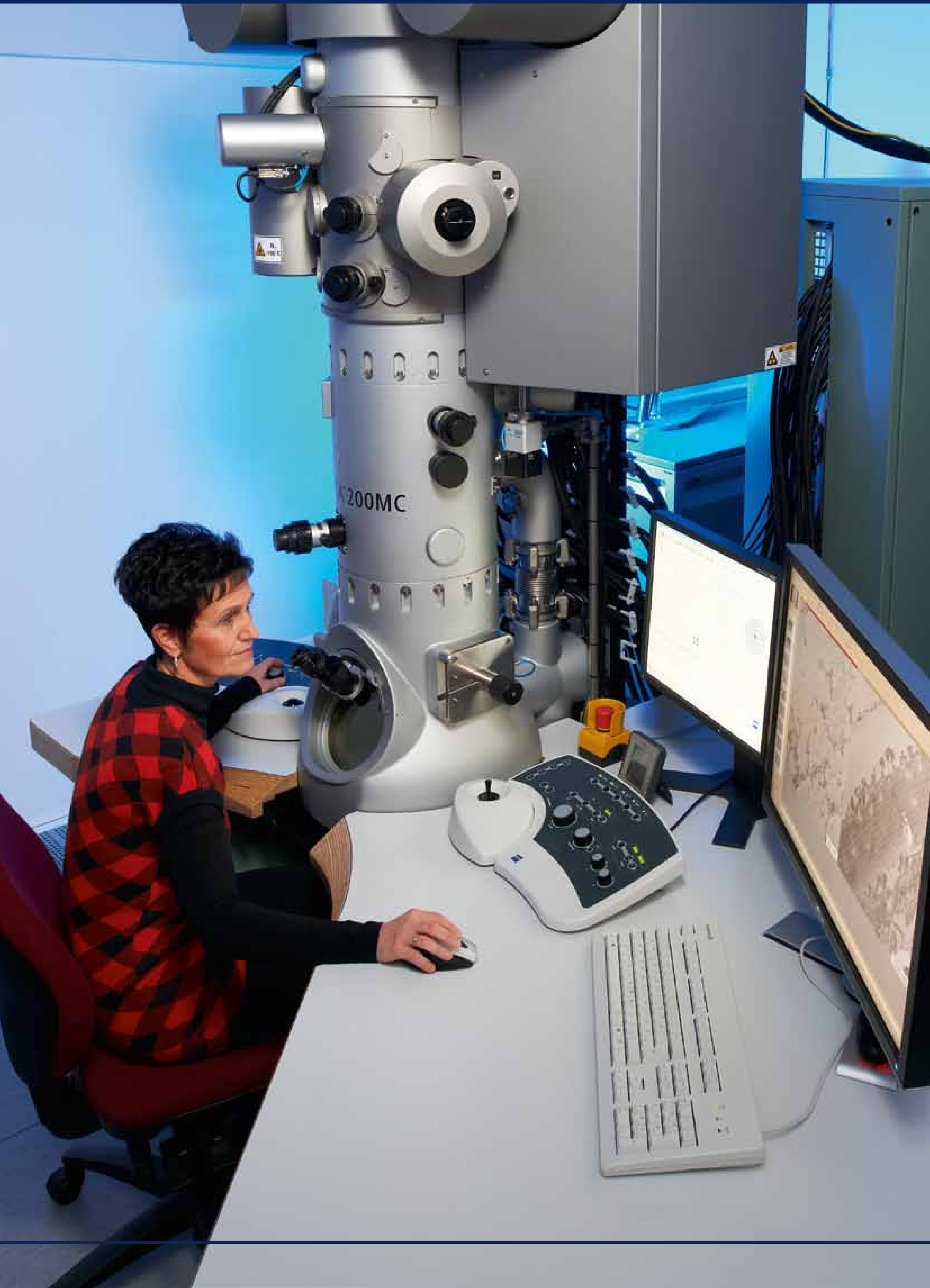
Leibniz-Institut
für Polymerforschung
Dresden e.V.

Polymer Research

Fascination. Innovation.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Our Mission

The Leibniz Institute of Polymer Research Dresden (IPF) is one of the largest polymer research facilities in Germany. As an institute of the Leibniz Association, the IPF is committed to carrying out application-oriented fundamental research and receives its basic funding in equal parts from the federal and state governments.

The approach is holistic, covering synthesis and modification of polymer materials, their characterization and theoretical investigation, up to processing and testing. A special feature of the institute's activities is the close cooperation of scientists and engineers and a broad range of modern instruments and methods are available including pilot plants allowing material and technology development under industry-relevant conditions.

The research focus is on materials problems and needs which can be approached by control of interface-related properties as well as interactions at interfaces and surfaces. A deep understanding of techniques and processes as well as of underlying physical aspects shall provide the basis to develop long-term concepts for technological implementation and applications of new polymer materials.

The topics dealt with at the institute are highly future-oriented. They include development of materials, technologies, and systems which are crucial to guarantee the strength of Germany's economy also in future and to ensure both quality of living and sustainability. The polymer materials address innovations for further development in, e. g., medicine, transport and mobility, as well as energy efficiency and advanced communication technologies.

The institute's profile is determined by four strategic topics that are approached in close collaboration of all departments of the institute.

Functional nanostructured interfaces and polymer systems

Biology-inspired interface and material design

Polymer networks: Structure, theory, and application

Process-controlled structure formation in polymer materials

Based on these topics the IPF is linked with leading research groups in Germany and worldwide, but, first of all, it is part of the powerful network of research institutions in Dresden and a very active member of DRESDEN concept.

DRESDEN concept

Picture:
TEM for investigation of the nanostructure of materials

Organizational Structure of the Institute

August 2011

General Meeting

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Prof. Dr. Brigitte Voit, Prof. Dr. Manfred Stamm

Functional nanostructured interfaces and polymer systems

Highly integrated new technologies in the fields of communication, transportation, medicine, microelectronics and micro system technology as well as for efficient power generation, storage, and utilization require materials with novel, precisely defined properties and adjusted functionalities. Functional nanostructured polymers offer a great potential in this respect as they may be tailored for a large number of applications and can take over specific functions.

Research activities at the IPF are focussed on exploiting this potential by development of functional polymers and nanostructured (hybrid) materials. Efforts aim at precise

adjustment of architecture, functionalities, self-assembly, and nanostructure of polymers by novel and improved synthesis strategies as well as by control of physical interactions and interface properties. In addition, better understanding of correlations between molecular structure, nanomorphology, interface functionality, and the macroscopic material and end-use properties are to be achieved.

For integration of functions it is necessary that polymer materials with desired functionality and morphology can be combined with other materials and integrated into complex systems with high reproducibility and long-term stability. This concerns design of novel functions, while, at the same time, environmentally-friendly and cost-efficient procedures are required. Application of macromolecules as nanoscale functional elements is achieved by adjustment of chemical constitution and architecture, but also by control of positioning and manipulation of single molecules. The required chemical and structural nanoscale analysis is performed by top-level characterization techniques.

