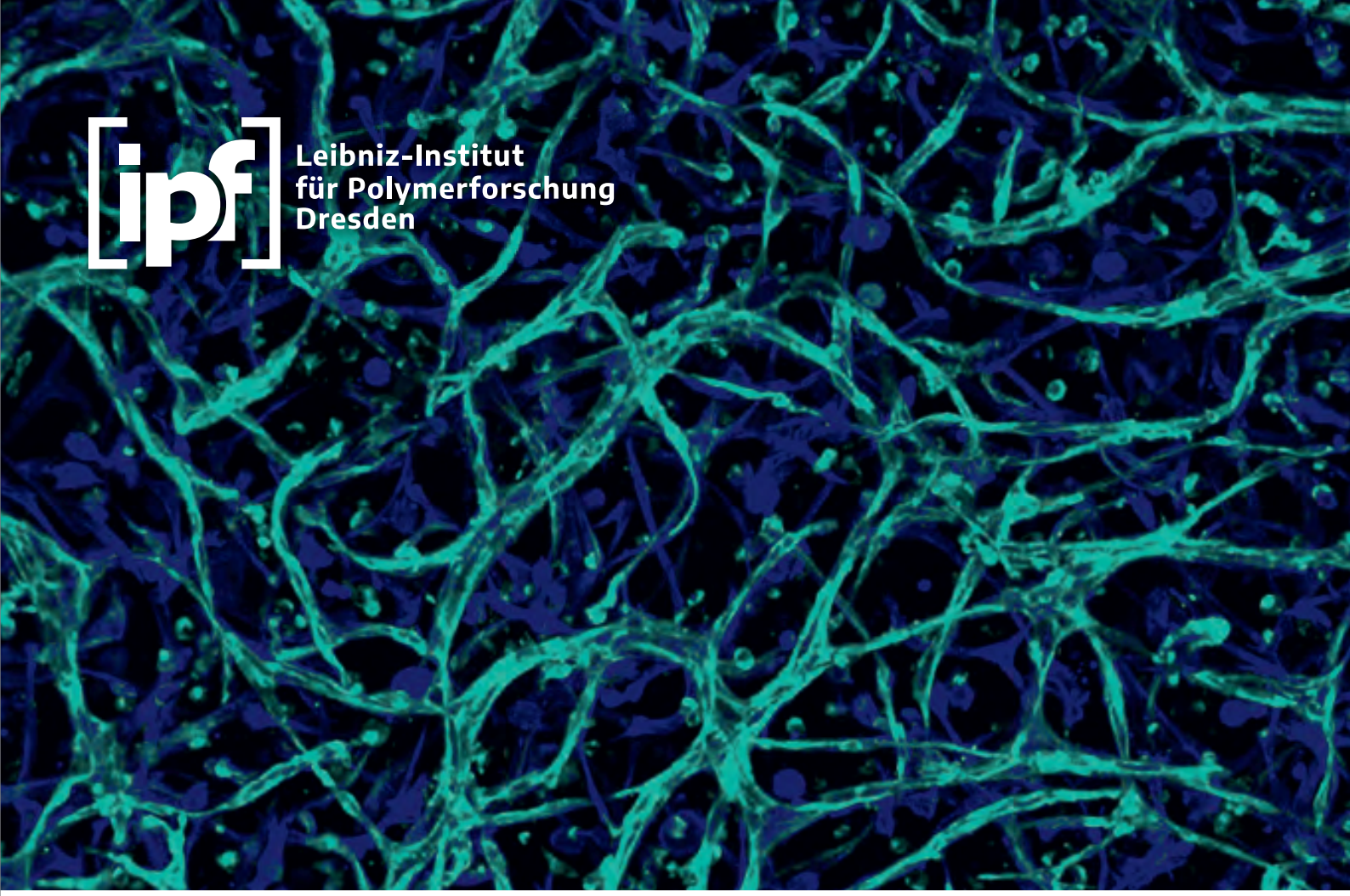
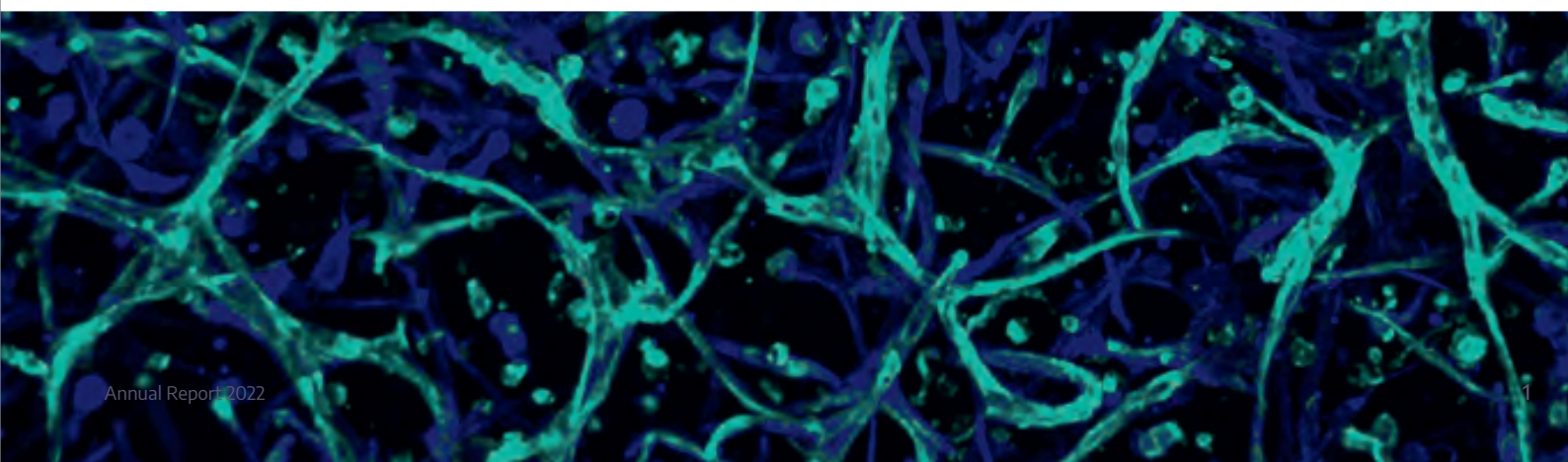


Leibniz-Institut
für Polymerforschung
Dresden

Annual Report 2022

Leibniz Association

DRESDEN concept
SCIENCE AND INNOVATION CAMPUS



Leibniz-Institut
für Polymerforschung
Dresden

Leibniz Institute of Polymer Research Dresden

Annual Report 2022

Contents

Preface

Dear readers,

The year 2022 has changed our worldview. The threat to our civilizational basis has become terribly concrete with the Russian invasion of Ukraine. The year at our institute was marked by this threat.

Nevertheless, there are positive things to report:

In March 2022, our institution's performance over the past seven years was evaluated. The institute's research units were rated excellent, very good to excellent and very good. We thank all the staff members who made this excellent result possible! We are particularly grateful to the present chairman of the Scientific Advisory Board, Professor Dr. Matthias Ballauff, and his predecessor Dr. Jens Rieger for their valuable support in preparing our presentation.

The evaluation commission strongly supported our plans to expand materials research into system integration for digital health technologies so we could apply for a corresponding strategic extension of our research program.
The specific recommendations from the evaluation are the starting point for the structured further development of the institute's research strategy, initiated in autumn 2022, with which we also refer to our participation in excellence cluster initiatives at TU Dresden and the growing number and relevance of independent (junior) research groups at the institute.

The survey for the year 2022 presented to you with this report shows the institute's high performance level despite pandemic-related restrictions. We are particularly pleased that we are increasingly succeeding in using the joint research of complementary organizational units of the IPF and the cooperation with partners from the excellent Dresden environment for top scientific achievements. We are certain that this synergetic approach will enable us to contribute even more effectively to solutions for the global meta-topics of resources, health and information.

The undersigned have taken office on the IPF Board in 2022 and are looking forward to meeting the opportunities and challenges of the institute, focusing on a balance of continuity and renewal and constructive exchange with all.

We would like to acknowledge the commitment, support and partnership that the institute received during the past year, and express our gratitude to our coworkers for their dedicated and creative work!

The Board of the IPF
Carsten Werner und Agnes Schausberger

Large Molecules – Great Ideas

Innovative polymer systems for future technologies

Research Program

The IPF's holistic materials research encompasses synthesis, characte as well as their processing into materials for high-tech applications. importance in this context. Together with partners, especially in key questions in the fields of resources, health and information.

The IPF is divided into five **Scientific Institutes / Program Areas** supported by Administration / Technical Services and Research Technology.

Program Area 1

The IPF Institute
Macromolecular Chemistry
focuses on aspects of chemical synthesis. The focus is on polymer-based materials for organic electronics and optics, functional materials for coatings, responsive polymers for sensors, actuators and biomedicine, and nanocomposites as energy and sensor materials.

Program Area 2

The IPF Institute
Physical Chemistry and Polymer Physics
focuses on understanding and designing interfaces and surfaces in polymer-based and colloidal systems. Method development is linked with the exploration of chemical and physical assembly strategies.

Program Area 3

The IPF Institute
Polymer Materials
realizes engineering research for the development of structural materials and functional polymer materials. This research area includes both the design of processing technologies and the manufacture of materials with tailored properties.

Program Area 4

The IPF Institute
Biofunctional Polymer Materials
explores the structural basis of potentially useful functionalities of living matter, designs biology-inspired materials, and enables the translation of new biomaterials into medicine and biotechnology.

Program Area 5

The IPF Institute
Theory of Polymers
focuses on the universal properties of polymers and soft matter and develops – in close cooperation with experimental research – new concepts and methods of theoretical polymer physics and simulation.

rization, theory and simulation of polymers and their interactions, The control of interfacial properties and processes is of particular Dresden and at the Leibniz Association, the institute thus addresses

The IPF currently has **20 Independent (Junior) Research Groups** that are often trans-disciplinary and cross-institutional, exploring new topics and methods within contemporary and advanced flexible research structures.

IPF research is increasingly focused on integrative **Strategic Topics** that shape the profile of the institute and synergistically combine the expertise of the program areas:

- Basic concepts of soft matter
- Bioinspired materials
- Functional materials and systems
- Process-controlled structural materials
- Data science-based material research
- Sustainability and environmental protection

For example, the collaboration of scientists from different IPF program areas has led to the physical elucidation of switching principles in stimuli-responsive polymer systems, establishment of chemokine-affine biohybrid hydrogels for the treatment of chronic inflammation, fabrication of polymeric semiconductors with high charge mobility for organic electronics, preparation of functional nanocomposites for electrical energy storage, development of novel self-healing elastomers, and tailored absorber materials to remove pollutants from water.

Expanding the boundaries of polymer analysis

A research group led by Professor Dr. Albena Lederer, head of the Center for Macromolecular Structure Analysis at the IPF Institute of Macromolecular Chemistry and a professor at Stellenbosch University in South Africa, is developing innovative methods to effectively and reliably analyze biomimetic, responsive and highly complex macromolecular systems. Understanding the interplay of multiple structural parameters and their simultaneous determination in minute sample quantities allows, for example, the rapid development and screening of polymer drug carriers or polymer-hybrid structures.

Material design through innovative nanotechnologies requires the accurate and reliable characterization of new structures and demands flexible analytical methods for quantitatively determining multiple components in complex polymer-nanoparticle systems. Reliable separation of components and simultaneous detection of size, chemical structure, topology, shape, and quantity in just one measurement of minute sample quantities are essential in this context.

