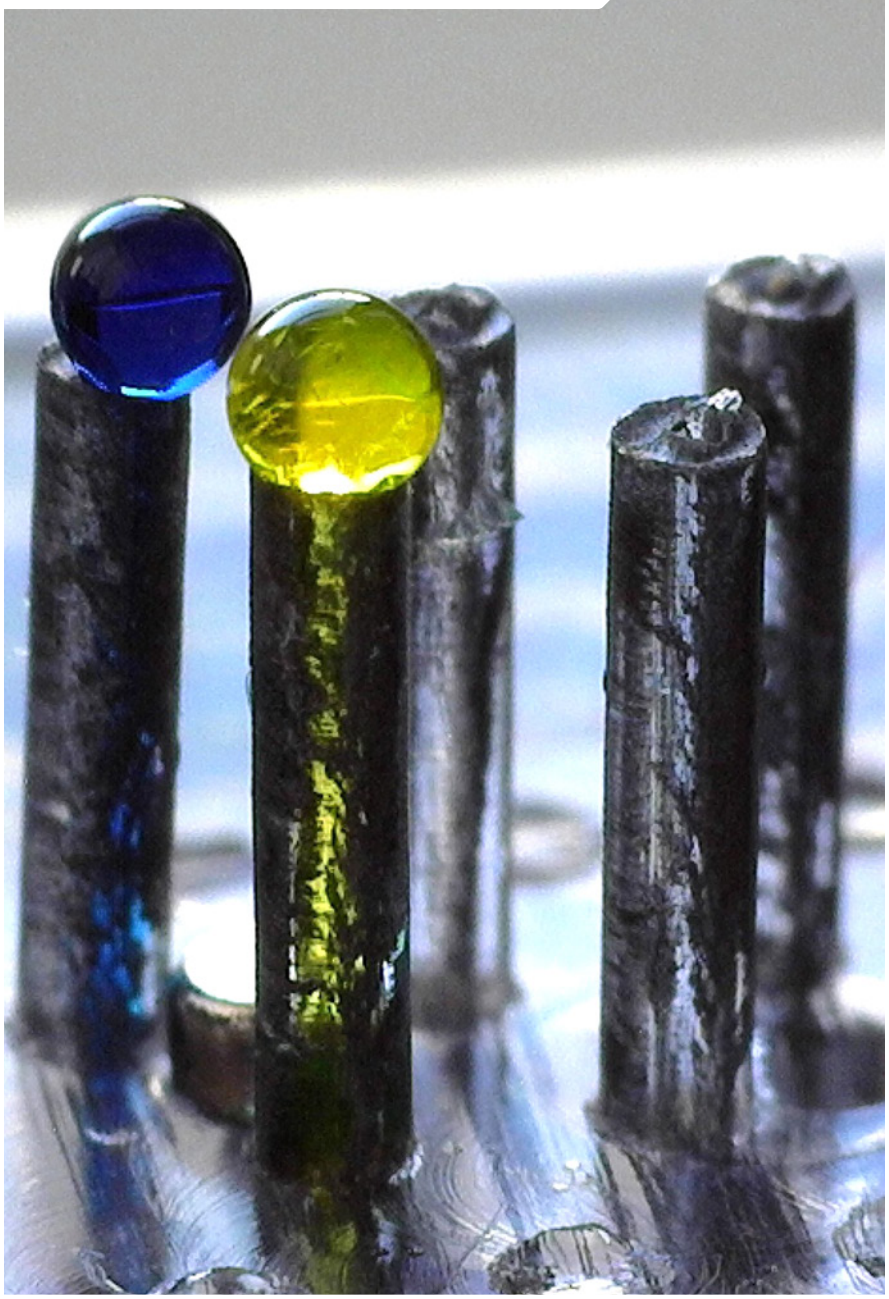
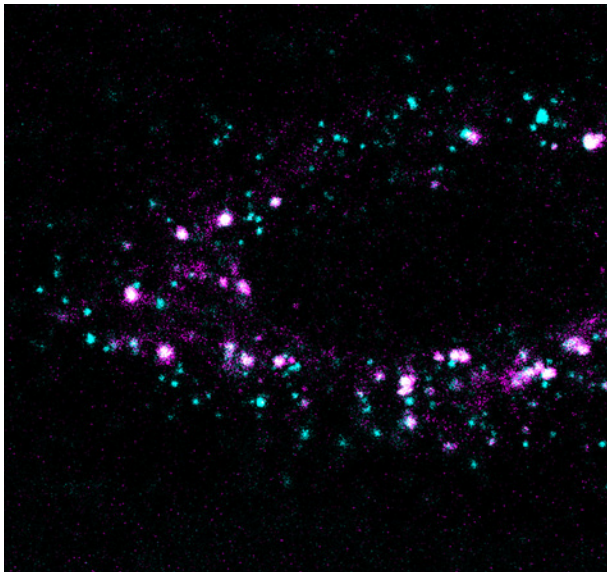
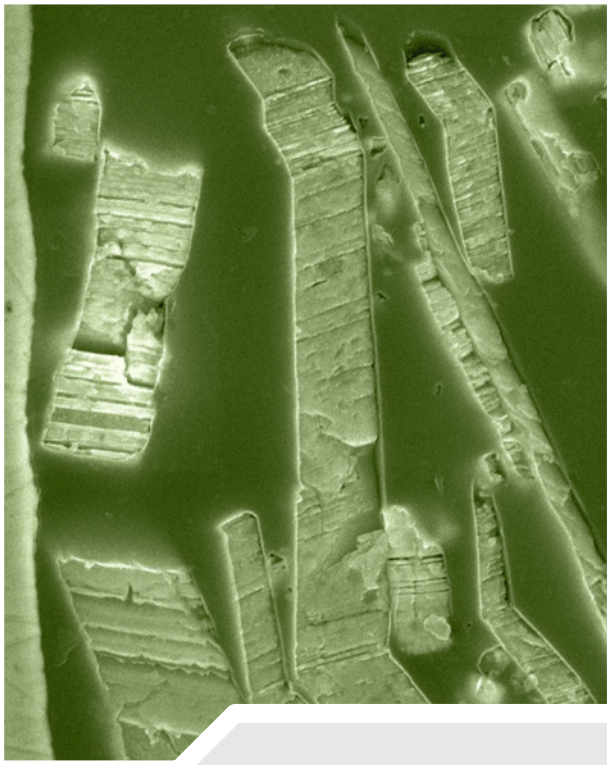
Neues Denken. Neue Materialien.







JAHRESBERICHT 2016
ANNUAL REPORT 2016

Leibniz Gemeinschaft

INM
Leibniz-Institut für Neue Materialien

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FAKTEN UND ZAHLEN / FACTS AND FIGURES

Günter Weber

Kaufmännischer Geschäftsführer/ Business Director

Prof. Dr. Aránzazu del Campo

Wissenschaftliche Geschäftsführerin/ Scientific Director

Prof. Dr. Eduard Arzt

Wissenschaftlicher Geschäftsführer und Vorsitzender der Geschäftsführung/ Scientific Director and CEO

LIEBE FREUNDINNEN UND FREUNDE DES INM,

2016 war wieder ein sehr erfolgreiches Jahr für das INM. Sowohl Publikationen als auch die Drittmitteleinwerbung sind – von einem hohen Niveau ausgehend – weiter gestiegen. Und wir sind stolz, wenn „die Köpfe dahinter" externe Anerkennung für ihre Arbeit erhalten, so wie im letzten Jahr beispielsweise diese drei:

Seit Dezember ist Tobias Kraus, Leiter des Programmbereichs *Strukturbildung*, W3-Professor für Kolloid- und Grenzflächenchemie an der Universität des Saarlandes. Damit sind nunmehr sechs unserer leitenden Wissenschaftlerinnen und Wissenschaftler gleichzeitig Professorinnen und Professoren an unserer Universität.

Erfreulich war auch die Wertschätzung, die unser Programmbereichsleiter Niels de Jonge im letzten Jahr erhielt: Er wurde für seine Pionierarbeiten im Bereich der Elektronenmikroskopie gleich mit zwei hochrangigen internationalen Preisen ausgezeichnet, dem MRS Innovation in Materials Characteristic Award (mit Frances Ross und Chongmin Wang) und dem European Microscopy Award der European Microscopy Society.

Nach 7 Jahren sehr erfolgreicher Arbeit am INM hat Ingrid Weiss den ehrenvollen Ruf auf eine W3-Professur für Biobasierte Materialien an die Universität Stuttgart angenommen.

2017 ist für das INM das Jahr der Evaluierung durch die Leibniz-Gemeinschaft. Wir hoffen und rechnen damit, dass Sie, Freunde, Partner und Förderer des INM, geneigte Leserinnen und Leser, uns weiter auf unserem Weg begleiten werden.

DEAR FRIENDS OF INM,

2016 was again a very successful year for INM. Starting from a high level, publications as well as the acquisition of external funds have further increased. And we are very proud that "the heads behind" keep gaining recognition for their work, as for example the following three:

In December, Tobias Kraus, Head of the Program Division *Structure Formation* was appointed W3-Professor for Colloid and Interface Chemistry at Saarland University. With him, now six of our group leaders hold joint professorial appointments at our university.

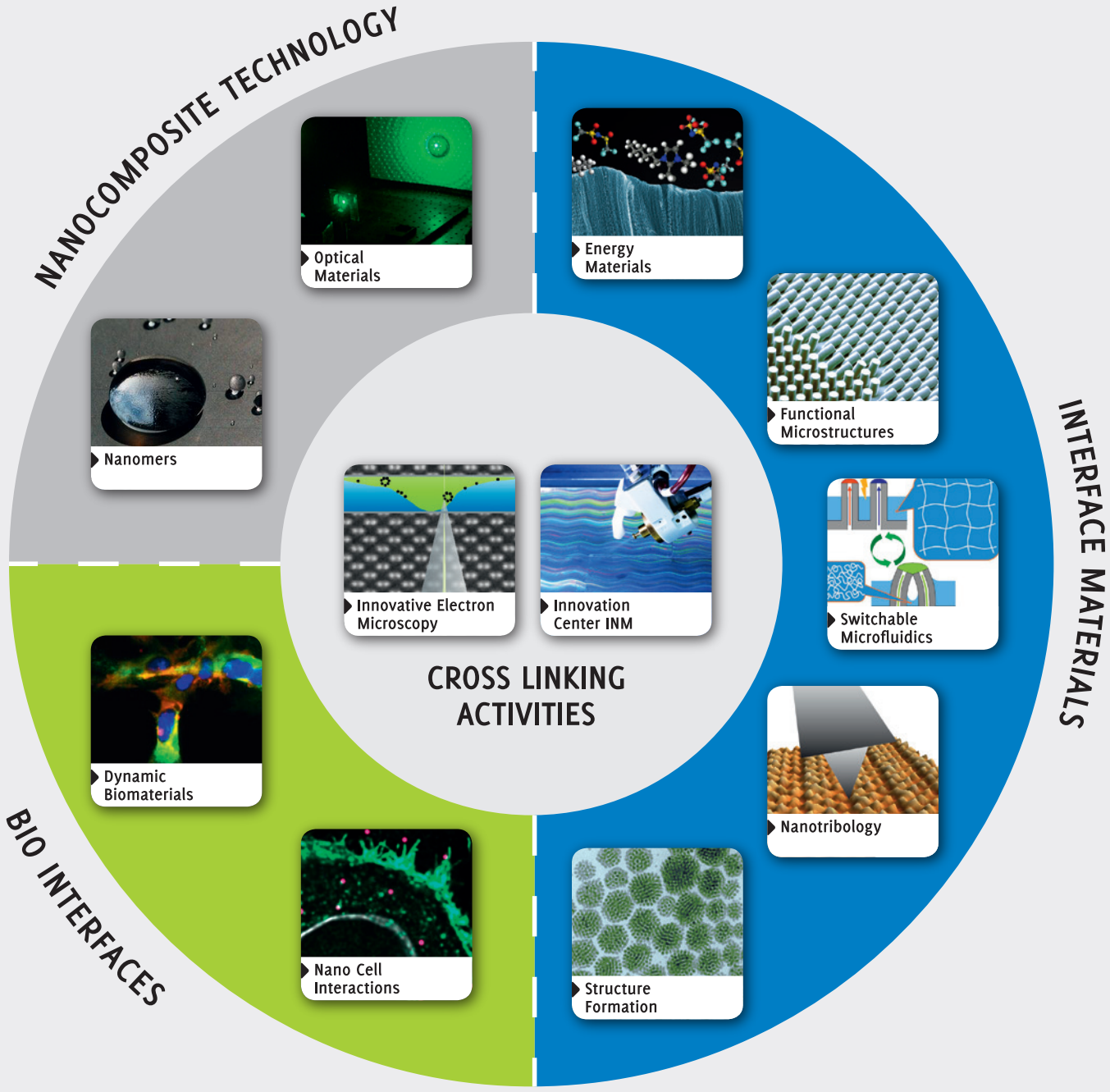
Another cause for joy was the appreciation that our Head of Program Division, Niels de Jonge, gained in the last year: For his pioneering contributions to the field of Electron Microscopy, he received two distinguished international awards, the MRS Innovation in Materials Characteristic Award (with Frances Ross and Chongmin Wang) and the European Microscopy Award of the European Microscopy Society.

After 7 years of very successful work at INM, Ingrid Weiss accepted the offer of a W3-Professorship for Biobased Materials at the University of Stuttgart.