Functional nanostructured interfaces and polymer systems

Prof. Dr. Brigitte Voit, Prof. Dr. Manfred Stamm

Fields of work

Functional nanostructured polymer systems

Development of synthesis strategies, polymer architectures, and complex analytical techniques as well as application of methods of interface chemistry for synthesis of tailor-made functional and nanostructured polymer systems

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Polymers for functional nanoelements and nanotemplates

Functional films and structured nanotemplates for applications in nanoelectronics, energy and environmental engineering, highly integrated microsystem technology, and nanobiotechnology

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Smart systems

Functional microstructured and nanostructured responsive layers for smart systems, sensorics, adhesion, catalysis and biofunctionality including investigation of physical interactions and processes at surfaces and interfaces

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Functional coatings and layers

Preparation of technologically relevant functional layers by control of nanostructure as well as interfacial chemistry and functionality, membranes, interfacial and surface characterization

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Charged polymers in dispersions, polyelectrolytes, and complex particles

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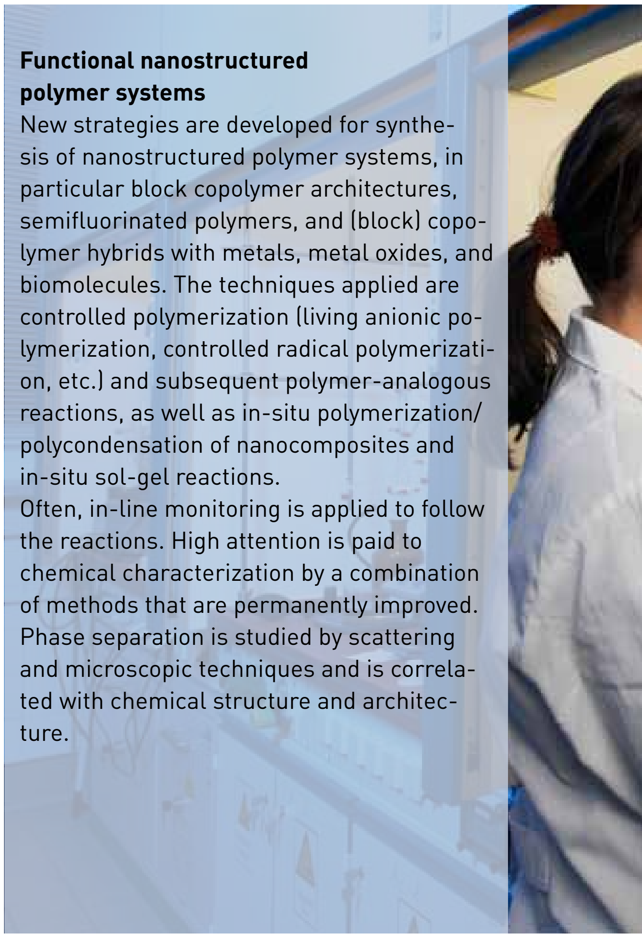
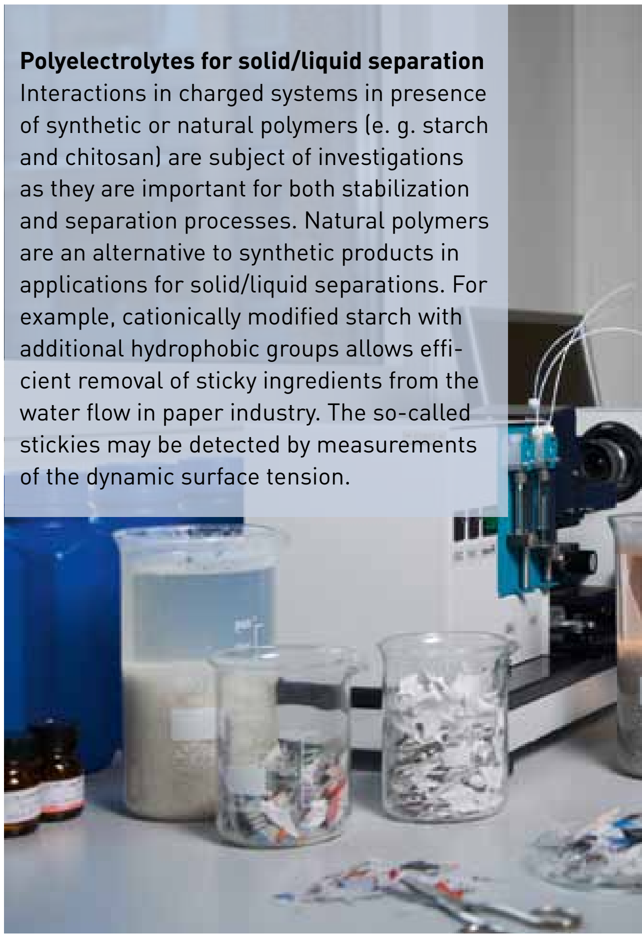
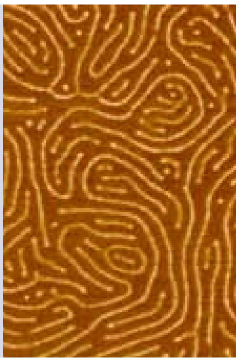


Functional nanostructured polymer systems
New strategies are developed for synthesis of nanostructured polymer systems, in particular block copolymer architectures, semifluorinated polymers, and (block) copolymer hybrids with metals, metal oxides, and biomolecules. The techniques applied are controlled polymerization (living anionic polymerization, controlled radical polymerization, etc.) and subsequent polymer-analogous reactions, as well as in-situ polymerization/polycondensation of nanocomposites and in-situ sol-gel reactions.
Often, in-line monitoring is applied to follow the reactions. High attention is paid to chemical characterization by a combination of methods that are permanently improved. Phase separation is studied by scattering and microscopic techniques and is correlated with chemical structure and architecture.

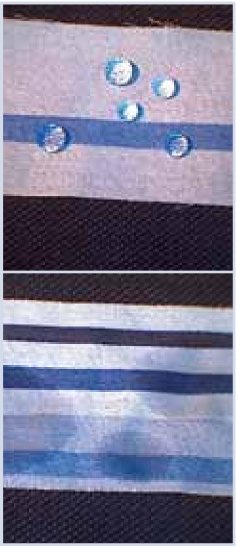


Polyelectrolytes for solid/liquid separation
Interactions in charged systems in presence of synthetic or natural polymers (e. g. starch and chitosan) are subject of investigations as they are important for both stabilization and separation processes. Natural polymers are an alternative to synthetic products in applications for solid/liquid separations. For example, cationically modified starch with additional hydrophobic groups allows efficient removal of sticky ingredients from the water flow in paper industry. The so-called stickies may be detected by measurements of the dynamic surface tension.