"We wanted to know whether we could track internal folding processes, such as those occurring in proteins, with high sensitivity in small, single-chain nanoparticles. Can the accumulation of proteins responsible for Alzheimer's disease be detected quantitatively in this way? Is it possible to obtain quantitative and qualitative information as well as the location of the encapsulated drug or protein in vesicles, such as polymersomes, nanoreactors or modified exosomes, in order to optimize drug transport?" is how Albena Lederer outlines what drove the researchers.

Answers to such questions can be provided by asymmetric flow field flow fractionation (AF4) with fivefold detection, including various light scattering, ultraviolet radiation and viscosity detection methods, which helps understand structural changes depending on loading or modification processes. Especially for fragile nanostructures, such as hybrids of polymers, proteins, nanoparticles, or enzymes, which are difficult to study with other analytical methods, AF4 will enable the elucidation of intra- and intermolecular interactions between different molecules and of their spatial arrangement.

For many years, scientists from the IPF have been cooperating with colleagues at the University of Stellenbosch on all the

questions regarding the specific adaptation of field flow fractionation (FFF) methods. The collaboration intensified when Dr. Upenyu Muza was hired as the first African scientist to be integrated into the IPF within an EU project. After Albena Lederer was appointed as a professor at Stellenbosch University in 2020, a powerful German-South African Polymer Separation Research Group was formed. This group has since been instrumental in advancing the development of innovative FFF methods and expanding the frontiers for the analysis of supramolecular and complex polymers. Especially by coupling different methods, Albena Lederer's group has enriched the deep understanding of structural changes within complex macromolecular samples as a function of various parameters (such as molar mass, crosslinking, pH, concentration, etc.). Multiple detections provide a large quantity of information from a single measurement. Numerous parameters describing the molecular shape in dilute solutions are considered, such as scaling, molar mass, size, shape, apparent density and intrinsic viscosity. The separation and quantification of encapsulated or released drugs realized in this manner are of great importance for the development of new therapeutic methods.

> » FFF was still a very unknown niche method in 2007. The immense research of the last few years has led us to expect that we will soon be able to use it as a particularly powerful analytical tool for high-tech polymer development. «

In the future, a single measurement will provide even more information when quintuple detection is coupled with thermal FFF (ThFFF). Due to the thermophoretic properties of the analytes, it will then also be possible to separate and analyze polymers according to microstructure, topology and chemical composition. "In recent years, we have made great progress in moving from a trial-and-error approach to a targeted theory-based method, including analytical predictions," says Albena Lederer. In addition, she says, we have demonstrated the potential of ThFFF for characterizing crosslinked and branched polymer topologies. ThFFF is, therefore, to be developed over the next few years into a powerful tool that can be used, for example, to study ultrahigh-molecular-weight polyolefins or the distribution of plasmonic properties in metal-polymer hybrid systems.

Publications on the subject:
https://www.polymerseparation.org/ptm/?team_id=1

Polymer Separation Group Albena Lederer expanded her Polymer Separation Group, founded in 2007, after her joint appointment at Stellenbosch University. This group is the first at the IPF to integrate with an international university. The group's focus is on innovative analytical methods based on interaction and size exclusion chromatography, field flow fractionation and multiple detection techniques. The elucidation of structure-property relationships in complex macromolecular systems benefits greatly from international expertise and mobility, involving PhD students, scientists and technicians in Germany and South Africa alike.

Picture above (from left to right): Leading young scientists Dr. Susanne Boye, Dr. Martin Geisler, Dr. Zanelle Viktor, Dr. Helen Pfukwa, Dr. Upenyu Muza as well as Prof. Dr. Albena Lederer (front)

Microplastics and their physicochemical interactions with the environment

What interactions occur between microplastic particles and biological surfaces? Scientists in the “Polymer Interfaces” department at the IPF Institute of Physical Chemistry and Polymers Physics are working on this question. The research is affiliated with the “Collaborative Research Centre Microplastics”, which was established at the University of Bayreuth in 2019 to scientifically investigate the contamination of the environment by plastics and develop innovative solution approaches. The Dresden researchers are bringing a physicochemical perspective to the project, which will then be combined with biological findings.

“In the last few decades a lot of plastic materials have entered to the environment. This led to a large amount of microplastic particles that may interact with nature in various ways,” says Dr. Günter K. Auernhammer, head of the Polymer Interfaces department. The spectrum of microplastic particles is broad: They differ in shape, size, polymer type and degree of weathering in nature. The variability is also increased by organic and inorganic material adsorbed on the surfaces of microplastic particles due to environmental influences. This, in turn, creates new interactions and gives rise to a layer called the “eco-corona”. The interactions of microplastic particles with their surroundings are determined by both the particle itself and its eco-corona.

It is precisely these interactions of microplastic particles with biological surfaces that are being investigated at the IPF as part of the Collaborative Research Centre on Microplastics based at the University of Bayreuth. The eco-corona can be described very well by classical polymer physics.

Günter K. Auernhammer explains: “For example, we are investigating how certain microplastic particles internalize in cells or what adhesion they have on cell surfaces. We usually do this with nonbiological surfaces that resemble natural properties. Or those that deliberately have completely different properties.” In the first funding period, the scientists used simple, spherical model particles to study the basic principles of interactions since they are easier to examine analytically.

The collaborative research of scientists in Dresden and Bayreuth showed that the great variability of microplastic particles in terms of particle adhesion can be reduced to a few physicochemical parameters of the surfaces: The zeta potential, which measures the electrical charge on the surface of the particles, and the mechanical properties of the surface of the microplastic particles, including the eco-corona. The scientists thus succeeded in creating categories to summarize the properties of different microplastic particles and their interactions. Günter K. Auernhammer explains: “We need generalizing principles that describe interactions.”

The second funding period is currently underway. The simple model particles are being further developed to increasingly reflect the properties of microplastic particles found in nature. For this purpose, biochemical properties are specifically modeled. “Maybe physicochemistry does not explain everything;

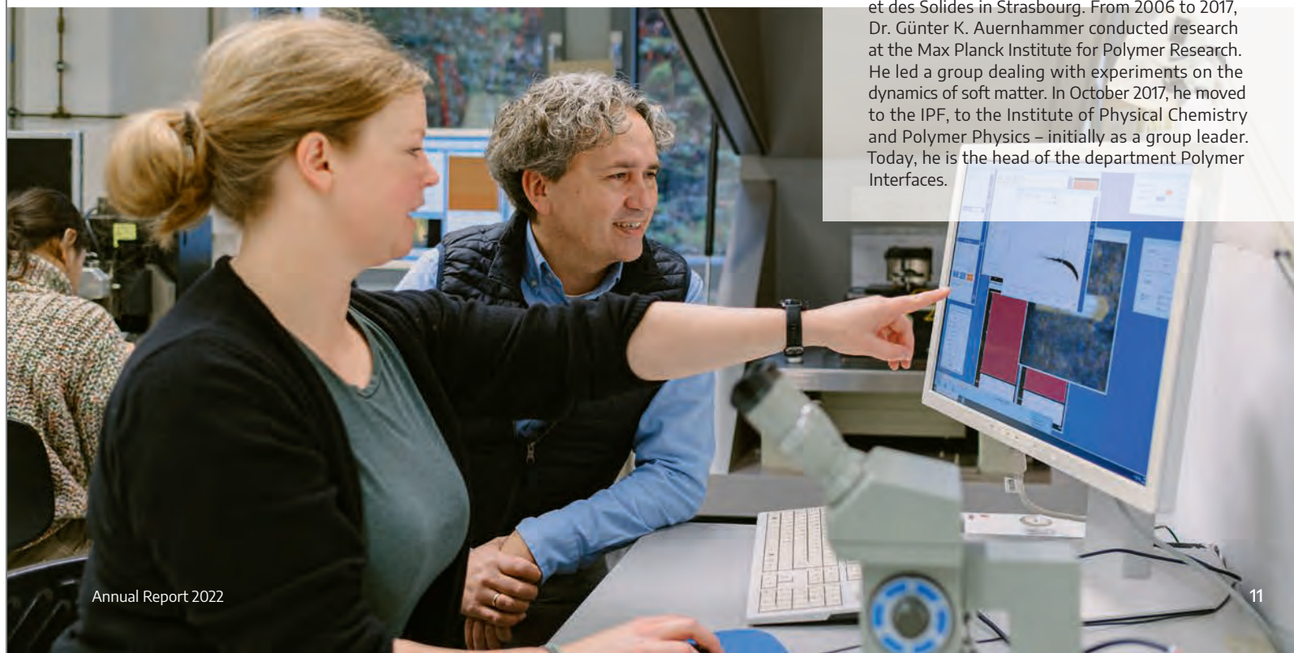
perhaps there are also specific biological interactions,” says Günter K. Auernhammer. There could also be an interplay of physicochemical and biological properties. In this funding period, scientists aim to provide information about the influences of microplastic particles on living organisms. The fundamental questions are as follows: What relevance do the particle properties have for the adhesion of the particles to cells and their internalization into cells?

» If I had to sum up the last four years in one sentence, I would say: Polymer physics also works for the eco-corona. That means we have elaborated theoretical models from polymer physics that we can use for our understanding. We bring that together with the understanding of our colleagues from biology. «

Finally, the researchers want to answer concerns important for the environment and society: What are the properties of the various microplastic particles that are harmless or dangerous to living organisms? How can the formation and spreading of harmful particles be avoided?

Dr. Günter K. Auernhammer
studied physics in the 1990s at the University of Bayreuth and at the Université Denis Diderot in Paris, France. In Bayreuth, he completed his doctorate as a theoretical physicist on theoretical hydrodynamics. He then began experimenting as a postdoc, as an individual Marie Curie Fellow in France, at the Institute de Mécanique des Fluides et des Solides in Strasbourg. From 2006 to 2017, Dr. Günter K. Auernhammer conducted research at the Max Planck Institute for Polymer Research. He led a group dealing with experiments on the dynamics of soft matter. In October 2017, he moved to the IPF, to the Institute of Physical Chemistry and Polymer Physics – initially as a group leader. Today, he is the head of the department Polymer Interfaces.