For the INM 2017 will be the year of the evaluation by the Leibniz Association. We hope and expect that you, dear friends, partners, funders of the INM, and readers, will continue to accompany us on our path.

GRUPPENBERICHTE / GROUP REPORTS

FORSCHUNGSFELDER / RESEARCH FIELDS



DIE FORSCHUNGSFELDER DES INM

Die Arbeiten des Instituts sind in drei Forschungsfelder und ein Querschnittsfeld gegliedert, die thematisch nahestehende Programmbereiche und Juniorforschungsgruppen zusammenfassen:

Grenzflächenmaterialien: Das Forschungsfeld beschäftigt sich mit neuen Methoden der Oberflächen- und Grenzflächenstrukturierung und erforscht insbesondere physikalische Mechanismen an Oberflächen und Grenzflächen. Im Vordergrund stehen z. B. neue Materialien zur Energiespeicherung, steuerbare tribologische und adhäsive Phänomene und flexible Schichten für die Photovoltaik.

Biogrenzflächen: Dieses Forschungsfeld entwickelt Materialien und Oberflächen, die mit Zellen und Geweben wechselwirken und sich für Anwendungen im biomedizinischen Bereich eignen. Die Themen umfassen lichtgeregelte Biomaterialien und safe-by-design-Nanopartikel. Biologische Antworten auf Biomaterialien werden im Kontext regenerativer Medizin, fibrotischer Erkrankungen und Nanosicherheit untersucht.

Nanokomposit-Technologie: Das Feld widmet sich nichtmetallisch-anorganischen Hybridmaterialien, vorwiegend in Form von Beschichtungen, und ihren funktionellen Eigenschaften. Schwerpunkte sind nasschemische Synthesemethoden und die Nutzung funktionalisierter Nanopartikel. Ein Fokus der Arbeiten liegt in der Nutzung der Konzepte für konkrete industrielle Anwendungen.

Querschnittsfeld: Das Querschnittsfeld fasst übergreifende Forschungs- und Entwicklungsthemen zusammen, die die Arbeiten der Forschungsfelder methodisch ergänzen. Die Schwerpunkte umfassen hochmoderne, innovative Elektronenmikroskopie sowie die Verbindung der Wissens- und Technologiebasis des INM mit Industrieunternehmen.

THE RESEARCH FIELDS OF INM

The research in the institute is grouped in three research fields and cross-linking activities. These research fields merge Program Divisions and Junior Research Groups with similar thematic orientation:

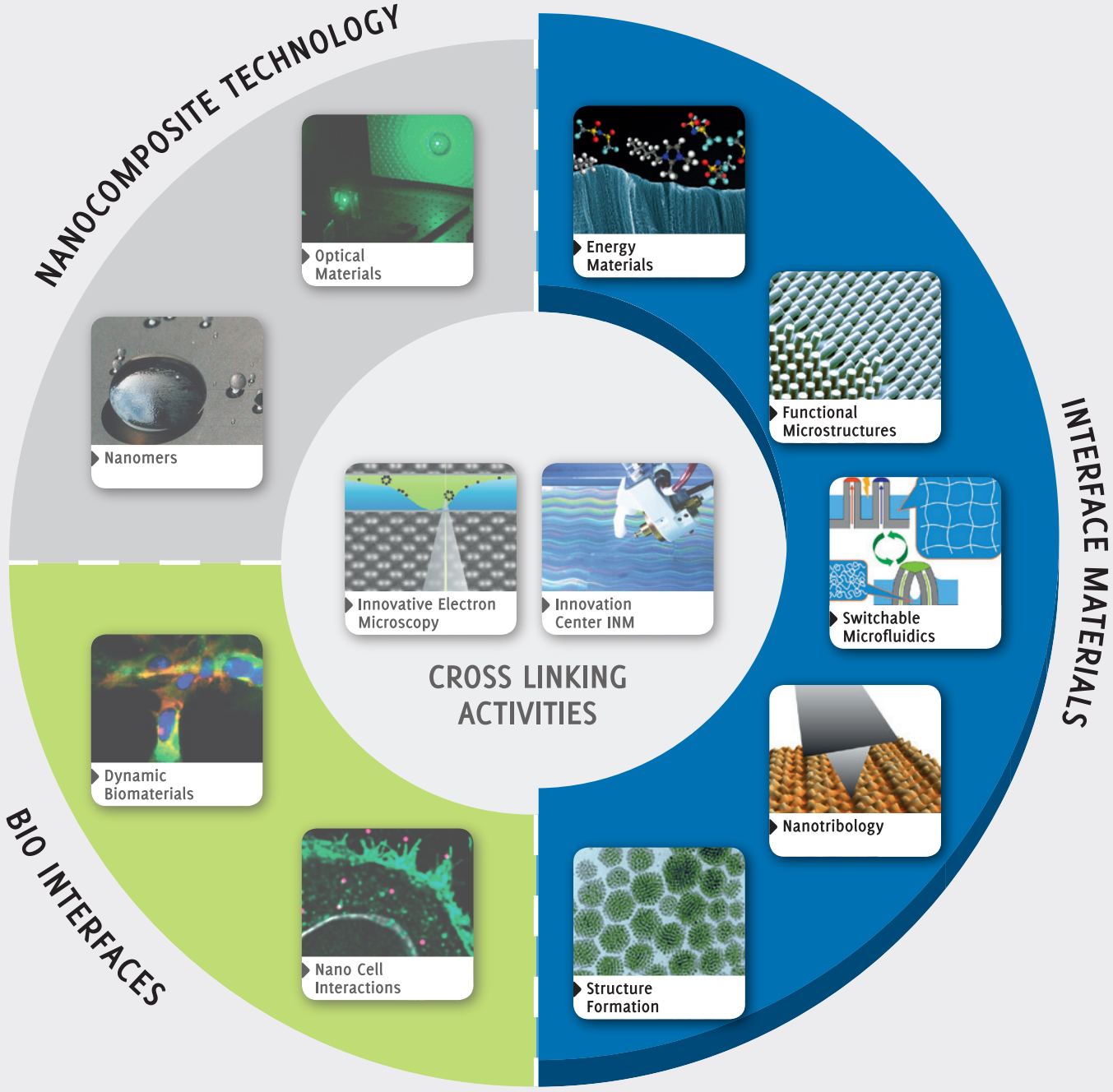
Interface Materials: The research field deals with new methods of surface and interface patterning and investigates especially physical mechanisms at surfaces and interfaces. It focusses for example on new materials for energy storage, switchable tribologic and adhesive phenomena and flexible coatings for photovoltaics.

Bio Interfaces: This research fields developes materials and surfaces that interact with cells and tissues and are conceived for application in the biomedical field. Specific topics include optoregulated biomaterials and safe-by-design nanoparticles. Biological responses to biomaterials are studied in the contexts of regenerative medicine, fibrotic diseases and nanotoxicity.

Nanocomposite Technology: The research field addresses non-metallic-inorganic hybrid materials and their functional, especially optical, tribological, and protective properties. Key aspects are wet chemical synthesis methods and the use of functionalized nanoparticles. A strong focus is on the utilization of concepts for practical applications in industry.

Cross Linking Activities: The area combines comprehensive research and development activities, which methodically complement the competencies of the research areas. Major components are up-to-date innovative electron microscopy and the linking of INM's scientific and technological know-how with industry.

GRENZFLÄCHENMATERIALIEN / INTERFACE MATERIALS



DAS FORSCHUNGSFELD *GRENZFLÄCHENMATERIALIEN*

Das Forschungsfeld *Grenzflächenmaterialien* befasst sich mit neuen Methoden der Oberflächen- und Grenzflächenstrukturierung und erforscht insbesondere physikalische Mechanismen an Oberflächen und Grenzflächen. Im Vordergrund stehen neue Materialien zur Energiespeicherung, steuerbare tribologische und adhäsive Phänomene und flexible Schichten für Elektronik und Photovoltaik.

Das Forschungsfeld besteht zum 31.12.2016 aus vier Programmbereichen und einer Juniorforschungsgruppe:

- Programmbereich *Energie-Materialien*
  Leitung: Prof. Dr. Volker Presser
- Programmbereich *Funktionelle Mikrostrukturen*
  Leitung: Prof. Dr. Eduard Arzt, Dr. René Hensel
- Programmbereich *Nanotribologie*
  Leitung: Prof. Dr. Roland Bennewitz
- Juniorforschungsgruppe *Schaltbare Mikrofluidik*
  Leitung: Dr. Jiaxi Cui
- Programmbereich *Strukturbildung*
  Leitung: Prof. Dr. Tobias Kraus

THE RESEARCH FIELD *INTERFACE MATERIALS*

The research field *Interface Materials* deals with new methods of surface and interface patterning and investigates especially physical mechanisms at surfaces and interfaces. It focuses for example on new materials for energy storage, switchable tribologic and adhesive phenomena and flexible coatings for electronics and photovoltaics.

The research field *Interface Materials* consists of four Program Divisions and one Junior Research Group (as of December 31, 2016):

- Program Division *Energy Materials*,
  Head: Prof. Dr. Volker Presser
- Program Division *Functional Microstructures*,
  Head: Prof. Dr. Eduard Arzt, Dr. René Hensel
- Program Division *Nanotribology*,
  Head: Prof. Dr. Roland Bennewitz
- Junior Research Group *Switchable Microfluidics*,
  Head: Dr. Jiaxi Cui
- Program Division *Structure Formation*,
  Head: Prof. Dr. Tobias Kraus

Mehr Informationen über das Forschungsfeld *Grenzflächenmaterialien* finden Sie hier.

More informations about the research field *Interface Materials*.

ENERGIE-MATERIALIEN / ENERGY MATERIALS

PROF. DR. VOLKER PRESSER

ZUSAMMENFASSUNG

Der Programmbereich *Energie-Materialien* entwickelt funktionale Nanomaterialien und erforscht elektroaktive Grenzflächen für elektrochemische Anwendungen zur Energiespeicherung und Wasseraufbereitung. Unsere Forschung umfasst hochporöse Kohlenstoffe und Nanokohlenstoffe (z. B. Kohlenstoff-nanozwiebeln), die durch Einbringung von nanoskaligem Metalloxid in Nanohybridmaterialien überführt werden können. Wir untersuchen zudem Faraday'sche Materialien wie MXen, eine neue Familie von 2D Übergangsmetallkarbiden. Jenseits unserer Materialforschung erforschen wir redox-aktive Elektrolyte zur Entwicklung schneller Batterien mit hoher Speicherkapazität. Besondere Bedeutung nimmt die Charakterisierung elektrochemischer Phänomene ein, die mit *in-situ* Methoden detailliert untersucht werden. Unsere Aktivitäten reichen von Materialsynthese und Grundlagenforschung bis hin zu Methodenentwicklung, Zelldesign und Industriekollaborationen zur angewandten Energieforschung.

PROF. DR. VOLKER PRESSER

received his doctorate in Applied Mineralogy at the University of Tübingen in 2009, and worked formerly as Research Assistant Professor at Drexel University, Philadelphia, USA. He is Professor for Energy Materials at Saarland University.

MISSION

Research at the Program Division *Energy Materials* is focused on the synthesis, characterization, and application of electroactive interfaces and functional nanomaterials. Our activities focus on electrochemical energy storage (supercapacitors, redox electrolytes, batteries) and water treatment using capacitive deionization. Carbon materials and nanohybrids are the most important electrode materials, and we utilize non-porous carbon nanoparticles (carbon onions, carbon black) and nanoporous carbon materials (activated carbons, carbide-derived carbon, polymer-derived carbon, carbon nanofibers) to obtain electrodes for electrochemical applications. Hybridization of carbon is accomplished by implementation of nanosized metal oxides, and we also investigate Faradaic materials, such as MXene. Redox electrolytes capitalize on the rapid charge transfer when nanoconfined; utilized as nanoreactors, nanoporous carbons combined with redox electrolytes enable the unique combination of battery-like energy storage while maintaining supercapacitor-like charge/discharge rates. We focus on a comprehensive array of materials characterization techniques and in-situ methods to gain novel insights into electrochemical processes. Our contributions extend from basic research, materials synthesis, and the refinement of testing procedures to industrial collaboration and technology development.

CURRENT RESEARCH

Carbon/metal oxide nanohybrids derived from metal carbides for lithium ion batteries

Many metal oxides have a high energy storage capacity, but suffer from a limited electrical conduc-

tivity. The nanoscopic implementation hybridization of carbon and metal oxides allows combining a facile network for electron transport with a large amount of electrochemically active material via lithium intercalation. Using a novel two-step synthesis approach, we also developed, in collaboration with Prof. Etzold (TU Darmstadt, Germany), a novel core/shell material with vanadia cores engulfed by a carbide-derived carbon shell. This configuration allows for easy electron transport across particles and still provides a large ion storage capacity due to the metal oxide core.

