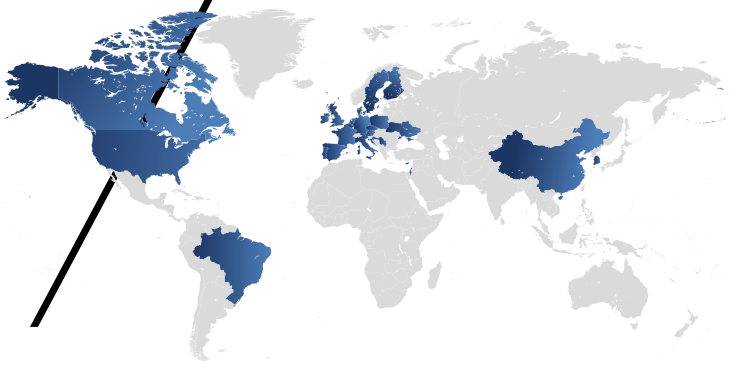


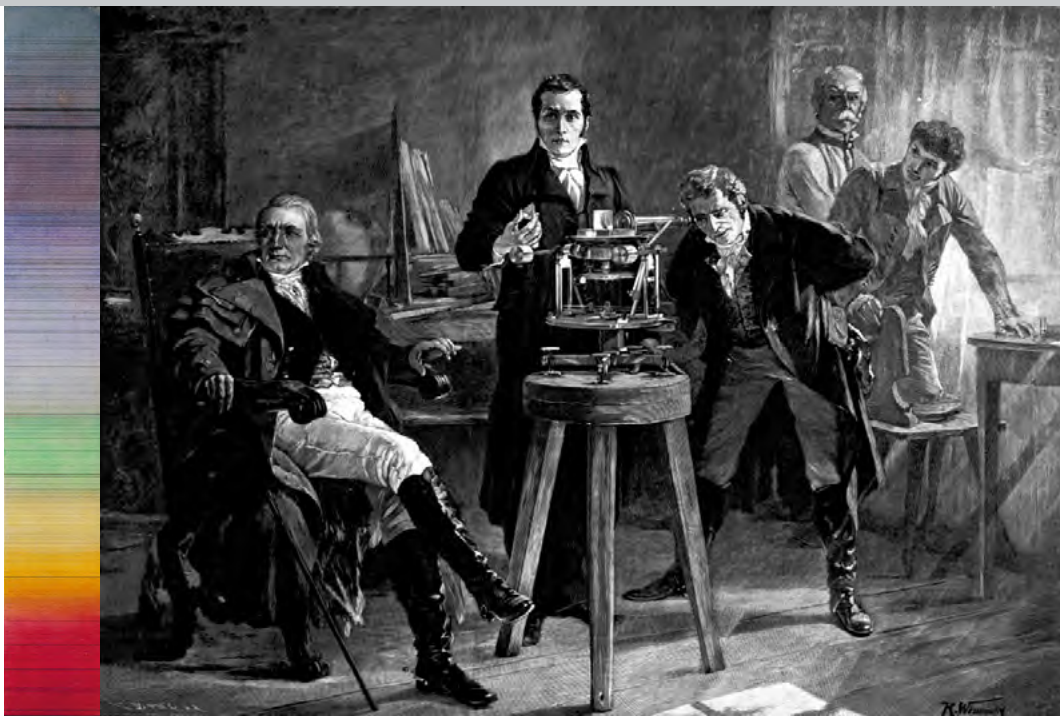
THE FRAUNHOFER-GESELLSCHAFT

Joseph von Fraunhofer

The Fraunhofer-Gesellschaft is the world's leading applied research organization. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of this work by business and industry, Fraunhofer plays a central role in the innovation process. Based in Germany, Fraunhofer is an innovator and catalyst for groundbreaking developments and a model of scientific excellence. By generating inspirational ideas and spearheading sustainable scientific and technological solutions, Fraunhofer provides science and industry with a vital base and helps shape society now and in the future.