Original publication on the subject:
https://pubs.acs.org/doi/10.1021/acs.langmuir.1c03204



The tailored fiber placement process for extreme lightweight construction

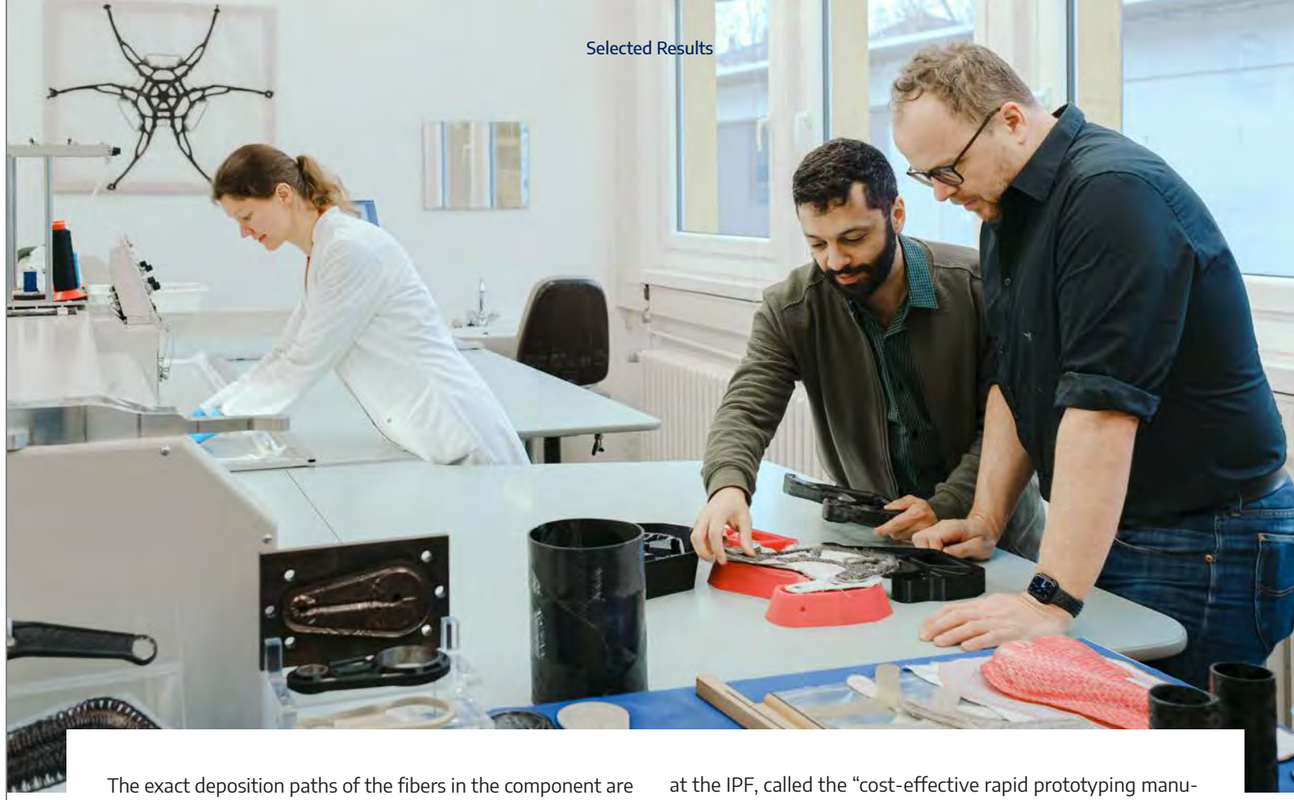
The tailored fiber placement (TFP) process was invented at the IPF in Dresden. This process is used to manufacture extremely stiff fiber-reinforced plastic (FRP) composites suitable for high loads. The “Complex Structural Components” group of Professor Dr.-Ing. Axel Spickenheuer of the IPF Institute Polymer Materials demonstrated the potential of this process - together with two specially developed software tools - for extreme lightweight construction. They developed a component, a so-called C-frame, that has the same stiffness as its steel counterpart but is approximately 80 percent lighter.

Clinching pliers are tools used to join materials, often sheet metal, together as part of a joining process by forming the materials without the use of any filler materials. Such joints have the advantage of greater average strength than, for example, spot-welded joints, rivets or screws. However, this joining process usually requires high forces. The clinch clamp, called the C-frame, must also withstand these forces. It is primarily subjected to compressive forces during the joining process. C-frames have been correspondingly robust and heavy up to now.

Recently, the group led by Axel Spickenheuer, who is also head of the Integrative Simulation cluster, successfully developed a replacement for a metallic clinch clamp that makes working with the tool considerably easier: A part made of FRP has a significantly reduced mass but equal stiffness and strength.

To achieve this, the scientists used the TFP process developed at the IPF. In this process, a modified automatic embroidery machine is used to fix the reinforcing fibers, which always function as load-bearers in composites, to a flat base material in accordance with the requirements of the subsequent component load. The result is a preform that is optimally adapted to the load. Axel Spickenheuer explains, “We can – according to the principle of anisotropy, i.e., the directional dependence of properties – specifically adapt the characteristic values of the composite component by means of a targeted fiber orientation.”

Dr. Tales de Vargas Lisbôa spent his entire undergraduate career in Brazil. At the Federal University of Rio Grande do Sul, he completed a bachelor’s and master’s degree in mechanical engineering before beginning work on his doctoral thesis at the same location. During this time, he came to the University of Siegen, Germany, for a year. After completing his PhD, he worked in scientific institutions and companies in Brazil. In 2019, Tales de Vargas Lisbôa joined the IPF as a visiting scientist and has been a research associate since June 2020.



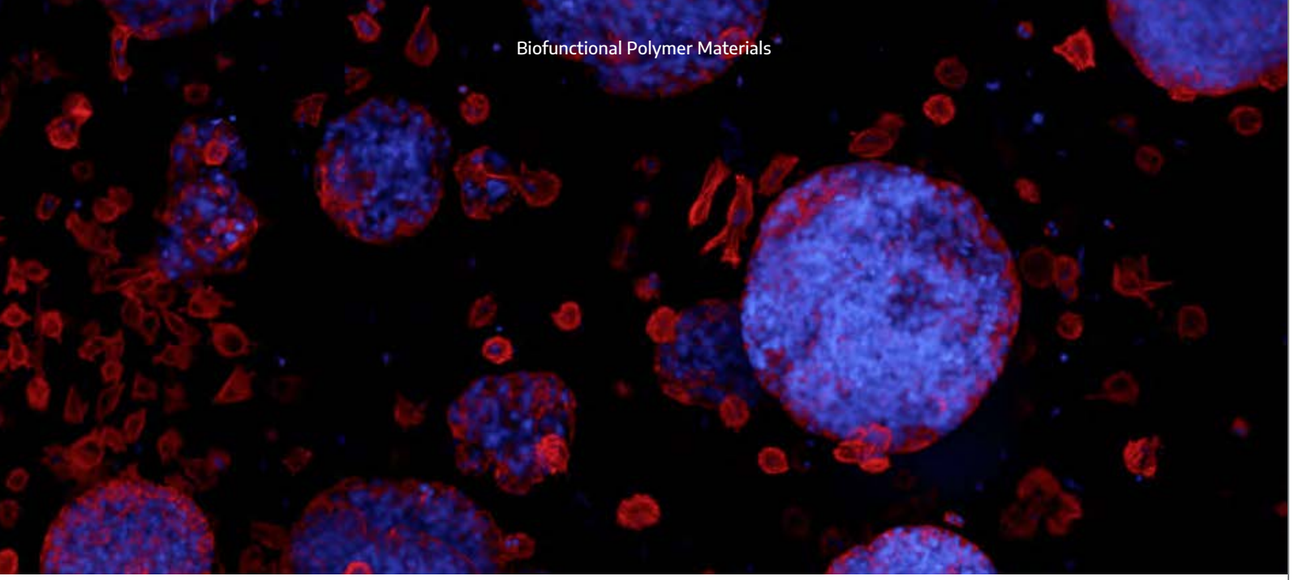
The exact deposition paths of the fibers in the component are calculated in advance of prototype production using simulation. For this purpose, the IPF scientists developed two software solutions to address the specific characteristics of the TFP process, dealing with the manufacturing process itself on the one hand and with the virtualization of the components for finite element analysis (FEA) on the other. The software tools have already been made available to TFP component developers as part of a spin-off. The integration of these tools into an iterative optimization process greatly facilitates the design of stress-optimized components. “We calculate the effects on the component: On shape and geometry, on deformations in the application or what a possible failure would look like,” explains Dr. Tales de Vargas Lisbôa, a research associate in the working group. Depending on the results, the deposition paths are then varied to further optimize the component. The results of the FEA thus indicate areas where adjustment of the component geometry and/or optimization of the fiber deposition pattern could be beneficial.

Finally, the consolidation of the components, the joining of fibers and matrix, is conducted by a process also developed at the IPF, called the “cost-effective rapid prototyping manufacturing process”. Here, the component’s thickness profile determined with the software's help serves as the basis for positive molds to be modeled and created using the 3D printing process. These molds are used for casting silicone negative molds. The fiber preforms are infiltrated with epoxy resin and cured in a vacuum-assisted process. Once the final component design is ready, only two to five days are usually needed to produce all the tools required for consolidation. In comparison, this process takes several weeks for metal tools.

> » With the help of mathematical optimization, we want to develop the best possible component. «

With the TFP process and the corresponding calculations and simulations using software, the scientists finally achieved the target goal: The mass of the C-frame could be reduced to approximately 21 percent of the reference component – 520 grams instead of 2.45 kilograms.

Further publications on the subject:
https://www.ipfdd.de/en/research/institute-of-polymer-materials/materials-engineering/research-group-complex-structural-components/



Developing better therapies against pancreatic cancer using tissue engineering

In the project “CHIPIN – Culture of Human cells Isolated from Pancreatic cancer tissues IN 3D”, a group of scientists at the IPF Institute Biofunctional Polymer Materials is working on new forms of therapy to combat pancreatic cancer. The group, led by Professor Dr. Daniela Lössner, is developing biomimetic 3D tumor models to decipher tumor cell extracellular and cellular communication.

Cancer is a diagnosis associated with great fear, especially pancreatic cancer. With a five-year overall survival rate of approximately ten percent, pancreatic cancer is one of the most aggressive and deadly cancers. Surgical removal of the diseased tissue and chemotherapy often have unsatisfactory results. Therapies that use the immune system have not been successful in clinical trials thus far.
At the IPF, a group of scientists established by Professor Dr. Daniela Lössner aims to find better therapies for this type of cancer. In the “CHIPIN” project, researchers are focusing on mimicking the tumor microenvironment through tissue engineering. Only in the last few years has it been discovered that the microenvironment plays a major role in tumor. Daniela Lössner established the working group on the basis of a Consolidator Grant from the European Research Council; she is also researching and teaching at the Faculties of Engineering and Medicine at Monash University, Australia.
In tissue engineering, living tissues are artificially produced in the laboratory using biomaterials and cells. Cell biologists are collaborating with engineers to develop precisely designed 3D tumor models. While engineers are familiar with biomaterials, their properties and modifications and the possible combinations, biologists know how cells can be grown in the 3D model and which analyses must be performed after the experiments. For this purpose, the multidisciplinary team builds the matrix of the tumor, i.e., the scaffold in which the tumor grows, with synthetic polymers and biopolymers derived from nature.
Once the scaffold is in place, tumor cells and tumor-surrounding cells, called stromal cells, are introduced into it and begin to grow. The advantage of this is that “we can control and

monitor this system very precisely”, as doctoral student Verena Kast, who has been working on CHIPIN from the beginning, explains. For example, the team can control the growth of the tumor cells by introducing and concentrating certain adhesion molecules. Verena Kast continues, “By replicating the biomechanical properties and the 3D environment, the tumors cells grow just as in their original environment and not on plastic in conventionally used 2D cell culture flasks.” Animal testing can also be increasingly eliminated when using this method.

» I developed the project for personal and scientific reasons. The future simply lies in 3D cell culture models. «

Using the 3D model developed by Daniela Lössner and her group for the precisely controlled modification of the microenvironment of tumors and metastases, it is possible to decipher the communication between tumor and stromal cells or between tumor cells and the matrix surrounding them. “Biomechanics plays a very decisive role here, as it initiates various signaling pathways in the tumor, which then lead to its growth, for example,” says Verena Kast.

Alternatively, signaling pathways can lead to a reduction in growth. For example, scientists succeeded in slowing tumor growth in their 3D *in vitro* model by combining immunotherapy and chemotherapy in 2022. “Of course, we would like to expand on this in further studies. In particular for pancreatic cancer, it is extremely difficult to find a treatment that also achieves the effect in the clinic,” explains Verena Kast.