Redox electrolytes for high performance energy storage

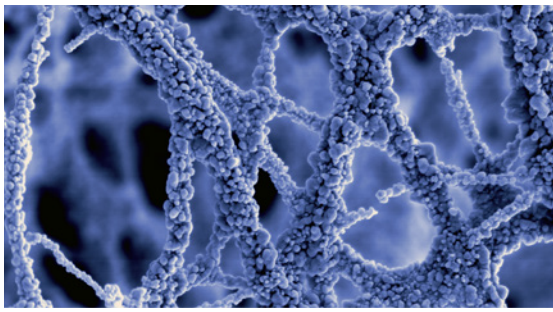
Aqueous electrolytes are particularly attractive for energy storage devices per the fast mobility of dissolved ions and non-flammability. The use of redox-active aqueous electrolytes, such as potassium ferricyanide or vanadyl/tin sulphate solutions, enables the continued use of activated carbon, but severely enhances the energy storage capacity to battery-like levels. As a unique feature in nanoconfinement, the synergy of redox-activity of solved ions in aqueous media and fast Faradaic charge transfer inside carbon nanopores enables combination of high power ratings and high energy storage capacity.

Faradaic materials for water treatment

Capacitive deionization is an emerging technology for energy efficient water desalination, usually employing nanoporous carbon electrodes. As the first study in the field, our team was able to demonstrate that MXene could serve as an alternative electrode material. Our joint work with Prof. Suss (Technion, Israel) demonstrated a promising salt removal capacity purely by ion intercalation instead of ion electrosorption. Faradaic deionization (FDI) will open a new field for the application of many battery materials for water desalination.

OUTLOOK

Our team will continue to broaden the utilization of interfacial electrochemistry and hybrid carbon nanomaterials. We will further explore electroactive interfaces and Faradaic materials for advanced electrochemical desalination. The latter critically requires thorough understanding of the structural changes during charging/discharging and the selectivity of Faradaic materials towards ionic species. We will also continue our collaborative work to understand ion electrosorption within carbon nanopores by complementing experimental *in situ* data with simulation, creating a model toolbox. Another focus will be on enhancing our collaboration with industry for the development of high capacity energy storage devices, with a strong focus on carbon/metal oxide nanohybrid materials.



Niobia / carbon nanofibers for high capacity energy storage in lithium ion batteries.

FUNKTIONELLE MIKROSTRUKTUREN / FUNCTIONAL MICROSTRUCTURES

PROF. DR. EDUARD ARZT, DR. RENÉ HENSEL

ZUSAMMENFASSUNG

Der Programmbereich befasst sich mit der experimentellen und numerischen Untersuchung mikrostrukturierter Oberflächen, die spezielle mechanische, optische, thermische und haptische Funktionalitäten aufweisen. Vorbild für Gestalt und Funktionen der Strukturen sind Konzepte aus der belebten Natur, die auf künstliche Systeme übertragen werden. Der Fokus der laufenden Arbeiten liegt auf fibrillären, bioinspirierten Haftsystemen für die temporäre Adhäsion auf rauen, weichen und hautähnlichen Substraten sowie anwendungsrelevanten Fragestellungen. Ein Schwerpunkt ist die numerische Modellierung der Spannungsverteilungen in der Kontaktfläche und die darauf aufbauende Optimierung des Haftverhaltens. In Kooperation mit Industriepartnern und Klinikern werden derzeit technische Gecomer-Greifsysteme entwickelt und Anwendungen im Bereich medizinischer Oberflächen erschlossen. Das Thema wird von der DFG (Nachwuchsakademie), der EU (ERC Advanced Grant und ITN Trainee Network) und einem Projekt der Leibniz-Gemeinschaft gefördert.

MISSION

The Program Division *Functional Microstructures* conducts research on the fabrication and characterization of functional micro- and nanopatterned surfaces. By combining suitable morphology and materials, surface features are designed that enhance various functionalities such as mechanical, optical, thermal or haptic characteristics. Inspired by the adhesive performance of natural systems, the group mimics such mechanisms to control the adhesion of synthetic surfaces (fig. 1). Presently, our scope lies on the exploration of the mechanisms of contact between adhesive fibrillar structures and soft, compliant surfaces with finite roughness, such as skin. Numerical modeling of the stress distributions in the contact interface is performed to optimize the adhesion. In cooperation with industrial partners and clinicians, we currently transfer our Gecomer Technology into industrial applications and explore its potential for biomedical surfaces. Our research is funded by an ERC Advanced Grant, the German Research Foundation (DFG Nachwuchsakademie), an EU ITN Trainee Network, and a Leibniz transfer project.

PROF. DR. EDUARD ARZT (HEAD)

is scientific director and CEO of INM and professor for new materials at Saarland University. After his PhD at the University of Vienna, he performed research, amongst others, at Cambridge University, Stanford University and MIT and was director at the Max Planck Institute for Metals Research, Stuttgart.

DR. RENÉ HENSEL (DEPUTY HEAD)

studied materials science at Technische Universität Dresden. He completed his doctorate at the Leibniz Institute of Polymer Research Dresden (IPF) and the Max Bergmann Center of Biomaterials Dresden (MBC). Since 2014, he has been deputy head of the Program Division *Functional Microstructures.*

INM's Gecobot for demonstration of novel pick & place processes using bioinspired adhesion devices.

CURRENT RESEARCH

Adhesion to rough surfaces – why fibril dimensions matter

Surface roughness commonly limits the adhesion performance due to a reduced contact area. In an experimental study, micropatterned adhesives adhering to glass substrates with various roughnesses were designed and systematically analyzed. Our results revealed, for the first time, adhesive and non-adhesive states depending on the micropillar dimensions relative to the surface roughness profile. The data demonstrate that, in the adhesive regime, fibrillar gecko-inspired adhesive structures can be used with advantage on rough surfaces. This finding may open up new applications where roughness currently limits the adhesive performance.

Theoretical contact mechanics – the key to rational optimization

Analyzing the performance of micropatterned adhesives requires an understanding of the relevant mechanics involved. In cooperation with a team of international experts (R. M. McMeeking, UC Santa Barbara; N. Fleck, University of Cambridge; A. Kossa, Budapest UTE; M. Bacca, University of British Columbia), we theoretically explore the adhesion of fibrils to dissimilar substrates and novel designs such as composite fibrils (see Highlight Article). Adding soft terminal layers to stiffer stalks was found to reduce the magnitude of edge stress singularities, which can explain the improved adhesion in our experiments. Further topics are the numerical design of optimized fibrils for applications, detailed studies on confined adhesive layers, and the understanding of the detachment statistics.

Technology transfer – Gecomer Technology on the rise

INM's Gecomer Technology has now been validated for numerous pick & place scenarios from micro to macro objects and in non-ideal conditions. R&D projects and new patents rapidly drive our progress and aimed at specific applications relevant to industry partners. In-house activities on up-scaling fabrication via roll-to-roll micropatterning reinforce our efforts related to application and commercialization of bioinspired adhesion devices (collaboration with the *InnovationCenter INM*).

OUTLOOK

Scientifically, micropatterned surfaces will play a central role in INM's research portfolio. Among the fundamental aspects to be explored are the kinetics and statistics of detachment events of fibrillar arrays, contact mechanics in the presence of edge and misalignment effects, and the mechanics of interaction with ultra-soft substrates. In collaboration with the Junior Research Group *Switchable Microfluidics*, new approaches for switchable adhesives will be investigated. In cooperation with Saarland University Hospital (Prof. Schick, Homburg), biomedical prototypes will enter the stage of *in-vivo* testing. New functions such as electrical interfacing and haptics will be explored in future collaborations (e.g. with *Nanotribology*). Micromechanical modeling of adhesion performance will remain an important baseline to rationally optimize adhesion, e.g. for intelligent gripping devices with adjustable touch. The potential applications range from medical devices to space robotics.

NANOTRIBOLOGIE / NANOTRIBOLOGY

PROF. DR. ROLAND BENNEWITZ

ZUSAMMENFASSUNG

Der Programmbereich *Nanotribologie* forscht an der Entwicklung neuer Materialien mit besonderen adhäsiven und tribologischen Eigenschaften. Im Zentrum stehen dabei die Funktionalisierung von Oberflächen und das Verständnis der mikroskopischen Mechanismen von Reibung und Verschleiß. Unsere experimentellen Projekte basieren auf unserer Expertise in der hochauflösenden Rasterkraftmikroskopie, die wir auch im Ultrahochvakuum und in Flüssigkeiten sowie unter elektrochemischer Kontrolle betreiben. Auf verschiedenen Längenskalen wurden synergistische Effekte von Füllern in Beschichtungen des Programmbereichs *Nanomere* untersucht. Zu den wichtigsten Ergebnissen des Jahres 2016 gehören die Entwicklung einer neuen Methode für rheologische Messungen an extrem dünnen Schmiermittellagen sowie eine Untersuchung der Bildung von polymeren Tribofilmen in der Umgebung von Rauheitsspitzen auf Stahloberflächen.

PROF. DR. ROLAND BENNEWITZ

is Honorary Professor of Experimental Physics at Saarland University. He obtained his Dr. rer. nat. in physics from the Freie Universität Berlin, did postdoctoral studies at the University of Basel, and held the Canada Research Chair in Experimental Nanomechanics at McGill University in Montreal.

MISSION

The Program Division *Nanotribology* explores new materials with specific mechanical surface properties. We focus on surface functionalization and on understanding the microscopic mechanisms in friction, wear, and lubrication. Our experimental projects rely on our expertise in the field of high-resolution force microscopy under ultra-high vacuum conditions or in liquids where the surfaces can be electrochemically controlled. Furthermore, we develop new experimental methods in the field of nanorheology and multi-scale mechanical testing. Our methods, results, and know-how on fundamental nanotribology led to fruitful collaborations, in particular within the INM and with Saarland University. Examples are joint projects with the Program Division *Nanomers* on synergistic effects of particulate fillers in tribological polyimide coatings and with the *Chair of Organic Macromolecular Chemistry* of Saarland University on the control of friction and adhesion by shape-resistant polymers.

CURRENT RESEARCH

The following examples describe research results which resulted in manuscripts for publication in international research journals:

Contrast in nanoscale friction between rotational domains of graphene on Pt(111)

The nanoscale lubrication properties of graphene depend on chemical functionalization, adsorbants, and bonding to the substrate. The dependence of friction on the rotational orientation of graphene on a Pt(111) surface was studied by high-resolution friction force microscopy in ultra-high vacuum and interpreted through complementary simulations.

Lateral forces reveal an atomic-scale stick-slip motion with the periodicity of the graphene structure. Additionally, the lateral forces were modulated by a Moire pattern, which depends on the rotation of the respective domain. Domains with preferred orientations exhibited lower average friction than those with orientations less frequently observed.

Tribological synergy of filler components in multifunctional polyimide coatings

Platelets as fillers in polymer coatings contribute to their corrosion resistance by increasing the diffusion path of gases. We demonstrated that the same platelets can improve tribological properties and, thus, open a new way to design multifunctional polymer coatings. Improved corrosion resistance, low friction, and low wear were reported for polyimide composite coatings filled with a combination of boron nitride, pigment platelets, perfluoropolyether, and Si_3N_4 particles. Contributions of different fillers to the tribological performance are explored for coatings with different filling protocols. The synergy of four components leads to the excellent tribological performance of the fully formulated coatings, while they cannot impart significant improvement in friction and wear when used separately.

Dynamic shear force microscopy of viscosity in nanometer-confined hexadecane layers

Hexadecane exhibits pronounced molecular layering upon confinement to gaps of a few nanometer width which is discussed for its role in boundary lubrication. We have probed the mechanical properties of the confined layers with the help of an atomic force microscope, by quasi-static normal force measurements and by analyzing the lateral tip motion of a magnetically actuated torsional cantilever oscillation. The molecular layering is modeled by an oscillatory force curve and the tip approach is simulated assuming thermal equilibrium correlations in the liquid. The shear response of the confined layers reveals gradually increasing stiffness and viscous dissipation for a decreasing number of confined layers.

OUTLOOK

We will continue to investigate the mechanisms which link the structure and the dynamics of surfaces to friction and wear in new materials. Our current funded projects include studies of friction and contact ageing on clean metals, and of the role of surface structure and chemistry for friction and wear in metallic glasses. A project with Kaiserslautern University relates the scratch mechanisms in polymers across length scales to their macroscopic tribological responses. We aim to apply the results of our research in projects with industrial partners on molecular mechanisms in additive lubrication. Finally, our group now develops the experimental expertise to investigate the mechanical properties of biophysical hydrogels at the molecular scale.

On the occasion of the 300th anniversary of Leibniz' death in 2016, we discovered a rather small Leibniz by scanning electron microscopy. The wig of this nano-scale sculpture was formed by the transfer of gold to the tip of an atomic force microscope in repeated cycles of a friction experiment.

STRUKTURBILDUNG / STRUCTURE FORMATION

PROF. DR. TOBIAS KRAUS

ZUSAMMENFASSUNG

Der Programmbereich *Strukturbildung* erforscht die Anordnung von kolloidalen Partikeln und Polymeren und wendet sie zur Herstellung neuer Materialien aus flüssigen Vorstufen an. Partikel und Polymere werden miteinander kombiniert, um Komposit- und Hybridmaterialien mit definierten Strukturen herzustellen. Wir beobachten die Bildung von Mikrostruktur und inneren Grenzflächen während der Materialsynthese aus flüssigen Vorstufen und untersuchen, wie sich die Struktur auf die Eigenschaften auswirkt, indem wir systematisch Größe, Geometrie, Zusammensetzung und Anordnung der Komponenten variieren. So entstehen zum Beispiel transparent leitfähige Schichten aus ultradünnen Metalldrähten, Suprapartikel als Kombinationen optisch aktiver und supraparamagnetischer Nanopartikel und hybride Nanopartikel, die sich in Umweltproben eindeutig wiederfinden lassen. Für Materialien der Zukunft suchen wir nach Partikeln, die sich gezielt bewegen lassen, um die Materialeigenschaften verändern zu können.