At the Fraunhofer-Gesellschaft, interdisciplinary research teams work together with partners from industry and government in order to transform novel ideas into innovative technologies, to coordinate and realize key research projects with a systematic relevance, and to strengthen the German and the European economy with a commitment to creating value that is based on human values. International collaboration with outstanding research partners and companies from around the world brings Fraunhofer into direct contact with the key regions that drive scientific progress and economic development.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 74 institutes and research institutions. The majority of our 28,000 staff are qualified scientists and engineers,



Fraunhofer demonstrates the spectrometer

www.fraunhofer.com

who work with an annual research budget of 2.8 billion euros. Of this sum, 2.3 billion euros is generated through contract research. Around 70 percent of Fraunhofer's contract research revenue is derived from

contracts with industry and publicly funded research projects. The remaining 30 percent comes from the German federal and state governments in the form of base funding. This enables the institutes to work on solutions to problems that are likely to become crucial for industry and society within the not-too-distant future.

Applied research also has a knock-on effect that is felt way beyond the direct benefits experienced by the customer: our institutes boost industry's performance and efficiency, promote the acceptance of new technologies within society, and help train the future generation of scientists and engineers the economy so urgently requires.

Our highly motivated staff, working at the cutting edge of research, are the key factor in our success as a scientific organization. Fraunhofer offers researchers the opportunity for independent, creative and, at the same time, targeted work. We therefore provide our employees with the chance to develop the professional and personal skills that will enable them to take up positions of responsibility at Fraunhofer, at universities, in industry and within society. Students who work on projects at Fraunhofer Institutes have excellent career prospects in industry by virtue of the practical training they enjoy and the early experience they acquire of dealing with contract partners.

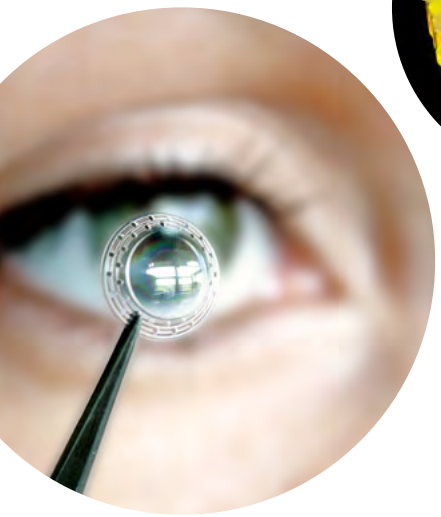
The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur. **//**

Status: January 2020

FRAUNHOFER GROUP MATERIALS

The Fraunhofer group MATERIALS combines the competencies of the material science oriented institutes of the Fraunhofer-Gesellschaft and covers the entire value chain, from the development of new and the improvement of existing materials and substances, through the appropriate manufacturing processes on a semi-industrial scale, the characterization of properties to the evaluation of application behavior. This also applies to the components and products manufactured from the materials and their system behavior in the respective applications.

In addition to experimental investigations in laboratories, pilot plants and in field tests, numerical simulation and modelling methods are equally important, from the molecule via the component to the complex system and process simulation.



In terms of materials, the Fraunhofer group MATERIALS covers the entire range of metallic, inorganic-non-metallic, polymeric and renewable raw materials as well as semiconductor materials. Hybrid materials and composite materials have gained great importance in recent years.

The scientists in the group institutes apply their know-how and expertise on behalf of customers, above all in the business areas energy and environment, mobility, health, mechanical and plant engineering, construction and housing, microsystems technology and safety. They are well networked nationally and internationally and contribute to materials-related innovations and innovation processes across a wide range of disciplines. //

key data:

– biggest group within the Fraunhofer-Gesellschaft
– 17 member institutes
– 5 guest institutes
– more than 2,400 scientists in member institutes
– approx. 462 million euro budget

More information on the Fraunhofer group MATERIALS and its member instituts are available at:
https://www.materials.fraunhofer.de/en.html

ALLIANCES, NETWORKS AND ASSOCIATIONS

Networking and exchange among each other is essential for successful research. For this reason, the Fraunhofer IAP collaborates with Fraunhofer Institutes from various scientific areas in Fraunhofer Alliances and networks. Our scientists also participate in numerous renowned committees and are engaged in associations and networks.