Prof. Dr. Daniela Lössner teaches and conducts research also at the Faculties of Engineering and Medicine at Monash University in Australia. She holds a bachelor and master degree in biology and a doctorate in natural sciences (Dr. rer. nat.) from the Faculty of Chemistry at the Technical University of Munich. For more than 17 years, she has worked as a researcher and group leader in Germany, Australia, Switzerland, the USA and the United Kingdom.
She was Deputy Director of the Centre for Regenerative Medicine at Queensland University of Technology, Australia, and Reader in Bioengineering and Cancer at Barts Cancer Institute, Queen Mary University of London, United Kingdom. She has received a number of national and international awards for her research, including the Joint Promotion Prize from the E.K. Frey - W. Werle Foundation and the Henner Graeff Foundation. The IPF considers itself fortunate to have been selected by Daniela Lössner as a partner institution of the “CHIPIN” project, which she has established within the framework of an ERC Consolidator Grant.

The research group was able to explain the underlying concept of tumor tissue engineering in a recent article in *Nature Reviews Materials*

https://doi.org/10.1038/s41578-023-00535-3

Liquid condensates in cells control many vital functions

Within the framework of the Cluster of Excellence “Physics of Life” (PoL), a group of scientists led by Professor Dr. Jens-Uwe Sommer from the IPF Institute Theory of Polymers is working on biomolecular condensates, separated liquid phases in living cells, which are indispensable for the explanation of many elementary life functions.

Physics of Life – PoL In the Cluster of Excellence “Physics of Life”, located at the TU Dresden, scientists from several research institutions concentrate on the laws of physics that underlie the organization of life in molecules, cells and tissues. One of the core groups of the cluster, the “Theoretical Physics of Living Matter” group, is headed by Professor Dr. Helmut Schießel, who is also the deputy speaker in the Cluster of Excellence. A group affiliated with the cluster, which deals with the theory of polymers, is led by Professor Dr. Jens-Uwe Sommer, head of the Institute Theory of Polymers at the IPF.

Picture above (from left to right): Dr. Holger Merlitz, Prof. Dr. Jens-Uwe Sommer, Prof. Dr. Helmut Schießel

A question concerning the activation of genes in a cell that could be answered with the help of polymer physics has brought together Professor Dr. Jens-Uwe Sommer and Dr. Holger Merlitz with Professor Dr. Helmut Schießel within the framework of the PoL Cluster of Excellence. Jens-Uwe Sommer is head of the Institute Theory of Polymers at the IPF; Helmut Schießel holds the Chair of Theoretical Physics of Life at the Technische Universität Dresden, and Holger Merlitz is the group leader and expert in computer simulations at the IPF. Their joint research addresses the following question: How is epigenetic information transferred through liquid condensates?

As background, the provision of hereditary information is realized not only by the DNA itself but also by proteins that adhere to the DNA, packaging it. When cells divide, this extra information on the proteins is not duplicated in advance like the DNA but is separated. As a result, some of these proteins with the extra information are attached to one DNA molecule, the others to the second molecule. Therefore, information is missing in each case. “I was interested in how all this could be reconstructed, how the missing information could be put back on the DNA,” says Helmut Schießel.

This can be explained with the help of so-called biomolecular condensates, separated liquid phases that proteins form in living cells under certain conditions, including corresponding polymers produced by the cell. Therefore, the authors named this process polymer-assisted condensation, PAC for short, which is closely related to the segregation of polymers in solutions. Polymer physics concepts are important for understanding biological functions. Biological polymer solutions, such as fluids in the cell or the cell nucleus, comprise many components and form

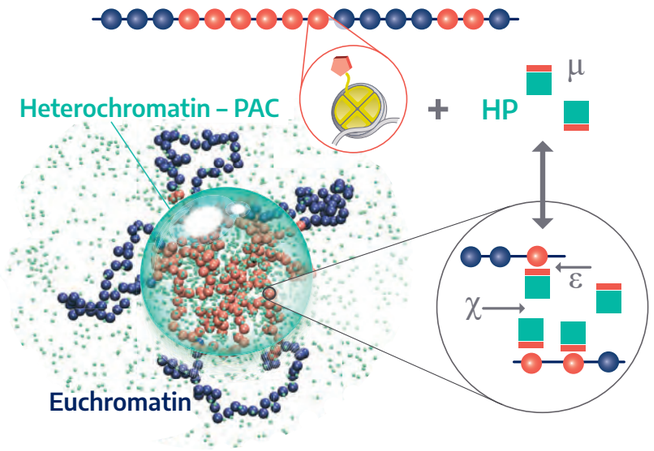
a complex solvent for large biopolymers, such as DNA and RNA.

In their research, the scientists developed a new theoretical concept that can explain, in particular, the role of biomolecular condensates in chromatin organization. Chromatin is the form DNA takes in the cell nucleus. Using both their calculations and computer simulations, the researchers showed that the PAC causes compact chromatin structures that suppress gene transcription depending on their relevance to the cell. The repression could be realized with the help of the PAC condensate. The researchers also found that the PAC condensates may serve as reaction containers, trapping enzymes with their properties and ensuring that they are mainly active within the condensate, restoring the epigenetic information. The research findings suggest that the condensates organize in a spatial structure and thus ensure the transmission of epigenetic information across cell generations.

The model developed thus aims to understand the formation of macromolecular condensates within the cell nucleus. Some crucial questions still need to be clarified, as Jens-Uwe Sommer adds: “Why are the condensates so important for explaining life functions? Why does a transcription factor, i.e., an enzyme or protein that searches for some site on the DNA, find exactly this site so quickly?”

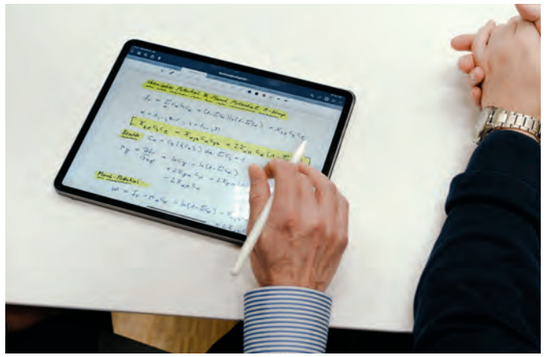
Answers to these basic research questions promise various future applications, for example, for controlling the drug efficacy or developing therapies for diseases related to malfunctions of biomolecular condensates. Additionally, the development of new materials could benefit from better controllable synthesis methods.

Original publication on the subject:
https://pubs.acs.org/doi/10.1021/acs.macromol.2c00244



Heterochromatin forms in the PAC model by specific proteins (HP) forming a condensate in the presence of the polymer. The heterochromatin sequences (red) are thereby trapped in the condensate. This droplet can subsequently serve as a reaction container (e.g., to restore all chemical labels) as well as a barrier to transcription, because one function of heterochromatin is to silence genes that are not needed in a specialized cell.

» The polymers are extremely important for the processes. They ensure that condensation only takes place in very specific environments. And the principle apparently applies to all cells in our body. «

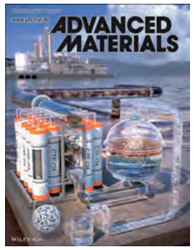


Exemplary Publications

Synthesis of novel ruthenium-polymetallaynes and their application in multistate electrochromic memory

Po Yuen Ho, Evgenia Dmitrieva, Ningwei Sun, Olga Guskova, and Franziska S.-C. Lissel

Advanced Materials Technologies, DOI: 10.1002/admt.20220031



Multifunctional 4D-printed sperm-hybrid microcarriers for assisted reproduction

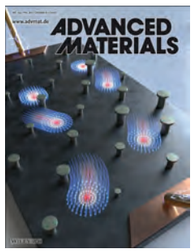
Fatemeh Rajabasadi, Silvia Moreno, Kristin Fichna, Azaam Aziz, Dietmar Appelhans, Oliver G. Schmidt, and Mariana Medina-Sánchez

Advanced Materials, DOI: 10.1002/ADMA.202204257

Mechanofluorescent polymer brush surfaces that spatially resolve surface solvation

Quinn A. Besford, Holger Merlitz, Simon Schubotz, Huaisong Yong, Soosang Chae, Max J. Schnepf, Alessia C. G. Weiss, Günter K. Auernhammer, Jens-Uwe Sommer, Petra Uhlmann, and Andreas Fery

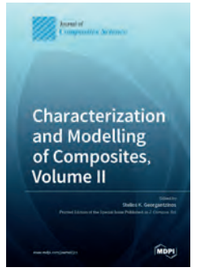
ACS Nano, DOI: 10.1021/acsnano.2c00277



Magnetic alignment for plasmonic control of gold nanorods coated with iron oxide nanoparticles

Mehedi H. Rizvi, Ruosong Wang, Jonas Schubert, William D. Crumpler, Christian Rossner, Amy L. Oldenburg, Andreas Fery, and Joseph B. Tracy

Advanced Materials, DOI: 10.1002/adma.202203366



The impact of fiber orientation on structural dynamics of short-fiber reinforced, thermoplastic components – A comparison of simulative and experimental investigations

Alexander Kriwet and Markus Stommel

Journal of Composite Science, DOI: 10.3390/jcs6040106

Elastomeric microwell-based triboelectric nanogenerators by *in situ* simultaneous transfer-printing

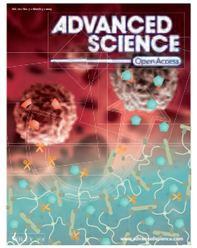
Injamamul Arief, Philipp Zimmermann, Sakrit Hait, Hyeyoung Park, Anik Kumar Ghosh, Andreas Janke, Santan Chattopadhyay, Jürgen Nagel, Gert Heinrich, Sven Wießner, and Amit Das

Materials Horizons, DOI: 10.1039/D2MH00074A

Electrically controlled click-chemistry for assembly of bioactive hydrogels on diverse micro- and flexible electrodes

Aruã Clayton Da Silva, Teuku Fawzul Akbar, Thomas Edward Paterson, Carsten Werner, Christoph Tondera, and Ivan Rusev Minev

Macromolecular Rapid Communications, DOI: 10.1002/marc.202200557



Inflammation-controlled anti-inflammatory hydrogels

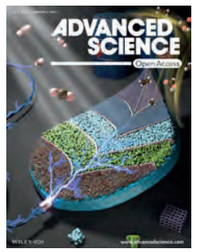
Tina Helmecke, Dominik Hahn, Nadine Matzke, Lisa Ferdinand, Lars Franke, Sebastian Kühn, Gunter Fischer, Carsten Werner, and Manfred F. Maitz

Advanced Science, DOI: 10.1002/advs.202206412

Molecular assembly lines in active droplets

Tyler S. Harmon and Frank Jülicher

Physical Review Letters, DOI: 10.1103/PhysRevLett.128.108102



Charge-compensated N-doped π-conjugated polymers: Toward both thermodynamic stability of N-doped states in water and high electron conductivity

Fabian Borrmann, Takuya Tsuda, Olga Guskova, Nataliya Kiriy, Cedric Hoffmann, David Neusser, Sabine Ludwigs, Uwe Lappan, Frank Simon, Martin Geisler, Bipasha Debnath, Yulia Krupskaya, Mahmoud Al-Hussein, and Anton Kiriy

Advanced Science, DOI: 10.1002/advs.202203530

Events of the Year

Max Bergmann Symposium

“Assembling matter at all scales – from simple molecules to mighty materials”

More than 120 researchers from over 30 nations discussed the latest findings in research on biology-inspired materials, from the elucidation of cross-scale assembly processes to the translation of biomaterials into future technologies.