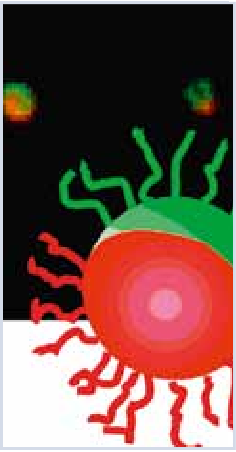
Nanotemplates
Templates for production of metal, silica, and other nanostructures are prepared by self-organization of diblock copolymers. The picture shows silica nanotubes in a template of a methacrylate diblock copolymer synthesized by anionic polymerization and subsequent in-situ sol-gel synthesis (picture height corresponds to 2 mm)



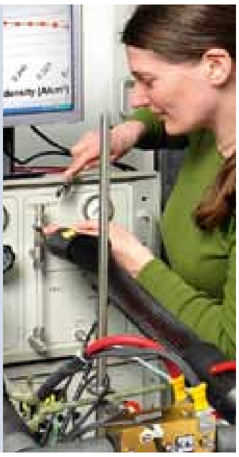
Switchable textiles
The few nanometer thin layer of a so-called mixed polymer brush made of two incompatible, end-functionalized linear polymers will modify textiles in such a way that their wetting behaviour can be reversibly switched between (ultra-)hydrophobic and hydrophilic. Thus, textiles may be both soil and water resistant as well as washable. The switching characteristics of the textiles may be precisely controlled by the specific properties of the polymers (i. e. hydrophilic in contact with basic water in the washing machine above a certain temperature, hydrophobic in contact with air in the tumble dryer).



Janus particles
Janus particles are particles with different properties (charge, polarity, optical, or magnetic ones) at opposite sides and are unique among other micro- and nanoparticles due to their anisotropic nature. Such Janus particles are synthesized and used for design of switchable functional surfaces and interfaces as well as ultrahydrophobic materials with advanced properties.



Membranes for fuel cells
The development of proton-conducting membranes based on fully aromatic polymers, working reliably and with sufficient conductivity in fuel cells at operating temperatures of up to more than 100 °C and at relative humidity below 90 per cent, opens up the path for broad application of fuel cells, e.g. in automotive industry.



Prof. Dr. Carsten Werner, Prof. Dr. Brigitte Voit

Biology-inspired interface and material design

The rapid gain of knowledge in molecular life sciences, mainly in the fields of cell biology, genetics, developmental and system biology, provides today's polymer research with new opportunities for biology-inspired design of functional materials referring to the archaic principle of learning from nature. Application of functional molecular units allows to mimick in synthetic systems materials properties never achieved before and – beyond that – to create completely new combinations of properties. The resulting developments permit to meet challenges of the future globalized civilization such as health, energy efficiency, and resource conservation.

To make use of its competence and capacities in the fields of theory, synthesis, interface design, and processing of polymers for biology-inspired materials development, the IPF established the Max Bergmann Center of Biomaterials (MBC) together with the Institute of Material Science of the Technische Universität Dresden. The MBC follows an interdisciplinary approach and cooperates closely with the Centres for Regenerative Therapies (CRTD) and Molecular Bioengineering (B CUBE) of the Technische Universität Dresden.

The research aims at application perspectives in medicine, especially in regenerative therapies to fight neurodegenerative, cardiovascular, and hematological and oncological diseases. On the other hand, also non-medical technologies such as sensorics, surface technology, and environmental engineering can benefit from novel biomimetic materials with properties such as controlled bioadhesion, friction, or adaptive or self-healing behaviour.

Biology-inspired interface and material design

Prof. Dr. Carsten Werner, Prof. Dr. Brigitte Voit

Fields of work

Understanding of interactions

at materials interfaces in contact with biosystems using complementary analytical techniques as well as theory and simulation

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Development of bioactive polymeric functional layers

via structuring and bioaffinity methods as well as functional reconstitution of biomolecular assemblates

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Design of multi(bio-)functional polymer matrices

based on biomimetic and bioanalogous molecules, by means of self assembly and adaptation principles

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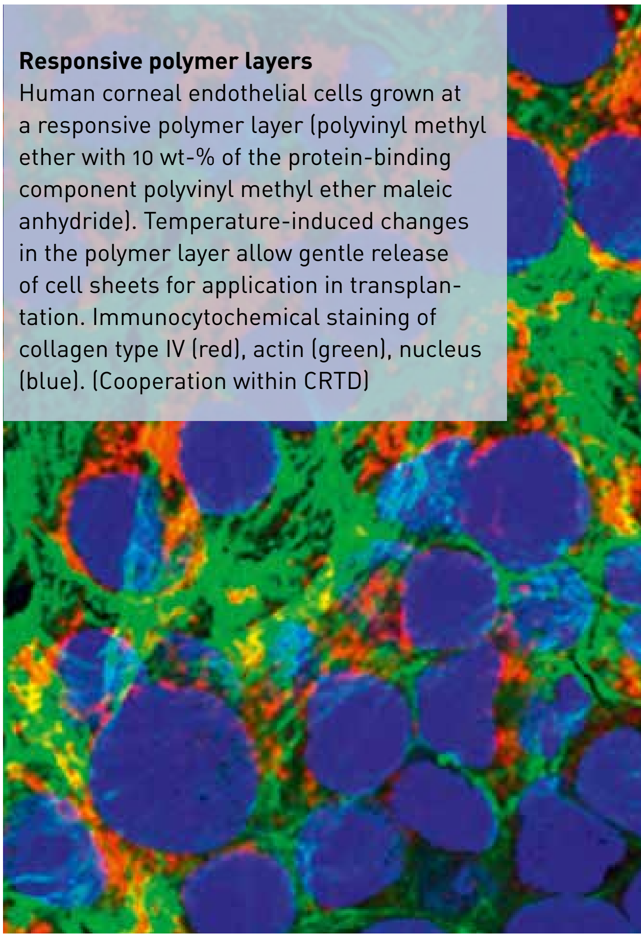
Adaptation of approaches of chemical biology and bionanotechnology

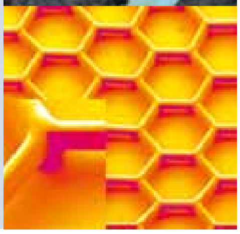
to develop novel concepts for biomaterials, also for non-medical applications

Hemocompatibility assessment
Material surfaces with passive or bioactive functionalization are exposed to freshly drawn human whole blood for several hours in specific screening incubation chambers (institute-made). Subsequently, activation reactions are revealed by detection of molecular markers of the blood.
The pictures shows a pipetting machine for immunosorbent assays and a scanning electron micrograph of thrombocytes at a surface showing characteristic changes.