PROF. DR. TOBIAS KRAUS

is a chemical engineer trained at TU Munich, MIT, and the University of Neuchatel. He obtained his Dr. rer. nat. in materials science from ETH Zurich and the IBM Research Laboratory. Kraus is Deputy Head of the *InnovationCenter INM* and Professor for Colloid and Interface Chemistry at Saarland University.

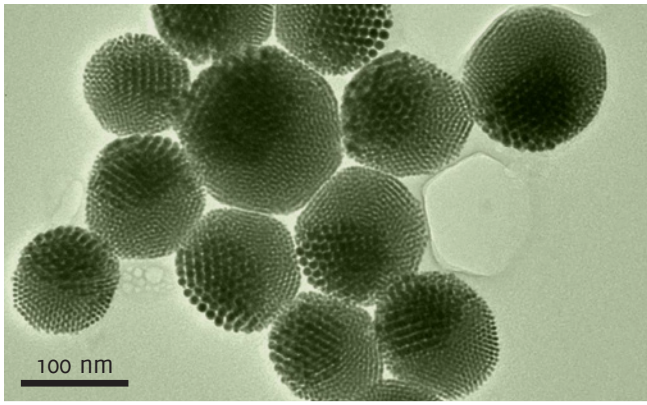
MISSION

The Program Division *Structure Formation* investigates the assembly of colloidal particles and polymers and applies this process for the preparation of new material from liquid precursors. Particles and polymers are combined to create composite and hybrid materials with defined structures. We observe how microstructure and internal interfaces form during material synthesis. We investigate how structure affects properties by systematically varying size, geometry, composition and arrangement of the components. This leads, for example, to transparent conductive coatings from ultrathin metal wires, to supraparticles as combinations of optically active and superparamagnetic nanoparticles, and to hybrid nanoparticles that can be unambiguously detected in environmental samples. For future materials, we seek particles that can be moved to change material properties.

CURRENT RESEARCH

Self-organizing and hybrid inks for electronics

There are two great challenges in printing electronic structures from liquid inks: the printed structures have to percolate (they have to be connected throughout), and there should be no insulating layers between the conductive components after drying. We address both issues in the BMBF project *NanoSpekt* and introduced two new concepts to solve them: *Self-organizing* inks contain metal nanowires that spontaneously form percolating bundles during drying; thus, continuous conductive pathways form at small scales without the need for local intervention. *Hybrid inks* contain a hard metal nanostructure inside a soft conductive polymer



Supraparticles consisting of various gold nanoparticles formed in oil-in-water emulsions with different surfactants. The structure is controlled by the surfactant choice through Laplace pressure.

shell. They form conductive films immediately after drying without the conventional sintering step because the soft polymer bridges the non-conductive gaps between the metal. Both concepts were fully established in 2016; the resulting inks and printing processes are currently adapted to different user cases and scaled up for commercial evaluation. We closely collaborate with the Program Division *Optical Materials* on this topic.

Porous and hybrid silicon structures

Particle-based porous films are promising materials for future application as sensors and biomaterials. We collaborate with the group of Prof. Nicolas Voelcker at the Future Industries Institute and the University of South Australia in Adelaide, an expert on the synthesis of porous silicon and its functionalization for biomedical purposes. We have developed methods to structure silicon and metal surfaces using particles that we tested as cell substrates and sensors in collaboration. The collaboration was highly successful, and we are delighted to have Prof. Voelcker as an INM Fellow starting in January 2017.

Binary supraparticles

The group has worked on the control and assembly of spherical nanoparticles inside the oil droplets of oil-in-water emulsions for several years. In 2016, we managed to arrange mixtures of two different nanoparticle types inside the same droplet and to observe the structure of the resulting binary particles (Figure). Prof. Tanja Schilling of the University of Luxembourg collaborated with us to predict the structure of the superstructures and helped us to understand how the process parameters – in particular the choice of surfactant – influenced the structure of the supraparticles. It is now possible to tune the geometry of the resulting objects between supercrystal, Janus, and core-shell particles.

OUTLOOK

The Program Division will continue to exploit colloidal mechanisms for the creation of new materials. This strategy has been very successfully applied to create new inks for printed electronics. We are currently employing the new principles to create solutions for specific technical challenges and bring them to industry. This application-oriented work has led to new fundamental questions, for example, on the stability of metal particles with dense alkyl ligands shells in organic solvents. Basic research is under way to better understand their stability, and a collaboration with Prof. Paul Mulvaney in Melbourne will help to extend it to semiconductor particles. The INM Fellowship of Prof. Voelcker will allow us to intensify collaboration towards particle-based drug delivery and porous sensor materials.

SCHALTBARE MIKROFLUIDIK / SWITCHABLE MICROFLUIDICS

DR. JIAXI CUI

ZUSAMMENFASSUNG

Die Juniorforschungsgruppe *Schaltbare Mikrofluidik* wurde 2015 gegründet. Sie wird durch das Projekt „Bio/Synthetische Multifunktionale Mikro-Produktionseinheiten“ im Rahmen eines Leibniz Research Clusters (LRC) gefördert. Das Ziel der Gruppe besteht in der Entwicklung schaltbarer strukturierter Oberflächen zur Anwendung in Gebieten wie Biosynthese, Biomedizin, Anwuchsverhinderung, Bildgebung und Adhäsion. Es werden dynamische weiche Materialien entwickelt und hergestellt, die ihre Eigenschaften wie Volumen, Form, Benetzbarkeit, optische Eigenschaften, Adhäsion und weitere unter externen Stimuli verändern können. Aus diesen Materialien werden Komponenten hergestellt, die die gezielte Manipulation von Flüssigkeiten erlauben. Dazu werden diverse Ansätze wie z. B. Polymerisation, Selbstorganisation, molekulare Wiedererkennung oder Mischung genutzt. Daneben entwickeln wir neue Technologien zur Mikrofabrikation dynamischer weicher Materialien.

DR. JIAXI CUI

received a Dr. phil. in chemistry from Peking University in 2008. Postdoctoral stays led him to the Max Planck Institute for Polymer Research in Mainz and Harvard University. Since 2015, he is the head of Junior Research Group *Switchable Microfluidics*.

MISSION

The Junior Research Group *Switchable Microfluidics* aims to develop switchable structural surfaces for applications in biosynthesis, biomedicine, adhesion, and other areas. For this, we design and synthesize dynamic soft materials that can change their properties such as volume, shape, wettability, adhesion, etc., under external stimuli. We apply approaches such as self-assembly, molecular recognition, site-specific polymerization or blending, to fabricate these compounds into components which allow the manipulation of fluids. We also develop new technologies for the microfabrication of dynamic soft materials.

CURRENT RESEARCH

Switchable microreactor platform

We develop switchable meso-structural surfaces as micro-reactor platforms that permit simultaneous and unprecedented levels of control over reaction pathways. The project is inspired by the compartmentalized synthetic strategy in living cells: chemical reactions initiated under defined conditions, conclude with a desired product that is automatically transferred in a programmable and precisely controlled mode to the next reaction compartment. To mimic this, we designed a complex structure consisting of meso-structural surfaces with geometrically arranged hollow pillars and a soft actuating system to switch the channels. In 2016, we have developed this structure and a magnet-responsive elastomer. We also prepared hollow pillar structures with magnetic materials which allow the manipulation of liquid droplets while responsiveness leads to a bending of pillars for liquid mixing

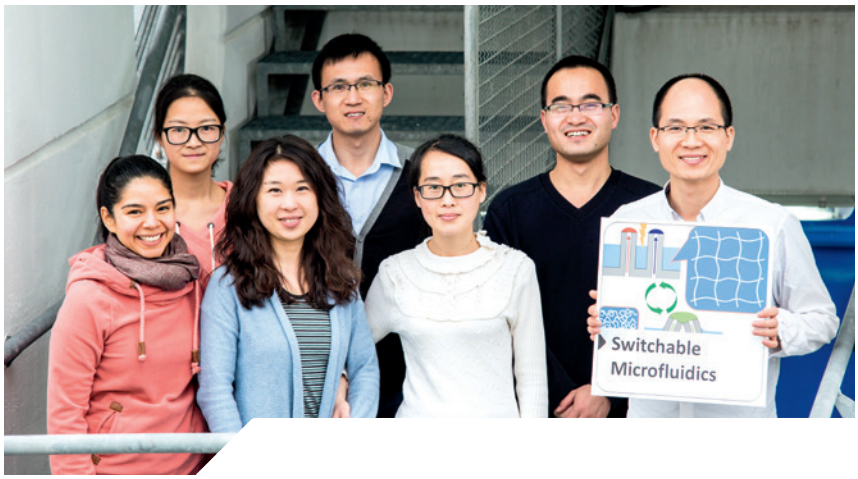
under magnetic field and offers an opportunity to control dry-adhesion. We are cooperating with the Program Division *Functional Microstructures* to develop switchable adhesion layers.

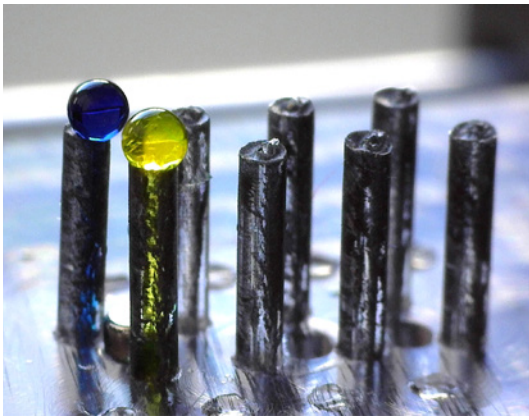
Patterning droplets in elastomers

Localized inclusions of liquids provide solid materials with functions, such as self-healing, secretion, and tunable mechanical properties. We prepared elastomer materials with liquid inclusions and developed a facile approach to selectively localize liquid droplets in a supramolecular gel/elastomer by evaporative lithography. This method is suitable for current coating techniques. We selectively embedded silicone lubricant droplets in silicone-based elastomers. The droplet-embedded domains result in slippery surfaces that can be used for the control of the directional movement of water droplets. We are cooperating with the Program Division *Nanotribology* on the investigation of the pressure-induced increase in the coefficient of friction.

Photoregulated polymer brushes

The modification of surfaces by polymer brushes is effective to tailor physical and chemical interface properties. Controlled/living radical polymerizations are often applied by surface-initiated approaches triggered by temperature, light, and other stimuli. Light-induced surface polymerization takes particular advantages of spatial and temporal control, room temperature operation, and others. In addition to the growth of polymer brushes, light can also post-mediate the properties of polymer brushes. We developed a novel approach to controll growth and detachment of polymer brushes by lights with various wavelengths. The approach is based on a nitrodopamine-based initiator (NO_2-BDAM) which contains a catechol structure for surface modification, an alkyl bromide group for atom transfer radical polymerization, and an o-nitrophenyl ethyl moiety for photolysis. Dimanganese decacarbonyl is applied together with NO_2-BDAM as an initiating system which allows the growth of polymer brushes by visible light (460 nm) and the detachment of the polymer chains by UV light (360 nm). This method is suitable for diverse monomers on many substrates, providing a facile and robust pathway to regulate surface properties.



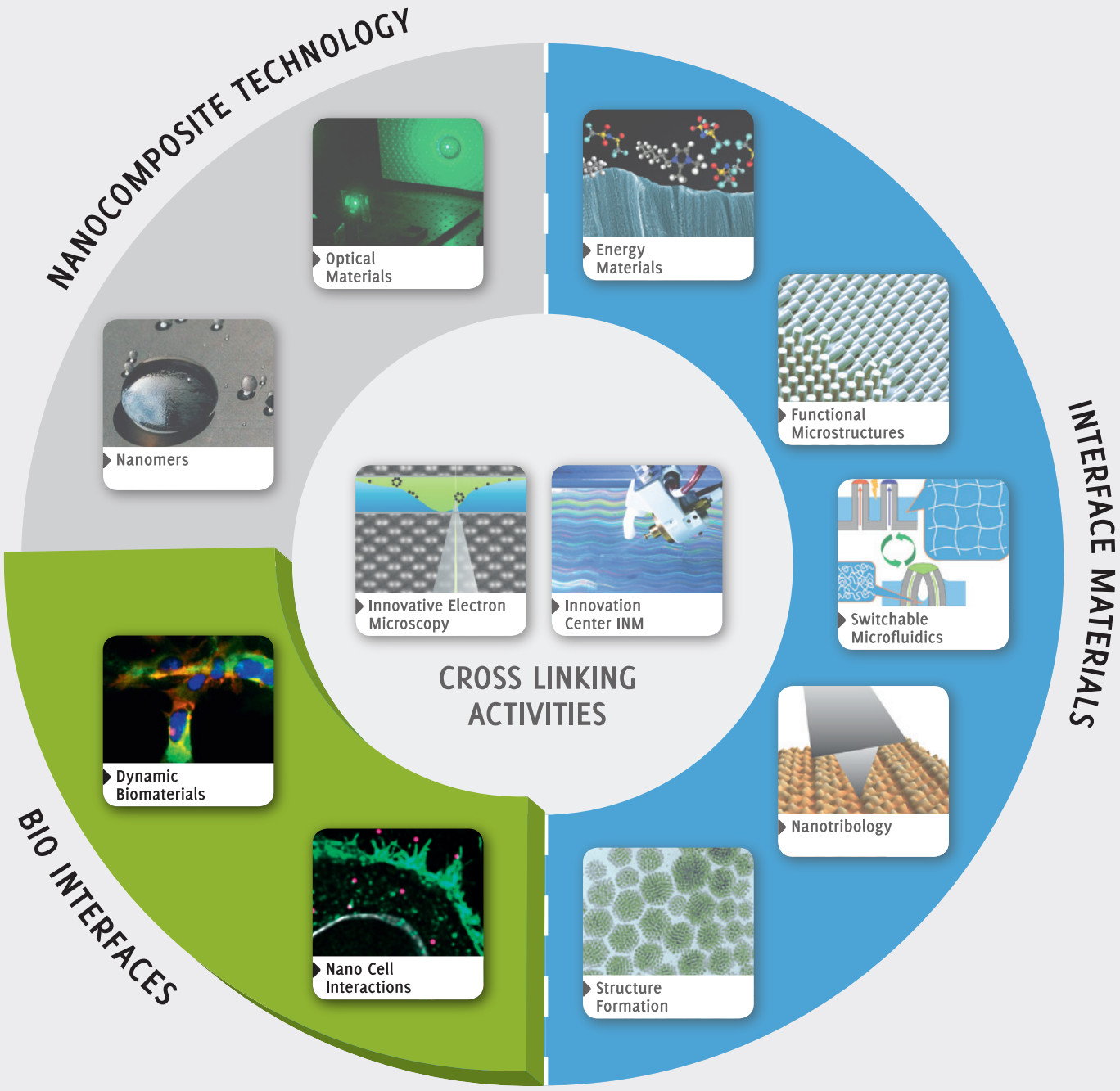


Droplet formation on a magnetic responsive meso-surface.