Prof. Dr. Bert Meijer, Eindhoven University of Technology

Dr. Ye Tao, MEER Organisation

Prof. Dr. Tanja Weil, Max Planck Institute for Polymer Research Mainz

Fotos: © Dr. Krishna Gupta

Highlights of the event were keynote lectures by Professors Bert Meijer (Eindhoven University), William Shih (Harvard University), Tanja Weil (Max Planck Institute for Polymer Research Mainz), and Zemer Gitai (Princeton University), and a presentation on challenges of translating new material systems into medical devices by Dr. Pau Turón and Dr. Matthias Henke (B Braun AG).

International Electrokinetics Society founded

Electrokinetic interface phenomena are a research topic for which the IPF has attained special visibility. Martin Bazant (Massachusetts Institute of Technology) and Carsten Werner (IPF) initiated the foundation of the International Electrokinetics Society (IES) in 2022 to intensify the interdisciplinary exchange of experts in this field. The first IES conference was held in Tel Aviv in June 2022 and was met with a very good response.

» www.electrokinetics.net

Five new M-ERA.NET projects

IPF teams, together with partners from eleven countries, have attracted five new international collaborative projects in the M-ERA.NET program on materials research, materials technology and battery research. The M-ERA.NET program networks researchers from Europe and beyond to promote the European Green Deal.

Digital materials factory

In IPF’s new digitalized polymer processing lab, massive quantities of process and material data are continuously collected across systems and linked and analyzed in real-time. AI algorithms recognize patterns and correlations that will lead to a deeper understanding of the entire process chain and new planning and control systems: Industry 4.0. This approach will also allow us to exploit the enormous potential of renewable raw materials for generating high-quality materials.

Greeting address by Dr. Babett Gläser, representative of the Saxon State Ministry of Science, Culture and Tourism

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Innovation Award for the team of Professor Axel Spickenheuer

The Innovation Award of the IPF Supporters' Association was granted to the development of a new process to produce fiber-reinforced plastic composites (FRPs) with locally varying matrix materials. The process is an extension of the tailored fiber placement (TFP) technology invented several years ago at the IPF that is now widely used in industry. The innovation developed together with the Institute for Precision Engineering and Electronic Design at TU Dresden, E.F.M. GmbH, Mountek GmbH, and REHA-OT Lüneburg Melchior and Fittkau GmbH opens up new applications, for example, for composite components with flexible, elastomeric zones for joints in orthopedics and rehabilitation technology or for applications in soft robotics. [Patent DE10 2019 110 462 A1]

Doctoral Thesis Award for Dr. Martin Mayer

The Doctoral Thesis Award of the institute's Supporters' Association was awarded to Dr. Martin Mayer. He was able to demonstrate novel ways to synthesize defined plasmonic nanoparticles and produce coatings with specific optical properties from these particles, which have great potential for applications in sensor technology, photonics, photovoltaics and photocatalysis. The results of his research have already been very visibly published.

Professor Franz Brandstetter Prize for Sophie Klempahn

Active matter is still in the early research phase in physics. As a bachelor's student, Sophie Klempahn developed a mathematical theory that could contribute to a deeper understanding of living matter and the construction of autonomous nanomachines. She received the Professor Franz Brandstetter Prize for her bachelor's thesis.

In 2022, the **Supporters' Association of the IPF** had 42 members: 23 companies/institutions and 19 individuals.

Dresden Science Night

The Dresden Science Night was met with great enthusiasm. Approximately 1300 guests came to the IPF – more than ever before. Over 100 coworkers of the institute had come up with many ideas to shape an interesting program and to convey the fascination of science and technology in an inspiring way. Once again, the special experimental program and lecture for children attracted many children and families for the seventeenth year in row with Dr. Jürgen Pionteck as spiritus rector.

30 years of Leibniz in Saxony

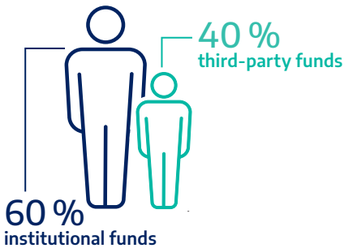
Together with the other institutes of the Leibniz Association in Saxony, the IPF celebrated the 30th anniversary of its foundation within a festive event in the International Congress Center Dresden. Speakers from politics and science paid tribute to the work of the institutes, appreciating their contributions to the successful development in the fields of science and technology and the importance of their research with regard to future challenges.

Leibniz Trainee Award

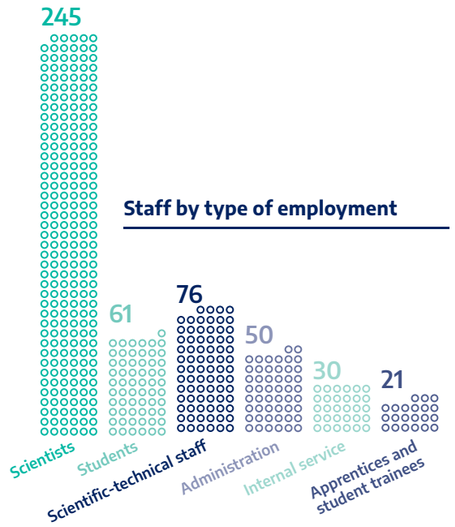
Chemistry lab technician Melinda Arnold, who was trained at the IPF, received the Leibniz Trainee Award for her outstanding performance. The institute is currently training 23 chemical laboratory assistants, biotechnologists, and process mechanics.

Figures

Employees by funding source



Staff by type of employment



49 % Female employees

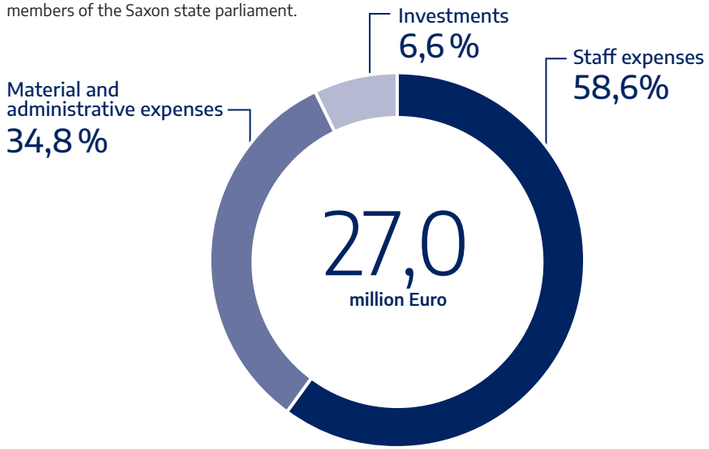
25 % Employees with foreign citizenship

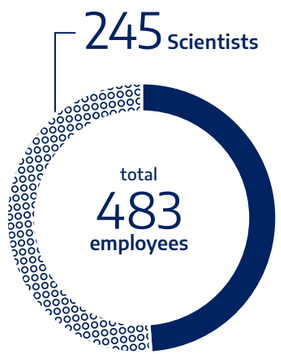
127 Visiting scientists

Zertifikat seit 2010 audit berufundfamilie

Institutional funding

The IPF is jointly funded by the federal and state governments. The institute is co-financed by tax funds on the basis of the budget passed by the members of the Saxon state parliament.





Apprentices 21

- Chemical lab technicians 12
- Biotechnologists BSc 8
- Process technician 1

Third-party funding

Leibniz Association
5 projects
Coordinator of 1 SAW-project, participation in 1 SAS-Projekt and 3 SAW-projects
4 new in 2022

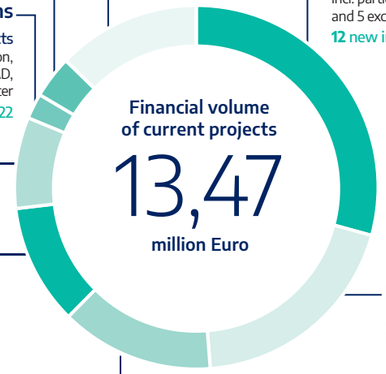
Foundations
15 projects
Liebig Fellowship of the FCI, Alexander von Humboldt Foundation, Volkswagen Foundation, Boehringer Ingelheim Foundation, DAAD, Dutch Polymer Institute, Else Kröner Fresenius Center
5 new in 2022

European Union
6 projects, incl. 2 ERC Grants
1 new in 2022

Free State of Saxony
19 projects
2 SAB/EuProNet, 6 SAB/EFRE and 9 SAB/M-ERA.NET
7 new in 2022

Industry
29 projects
9 new in 2022

DFG Deutsche Forschungsgemeinschaft
55 projects
incl. participation in 7 SFB and 5 excellence initiative projects
12 new in 2022



Federal ministries
21 projects (16 BMBF, 3 BMWK, 2 BMEL) incl. 2 VIP+ and 1 EXIST projects
2 new in 2022

AiF BMWK supported
19 IGF-projects
4 within CORNET program and 5 ZIM projects
7 new in 2022

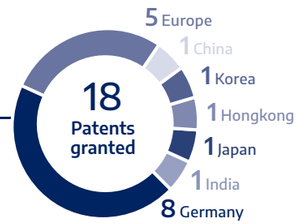
Publications 678

- Articles in journals 273
- Articles in books 8

Graduations completed 59

- PhD theses 27
- Diploma and master theses 22
- Bachelor theses 14

Patents



FIRST FILING

- **7** Patents
- **2** Wordmarks
- **5** Patentable inventions transferred to industrial and cooperation partners

Leibniz-Institut
für Polymerforschung
Dresden

Jahresbericht 2022
Annual Report 2022

Daten & Fakten
Facts & Figures

Inhalt Contents

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Zambrano, A.; Fracasso, G.; Gao, M.; Ugrinic, M.; Wang, D.; Appelhans, D.; deMello, A.; Tang, T. Y. D.:
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Zhang, Y. L.; Müller, M. T.; Boldt, R.; Stommel, M.:
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Zhou, L.; Zhang, L.; Li, P.; Maitz, M. F.; Wang, K.; Shang, T.; Dai, S.; Fu, Y.; Zhao, Y.; Yang, Z.; Wang, J.; Li, X.:
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Zhou, Z.; Luo, R.; Chen, L.; Hu, C.; Chen, C.; Maitz, M. F.; Li, L.; Yang, L.; Deng, D.; An, Y.; Wu, H.; Yang, Y.; Dai, Y.; Xin, J.; Wang, Y.:
Dressing blood-contacting devices with platelet membrane enables large-scale multifunctional biointerfacing.
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Zhu, S.; Gruschwitz, M.; Tsikourkitoudi, V. P.; Fischer, D.; Simon, F.; Tegenkamp, C.; Sommer, M.; Choudhury, S.:
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Zou, L.; Chang, B.; Liu, H.; Zhang, X.; Shi, H.; Liu, X.; Euchler, E.; Liu, C.:
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BEITRÄGE IN BÜCHERN
BOOK CONTRIBUTIONS

Alig, I.; Hilarius, K.; Lellinger, D.; Pötschke, P.:
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Bittrich, E.; Eichhorn, K.-J.:
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da Rocha, J. T.; Lisbôa, T. V.; Marczak, R. J.:
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Klumperman, B.; Pfukwa, R.; Lederer, A.:
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Papathanasiou, T. D.; Kühnert, I.; Polychronopoulos, N. D.:
Flow-induced alignment in injection molding of fiber-reinforced polymer composites.
in: Flow-Induced Alignment in Composite Materials / T. D. Papathanasiou, A. Bénard. Amsterdam [u.a.] : Elsevier, 2022. 123-185; ISBN 978-0-12-818574-2