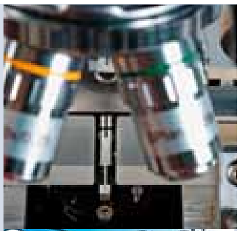


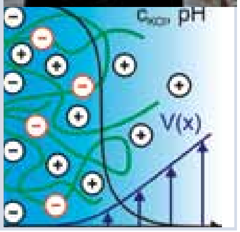
Responsive polymer layers
Human corneal endothelial cells grown at a responsive polymer layer (polyvinyl methyl ether with 10 wt-% of the protein-binding component polyvinyl methyl ether maleic anhydride). Temperature-induced changes in the polymer layer allow gentle release of cell sheets for application in transplantation. Immunocytochemical staining of collagen type IV (red), actin (green), nucleus (blue). (Cooperation within CRTD)

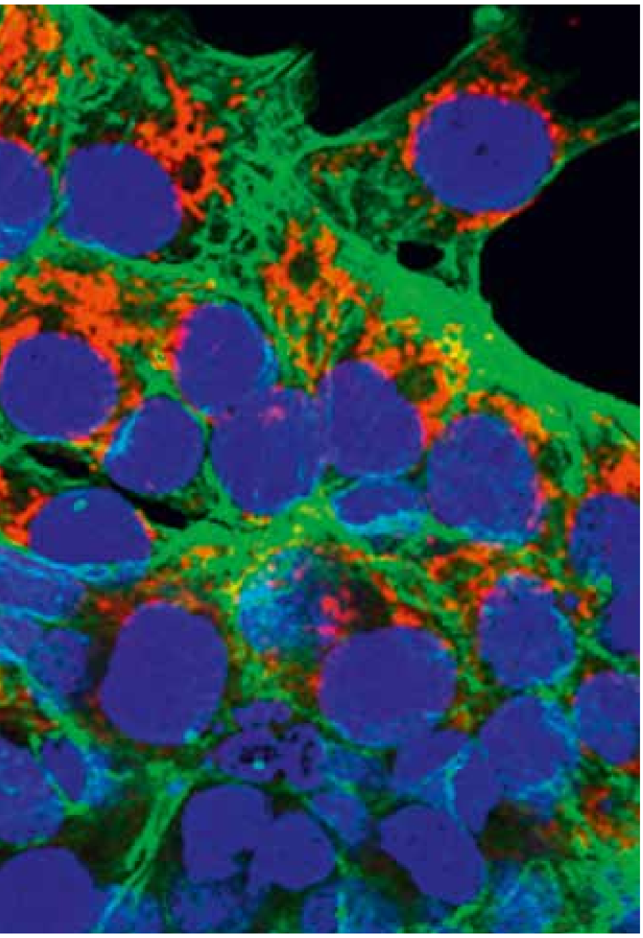
Biomimetic surface design
The mechanically stable, wetting-resistant skin of Collembola serves as a model for design of surfaces of artificial materials. As an example: Photochemically generated polyethylene glycol diacrylate network, prepared using the soft-lithographic replicating technique PRINT.



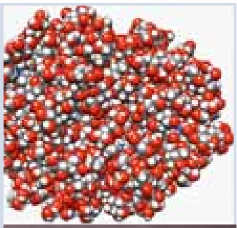
Charging and structure of polymer films
Experiments using the microslit electrokinetic set-up, a device developed at the IPF, allow to quantify the charge of polymer layers in aqueous electrolyte solutions. For interpretation of these data, models of the electrohydrodynamics at diffuse soft interfaces are developed. Based on the confrontation between experiment and theory, correlations between ionization and polymer structure are derived.



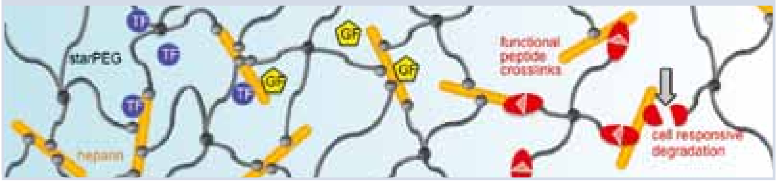




Glycopolymers
Glycopolymers with different molecular architectures open new possibilities in several fields of nanotechnology, e.g. for molecular carriers for drugs, active components and biomolecules, as well as in sensor applications. The pictures show the 3D structure of a glycodendrimer (M. Maly, Usti nad Labem) and the ligand controlled uptake of a glycodendrimer into an estradiol-sensitive breast cancer cell.



Biohybrid hydrogels
Biohybrid hydrogels based on heparin, branched polyethylene glycol units, and peptides can be applied as artificial extracellular matrices with tunable properties. Thus they offer a broad spectrum of options to control cellular processes in vitro and in vivo. They even allow to deliberately influence the development of organ cultures.
(Cooperation within CRTD)



Prof. Dr. Jens-Uwe Sommer, Prof. Dr. Gert Heinrich

Polymeric networks: Structure, theory, and application

Crosslinking processes are a major route to provide soft polymer materials with solid-state properties, such as reversible deformation and reversible swelling behaviour.
In combination with structuring processes due to preparation and self-organization, cross-linking processes are used to stabilize nano-structured materials, to control the properties of composite materials, or to prepare sub-strate materials for biologically active systems. Swollen polymer networks (gels) are of in-creasing importance in biomedical applications as well as for smart materials such as actua-

tors, sensors, and for microfluidics/microsystem technology.

Crosslinked polymers are indispensable also as construction materials, being used as elastomeric materials and composites especially in energy-efficient light-weight construction and mobility technologies.

Research on polymer networks at the IPF is focussed on overcoming deficits in understanding of correlations between molecular and supramolecular structure, topology, and properties in crosslinked polymer systems. Of particular interest are those formed in confined geometries (e.g. polymer films) or in self-assembled multi-component polymer systems.

Theoretical and analytical models are developed as fundamentals for new functional and construction materials and they are verified in experiments and refined for specific applications.

Polymeric networks: Structure, theory, and application

Prof. Dr. Jens-Uwe Sommer, Prof. Dr. Gert Heinrich

Fields of work

Further development of theoretical models and simulation procedures for polymer networks /crosslinked polymers

Computer simulations allow to observe crosslinking processes and network structures on molecular scale and to improve the theoretical models of thermodynamic and dynamic properties.

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Theoretical fundamentals of elastomer materials

Development of physically consistent theoretical fundamentals of structure-poperty relations in functional and high-performance elastomers with particular respect to deformation processes

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Generation of networks and gels with functional properties

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Elastomer nanocomposites

Development and characterization of novel elastomer composites for application in energy-efficient mobility technologies

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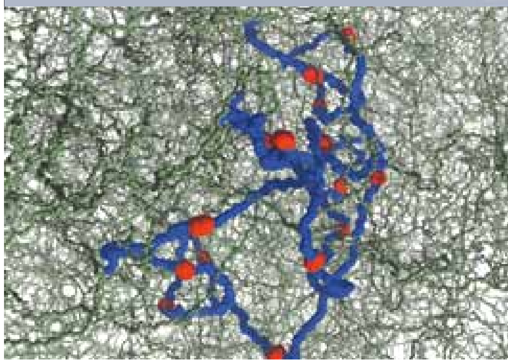
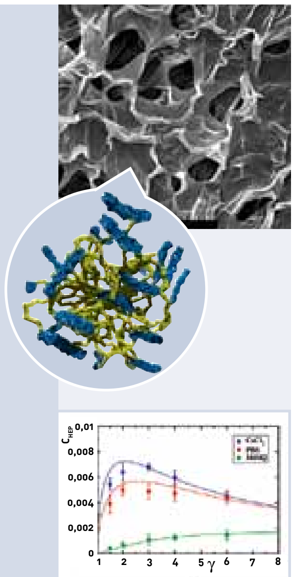
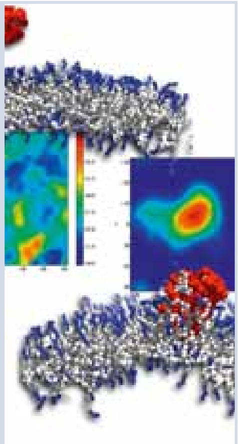
Polymer networks
Computer simulations of polymer networks: View into a simulated polymer network made of star polymers. A defect structure of the network connectivity is highlighted.