In the **Fraunhofer Alliance Polymer Surfaces POLO**, six Fraunhofer Institutes develop polymer products with functional surfaces, interfaces or thin layers. The focus of the Fraunhofer IAP's work in the **Fraunhofer Alliance Nanotechnology** are nanomaterials. The 13 Fraunhofer Institutes of the **Fraunhofer Alliance Textile** combine their expertise to cover the entire textile value chain.

The Fraunhofer IAP is also an active member of the **Fraunhofer Network Electrochemistry**, one of 22 institutes in the **Fraunhofer Network Sustainability**, and a member of the **Forschungsallianz Kulturerbe**, an alliance of the Fraunhofer-Gesellschaft, the Leibniz Association and the Stiftung Preußischer Kulturbesitz. ***//***

For more information, please visit:

www.polo.fraunhofer.de/en.html
www.nano.fraunhofer.de/en.html
www.textil.fraunhofer.de/en.html
https://s.fhg.de/U5w

SERVICES OF THE FRAUNHOFER IAP

The Fraunhofer IAP's range of services offers innovative and sustainable material, process and product developments for the entire variety of polymer applications.

A broad spectrum of analytical methods ensures process control, material testing and routine analysis, as well as enabling the investigation of chemical and physical structures.

An overview of the wide range of services is available at:
https://www.iap.fraunhofer.de/en/services.html

EVENTS AND FAIRS

In order to get in dialogue with politics, economy, research and citizens, the Fraunhofer IAP also presented itself in various seminars, workshops, conferences and eight, partly international trade fairs in 2019.
Whether at JEC World, LOPEC, the International Green Week or the K2019 plastics trade fair, the Fraunhofer IAP always strives to provide an insight into its latest developments and broad research spectrum. The focus is both on citizen-oriented events, such as the Innovation Summit in Hamburg, the Potsdamer Tag der Wissenschaften, and on specialist events, such as the Quantum Dot Forum or the workshop on functional integration held in collaboration with the VDI. Further events can be found on:

https://www.iap.fraunhofer.de/en/events.html

Further information on memberships, networks and alliances are available at:
https://s.fhg.de/BkJ

FIGURES 2019

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PUBLISHED PATENTS

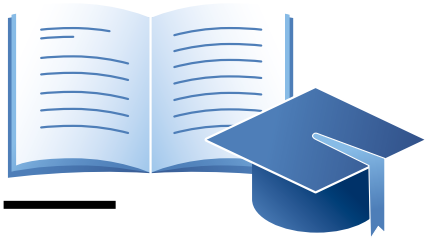
36

GRANTED PATENTS

AWARDED

Also in 2019 our scientists were awarded for their work.

Find out more about this topic: ***https://s.fhg.de/Nib***



51

THESES

thereof 10 bachelor theses, 20 master theses and 21 dissertations.

121

PUBLICATIONS

20 lectures, 17 posters and 84 publications, thereof also published online: 44

Find out more about publications: ***https://s.fhg.de/5SP***

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LECTURING ACTIVITIES
HELD

Prof. Dr.-Ing. Michael Bartke
lecture: Polymerisationstechnik,
Martin Luther University Halle-Wittenberg

Prof. Dr.-Ing. Michael Bartke
lecture: Polymer Reaction Engineering,
Martin Luther University Halle-Wittenberg

Prof. Dr. Alexander Böker
lecture: Biobased Building Blocks for Nanotechnology, University of Potsdam

Prof. Dr. Alexander Böker
lecture: Verarbeitung von polymeren Werkstoffen in Hinblick auf ihre Anwendung, University of Potsdam

Prof. Dr. Alexander Böker
seminar: Diplomanden-, Doktoranden-, Mitarbeiterseminar der Kolloid- und Polymerchemie, University of Potsdam

Dipl.-Ing. Thomas Büsse
lecture: Technologien der Kunststoffverarbeitung, Brandenburg University of Technology Cottbus - Senftenberg

Dipl.-Ing. Thomas Büsse
practical course: Kunststoffverarbeitung, Brandenburg University of Technology Cottbus - Senftenberg

Prof. Dr. Christian Dreyer
lecture: Allgemeine Chemie,
Technical University of Applied Sciences Wildau

Prof. Dr. Christian Dreyer
lecture: Chemische Grundlagen,
Technical University of Applied Sciences Wildau