Popa, M.-M.; Brünig, H.; Curosu, I.; Mechtcherine, V.; Scheffler, C.:
Spinability and characteristics of particle-shell PP-bicomponent fibers for crack bridging in mineral-bonded composites.
in: Fibre Reinforced Concrete: Improvements and Innovations II: X RILEM-fib International Symposium on Fibre Reinforced Concrete (BEFIB) 2021 / P. Serna et al. (Eds.). Cham : Springer, 2022. 255-264 (RILEM Bookseries; Volume 36); ISBN 978-3-030-83718-1

Absolventen Graduates

PROMOTIONEN DOCTORAL THESES

Olha Aftenieva
Antisotropic optical properties in colloidal self-assembled metasurfaces
Technische Universität Dresden

Konstantin Borchert (geb. Klein)
Synthesis and characterization of nanoporous resin particles for water purification
Technische Universität Dresden

Sanket Vijay Chougale
Physically motivated modelling of magnetoactive elastomers
Technische Universität Dresden

Nicholas Robert Dennison
Combinatorial development of hydrogel-based vasculogenesis models for high-throughput screening
Technische Universität Dresden

Kristina Ditte
Semiconducting organosiliconbased hybrids for the next generation of stretchable electronics
Technische Universität Dresden

Shamila Firdaus
Synthesis of multifunctional glyco-pseudodendrimers and glycodendrimers and their investigation as anti-Alzheimer agents
Technische Universität Dresden

Sakrit Hait
Development of sustainable polybutadiene elastomer composites based on alternative feedstock
Technische Universität Dresden

Thomas Heida
Design and microfluidic fabrication of hyaluronic acid-based microgels for constructing cell-free protein synthesis microenvironments
Technische Universität Dresden

Christoph Horn
Struktur-Eigenschafts-Beziehungen von Hydrogelsystemen mit immobilisierten Enzymen und polymerbasierten heterogenen Fenton-Katalysatoren für den Spurenstoffabbau
Technische Universität Dresden

Bettina Keperscha
Wirkstofftransportsysteme auf Basis dendritischer Glykopolymere für die regulierte Freisetzung des Wirkstoffs Bortezomib aus Calcium-phosphatzementen als lokale Therapie des multiplen Myeloms
Technische Universität Dresden

Markus Koch
The influence of light on a three-arm azobenzene star: A computational study
Technische Universität Dresden

Tony Köhler
Cell-free applications of DNA - from DNAzymes to cell-mimicking hydrogel particles
Technische Universität Dresden

Sebastian Kühn
A biohybrid microgel platform for *in vitro* tissue models, multiplex bioassays and new therapeutic applications
Technische Universität Dresden

Max Julius Männel
Fabrication of microreactors for cell-free biotechnology via additive manufacturing and photolithography
Technische Universität Dresden

Inga Melnyk
Mechanical characterization and adhesion properties of micro-capsules
Technische Universität Dresden

Toni Müller
Theory and simulation of tendomers
Technische Universität Dresden

Eike Thomas Röchow
Synthese und Charakterisierung Imidazolium-basierter Polymerelektrolyte
Technische Universität Dresden

André Ruland
Synthesis, characterization and applications of amphiphilic copolymers as a novel coating platform for biofunctionalization
Technische Universität Dresden

Melissa Sikosana
Antimicrobial coatings to maintain drinking water quality at point-of-use
Technische Universität Dresden

Anja Maria Steiner
Synthesis and self-assembly of metallic nanoparticles into optical functional structures
Technische Universität Dresden

Juliane Valtin
Development of an *in vitro* blood flow model to evaluate antimicrobial coatings for blood-contacting devices
Technische Universität Dresden

Hidde Vujik
Self-propelled particles with inhomogeneous activity
Technische Universität Dresden

Peng Wang
Optimization of pH-responsive polymersomes for enzyme reactions
Technische Universität Dresden

Janek Weißpflog
Abtrennung von Schwermetall- und Oxyanionen aus wässrigen Lösungen mithilfe von Biopolymeren
Technische Universität Dresden

Fei Xiang
The role of strain-induced crystallization and cavitation on the mechanism of crack splitting and crack deviation in natural rubber
Technische Universität Dresden

Bharti Yadav
Modeling optical inscription of complex surface patterns in azobenzene-containing materials
Technische Universität Dresden

DIPLOM- UND MASTERARBEITEN DIPLOMA AND MASTER THESES

Azra Atabay
A DNA origami-Cas9 nanodevice for high performance gene editing
Technische Universität Dresden

Valentine Comoy
Spreading of granular suspensions on flat surfaces
Technische Universität Dresden

Anais Frezel
PH responsive polyester from radical ring opening polymerization
Technische Universität Dresden

Marcel Glomba
Herstellung und Charakterisierung von Ionenaustauschermembranen für die selektive Entfernung von monovalenten Anionen
Technische Universität Dresden

Niklas Hoenen
Entwicklung eines mikromechanischen Modells zur Berechnung kurzfaserverstärkter Thermoplastbauteile unter Berücksichtigung inhomogener Faserverteilungen
Technische Universität Dresden

Sarah Rose Amandine Imhoff
Development of thermoelectric modules based on doped carbon nanotube buckypapers
Technische Universität Dresden

Lisa Kleber
Chemische Modifizierung von bestrahltem PTFE und Einfluss der Additive auf Polyallophanatfilme
Hochschule für Technik und Wirtschaft Dresden

Fabian Kopsch
Anti-Biofouling-Oberflächen auf Basis amphiphiler Polymere und Partikel
Technische Universität Dresden

Akshay Kulkarni
Coating of polymer membranes with photoactive nanoparticles and studies on degradation of water pollutants
Technische

Felix Lentz
Experimentelle und numerische Untersuchungen von drei-dimensionalen Tragwerksstrukturen auf Basis von Tailored Fiber Placement-Preformen
Technische Universität Dresden

Laura Meinig
Untersuchungen zum Einfluss der Prozessparameter und des D-Isomeranteils auf die Kristallisation, Struktur und Eigenschaften von spritzgegossenen PLA-Prüfkörpern
Technische Universität Dresden

Till Meißner
Kinetic studies towards the radical ring opening polymerization (RROP) of 2-methylene-1,3,6-trioxocane
Technische Universität Dresden

Alisa Noll
Functional extracorporeal blood system via e-beam activated modification
Otto-von-Guericke-Universität, Magdeburg

Soyoung Park
Synthesis and characterization of a nanocar and a molecular rotor
Technische Universität Dresden

Marc Päßler
Synthese und Charakterisierung von konjugierten Polyelektrolyten für organisch-elektronische Anwendungen
Technische Universität Dresden

Maria Alejandra Ramirez Martinez
Characterising 3D *in vitro* vasculogenesis in a high-throughput screening platform
Technische Universität Dresden

Lynn Ratajczak
Strategien zur Einbindung von PTFE als Festschmierstoff in Polyallophanat-Pulverlacke
Technische Universität Dresden

Anneke Selle
Scherinduzierte Kristallisation von isotaktischem Polypropylen (iPP): Quantifizierung kritischer Kenndaten mittels rheologischer Messmethoden
Technische Universität Dresden

Luise Wirth
Responsives Freisetzungssystem für Bakteriophagen auf der Basis von Polyelektrolytkomplexen
Technische Universität Dresden

Haoran Zhang
Combining semiconductive polymers and gold nanoparticles (AuNP) via N-heterocyclic carbenes
Technische Universität Dresden

BACHELORARBEITEN
BACHELOR THESES

Léo Dagand
Präparation und Charakterisierung von Polymerbürsten schwacher Polyelektrolyte mit negativer Ladung
Technische Universität Dresden

Nele Dammann
Herstellung von Faserverbundwerkstoffen basierend auf modifiziertem Lignin
Hochschule Emden/Leer

Marisa Fischer
Messung von Kräften zwischen bewegten Tropfen und Oberflächen
Technische Universität Dresden

Lukas Haugk
Numercial investigations on polymer assisted condensation under the influence of force
Technische Universität Dresden

Fritz Henke
Dual synthesis approach of a novel poly(thioetheramide) dendrimer based on bis-MPA
Technische Universität Dresden

Daniel Kochale
Synthese und Charakterisierung von polyesterbasierten Antistatikadditiven
Hochschule für Technik und Wirtschaft Dresden

Hanna Krug
Peptid-Arrays zum Proteasen-Screening in Blut
Staatliche Studienakademie Riesa

Katherina Löbel
Freisetzung von Wachstumsfaktoren aus Poly(ethylen-glykol)-glykosaminoglykan-basierten Mikrogelen
Technische Universität Dresden

Nick Maryshchak
Charged rouse chain in magnetic field
Technische Universität Dresden

Sahar Nasirian
Prozessintegrierte Herstellung von oberflächenmodifizierten Formteilen durch reaktives Spritzgießen und deren Charakterisierung
Technische Universität Dresden

Jannik Rothkegel
Gitterbasierte Monte-Carlo-Methoden zur Untersuchung von selektiven Lösungsmitteleffekten
Technische Universität Dresden

Marten Samulowitz
Designing synthetic sulfated and sulfonated polymer hydrogel to guide microvascular network formation in a 384-well formate
Staatliche Studienakademie Riesa

Jasmina Schröter
Ein Vaskulogenese-Model für *In vitro*-Toxizitätsmessung – Weiterentwicklung des Modells und Bewertung der Vorhersagekraft
Staatliche Studienakademie Riesa

Maximilian Schwabe
Investigation of single polymer conformations by unsupervised machine learning methods
Technische Universität Dresden

Auszeichnungen Awards

Dr. Franziska Lissel
Nachwuchsstipendium der Fachgruppe Makromolekulare Chemie der Gesellschaft Deutscher Chemiker
für ihre Arbeiten zu Triblockcopolymeren für Anwendungen in polymeren Halbleitern:
„Using nanophase separation to achieve low modulus, elastic deformation, and good mobility in polymer semiconductors“

Prof. Dr.-Ing. Axel Spickenheuer, Simon Konze, Sascha Bruk, Dr. Tales de Vargas Lisbôa und Nicole Schmidt
Innovationspreis des IPF und des Fördervereins des IPF
für die Entwicklung eines neuen Verfahrens zur Herstellung von Faser-Kunststoff-Verbunden mit lokal variierenden Matrixmaterialien

Dr. Martin Mayer
Doktorandenpreis des Fördervereins des IPF
für seine Dissertation
„From single particles to coupled plasmonic assemblies“

Sophie Klempahn
Professor-Franz-Brandstetter-Preis
für ihre Masterarbeit
„Modeling active rigid dimers“

Dr. Patrick Probst
Förderpreis
für seine Dissertation
„Designing plasmonic metasurfaces via template assisted 1D, 2D and 3D colloidal assembly“

Andrea Koball
3. Preis auf dem European Polymer Congress
für das Poster
„Compartmentalization of multi-enzymatic reaction in microfluidic devices and integration of polymersomes for additional reaction control“
Autoren: F. Obst, C. Jiao, J. Gaitzsch, B. Voit, D. Appelhans

Vaidehi Londhe
Posterpreis des Springer-Verlages auf der 51. Hauptversammlung der Kolloid-Gesellschaft
für das Poster
„Understanding the biomolecular corona at the nano-bio interface“
Autoren: V. Londhe, A. C. G. Weiss, Q. A. Besford und C. Werner