Elastomer nanocomposites
The properties of tires and other elastomer materials used in automotive applications are decisively influenced by the filler particles in the rubber matrix. Using novel nanoparticles as fillers and developing thermodynamic concepts for overall description of the polymer-solid interactions, new elastomer materials are created that contribute to enhanced road safety, environment protection, and efficient use of resources.

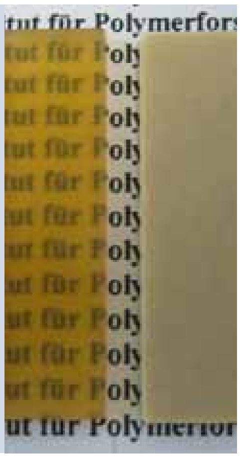


Biohybrid gels
Biohybrid gels of heparin and polyethylene glycol (PEG) are studied as materials for applications as extracellular matrices. The investigations include experiments, theory, and simulations: Electron micrograph of a dried sample (top), view into the simulated network (middle) and comparison of theoretical predictions and experimental results for the biologically relevant heparin concentration in the swollen gel as a function of the PEG-content (bottom).

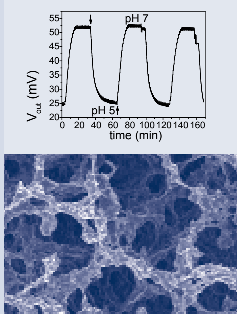


Membranes
Simulations describe the adsorption of a hydrophobic polymer chain by a lipid membrane and its effect on solvent permeability. Before adsorption (top), the permeability of the membrane is randomly distributed and rather homogeneous. After the adsorption (bottom) of the chain the permeability is strongly increased at the spot of the adsorbed polymer.

Environmentally-friendly rubber
If zinc-containing hydrotalcite (LDH) is used as a catalyst in the vulcanization of rubber instead of zinc oxide, the zinc content can be reduced to 10 per cent and, in addition, transparent sulphur-cured rubber may be produced. (Sample at the left side, as compared to the sample at the right side crosslinked conventionally using sulphur).



pH-sensitive hydrogels
Changes in the volume of a porous pH-sensitive hydrogel permit to obtain time-dependent signals of a piezoresistive microsensor for a cyclic change in pH between pH 5 and pH 7.



Prof. Dr. Gert Heinrich, Prof. Dr. Manfred Stamm

Process-controlled structure formation in polymer materials

The close cooperation of scientists and engineers at the IPF provides excellent conditions for the development of functional polymer and multi-component materials as well as of their processing technologies. Innovations are created by a complex approach integrating aspects of materials science, natural sciences, and process technology – from the molecule to the material in a complex component. They offer new solutions in power engineering, environmental technology, and light-weight construction and are applied, e.g., in mechanical and plant engineering, and automotive and aircraft industry.

A very efficient approach followed at the IPF is to utilize structure formation within the processing of polymer materials to get optimized, tailor-made materials properties. This is studied for reactive injection moulding of thermoplastics, reactive mixing of elastomers, electron-induced modification during processing, for chemically initiated dispersion strategies for polymer nanocomposites, and for structure formation, stabilization, and localization of nanofillers in multiphase polymer blends and polymer composites.

The scientific challenges are manifold. On the one hand they include development of novel technologies in process engineering via new materials concepts including multifunctional nanofillers. Simultaneously, appropriate methods of characterization, e.g. for determination of local structure and orientation, for analysis of topographically complex surfaces, and for characterization of internal interfaces, are developed as well as novel, adapted physical models describing, e.g., polymer-mediated filler interactions.

Process-controlled structure formation in polymer materials

Prof. Dr. Gert Heinrich, Prof. Dr. Manfred Stamm

Fields of work

Reactive processing

Control, characterization, and modelling of structure formation processes and material properties in reactive extrusion and interface-reactive injection moulding of multifunctional polymer and elastomer materials

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Composite materials

Design of interfaces in multicomponent and multifunctional composite materials and their structural and fracture-mechanical characterization

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Development of novel processing technologies

by combination with electron beam treatment and by melt spinning of novel multifunctional bicomponent fibres

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Composites and blends with carbon nanomaterials

Tailoring of properties during processing and optimization of the nanofiller-matrix interactions

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On-line monitoring in process control of nanostructured polymer materials materials

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Specific methods of characterization

Characterization of the (nano)structures, interfaces, and processes by advanced methods (X-ray scattering, electron microscopy, nuclear magnetic resonance, etc.) including further refinement of the methods