OUTLOOK

We will combine responsive materials and nanotechnologies to develop processes for switchable mesostructured surfaces. We will transfer the concept of dynamic bonds to macroscopic levels and develop new soft materials that can tune their composition, properties or shape on demand. We will apply these materials to develop high-performance hydrogels and flexible and self-healing wearable device and combine reversible chemistry and 3D printing to develop programmable liquid crystal elastomers (LCE) for microactuators.

BIOGRENZFLÄCHEN / BIO INTERFACES



DAS FORSCHUNGSFELD *BIOGRENZFLÄCHEN*

Dieses Forschungsfeld entwickelt Materialien und Oberflächen, die mit Zellen und Geweben wechselwirken und sich für Anwendungen im biomedizinischen Bereich eignen. Die Themen umfassen lichtgeregelte Biomaterialien und safe-by-design-Nanopartikel. Biologische Antworten auf Biomaterialien werden im Kontext regenerativer Medizin, fibrotischer Erkrankungen und Nanosicherheit untersucht.

Im Sommer 2016 wurde der Programmbereich *Biomineralisation* nach Weggang der Leiterin aufgelöst. Das Forschungsfeld besteht zum 31.12.2016 aus zwei Programmbereichen:

- Programmbereich *Dynamische Biomaterialien*
  Leitung: Prof. Dr. Aránzazu del Campo
- Programmbereich *Nano Zell Interaktionen*
  Leitung: Dr. Annette Kraegeloh

THE RESEARCH FIELD *BIO INTERFACES*

This research fields developes materials and surfaces that interact with cells and tissues and are conceived for application in the biomedical field. Specific topics include optoregulated biomaterials and safe-by-design nanoparticles. Biological responses to biomaterials are studied in the contexts of regenerative medicine, fibrotic diseases and nanotoxicity.

In summer 2016, the Program Division *Biomineralization* was terminated after the leaving of the head of the group. The research field *Bio Interfaces* consists of two Program Divisions (as of December 31, 2016):

- Program Division *Dynamic Biomaterials*
  Head: Prof. Dr. Aránzazu del Campo
- Program Division *Nano Cell Interactions*
  Head: Dr. Annette Kraegeloh

Mehr Informationen über das Forschungsfeld *Biogrenzflächen* finden Sie hier.

More informations about the research field *Bio Interfaces*.

DYNAMISCHE BIOMATERIALIEN / DYNAMIC BIOMATERIALS

PROF. DR. ARÁNZAZU DEL CAMPO

ZUSAMMENFASSUNG

Der Programmbereich *Dynamische Biomaterialien* entwickelt zellinstruktive Materialien, die mit Zellen kommunizieren und deren Verhalten steuern. Wir nutzen Licht, um die Eigenschaften von Biomaterialien zu modulieren und eingebetteten Zellen spezifische Signale mit räumlich-zeitlicher Auflösung zu senden. Unsere Materialien werden genutzt, um die Antwort der Zelle auf Wechsel in der Zusammensetzung und den biophysikalischen Eigenschaften von künstlichen, extrazellulären Matrizen zu untersuchen. Dabei werden Prozesse nachgeahmt, die in pathologischen Zuständen, wie zum Beispiel bei Krebs, Verletzungen, der Morphogenese oder beim Altern auftreten können. Ein langfristiges Ziel der Gruppe besteht in der Übertragung bestimmter Zellantworten auf Materialeigenschaften in konzeptionell diverse Strategien für die klinische Diagnostik und Therapeutik. Dynamische Biomaterialien können als fortgeschrittene Gerüste für prädiktive Gewebemodelle, effizientere instruktive Matrizen für die Gewebetechnik und als Träger höherer Verpflanzungsverhältnisse bei der Zelltherapie vorgestellt werden.

PROF. DR. ARÁNZAZU DEL CAMPO

is Scientific Director at INM and Professor for Materials Synthesis at Saarland University. After her doctorate in chemistry at the Instituto de Polímeros, Madrid, she performed research at the Universitá di Urbino, and Max Planck Institutes for Polymer Research in Mainz and for Metals Research in Stuttgart.

MISSION

The Program Division *Dynamic Biomaterials* develops instructive materials able to communicate with cells and guide their fate. We use light to modulate biomaterials properties and to provide specific signals to embedded cells on demand and with spatiotemporal resolution. Our materials are applied to investigate cellular responses to compositional and biophysical changes in artificial ECMs, mimicking processes occurring in fibrotic pathologies (such as cancer), injury, morphogenesis or ageing. A long-term goal of the group is the translation of distinct cell responses to material properties into conceptually different strategies for clinical diagnostics and therapeutics. Dynamic biomaterials are envisioned as advanced scaffolds for more predictive tissue models, as more efficient instructive matrices for tissue engineering and carriers for higher engraftment ratios in cell therapies.

CURRENT RESEARCH

In 2016, *Dynamic Biomaterials* became a functional multidisciplinary group, establishing the experimental infrastructure and personnel required for carrying out new research lines at the institute. In the following, a few highlights are described:

Ligand-specific mechanotransductive processes involved in tumor development

The optoregulation of integrin-mediated communication between cells and materials is a central topic in the division (*Biomaterials 2016*). With this topic, *Dynamic Biomaterials* takes a central role in the EU-FET Project “Mechanocontrol of Biological Function”, with a focus on the role of integrin-biomaterials interactions (mechanotransduction) in tu-

mours within the context of breast cancer. In cooperation with the Program Division *Nanotribology*, the mechanical properties of biomaterials as they are sensed by the cells (at the nanoscale and dynamically) are investigated.

New chemistries at physiological conditions

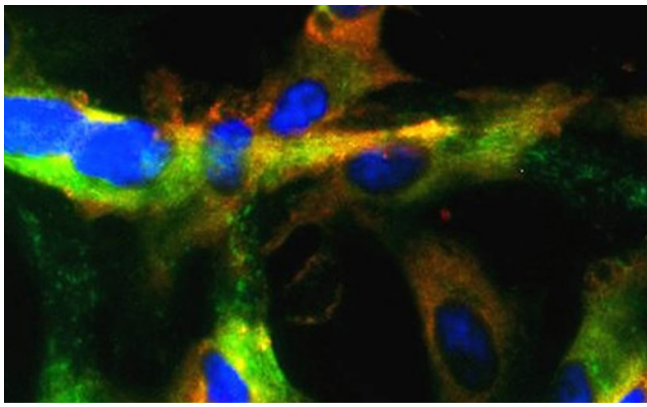
Hydrogels for 3D cultures or medical scaffolds require biocompatible effective chemistries for *in-situ* crosslinking and biofunctionalization. The group has developed new chemistries for selective reactions with thiol-derivatized molecules (*Angew Chem 2016, Biomacromolecules 2017*) and for effective gluing to natural tissues. Projects funded by the cosmetic industry on this topic have started in 2016.

Immunology and cell-cell interactions

The group became an active partner of the Collaborative Research Center *Physical modeling of non-equilibrium processes in biological systems* (SFB 1027) at Saarland University with a funded project to develop instructive hydrogels to investigate the role of physical forces in cell-cell contact at the immunological synapse.

OUTLOOK

The development of optoregulated cellular microenvironments remains a major topic in the group. In 2017 we will expand our synthetic competences to biochemical methods and also exploit optogenetic tools to regulate material properties and cell-materials interactions. Cooperation with Saarland University in cell-free biosynthesis methods have been initiated and will be strengthened. The understanding of dynamic and multifactorial interactions between cells and biomaterials in physiological scenarios will be expanded to in vivo scenarios. For this purpose, we will strategically strengthen our collaboration with the *Institute for Clinical Experimental Surgery in Homburg*. The combination of optoregulated cellular microenvironments and mouse window-models to visualize cellular responses to materials signals *in-situ* and *in vivo* is unique and will provide new insights into how biomaterials design affects regeneration at various time points of the healing process.



Light-guided endothelial sprouting on dynamic biomaterials.

We will implement optogenetic concepts to interfere with the cells machinery to secrete and assemble the extracellular matrix. Forces applied by the cytoskeleton are crucial in this process, and will be treated in close cooperation with INM's new junior research group *Cytoskeletal Fibers*. On a longer term, this research will deliver tools and pathways to program cells to generate functional tissue *in vitro*, breaking the classical border between synthetic and biosynthetic approaches in biomaterials science.

NANO ZELL INTERAKTIONEN / NANO CELL INTERACTIONS

DR. ANNETTE KRAEGELOH

ZUSAMMENFASSUNG

Der Programmbereich *Nano Zell Interaktionen* beschäftigt sich mit den Auswirkungen technisch hergestellter Nanoobjekte auf menschliche Zellen, um zu einer sicheren Anwendung von Nanomaterialien in technischen und biomedizinischen Bereichen beizutragen. Ziel ist es zu verstehen, wie bestimmte Partikeleigenschaften Struktur und Biochemie der Zellen beeinflussen, und aufzuklären, welche Mechanismen die Aufnahme und Lokalisation von Nanoobjekten vermitteln. Als Untersuchungsobjekt werden Nanopartikel aus anorganischen Materialien gezielt hergestellt und charakterisiert. Zur Lokalisation von Partikeln und Zellstrukturen werden vor allem lichtmikroskopische Techniken eingesetzt. Eine Besonderheit der Gruppe ist die Nutzung hoch-auflösender Stimulated Emission Depletion (STED)-Mikroskopie für diesen Zweck. Zur weiteren Analyse der Zellantwort werden darüber hinaus chemische, biochemische und molekularbiologische Techniken eingesetzt.

DR. ANNETTE KRAEGELOH

received her doctorate in biology at the University of Bonn in 2004 and then joined INM. She is coordinator of the *Leibniz Research Alliance for Nanosafety* and currently pursues her habilitation in cellular biochemistry at Saarland University.

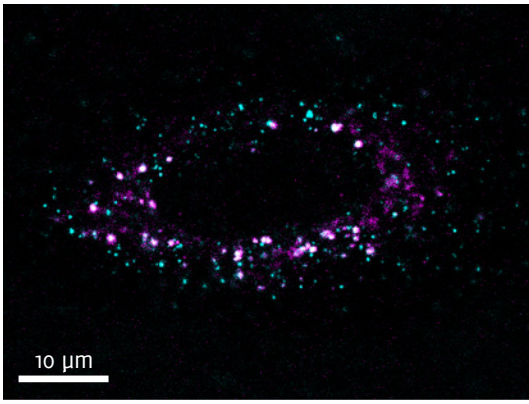
MISSION

The Program Division *Nano Cell Interactions* explores the effects of engineered nanoobjects on human cells to enable safe applications of nanomaterials in technical and biomedical fields. It strives to understand how particle properties influence structure and biochemistry of the cells and to elucidate mechanisms that affect the uptake or location of nanoobjects with the purpose to pave the way for the design of safer nanomaterials. For this reason, well-defined inorganic nanoparticles are prepared and characterized using techniques as Stimulated Emission Depletion (STED) microscopy. Further chemical, biochemical, and molecular biological techniques are used for the analysis of the cellular responses.

CURRENT RESEARCH

Morpheus – a test platform for the safety of nanomaterials

The ZIM (Central Innovation program for SMEs) project “Morpheus” aims at developing a multiparametric test platform for an early hazard assessment of nanoparticles. This platform is based on 3D liver microtissue and combines the quantification of metabolic with functional markers. Activity and expression of cytochromes P450 in response to nanoparticle exposure are investigated. Furthermore, the penetration of nanoparticles into microtissues is analyzed via light and electron microscopy (in cooperation with service group *Physical Analytics*). The results indicate that after pre-formation of the microtissues, the nanoparticles only enter the outer layers of the tissues. In contrast, when added during the process of tissue formation, nanoparticles are found all over the tissues. SiO_2



Colocalization (white) of nanoparticles (cyan) and ligands of a specific growth factor receptor (magenta).

nanoparticles do not seem to influence the formation and morphology of the tissues. Other types of nanoparticles will be investigated in future.