Jishnu Nirmala Suresh
1. Platz im Posterwettbewerb auf der International Rubber Conference 2022
für das Poster
„Tailoring the electro-mechanical actuation performance of liquid diene rubbers“
Autoren: J. N. Suresh, H. Liebscher, M. Tahir, G. Gerlach und S. Wießner

Melinda Arnold
Auszubildendenpreis der Leibniz-Gemeinschaft

IPF Fellows

Prof. Dr. Mahmoud Al-Hussein
University of Jordan, Department of Physics,
Amman, Jordan

Dr. Igor Kulic
CNRS, Institut Charles Sadron,
Strasbourg, France

Prof. Dr. Ivan Minev
The University of Sheffield,
Department of Automatic Control and Systems Engineering,
Sheffield, United Kingdom

Prof. Dr. Tilo Pompe
Universität Leipzig, Institut für Biochemie,
Leipzig, Deutschland

Prof. Dr. Kim Williams
Colorado School of Mines, Department of Chemistry,
Golden, Colorado, USA

Stipendiaten Visiting Scholars

Humboldt-Forschungsstipendium der Alexander von Humboldt-Stiftung

Prof. Dr. Susanta Banerjee
Indian Institute of Technology Kharagpur, India
Sulfur containing polytriazoles for optoelectronic applictions
17.05.2022 – 16.07.2022

Dr. Yue Dong
South China Normal University, China
Hybrid cholesteric hydrogels with stimulus reponsive chiral plasmonic structure
01.06.2021 – 31.02.2023

Dr. Yue Li
Chinese Academy of Sciences, Institute of Chemistry, Beijing, China
Bioinspired co-assembled microscopic hydrogel particles
as artificial photosystem via droplet microfluidics
28.10.2019 – 28.02.2022

Prof. Dr. Kinsuk Naskar
Indian Institute of Technology Kharagpur, India
Green routes to sustainable crosslinked elastomers
27.05.2022 – 25.06.2022

Dr. Anthony Ndiripo
University of Stellenbosch, South Africa
Multidimensional analysis of chain walking polyethylene
using high-precision separation and complementary techniques
01.08.2021 – 31.03.2022

Prof. Dr. De-Yi Wang
IMDEA Materials Institute, Spain
Bio-based flame retardant phase change materials
22.07.2022 – 22.08.2022

Dr. Ziwei Zhou
Jilin University, China
Dynamically tunable chiral plasmonics
of strongly coupled 3D nano-enantiomers
01.03.2019 – 30.06.2022

Liebig-Stipendium

Dr. Franziska Lissel
Organometallic donor-acceptor polymers for (opto)electronic applications
01.10.2021 – 31.12.2023

Dr. Christian Roßner
Maßgeschneiderte Nanohybridmaterialien
für die plasmonenverstärkte Photokatalyse
01.12.2022 – 30.11.2024

Stipendium des Deutschen Akademischen Austauschdienstes (DAAD)

Sayan Chakraborty
Stretchable piezoelectric and thermoelectric elastomer composites
01.10.2022 – 31.03.2023

Kedar Nath Dhakal
Tribhuvan University, Nepal, India
Meltspun nanofibers based on biodegradable
poly(butylene adipate-co-terephthalate)/Multiwalled carbon
nanotubes nanocomposites for strain sensor application
01.10.2021 – 31.03.2022

Rakesh Kumar Maji
Indian Institute of Technology Kharagpur, India
Polymersomes based on azobenzene-containing
amphiphilic block copolymers: A potential drug carrier
05.09.2022 – 31.03.2023

Kajari Mazumder
Materials Science Centre Indian Institute of Technology, India
Preparation of functional polymers and exploration of their applications
01.10.2021 – 31.03.2022

Stipendium der CAPES Foundation

Cristiano Baierle de Azevedo
Federal University of Rio Grande do Sul, Brasil
Hybrid process for the production of locally reinforced
cylinders filament winding and tailored fiber placement
16.05.2022 – 30.12.2022

Matheus Madrid Moreira
Federal University of Rio Grande do Sul, Brasil
Evaluation of post-impact strength in composites
manufactured through hybrid process of Filament Winding
and Tailor Fiber Placement under internal pressure
01.07.2022 – 31.12.2022

Stipendium des chinesischen State Scholarship Funds
vergeben über China Scholarshop Council (CSC)

Yixuan Du
Shanghai University, China
Design of Janus structures for high-performance organic
optoelectronic devices with plasmonic particles
14.11.2018 – 30.09.2022

Chen Jiao
Hydrogels with non-linear and selective response
on chemical information for microfluidic applications
01.10.2019 – 30.09.2023

Prof. Dr. Yongyue Luo
Agricultural Products Processing Research Institute, Hainan, China
Functional bio-based flame-retardant polymers for advanced application
01.07.2021 – 30.06.2022

Zhi Qiao
Development of reactive polymer matrices for MALDI and MALDI MSI
01.02.2020 – 31.03.2023

Xiaoying Xu
Donghua University, Shanghai, China
Artificial cell mimics based on polymersomes
and multicompartments for capturing pathogens
01.10.2018 – 30.04.2022

Junming Zhang
Lanzhou University, Lanzhou, China
Absorption performance of self-assembled plasmonic nanostructures
01.02.2021 – 31.01.2022

Kehu Zhang
Integrating attachable, self-sorting, multi-stimuli-responsive
polymersomes for applications in microfluidic channels
24.10.2019 – 31.03.2023

ERASMUS – Stipendium

Laia Lopez Fernandez
Universitat Autònoma de Barcelona, Spain
Electrochemical characterization of polymersomes.
Modification of different carbon electrodes with
polymersomes in order to sense metal ions or biomolecules
07.07.2021 – 07.01.2022

Stipendium der Evonik-Stiftung

Fabian Mehner
Synthese eines bioabbaubaren PEK-Surrogats mittels radikalischer
Ringöffnungspolymerisation von zyklischen Ketenacetalen
01.11.2021 – 31.10.2023

Stiftung zur Forschungsförderung im Staat São Paulo
Fundação de Amparo à Pesquisa do Estado de São Paulo

Giovanni Bortoloni Perin
UNICAMP, Brasil
Construction of biomimetic protocells based on
polyester nanoparticles and enzyme-loaded polymersomes
16.05.2022 – 01.12.2022

International Graduate Education Scholarship (YLSY), Türkei

Zeynep Tansu Atasavum
Investigation of the effects of extracellular matrix on
neurodegeneration from a molecular and matrix biology perspective
17.08.2020 – 16.08.2024

Stipendium der Shenyang Zerone Tech Co. Ltd.

Yinglan Zhang
Investigations on electron irradiation induced structure formation
during melt fiber spinning of homo and hetero phase polymer materials
01.01.2020 – 30.06.2022

Short-Term Scientific Missions (STSM)-Stipendium
innerhalb einer COST Action der EU

Dr. Kaplan Müslüm
Bartin University, Turkey
Investigate ZnSnO3/carbon-based nanofiller/polymer
composites for sensor and piezoelectric applications
15.06.2022 – 15.07.2022

STUVIN-Stipendium

Viktor Greguš
Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic
Colloidal nanoaggregates of heteroboranes
14.11.2022 – 12.02.2023

Veranstaltungen Events

WISSENSCHAFTLICHE VERANSTALTUNGEN
SCIENTIFIC MEETINGS

GUMFERENCE 2022: Advanced testing of soft polymer materials
15.02.2022, online

CU Innovation Day: Tailored structures
5.04.2022, online

31. Seminar „Kunststoffrecycling in Sachsen“
24.05.2022, hybrid

Max Bergmann Symposium:
Assembling matter at all scales -
from simple molecules to mighty materials
9. & 10.06.2022, Dresden

Leibniz-Kolloquium: Science shapes application
aus Anlass des Ausscheidens von Prof. Dr.-Ing. Udo Wagenknecht
21.09.2022, Dresden

14th IPF Kolloquium:
Digitalisierung in der Kunststoff- und Elastomertechnik
22.09.2022, Dresden

28. NDVaK: Oberflächentechnologien für die Energiewende
5. & 6.10.2022, Dresden

Aachen-Dresden-Denkendorf International Textile Conference 2022
1. & 2.12.2022, Aachen

KOLLOQUIEN LECTURES

Prof. Dr. Jose Farinha
Instituto Superior Técnico, University of Lisbon, Portugal
Polymer nanoparticle-based spherical
photonic pigments dye-free bright colors
12.01.2022, online

Dr. Tim Erdmann
IBM Almaden Research Center, USA
Utilizing continuous flow reactors in polymer research:
From tailored segmented polyurethanes
to ring-openingpolymerizations in milliseconds
17.01.2022

Dr. Klaus-Dieter Klass
Senckenberg Naturhistorische Sammlungen Dresden, Deutschland
Skelettmuskelsystem und Bewegung der Arthropoden
mit Blick auf deren technisches Innovationspotential
2.02.2022, online

Prof. Dr. Ivan Minev
University of Sheffield, Department of Automatic Control
and Systems Engineering, United Kingdom
Materials and technologies for tissue-like bioelectronics
2.02.2022, hybrid

Dr. Philipp Seib
University of Strathclyde, Strathclyde Institute of Pharmacy
and Biomedical Sciences, Glasgow, United Kingdom
The biomedical use of silk
15.03.2022, hybrid

Dr. Lei Fang
Texas A&M University, Department of Chemistry, College , USA
Climbing the ladder to advanced rigid ladder polymers
28.03.2022, hybrid

Prof. Dr. Markus A. Schmidt
Leibniz-Institut für Photonische Technologien, Jena, Deutschland
Nanoparticle tracking analysis inside optical fibers -
a photonic platform for the characterization of
diffusing nano-scale specimen such as SARS-CoV-2
26.04.2022

Prof. Dr. Christian W. Pester
Pennsylvania State University,
Department of Chemical Engineering, USA
Engineering surfaces through light-mediated polymerization
16.05.2022, online

Rajkumar Biswas
Raman Research Institute, Bengaluru, India
Investigating the micro-rheology of aging clay suspensions
and dynamical heterogeneity in dense suspensions
18.05.2022, online

Dr. Christopher Synatschke
Max-Planck-Institut für Polymerforschung Mainz, Deutschland
Responsive supramolecular assemblies
for controlling cell-material communication
23.06.2022

Prof. Dr. Nicole R. Demarquette
Ecole de Technologie Supérieure de Montreal, Canada
Rheology as a tool to control the properties
of polymer blends and composites
23.06.2022, hybrid

Prof. Dr. Sergei Egorov
University of Virginia, Department of Chemistry, Charlottesville, USA
Phase behaviour of liquid-crystalline semiflexible
polymers in the bulk and under confinement
7.07.2022

Prof. Dr. Dror Seliktar
Technion - Israel Institute of Technology,
Faculty of Biomedical Engineering, Haifa, Israel
Gels in biomedicine: Controlling structure to improve performance
11.07.2022

Dr. Ellen Adams
Physics of Life Cluster of Excellence, Technische Universität Dresden
und Helmholtz-Zentrum Dresden, Deutschland
Hydration in confinement -
From ions to intrinsically disordered proteins
12.07.2022

Prof. Dr. James Sterling
Keck Graduate Institute, Riggs School of Applied Life Sciences,
Claremont, USA
Biopolymer condensates - membraneless organells that organize
cellular biochemistry: The role of electrostatics and hydration
12.07.2022

Dr. Tyler Harmon
Leibniz-Institut für Polymerforschung Dresden, Deutschland
Simulation of biocondensates
12.07.2022