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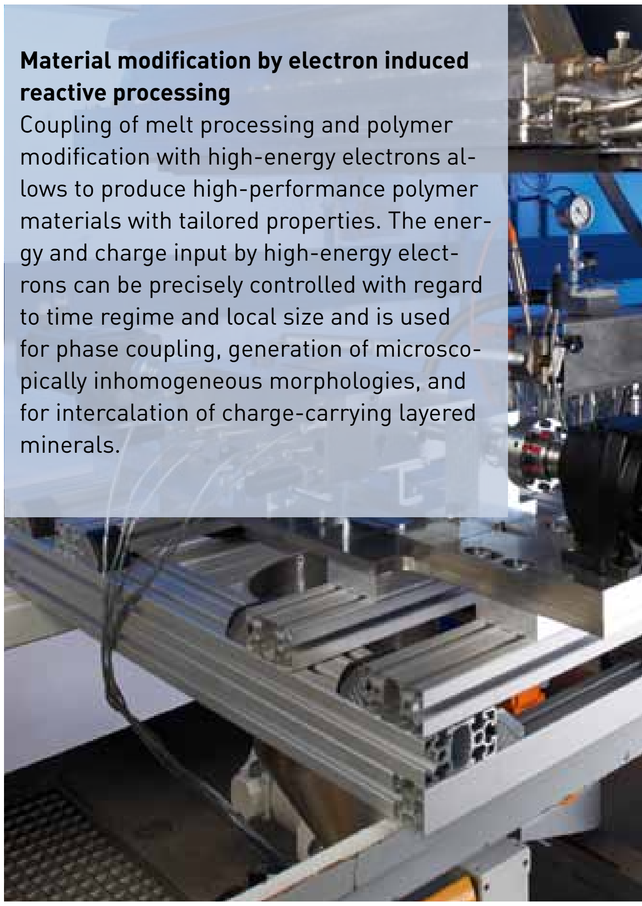
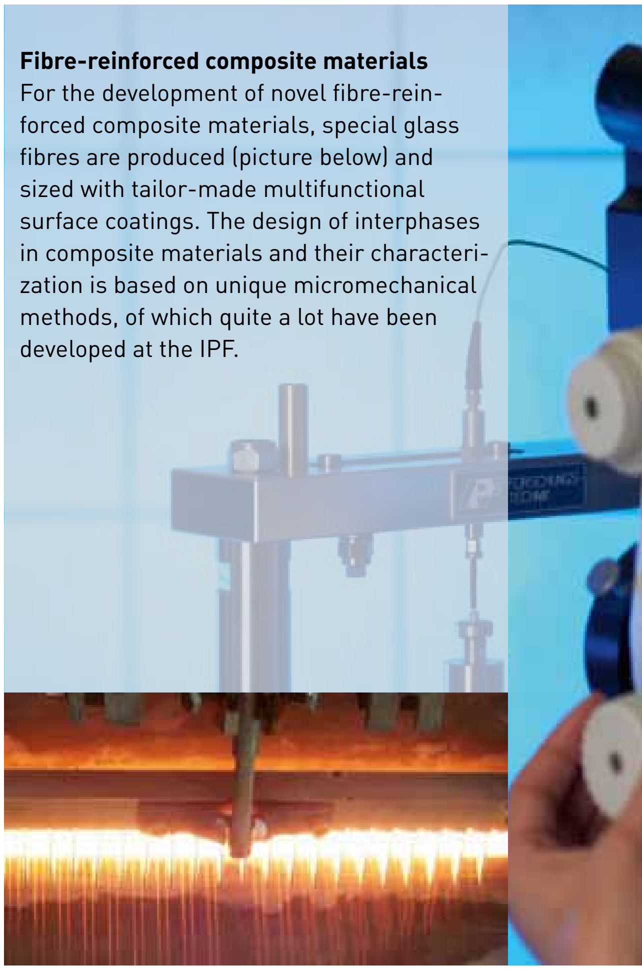
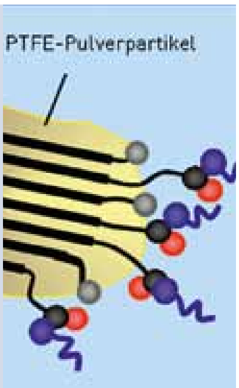


Material modification by electron induced reactive processing
Coupling of melt processing and polymer modification with high-energy electrons allows to produce high-performance polymer materials with tailored properties. The energy and charge input by high-energy electrons can be precisely controlled with regard to time regime and local size and is used for phase coupling, generation of microscopically inhomogeneous morphologies, and for intercalation of charge-carrying layered minerals.



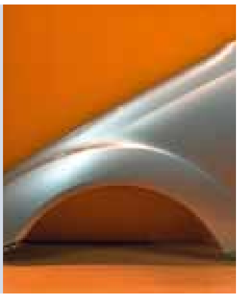
Fibre-reinforced composite materials
For the development of novel fibre-reinforced composite materials, special glass fibres are produced (picture below) and sized with tailor-made multifunctional surface coatings. The design of interphases in composite materials and their characterization is based on unique micromechanical methods, of which quite a lot have been developed at the IPF.

PTFE tribomaterials
Tribomaterials with excellent sliding friction and wear resistance have been obtained by coupling and compatibilization of polytetrafluoroethylene (PTFE) with commodity and high-performance plastics. Coupling of PTFE with oils leads to a new generation of high-performance lubricants.

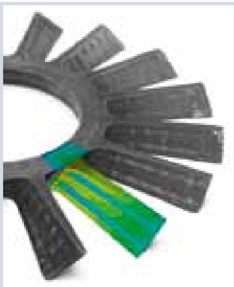


Process analytical technology (PAT)
On-line and in-line monitoring of polymer synthesis and processing by specific sensors in real time: Composition, particle size, dispersion/exfoliation, and conversion/kinetics can be determined quantitatively by in-line/on-line ATR-IR, NIR, UV/VIS, RAMAN and ultrasonic spectroscopy and light scattering, at high pressures (400 bar) and temperatures (300 °C) and simultaneously at different measuring positions.

Multifunctional light-weight materials
The properties of the on-line coated body car panel are a result of the combination of a multiphase polymer blend structure and selectively localized hybrid nanofillers such as carbon nanotubes and layered silicates.



Tailored Fibre Placement
Components of fibre-reinforced plastics with extremely high mass-specific stiffness and strength can be produced by means of the Tailored Fibre Placement technology and a novel software for design and optimization, both developed at the IPF.



Innovative coatings and additives
Development of functional duromer composites, (powder) coatings and additives in combination with innovative application, curing, and processing technologies. The picture shows an aluminium component with flexible powder coating withstanding (complex) multiaxial forming processes

Methods and Equipments (Selection)

Synthesis
- Equipment for controlled radical, anionic, cationic, and metallocene polymerization
- Reaction calorimeter for monitoring of reactions in solution (polymerizations, polymer-analogous reactions)
- 5L-stirring autoclave for reactions in solution
- 2.5L-stirring autoclave für melt polycondensations

Modification
- Electron irradiation plants (0.6 to 1.5 MeV or 300 eV, respectively) for modification of polymers, can be coupled to mixing units of extruders for modification of polymer melts
- Plasma processors and sputter coaters for surface modification

Analytics
- UV/Vis, IR, and RAMAN spectroscopy
- Spectroscopic Vis ellipsometry (also in situ)
- MALDI-TOF mass spectroscopy/elemental analysis, RFA
- NMR spectroscopy: NMR of solved substances, solid-state NMR, electrophoresis NMR, NMR flow imaging and imaging
- Chromatography: HPLC, SEC-MALLS, HT-GPC, pyrolysis and head-space GC-MS, asymmetric flow field flow fractionation (AF4)
- Light scattering of dispersions and macromolecules in solution (particle sizes and charges)
- X-ray structure analysis: WAXS, SAXS, RheoSAXS, reflectometry
- Thermoanalysis: TGA-FTIR, TMA, DSC, PVT measurements

Microscopy
- TEM, AFM, REM and light microscopes, including methods of preparation for (cryo)sections and thin films