Nanoparticle effects on signaling pathways

In the frame of a cooperation with the *Leibniz Research Institute for Environmental Medicine* (IUF), effects of nanoparticles on signaling pathways are investigated. Colloidal SiO_2 nanoparticles have been shown to modulate early signaling events, thereby affecting cellular responses. Mechanistic analyses have been conducted to elucidate the responsible molecular effects. It was shown by pharmacological inhibition that the nanoparticles are internalized by clathrin-mediated endocytosis. The same uptake pathway is used for internalization of growth factor receptors after activation by their ligands. Microscopy revealed the intracellular location of ligands of specific growth factor receptors and nanoparticles. The results depict that nanoparticles are able to induce specific cell responses, dependent on their physicochemical properties. Further analyses will show, whether these responses are cell-type specific.

Safe nanomaterials developments

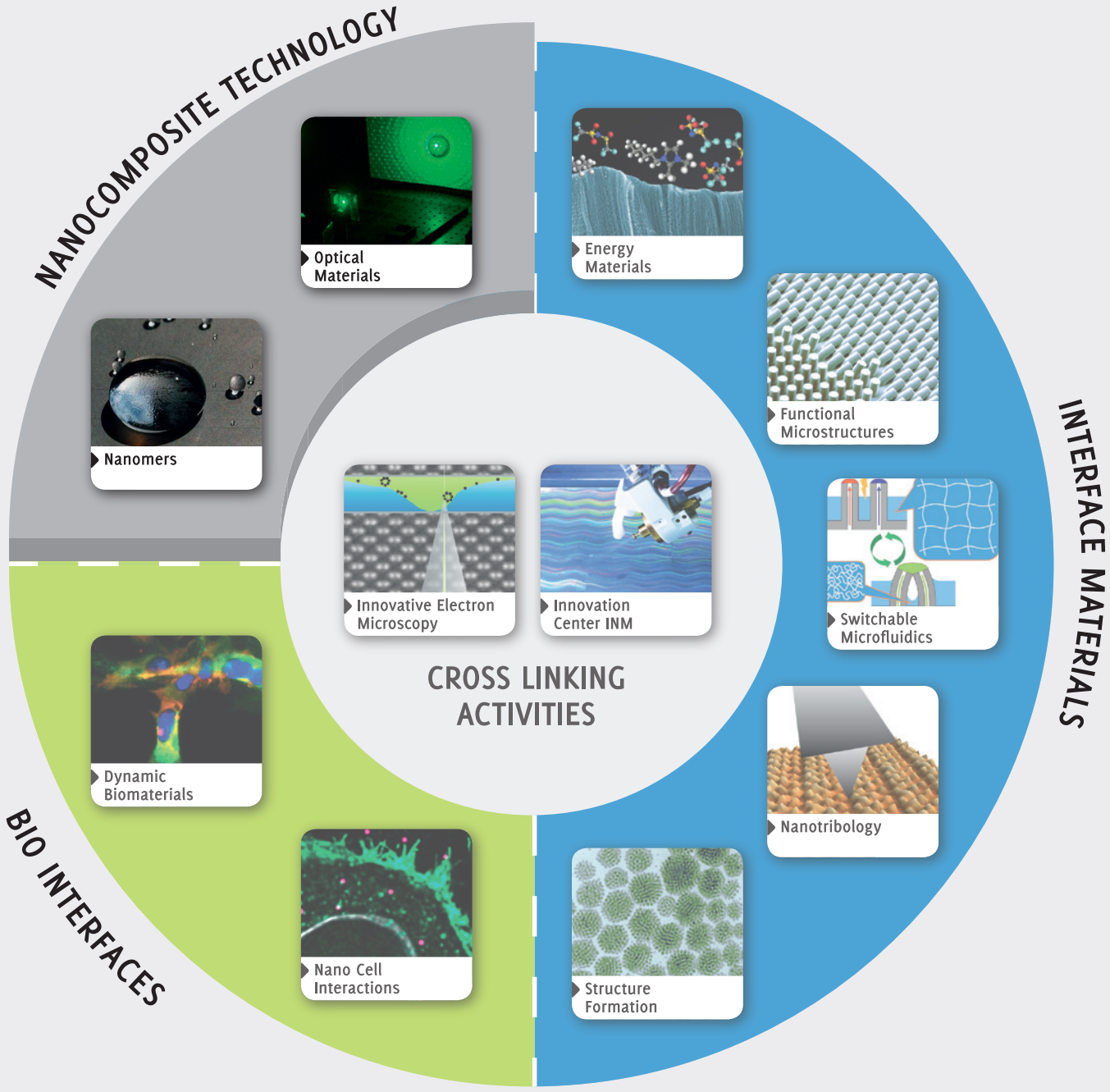
In the frame of the Horizon 2020 project NanoReg2, the group is involved in safe-by-design approaches in the context of regulatory aspects. It has developed the concept of the nanomaterials identity in order to systematically describe nanomaterials properties relevant for their functionality and their safety. The concept can be implemented into existing physicochemical data collections to obtain a systematic categorization of various nanomaterials, but also used to establish a systematic linkage between nanospecific properties and functionality of nanomaterials on one side and safety aspects on the other. Results of these analyses will help to identify potential safe-by-design applications to be implemented during early stages of nanomaterial development. The safe-by-design concept aims to reduce risks of nanomaterials on human and environmental safety and health. In this project, a cooperation with the *Innovation Center INM* was established.

OUTLOOK

Within the *Leibniz-Research Alliance for Nanosafety* coordinated by INM, the group will be involved in studies of the mechanisms of nanomaterials toxicity, reception of nanosafety, development of novel test platforms as well as safe-by-design approaches. Furthermore, the group will organize the international conference on Nanosafety to be held in October 2017 in Saarbrücken.

An objective of the future work is to translate the research results into the development of safe nanomaterials, future regulatory processes of nanomaterials as well as to facilitate biomedical applications of nanomaterials.

NANOKOMPOSIT-TECHNOLOGIE / NANOCOMPOSITE TECHNOLOGY



DAS FORSCHUNGSFELD *NANOKOMPOSIT-TECHNOLOGIE*

Das Forschungsfeld *Nanokomposit-Technologie* widmet sich nichtmetallisch-anorganischen Hybridmaterialien, vorwiegend in Form von Beschichtungen, und ihren funktionellen Eigenschaften. Schwerpunkte sind nasschemische Synthesemethoden und die Nutzung funktionalisierter Nanopartikeln. Ein Fokus der Arbeiten liegt in der Nutzung der Konzepte für konkrete industrielle Anwendungen.

Das Forschungsfeld *Nanokomposit-Technologie* besteht zum 31.12.2016 aus zwei Programmbereichen:

- Programmbereich *Nanomere*
  Leitung: Dr. Carsten Becker-Willinger
- Programmbereich *Optische Materialien*
  Leitung: Dr. Peter W. de Oliveira

THE RESEARCH FIELD *NANOCOMPOSITE TECHNOLOGY*

The research field Nanocomposite Technology addresses non-metallic-inorganic hybrid materials, especially coatings, and their functional properties. Key aspects are wet chemical synthesis methods and the use of functionalized nanoparticles. A strong focus is put on the utilization of concepts for applications in industry.

The research field *Nanocomposite Technology* consists of two Program Divisions (as of December 31, 2016):

- Program Division *Nanomers*
  Head: Dr. Carsten Becker-Willinger
- Program Division *Optical Materials*
  Head: Dr. Peter W. de Oliveira

Mehr Informationen über das Forschungsfeld *Nanokomposit-Technologie* finden Sie hier.

More informations about the research field *Nanocomposite Technology*.

NANOMERE / NANOMERS

DR.-ING. CARSTEN BECKER-WILLINGER

ZUSAMMENFASSUNG

Der Programmbereich *Nanomere* entwickelt multifunktionelle Schutzbeschichtungen und Kompaktwerkstoffe auf Basis von Kompositen mit organischen und hybriden organisch-anorganischen Matrizes sowie nano- und mikroskaligen, funktionellen Verstärkungselementen. Neue Werkstoffeigenschaften sollen hierbei auch für industrielle Anwendungen nutzbar gemacht werden. Neben Beschichtungen werden thermoplastische Kompaktwerkstoffe hergestellt. Beide Materialbasen eignen sich auch zur Weiterverarbeitung über additive Fertigungsverfahren. Als partikuläre funktionelle Füllstoffe sind anorganische keramische oder metallische Füllstoffe besonders interessant, da sie mit einer maßgeschneiderten Partikel-Matrix-Grenzfläche den Transfer festkörperphysikalischer Eigenschaften anorganischer Materialien in Polymere und Beschichtungen erlauben. Schwerpunkt der Aktivitäten sind schwermetallfreie, aktive Korrosionsschutzsysteme und Gleit-schichten, Antifouling-Oberflächen, temperaturbeständige Bindemittel, transparente, selbstheilende Oberflächen und 3D-druckfähige Filamentmaterialien.

DR.-ING. CARSTEN BECKER-WILLINGER

studied chemistry at the University of Freiburg. He obtained his degree of Dr.-Ing. in chemistry at Saarland University and INM. Since 2001, he has been head of *Nanomers*. His work focuses on functional nanoparticles and multifunctional composites.

MISSION

The activities of the Program Division *Nanomers* comprise the development of functional coatings and bulks based on the polymer matrix composite concept. A strong focus is set on application oriented projects for materials used in industry. Functions of interest are corrosion protection, control of friction, anti-fouling, temperature resistance transparent self-healing surfaces. Fields of application are in electronics, medical applications, optics, automotive, construction, mechanical and electrical engineering as well as additive manufacturing.

CURRENT RESEARCH

In the area of corrosion protection coatings a weld-through primer for the intermediate protection of mild steel was successfully developed during the EU-project WELDAPRIME. Sol-gel derived matrices filled with functional nanoparticles led to dense coating layers providing protection for mild steel without negative impact on welding and cutting ability. Intended areas of use are the automotive, construction as well as oil and gas industry. The results were presented on EUROCORR 2016 conference.

Investigations on particulate, platelet shaped zinc- and zinc-manganese phosphate additives revealed active corrosion protection in coatings in particular on mild steel. The corrosion protection behavior was investigated with Electrochemical Impedance Spectroscopy and standard corrosion tests. The results were presented on TechConnect World Conference and EUROCORR 2016.

The BMBF-project BioPolyMed in cooperation with the university hospital Greifswald was continued.

The main aim of the project is the development of medical equipment and the corresponding packaging material with anti-microbial activity for the risk minimization of hospital-acquired infections in intensive care units.

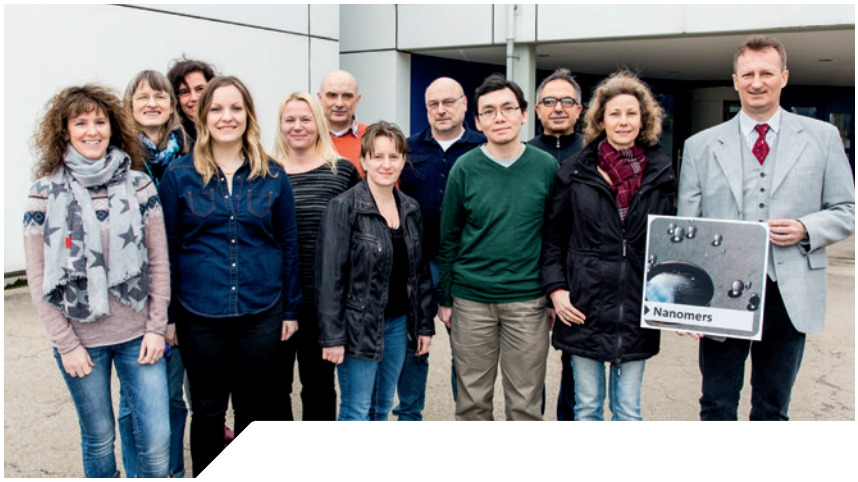
The new BMBF-VIP+-project Polyrotaxanlack (VIP = Validation of Innovation Potential), started in 2016, is focused on a new class of materials to establish the concept of self-healing scratch resistant coatings as technology platform. The approach is based on polyrotaxane based paints that are developed in close cooperation with Saarland University. The polyrotaxanes in combination with suitable cross-linkers and nanoparticulate additives lead to hard coatings that actually show complete self-healing when heated up to 90 °C.

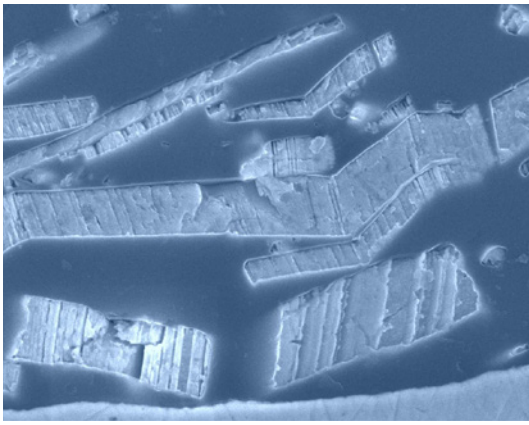
Furthermore, the BMZ-GIZ-project NaMiComp (Namibia Materials Institute Competence Development) with the University of Namibia started by the end of 2016. The aim is to analyze Namibia's locally available natural resources and use them as a base for new materials. In a long-term goal, the project supports the University in building up an on-site materials science institute.