Prof. Dr. Christian Dreyer,
Dr. Mathias Köhler
practical course: Konzept zur Umrüstung einer horizontalen Prepreganlage von thermischer Härtung auf UV-Härtung zur Herstellung von UV-härtbaren Prepregs, Technical University of Applied Sciences Wildau

Prof. Dr. Johannes Ganster
lecture: Biobasierte Polymerwerkstoffe I,
Brandenburg University of Technology Cottbus - Senftenberg

Prof. Dr. Johannes Ganster
lecture: Biobasierte Polymerwerkstoffe II,
Brandenburg University of Technology Cottbus - Senftenberg

Prof. Dr. Johannes Ganster
lecture: Strukturcharakterisierung von biobasierten Polymerwerkstoffen,
University of Kassel

Prof. Dr. Johannes Ganster
compact practical course: Methoden der Strukturcharakterisierung im Fraunhofer IAP,
University of Kassel

Prof. Dr. Dieter Hofmann
lecture: Physikalisch - Chemische Eigenschaften der Werkstoffe: PEW organisch,
Technische Universität Berlin

Priv.-Doz. Dr. Silvia Janietz
lecture: Polymere für die organische Elektronik, University of Potsdam

Prof. Dr. André Laschewsky
lecture: Functional Polymers (Stimuli-responsive Polymers), University of Potsdam

Prof. Dr. André Laschewsky
lecture: Naturstoffe und Makromolekulare Stoffe, University of Potsdam

Prof. Dr. André Laschewsky
lecture: Polymerchemie (AWP2),
University of Potsdam

Prof. Dr. André Laschewsky
lecture: Protecting Group Strategies (in Organic and Polymer Synthesis),
University of Potsdam

Prof. Dr. André Laschewsky
lecture: Technische Chemie,
University of Potsdam

Prof. Dr. André Laschewsky
practical course: Polymerchemie,
University of Potsdam

Dr. Rainer Rihm
lecture: Werkstoffkunde für Mechatroniker und Elektrotechniker I,
Beuth University of Applied Sciences Berlin

Dr. Rainer Rihm
lecture: Werkstoffkunde für Mechatroniker und Elektrotechniker II,
Beuth University of Applied Sciences Berlin

Dr. Rainer Rihm
exercise: Werkstoffkunde für Mechatroniker und Elektrotechniker I,
Beuth University of Applied Sciences Berlin

Dr. Rainer Rihm
exercise: Werkstoffkunde für Mechatroniker und Elektrotechniker II,
Beuth University of Applied Sciences Berlin

Dr. Joachim Storsberg
lecture: Macromolecular Chemistry in Pharmaceutical and Chemical Engineering, Beuth University of Applied Sciences Berlin

Prof. Dr. Horst Weller
lecture: Nanochemie I,
Universität Hamburg

Prof. Dr. Horst Weller
lecture: Physikalische Chemie für Fortgeschrittene, Universität Hamburg