Surface characterization
- Surface spectroscopy: XPS, spectroscopic ellipsometry, ATR-IR
- Surface roughness: chromatic aberration, confocal microscopy, and stereophotogrammetry, REM, optical interferometry
- Scanning force microscopy/direct force measurements: AFM, also with colloidal probe, nanoindenter, μTA
- Electrokinetic methods: Streaming potential/streaming current (with solid samples of different shapes), electroosmosis, particle electrophoresis and acustophoresis (in suspensions)
- Contact angle and surface tension measurements at liquid drops (including polymer melts) and inversely at air bubbles by ADSA and Wilhelmy technique (also for polymer melts), determination of the surface free energy of porous solid systems by capillary penetration/ diffusion of liquids
- Low-temperature gas sorption for determination of specific surface, pore radius, and pore radii distribution, water vapour sorption
- Nanostructuring and manipulation: FIB/SEM with nanomanipulation unit, AFM, lithography, plasma treatment

Thermoplastics and elastomer processing
- Mixers, kneaders, compounders and injection moulding units for small amounts
- Pilot-plant scale compounders, single and double screw extruders, injection moulding machines, also for two-component injection moulding,

Analytical investigation by pyrolysis gas chromatography

NMR laboratory: In-situ NMR while stretching

Pilot-scale reactors for synthesis of PAO-PTFE lubricants

Methods and Equipments (Selection)

Experiments in cell cultures under GMP conditions

Printing of protein micro arrays in silicon cavities for multiple cell culture experiments

Melt-spinning plant for polymer fibres

as well as presses, each with diverse feeding and downstream equipment

- On-line monitoring by NIR, UV/VIS, RAMAN, and ultrasonic spectroscopy and light scattering adaptable to the extruder
- Elastomer processing: internal mixer and laboratory roll mill with temperature control for manufacture of rubber compounds, vulcanising presses
- Melt spinning plants for polymer fibres and biofibres (GMP conditions) with stretching unit and measuring equipment for running fibres

Manufacture and characterization of fibre reinforced composites

- Spinning plants for special glass fibres and E glass fibres as well as for polymer-glass hybrid fibres
- Multistage size application unit
- Device for manufacture of composites by means of the prepreg technology and vacuum infiltration
- Laminate and vacuum presses
- Embroidery machines for tailored fibre placement (TFP)
- Micromechanic investigations (quasistatic, cyclic, impact load)

Materials testing

- Mechanical testing: quasistatic and dynamic test machines for tension/compression/bending as well as impact, optical strain measurement at room temperature and elevated temperatures
- Testing of elastomers: DMTS, TFA, biaxial tester
- Ageing tests
- Flammability tests
- Rheology: Rotation rheometer, measuring extruder, high-pressure capillary rheometer, viscosimeter
- Membrane testing methods

Modelling/simulation

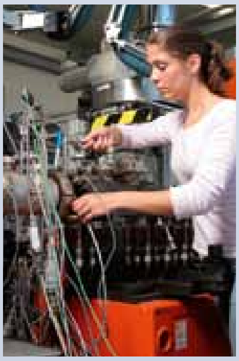
- Hardware for computer simulations and numerical tasks
- Linux cluster for computer simulations of polymers (800 cores)
- Software development of Monte Carlo and molecular dynamics simulations, as well as self-consistent field algorithms. Java platform for the bond fluctuation model JBFM
- Computational packages: LAMMPS, GROMACS, GAMESS, CERIUS2
- Software Moldflow Plastics Insight for simulation of polymer processing as well as institute-made software for modelling of melt spinning processes
- Software for simulation of structure and mechanical properties (ANSYS)

Bioengineering and characterization of bio-interface phenomena

- Surface modification techniques: Plasma processor, spin coaters, dipping techniques for preparation of gradient layers, nanoplotter
- Specific surface characterization and protein analytics: Electrokinetics including microslit elektrokinetic set-up, optionally coupled with ATR-IR or RIFS, spectroscopic methods, HPLC, ellipsometry, AFM with confocal microscopy, fluorescence microscopy
- Cell culture techniques and cytometry: cytometer, microscopic methods (e.g. LSM, ESEM), preparation and separation techniques
- Hemocompatibility assessment: incubation chambers, titration methods, blood cell counting and analysis equipment

Networking and Cooperations

Research network in Dresden
The capital of Saxony boasts an extraordinarily high number of research facilities which have made Dresden a leading research location, particularly in the fields of materials research, microelectronics, and biotechnology.
The Technische Universität Dresden, institutes of the Leibniz Association, the Max Planck Society, the Helmholtz Association, and the Fraunhofer Gesellschaft as well as leading cultural institutions have joined together in the network DRESDEN concept. Thus they strive to further intensify their co-operation and to create new synergies in academic education, research, infrastructure, and administration. The IPF is a member of DRESDEN concept.
Close links to the university have been established since the institute's foundation in 1992. Five leading scientists of the IPF are at the same time appointed professors at the university holding chairs in chemistry, physics, and material science. IPF and TUD have jointly created the Max Bergmann Center of Biomaterials, which has merged under one roof in a building opened at the IPF campus in 2002 activities of the two institutions in the field of molecular bioengineering.
With its research division Biofunctional Polymer Materials and the Max Bergmann Center of Biomaterials the IPF forms part of the DFG Research Centre 'Regenerative Therapies' and the Excellence Cluster 'From Cells to Tissues to Therapies'. In addition, the Innovation Center for Molecular Bioengineering B-Cube has been established on the basis of funding by the Federal Ministry of Education and Research within the program 'Entrepreneurial Regions'. The head of the research division Biofunctional Polymer Materials is the spokesman of this center.
The IPF is also involved in the 'European Centre for Emerging Materials and Processes Dresden (ECEMP)' established as an excellence cluster within the Excellence Initiative of the Free State of Saxony. Competences of Dresden institutes in this field had been bundled even much earlier by the Dresden Materials Research Association.



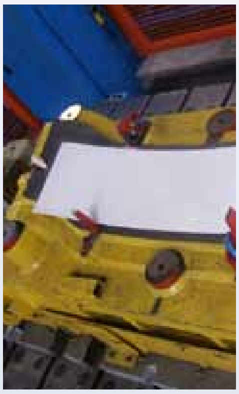
National and international co-operations
Co-operations, joint projects, and networks link the IPF with leading research groups at universities and research institutes in Germany and world-wide. Consequently, internationality is an everyday reality at the institute. Throughout the year there are visiting scientists or students from up to 30 countries working at the IPF for different periods, among them for example eight Humboldtians in 2010. Coworkers of the institute travel to partners abroad to give lectures or to work there within joint projects.
The participation in several collaborative research projects funded by the European Union demonstrates the international recognition of the institute and paves the way to new forms of cooperation within Europe. From the network of excellence 'Nanostructured and Functional Polymer Based Materials and Nanocomposites'(NANOFUN-POLY), the European Centre for Nanostructured Polymers (ECNP) was founded in order to allow beginning research networking in this field to continue on a permanent and sustainable basis.