In addition an industrial development project for optimization and scale-up of a sol-gel based synthesis for inorganic prepolymers for antiadhesive layers used in printing machinery was performed in its first phase.

OUTLOOK

The polymer composite approach will remain the base to tailor multifunctional interfaces. Recently developed concepts in the field of flake-type phosphate particles will be transferred to industrial partners in the paint and automotive supplier industry. In this direction the INM focus project "Nanocorr" (cooperation with *Innovative Electron Microscopy*) starting in 2017 will provide the basis for deeper understanding of early stage steel corrosion processes in the presence of zinc-phosphate flake-type particles, which further on helps to design new types of heavy metal free coatings with active corrosion protection mechanism. Formulations for protective layers will be adapted to environmentally friendly electrophoretic and powder coating techniques. In addition biocompatible 3D-printable compositions on a thermoplastic composite basis with pre-determinable mechanical and thermal properties will be developed.





Cross section of a corrosion protection layer containing zinc-phosphate flakes (magnification 12500 x).

OPTISCHE MATERIALIEN / OPTICAL MATERIALS

DR. PETER W. DE OLIVEIRA

ZUSAMMENFASSUNG

Der Programmbereich *Optische Materialien* erforscht Kompositmaterialien, deren besondere Eigenschaften und Funktionen auf der Wechselwirkung mit elektromagnetischer Strahlung beruhen. Zur Entwicklung von neuen optischen Beschichtungen werden Simulationen der optischen Eigenschaften mit Materialsynthesen sowie Applikations- und Strukturierungstechniken kombiniert. Diese Herangehensweise ermöglicht es, neue Materialkonzepte zu entwerfen: Zum Beispiel wird auf diese Weise mesoporöses Niobium-dotiertes Titandioxid durch Soft-Templating hergestellt. Neue Materialien für Membranen lassen sich aus einem hierfür angepassten Block-Copolymer über verdampfungsinduzierte Selbstorganisationsprozesse herstellen. Ein anderes Beispiel ist die Entwicklung fotoempfindlicher Materialien zur Herstellung von flexiblen, transparenten und dehnbaren, Indium-freien Touch-Sensoren. Hierbei werden Applikationsverfahren und Werkstoffe iterativ aufeinander angepasst.

DR. PETER W. DE OLIVEIRA

completed his Dr. rer. nat. in physics at Saarland University and INM in 2006. He combines basic studies with a strong industrial focus. Oliveira has been head of *Optical Materials* since 2005 and also heads the *InnovationCenter* INM.

MISSION

The Program Division *Optical Materials* works on the design of new optical and electro-optical composite materials to functionalize coatings on glass, ceramic and polymeric substrates. Our expertise in wet chemical syntheses of organic-inorganic matrices and in the production of nanoparticles with specific chemical modifications allows the development of material classes enabling novel solutions for current material challenges.

CURRENT RESEARCH

High-performance photocatalysts through block-copolymer (BCP) assisted self-assembly

Band-gap modified crystalline transition metal oxides, such as Niobium-doped Titanium dioxide (Nb:TiO_2), with a high surface area and an homogeneous mesoporous architecture are becoming increasingly important for photocatalytic applications. Mesoporous Nb:TiO_2 has been synthesized by an evaporation induced self-assembly based on a soft-templating utilizing a tailored BCP. The polymer template Poly(Isoprene-block-Styrene-block-Ethylene Oxide) has been synthesized by sequential anionic polymerization. The volume fraction of each block as well as the overall molecular weight has been adjusted to construct ordered TiO_2, Nb_2O_5 and Nb:TiO_2. We showed that structuring our materials into a highly ordered porous shape increased the activity up to 20 times. Moreover the extraordinary sizes of our pores combine sufficient diameter for penetration of the reactant and the electromagnetic stimuli.

Development of indium free inks for transparent conductive coatings (TCO)

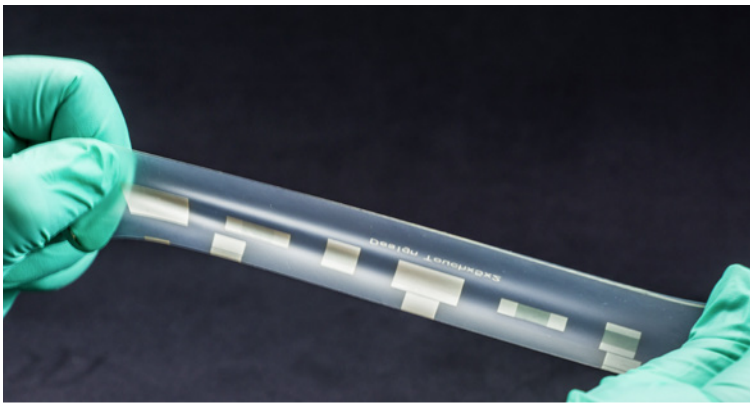
The objective of this work is the development of novel indium-free TCO inks for direct printing processes as gravure or ink-jet printing (EU project INFINITY). As alternative TCO materials, zinc oxide doped by aluminum or silicon will be tested and the properties will be compared with ITO coatings. In the project the INM is responsible for the fabrication and printing of the inks. The development of a printed coating with high conductivity demands the optimization of multiple parameters such as the deposition of particles during evaporation of the solvent having a big impact on quality and homogeneity of the patterns. Inhomogeneities such as the so called „coffee ring effect" may lead to inhomogeneous curing and poor functionality. Two strategies are employed to recirculate the solid material and obtain homogeneous depositions: induction of Marangoni flows by a surface tension gradient and management of spatial evaporation of solvents in a droplet.

Stretchable touch screen sensor trough photochemical metallisation

The objective of our work was to explore the possibilities of the photometallization process for the preparation of functional capacitive touch-sensors on flexible and stretchable substrates. The optical quality was comparable to samples on glass. Homogeneous silver deposition on the larger electrode areas were achieved as well as an excellent definition of the 5 µm wide mesh lines. A sheet resistance of 1.7 Ωsq was achieved on PET, which is comparable to results obtained on glass. The best results on PDMS were in the range of a few 100 Ωsq, indicating that very soft substrates pose some additional difficulties. However, the conductivity of silver films on PDMS experienced only little change even after considerable stretching. Bending of the PET substrate did not affect the conductivity of the silver film at all.

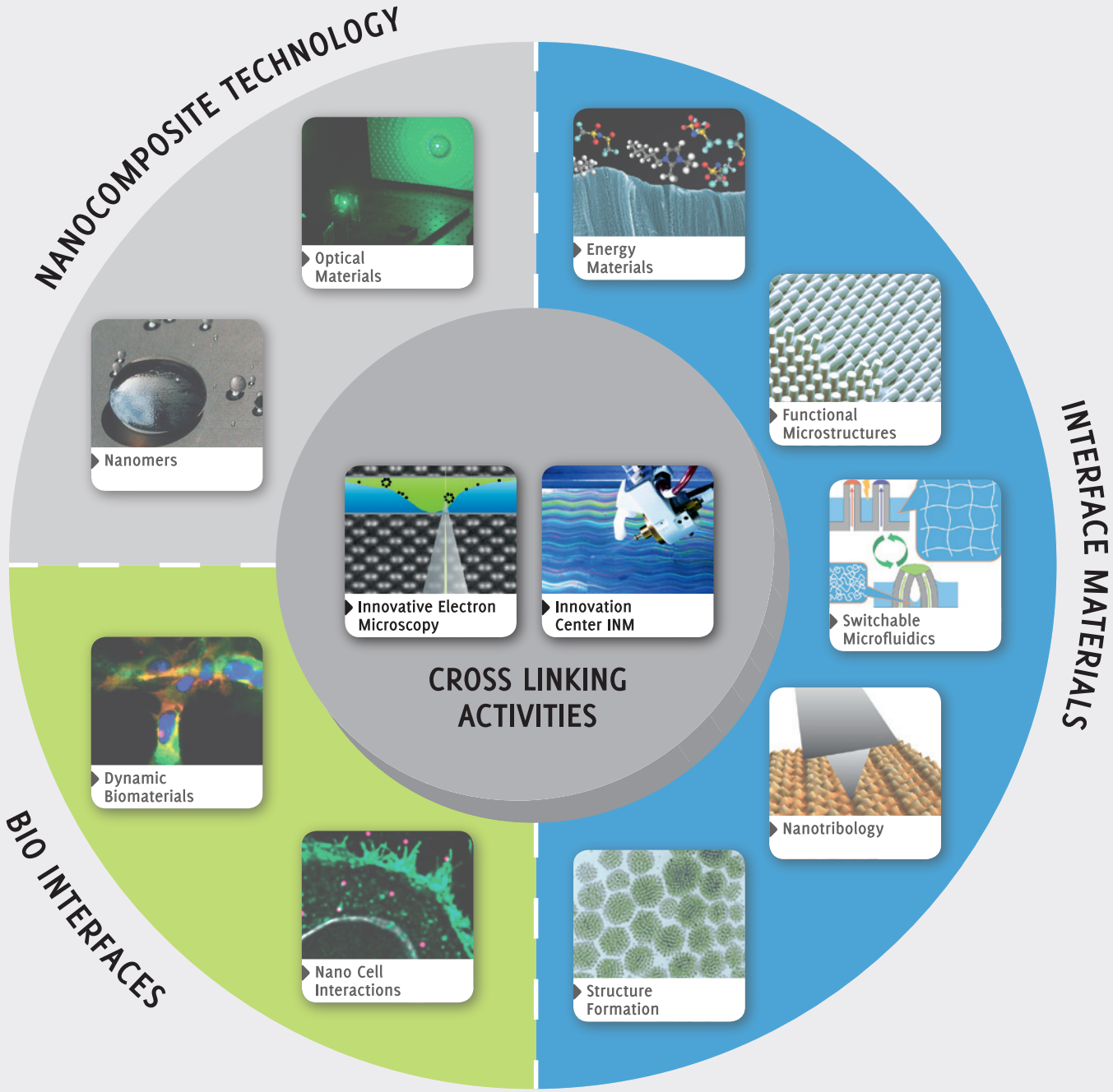
OUTLOOK

The Program Division *Optical Materials* will continue to focus primarily on designing materials with addressable optical properties comprising composite materials with nanoparticles or specific molecules as well as metamaterials including photonic crystals and plasmonic nanostructures. A thorough understanding of the wavelength dependent properties of the building blocks for these materials and their mutual interaction will be a key factor for tailoring material properties. Materials with novel optical functions like materials that can be induced virtual voxels (3D-Pixels) will increase in importance and market potential in the coming years with regard to the growing importance of security or information technologies. Progress gained with new materials will be complemented by adapted innovative coating and printing techniques. Targeted application fields such as display technology, energy conversion, and active optics are among the top priorities.



Prototype of a stretchable touch sensor on Polydimethylsiloxan substrate foil.

QUERSCHNITTSFELD / CROSS LINKING ACTIVITIES



DAS *QUERSCHNITTSFELD*

Das *Querschnittsfeld* fasst übergreifende Forschungs- und Entwicklungsthemen zusammen, die neben eigener Forschung die Arbeit der anderen Programmbereiche unterstützen. So wendet der Programmbereich *Innovative Elektronenmikroskopie* die elektronenmikroskopische Methodik auf neue materialwissenschaftliche und biologische Fragestellungen an. Das *InnovationsZentrum INM* verbindet die Wissenschafts- und Technologiebasis des INM mit Industrieunternehmen. Es koordiniert Kooperationsprojekte mit der Industrie und setzt diese um. Ferner entwickelt und skaliert das *InnovationsZentrum* Materialien und Prozesse in enger Verbindung von Material- und Verfahrenstechnik. Zusätzlich bietet es Beratung und analytische Serviceleistungen an.

Zum Jahresende wurde der Programmbereich *Modellierung/Simulation* aufgelöst; diese Fragestellungen werden künftig in einem Cluster mit externen Partnern bearbeitet. Das Querschnittsfeld besteht daher zum 31.12.2016 aus zwei Programmbereichen:

- Programmbereich *Innovative Elektronenmikroskopie*
  Leitung: Prof. Dr. Niels de Jonge
- Programmbereich *InnovationsZentrum INM*
  Leitung: Dr. Peter W. de Oliveira,
  Stv. Leitung: Prof. Dr. Tobias Kraus

SERVICEBEREICHE

Die Forschungsfelder des INM werden in ihrer Arbeit von vier Servicebereichen unterstützt. Der Servicebereich *Chemische Analytik* bietet ein breites Spektrum analytischer Dienstleistungen. Der Servicebereich *Physikalische Analytik* betreibt v. a. elektronenoptische und röntgenanalytische Verfahren. Der Servicebereich *Engineering* entwickelt und stellt Anlagen und Komponenten, von kleinen Laborgeräten bis zu großen Pilotanlagen, für die Programmbereiche her. Die *Bibliothek* erbringt Serviceleistungen im Bereich Information, Dokumentation, Recherche und Dokumentlieferung.