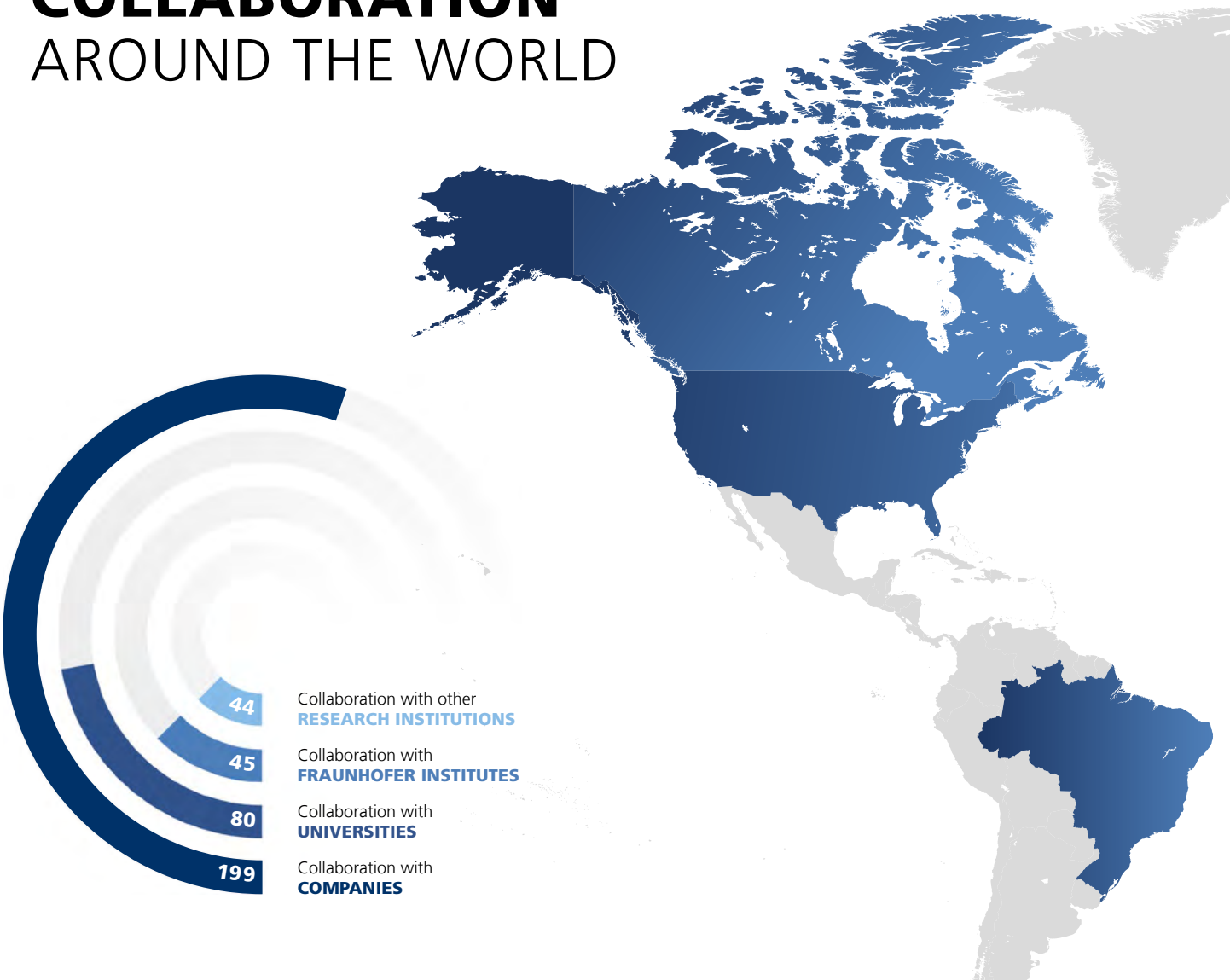
Prof. Dr. Horst Weller
practical course: Vertiefungspraktikum in Physikalischer Chemie, Universität Hamburg

Prof. Dr. Horst Weller
lecture series: Was wie wofür studieren – Seminar zu speziellen Themen der Nanochemie, Universität Hamburg

Prof. Dr. Horst Weller
practical course: Nanochemie,
Universität Hamburg

Dr. Ulrich Wendler
lecture: Makromolekulare Chemie,
Merseburg University of Applied Sciences