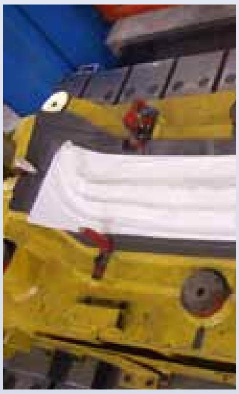
Partnership with Industry

Its position at the interface between fundamental research and application if the specific characteristics determining the IPF's role in the German research community and distinguishing it from other institutes active in the field of polymers.
Industrial enterprises, from large to small and medium sized firms, may benefit from the institute's research activities which are based on deep fundamental understanding but at the same time always aiming at potential applications. The combination of competences in natural sciences and engineering as well as high-tech equipment including both a broad spectrum of analytical methods and pilot-plant processing facilities contribute to successful technology transfer.
Third-party funding amounting to about two million Euro is obtained directly from industry annually. This is more than 20 per cent of third-party funding of the institute. The types of cooperation are manifold: Depending on the precise goals and the needs of the partners they reach from joint application for publically funded projects via transfer-oriented projects up to licensing and contract research. If it is in accordance with the institute's strategy, know-how and infrastructure are made available to partners in industry also as scientific services. New interfaces between science and industry are the Leibniz Application Laboratories established in 2010. The Leibniz Application Laboratory 'Multifunctional Polymer Materials' is one of 14 laboratories of this type and offers its support in development and implementation of product and technology innovations mainly to small and medium sized enterprises. The thematic focus is on electron-induced reactive processing and elastomer materials.

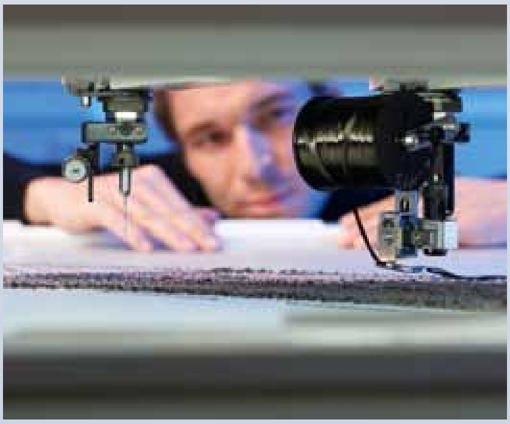
Whenever innovations with high commercialization potential are generated by researchers at the IPF, the institute promotes spin-offs. So far, three technology companies have been hived off:

Hightex Verstärkungsstrukturen GmbH
ZetaScience GmbH
Qpoint Composite GmbH





Top:
Tests on industrial appliances: Deep-drawing of exterior parts for cars from sheets precoated with flexible powder coating



Middle:
Two successful spin-offs of the IPF are based on the Tailored Fibre Placement technology developed here utilizing the embroidery technique

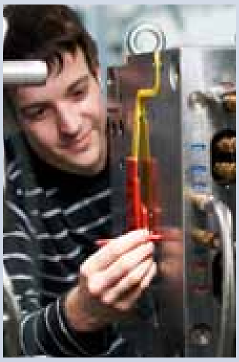
Bottom:
Measurement of additives and fillers in plastics by means of RFA, e.g. within projects aiming at new recycling technologies

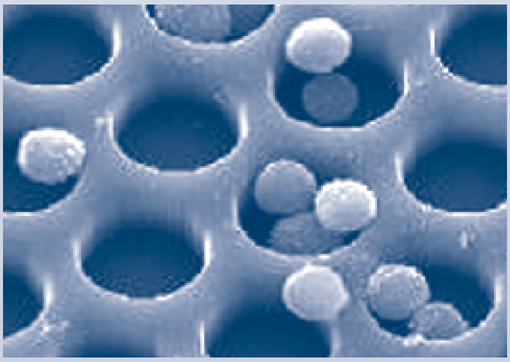
Academical and Vocational Training

The tasks of the institute include academical and vocational training.

Usually within the co-operation with the Technische Universität Dresden and the joint professorial appointments graduate students in the fields of chemistry, physics, and material science are doing their PhD work at the IPF. The subjects result from current research projects at the institute. Thus, the PhD students – at present almost 100 – get the opportunity to work on highly relevant scientific topics and to benefit from the excellent infrastructure as well as from the co-operation within interdisciplinary and often international teams. Specific framework conditions for PhD students have been created within the clusters of excellence active in Dresden: the Graduate School of the European Centre for Emerging Materials and Processes Dresden and the Dresden International Graduate School for Biomedicine and Bioengineering.

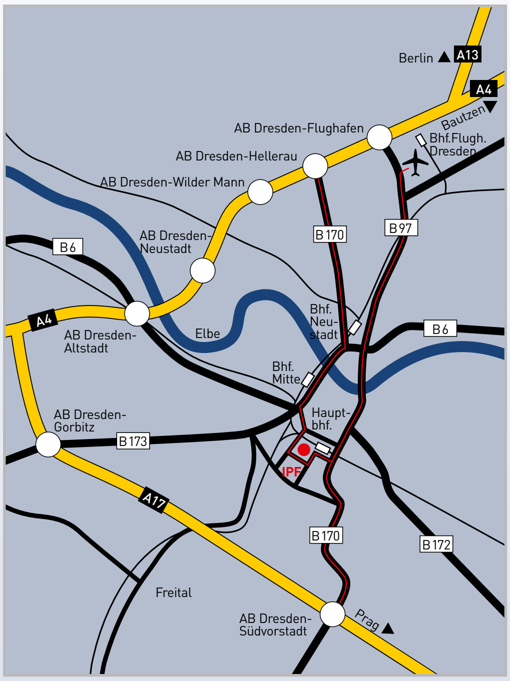
Scientists of the IPF act also as supervisors for diploma, master, bachelor, and other thesis papers of undergraduate students. Students collaborate in projects of the institute as trainees or assistants.

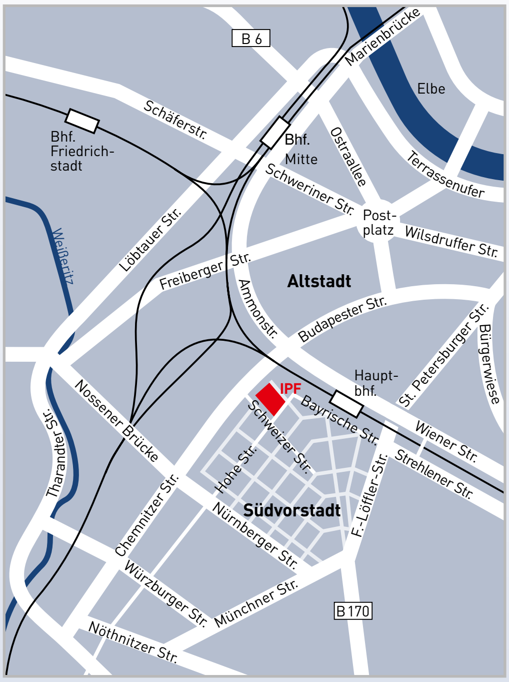




In cooperation with the University of Cooperative Education in Saxony the institute trains several biotechnicians per year within the bachelor degree course Laboratory and Process Engineering.

Based on the dual system of vocational training and together with educational institutions, the IPF also offers training for chemical laboratory assistants (usually three per year) and industrial mechanics/precision instrument engineering (up to one per year).





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