Prof. Dr. Werner Kunz
Universität Regensburg, Institut für Physikalische
und Theoretische Chemie, Deutschland
New types of ionic liquids and nanoparticle syntheses
27.07.2022

Prof. Dr. De-Yi Wang
IMDEA Materials Institute, New Materials Division, Madrid, Spain
Recent progress in fire-safe lithium-ion battery
16.08.2022, hybrid

Prof. Dr. Oded Rabin
University of Maryland, Institute for Research
in Electronics & Applied Physics, College Park, USA
Enhancement of light-matter interactions
with gap-rich and gapless plasmonic nanostructures
23.08.2022

Julius Zimmermann
Universität Rostock, Institut für Allgemeine Elektrotechnik, Deutschland
Towards digital twins of bioelectrochemical sensors
and electrical stimulation devices for cartilage tissue engineering
19.09.2022

Dr. Mokarram Hossain
Swansea University, School of Aerospace, Civil, Electrical,
General and Mechanical Engineering, United Kingdom
Experiments meet computational modelling:
A case study for soft materials under multiple loads
20.09.2022

Prof. Dr. Nikolai Gaponik
Technische Universität Dresden,
Professur für Physikalische Chemie, Deutschland
Assembling quantum dots in functional nanostructures
13.10.2022

Dr. Mariana Medina Sanchez
Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden,
Deutschland
Soft magnetically driven microcarriers
for targeted drug and cell delivery
13.10.2022

Prof. Dr. Sergei V. Kostjuk
Belarusian State University, Laboratory of Catalysis
of Polymerization Processes, Minsk, Belarus
Cationic (co)polymerization of isobutylene: From oil additives
to perspective materials for application in optoelectronic devices
14.10.2022

Dr. Denys Makarov
Helmholtz-Zentrum Dresden-Rossendorf, Deutschland
Flexible and printable magnetoelectronics
for human-machine interfaces and soft robotics
14.10.2022

Dr. Johannes C. Brendel
Friedrich-Schiller-Universität Jena,
Jena Center for Soft Matter, Deutschland
Form follows function: Purposeful design of polymer nanostructures
11.11.2022

Dr. David Smith
Fraunhofer-Institut für Zelltherapie und Immunologie IZI,
Leipzig, Deutschland
Enhancement of bioactive molecules with DNA-templated
oligovalence DNA structures: Programmable scaffolds
for new therapies and diagnostics (and analytics)
22.11.2022, hybrid

Prof. Dr. Joseph Brader
University of Fribourg, Department Physics, Switzerland
Superadiabatic-DDFT for interacting Brownian systems
25.11.2022, hybrid

Dr. Hendrik Schlicke
Fraunhofer-Institut für Angewandte Polymerforschung IAP, Fraunhofer-
Zentrum für Angewandte Nanotechnologie, Hamburg, Deutschland
Nanoparticle composites for new sensing
approaches and optoelectronic applications
1.12.2022

Prof. Dr. Jens Weber
Hochschule Zittau-Görlitz, Deutschland
Hydrophobicity assessment and dynamic wetting behavior of rough poly(dimethylsiloxane) model systems
6.12.2022, hybrid

Dr. Patrick McCall
Max-Planck-Institut für molekulare Zellbiologie und Genetik, Dresden, Deutschland
Resolving biomolecular composition with quantitative phase microscopy: Implications for biophysical properties and cell physiology
8.12.2022

Dr. George Karalis
University of Ioannina,
Department of Materials Science and Engineering, Greece
Large-scale energy harvesting and self-powered sensing from advanced structural composites for multiple applications
12.12.2022

MESSEAUFTRITTE TRADE FAIR PRESENTATIONS

Kompozyt Expo Krakau
Stand des IPF
28. – 29.09.2022

Kunststoffmesse K 2022, Düsseldorf
Stand des IPF im Science Campus
sowie Exkursion von Doktoranden des IPF zur Messe
19 – 26.10.2022

VERANSTALTUNGEN FÜR DIE ALLGEMEINE ÖFFENTLICHKEIT EVENTS FOR THE GENERAL PUBLIC

Dresdner Lange Nacht der Wissenschaften / Dresden Science Night
8.07.2022
Vorträge „Chemie für Kinder - Kleine Experimentalvorlesung“ und „Hautnah: Smart, vernetzt und nachhaltig – Zukunftsvisionen made of polymers für Elektronik und Medizin“ sowie 17 offene Labors und Technika, Kinderexperimentierprogramm, Ausbildungsinfostand u.a.

Girls’ Day
28.04.2022
Präsenz-Veranstaltung: Forschen an den Werkstoffen der Zukunft
Online-Veranstaltung: Ingenieurin werden – Zukunft mitgestalten
30 Teilnehmerinnen aus ganz Deutschland

30 Jahre Leibniz-Institute in Sachsen
14.09.2022
Festveranstaltung

Virtual Lab Day
22.06.2022
im Rahmen der Programme Virtual Lab Day und Werkstoffferien des Bundesministeriums für Bildung und Forschung

Fame Lab
23.03.2022, Regionalwettbewerb Dresden
Anne-Katrin Leopold: Die Metamorphose der Carbonfasern
Dr. Patrick Probst: Kleine Strukturen, großartige Effekte!

Book a scientist
8.11.2022, online
Krishna Gupta: Developing affordable point-of-care diagnostic devices using DNA nanotechnology
Dr. Julian Thiele: Künstliche Zellen – ein Ersatz für lebende Organismen?
Dr. Silvia Moreno: Artificial organelles: Restoring dysfunctional biological reactions

Studentenwettbewerb iGEM
International Genetically Engineered Machine Competition
26. – 28.10.2022, Paris
Unterstützung des IPF für das Studentenprojekt WunderBand: Bioresponsive hydrogel – Wundauflage für die Behandlung chronischer Wunden

DRESDEN-concept Wissenschaftsausstellung
„Wie werden wir in Zukunft leben?“
Standort: Station für Technik, Naturwissenschaften, Kunst – Weißwasser e. V., Weißwasser

Lehrtätigkeit Teaching

PROFESSUREN PROFESSORSHIPS

Technische Universität Dresden

Bereich Mathematik und Naturwissenschaften, Fakultät Chemie und Lebensmittelchemie

- **Prof. Dr. Andreas Fery**
  Professur für Physikalische Chemie Polymerer Materialien
- **Prof. Dr. Brigitte Voit**
  Professur für Organische Chemie der Polymere
- **Prof. Dr. Carsten Werner**
  Professur für Biofunktionelle Polymermaterialien

Bereich Mathematik und Naturwissenschaften, Fakultät Physik

- **Prof. Dr. Jens-Uwe Sommer**
  Professur für Theorie der Polymere

Bereich Ingenieurwissenschaften, Fakultät Maschinenwesen

- **Prof. Dr.-Ing. Markus Stommel**
  Professur für Polymerwerkstoffe
- **Prof. Dr.-Ing. Sven Wießner**
  Professur für Elastomere Werkstoffe

Medizinische Fakultät Carl Gustav Carus Zentrum für Regenerative Therapien Dresden

- **Prof. Dr. Carsten Werner**
  Professur für Biofunktionelle Polymermaterialien

ANDERE EINRICHTUNGEN OTHER INSTITUTIONS

Hochschule für Technik und Wirtschaft Dresden

Fakultät Design

- **Prof. Dr.-Ing. Axel Spickenheuer**
  Honorarprofessur für Werkstoffe und Simulationstechnik

Otto-von-Guericke-Universität Magdeburg

Fakultät für Verfahrens- und Systemtechnik

- **Prof. Dr. Julian Thiele**
  Leiter des Lehrstuhls für Organische Chemie

Stellenbosch University, Südafrika

Department of Chemistry and Polymer Science

- **Prof. Dr. Albena Lederer**
  SASOL Chair in Analytical Polymer Science

Monash University, Australien

Department Chemical and Biological Engineering

- **Prof. Dr. Daniela Lössner**
  Associate Professor

WEITERE LEHRAUFTRÄGE FURTHER TEACHING ASSIGNMENTS

Technische Universität Dresden

Bereich Mathematik und Naturwissenschaften

- **PD Dr. Tobias A. F. König** – TUD Young Investigator in der Fakultät Chemie und Lebensmittelchemie sowie Privatdozentur im Gebiet Physikalische Chemie
- **Dr. Elisha M. Krieg** – TUD Young Investigator in der Fakultät Chemie und Lebensmittelchemie
- **Dr. Franziska Lissel** – TUD Young Investigator in der Fakultät Chemie und Lebensmittelchemie
- **Dr. Christian Roßner** – TUD Young Investigator in der Fakultät Chemie und Lebensmittelchemie
- **Dr. Abhinav Sharma** – TUD Young Investigator in der Fakultät Physik
- **PD Dr. Martin Müller** – Privatdozentur im Gebiet Makromolekulare Chemie
- **Prof. Dr. Albena Lederer** – Privatdozentur im Gebiet Physikalische Chemie

Bereich Ingenieurwissenschaften

- **PD Dr. Marina Grenzer –** Privatdozentur für Rheologie komplexer Fluide
- **Dr.-Ing. Ines Kühnert** – Lehrauftrag in der Fakultät Maschinenwesen
- **Dr. Andreas Leuteritz** – Lehrauftrag in der Fakultät Maschinenwesen
- **Dr.-Ing. Christina Scheffler** – TUD Young Investigator in der Fakultät Bauingenieurwesen

Bereich Ingenieurwissenschaften, fakultätenübergreifend
Graduiertenkolleg 2430 „Interaktive Faser-Elastomer-Verbunde“

- **PD Dr. Marina Grenzer**
- **Prof. Dr.-Ing. Sven Wießner**

Graduiertenkolleg 1865 „Hydrogel-basierte Mikrosysteme“

- **Prof. Dr. Brigitte Voit**
- **Dr. Dietmar Appelhans**
- **Dr. Jens Gaitzsch**

Graduiertenkolleg 2767 „Supracolloidal Structures“

- **Prof. Dr. Andreas Fery**
- **Prof. Dr. Brigitte Voit**
- **Dr. Franziska Lissel**
- **Dr. Christian Roßner**

Graduiertenkolleg 2250 „Impaktsicherheit von Baukonstruktionen durch mineralisch gebundene Komposite“

- **Dr.-Ing. Christina Scheffler**

Zentrale Wissenschaftliche Einheit
„Center for Molecular and Cellular Bioengineering (CMCB)”

- **Prof. Dr. Carsten Werner**
- **Dr. Julian Thiele** – Lecturer

Dresden International Graduate School for Biomedicine and Bioengineering

- **Prof. Dr. Carsten Werner**

Center for Advancing Electronics Dresden – cfaed

- **Prof. Dr. Brigitte Voit**
- **Prof. Dr. Andreas Fery**
- **PD Dr. Tobias A. F. König**
- **Dr. Franziska Lissel**

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- **Prof. Dr. Brigitte Voit**
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Institut für Organische Chemie und Makromolekulare Chemie

- **Dr. Franziska Lissel,** Vertretungsprofessur „Funktionale Farbstoffe, Marker und molekulare Sensoren“

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School of Materials Science and Engineering

- **Dr. Manfred Maitz** – Gastprofessur

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Fakultät Maschinenbau, Elektro- und Energiesysteme

- **Dr.-Ing. Ines Kühnert** – Lehraufträge „Verarbeitungsbedingte Material-strukturen“ und „Aufbau und Materialverhalten der Kunststoffe“
- **Dr. Jens Gaitzsch** – Gastprofessur für Polymerchemie im B.Sc. Studiengang Materialchemie

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