COLLABORATION
AROUND THE WORLD



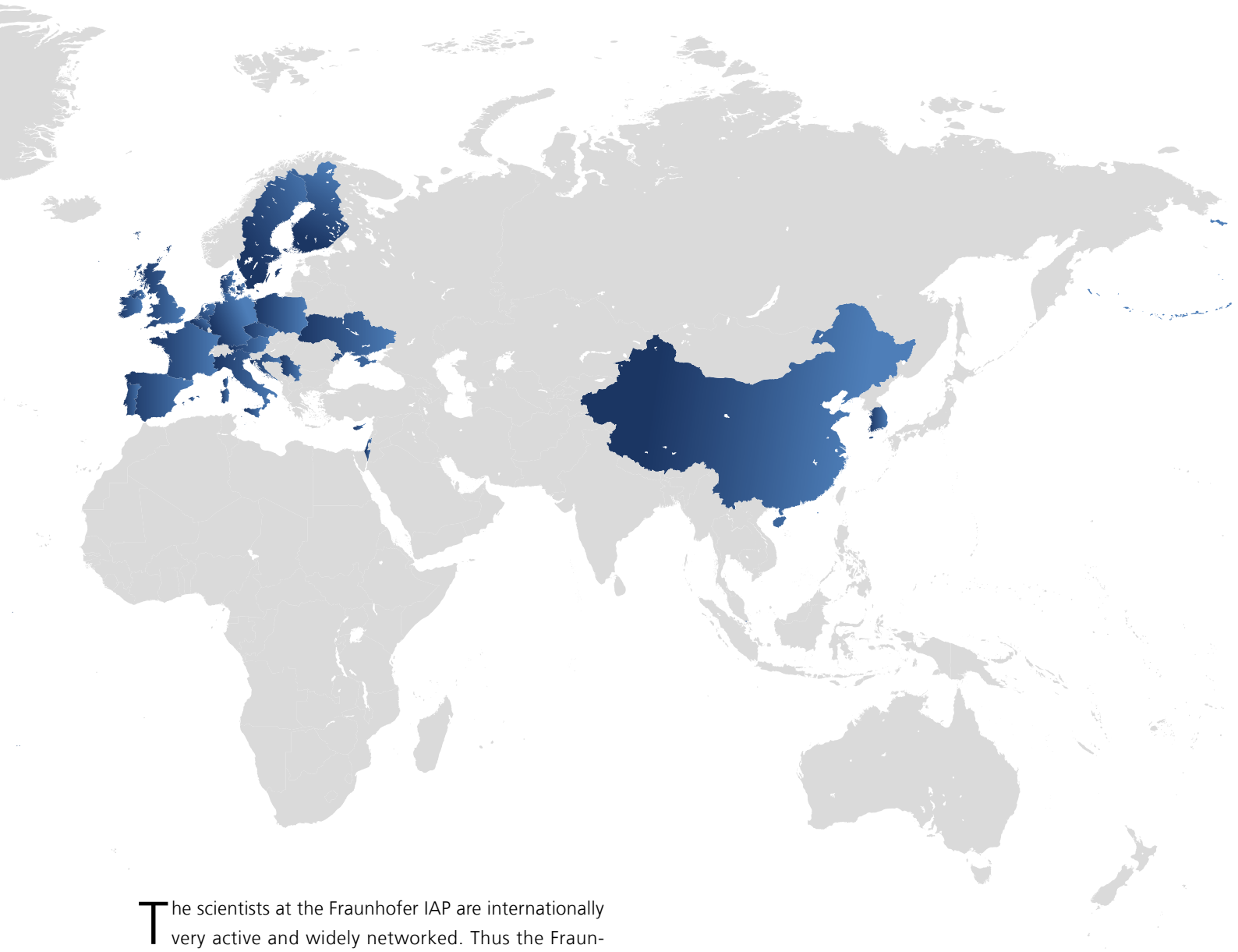
Collaboration with other **RESEARCH INSTITUTIONS**

Collaboration with **FRAUNHOFER INSTITUTES**

Collaboration with **UNIVERSITIES**

Collaboration with **COMPANIES**

6	4	-	3	AUSTRIA			
1	-	-	2	BELGIUM			
1	2	-	1	BRAZIL			
2	1	-	-	CANADA			
3	2	-	1	CHINA			
-	-	-	1	CROATIA			
-	1	-	-	CYPRUS			
-	1	-	-	CZECH REPUBLIC			
-	2	-	-	DENMARK			
1	1	-	1	FRANCE			
154	46	45	28	GERMANY			
2	4	-	-	GREAT BRITAIN			
1	-	-	-	GREECE			
-	1	-	-	IRELAND			
3	2	-	1	ISRAEL			
2	-	-	1	ITALY			
4	2	-	-	NETHERLANDS			
-	-	-	1	POLAND			
1	-	-	-	PORTUGAL			
3	2	-	1	REPUBLIC OF KOREA			
-	1	-	-	SERBIA			
1	-	-	-	SINGAPORE			
1	1	-	-	SPAIN			
2	-	-	-	SWEDEN			
6	-	-	-	SWITZERLAND			
-	3	-	1	UKRAINE			
5	4	-	2	USA			



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page 8 – 9	Till Budde (top left, top right, bottom right, bottom left), Michael Setzpfandt (center right)
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