CROSS LINKING ACTIVITIES

This area combines comprehensive research and development activities, which are supposed to methodically complement the competencies of the research fields. Among these activities, independent scientific research is of particular importance. For example the Program Division *Innovative Electron Microscopy* works on the application of electron microscopic techniques to material-related and biological problems. The *InnovationCenter INM* links the scientific and technological basis of INM with industry. It coordinates cooperation projects with industry and implements them. Furthermore the *InnovationCenter INM* develops and scales materials and processes in a close cooperation of materials- and chemical process technology. Additionally, it offers consulting and analytical services.

By the end of 2016, the Program Division *Modeling/Simulation* was closed down; this topic will be covered by a cluster with external partners. The *Cross Linking Activities* area thus consists of two Program Divisions (as of December 31, 2016):

- Program Division *Innovative Electron Microscopy*
  Head: Prof. Dr. Niels de Jonge
- Program Division *InnovationCenter INM*
  Head: Dr. Peter W. de Oliveira,
  Deputy head: Prof. Dr. Tobias Kraus

SERVICE GROUPS

Four Service Groups support the research fields of INM in their work. The Service Group *Chemical Analytics* provides analytical tools and knowledge ranging from standard characterization procedures to the development of complex new analysis routes. The Service Group *Physical Analytics* covers electron optical and x-ray analytical investigations. The Service Group *Engineering* deals with the development and construction of devices and components, from small laboratory scale equipment up to pilot plant scale devices, for the Program Divisions. The *Library* of the INM provides services in the area of information and documentation.

INNOVATIVE ELEKTRONENMIKROSKOPIE / INNOVATIVE ELECTRON MICROSCOPY

PROF. DR. NIELS DE JONGE

ZUSAMMENFASSUNG

Eine nanometergenaue Materialcharakterisierung ist unabdingbar für die Weiterentwicklung der modernen Nanotechnologie und der Biologie. Der Programmbereich *Innovative Elektronenmikroskopie* (IEM) betreibt interdisziplinäre Forschung an der Schnittstelle der Physik der Elektronenmikroskopie (EM), Biophysik, Materialwissenschaft, Zellbiologie und Bildverarbeitung. Wir entwickeln modernste Techniken im Bereich In-situ-Transmissions-EM (TEM) und Raster-TEM (STEM) für die Forschung an funktionellen Materialien und biologischen Systemen unter realen Bedingungen. Wir untersuchen auch neue Wege für die dreidimensionale (3D) Datenaufnahme. Wir verfügen über langjährige Erfahrung mit Bildverarbeitung sowie mit der Entwicklung von Protokollen für die spezifische Proteinmarkierung mit Nanopartikeln. Dem Programmbereich stehen ein hochmodernes Elektronenmikroskop (JEOL ARM200) zur Verfügung. Wir haben vielfältige Forschungskooperationen mit verschiedenen Universitäten und der Industrie.

PROF. DR. NIELS DE JONGE

completed his doctorate in biophysics at the University of Freiburg. He performed research at Philips Research, Eindhoven, the University of Tennessee and the Vanderbilt University School of Medicine, Nashville. De Jonge is Honorary Professor for Experimental Physics at Saarland University.

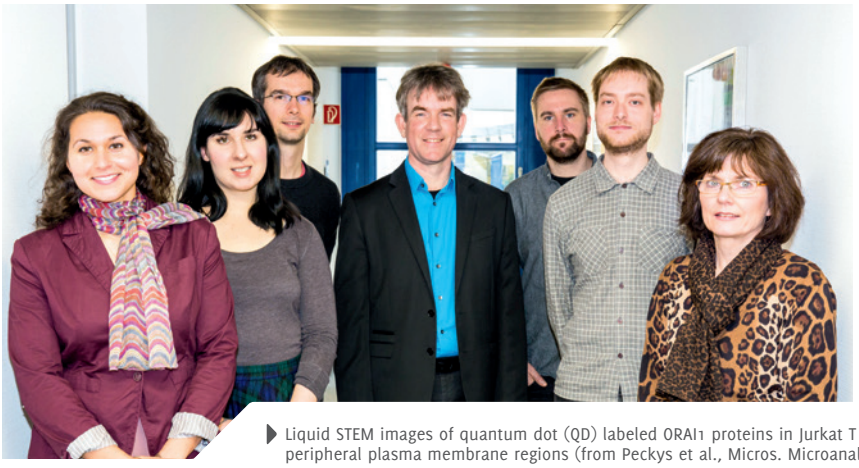
MISSION

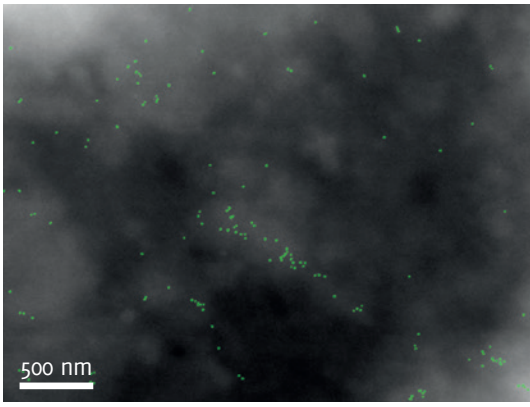
Nanoscale characterization is essential for the areas as modern nanotechnology, energy science, biology, and biomedical sciences. The Program Division *Innovative Electron Microscopy* (IEM) conducts interdisciplinary research at the interface of physics of electron microscopy, biophysics, materials science, cell biology, and image processing. The division is world leading in the area of liquid-phase electron microscopy. We develop forefront *in situ* transmission electron microscopy (TEM) and scanning TEM (STEM) methods for the study of functional materials and biological systems at realistic conditions, mostly using a liquid flow system. We are also exploring new routes for three-dimensional (3D) data acquisition using intelligent STEM- and image reconstruction strategies. We have extensive experience with image processing, and with developing protocols for specific labeling of proteins with nanoparticles. The group houses a state-of-the-art electron microscope (ARM200, JEOL). Various research collaborations exist both with academia, and industry.

CURRENT RESEARCH

Growth factor receptors in cancer cells

Our research involves members of the epidermal growth factor receptor (EGFR) family. HER2, one of the EGFR family members, is overexpressed in certain types of breast cancer, thereby contributing significantly to dysregulated cell growth. We have studied the intra- and intercellular variation of HER2 at the single-molecule level within whole breast cancer cells. Of major interest is to analyze differences in protein function between individual cancer cells (cancer cell heterogeneity). With our





Liquid STEM images of quantum dot (QD) labeled ORAI1 proteins in Jurkat T cell. Single QD-labels are visible as green spots in the peripheral plasma membrane regions (from Peckys et al., Micros. Microanal. 2016).

approach, it is possible to study the effect of cancer drugs on small sub-populations of cells, aiming to increase the effectiveness of HER2 targeting drugs. (cooperation with Prof. Stefan Wiemann, German Cancer Research Center, Heidelberg)

Studying the behavior of nanomaterials in liquid

TEM and STEM of liquid specimens offer unique options to study the nanometer-scale dynamic processes occurring in liquids. We have recently studied the electron beam induced electrochemistry of gold nanoparticles under varied liquid conditions. We discovered that nanoparticles in close proximity of a surface do not move as predicated by Brownian motion but many orders of magnitude slower, possibly explained by the presence of an interface layer of ordered liquid with exceptionally high viscosity.

3D STEM

We have developed a novel three-dimensional (3D) STEM technique for obtaining nanometer resolution on thick specimens. Aberration-corrected 3D STEM is capable of high-resolution 3D imaging without a tilt stage. We are currently improving the vertical resolution by combining focal- and tilt-series STEM. (cooperation with Dr. Tim Dahmen / Prof. Philipp Slusallek, German Center for Artificial Intelligence, Saarbrücken)

Stoichiometry of calcium channels

Liquid STEM is being used to study the stoichiometry of Ca^{2+} channels formed by ORAI proteins in mammalian cells as part of the research center SFB1027. A wide variety of cellular functions depend on the dynamics of intracellular Ca^{2+} signals. The relative ratio of the various ORAI channels is highly relevant for cell function. However, the stoichiometry of their heteromeric assembly is mostly unknown, and we aim to determine the assembly stoichiometry under various functional conditions. (cooperation with Prof. Barbara Niemeyer, Biophysics, Saarland University, Homburg Campus)

OUTLOOK

The Program Division *Innovative Electron Microscopy* is well situated to conduct research at the international forefront of electron microscopy both in the areas of biology/biophysics, and materials science. Our future aims are to study processes of protein complexes occurring in eukaryotic cells, to develop a new characterization method for membrane proteins in cancer cells, to improve the time-resolution of *in situ* STEM, and to explore the solid-liquid interface in materials science. With our novel microscopy methods, we may possibly discover new phenomena that are not visible with existing microscopy methods.

INNOVATIONSZENTRUM INM / INNOVATIONCENTER INM

DR. PETER W. DE OLIVEIRA, PROF. DR. TOBIAS KRAUS

ZUSAMMENFASSUNG

Im Jahr 2016 hat das *InnovationsZentrum INM* seine Aufgaben als Schnittstelle zwischen den Märkten und den Wissensplattformen des INM voll ausgefüllt. Dazu hat es zu Schutzschichten, „Gecomer"-Adhäsionsstrukturen, dekorativen Schichten und funktionellen Nanopartikeln Entwicklungen des INM analysiert, Firmenpartner identifiziert und kontaktiert sowie Transferprojekte durchgeführt. Gleichzeitig hat das Zentrum neue Projekte initiiert, die entweder aus technischen Entwicklungen „bottom up" entstanden oder aus strategischen Erwägungen „top down" als notwendig erkannt wurden, beispielsweise Arbeiten zu Materialien für die digitale Zukunft. Das Zentrum möchte in den kommenden Jahren Standardprozesse zur Unterstützung von Innovationen etablieren (BMBF-Projekt Science4KMU). Als seine anspruchsvollste Aufgabe betrachtet es die Identifikation und Auswertung potentiell disruptiver Entwicklungen aus der Grundlagenforschung.

MISSION

To increase INM's acquisition of industrial projects, the *InnovationCenter INM* provides support for science-to-business marketing. It develops an innovation strategy adapted to INM's competences. Continuous evaluation of the markets provides feedback to influence the direction of future basic research. Based on INM's research output, the *InnovationCenter* designs and develops novel coating materials, new surface structuring techniques, and corresponding processes up to pilot plant scale. The center assists R&D projectss along the entire innovation chain from basic concepts to quality control and validation of the production process.

CURRENT RESEARCH & DEVELOPMENT

Technology transfer activities in 2016 comprised adhesion control through microstructuring on glass and plastic, including surfaces suitable for the han-

DR. PETER W. DE OLIVEIRA

is the head of the *InnovationCenter INM*. The physicist also heads the Program Division *Optical Materials*.

PROF. DR. TOBIAS KRAUS

is deputy head of the *InnovationCenter INM* and in this function he is responsible for its analytical services. Kraus is head of the Program Division *Structure Formation* and Professor for Colloid and Interface Chemistry at Saarland University.

dling of microoptical devices; corrosion protection of aluminum, brass, magnesium, zinc, and stainless steel; decorative coatings on glass, watch cases, and wheels; and synthesis and quality control of functional nanoparticles.

Protective coatings

The project aims to develop a replacement for corrosion protection coatings with better performance to be easily applied by spray coating. Further requirements were low content of volatile organic compounds, excellent adhesion, resistance to fluids used in vehicles, among others. Within a year, we succeeded in developing a new composition of a corrosion protection coating material for steel that has better protection performance than existing cataphoretic paints and surpasses even galvanic zinc-nickel coatings. In addition, we created an application method for the reproducible coating of rails.

Gecomer upscaling

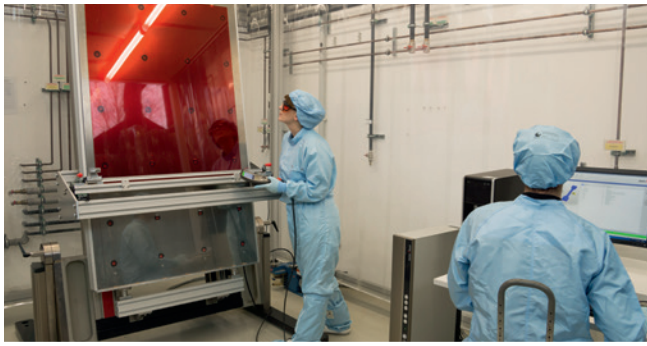
This internal cooperation with the Program Division *Functional Microstructures* brings an innovation from INM's research closer to application and thus supports joint projects with industrial partners. In a project funded by the Leibniz Association we exploit INM's gecomer technology to develop pick-and-place methods for the transport and positioning of microscale devices.

Science4KMU

In the BMBF project Science4KMU the *InnovationCenter* teamed up with two institutes specialized in Operation Organization and European Economic Research to react to rapidly changing markets and identify the most promising cooperation partners. The project aims at the development of methods to build up long term cooperations between the INM and small and medium enterprises (SMEs). Potential partner SMEs will be identified using two strategies: one is top-down with a "big data"-based approach, the other is bottom-up and based on a detailed survey.

Analytical services

The *InnovationCenter INM* also offers a broad range of value added analytical services to partners from industry. Our goal is to make INM's comprehensive analytical capabilities available to companies, allow them to improve the quality and competitiveness of their products, and create reciprocal trust that can initiate future R & D ventures in cooperation with the INM.



Wet coating equipment for very thin layer developed at the *InnovationCenter INM*.

OUTLOOK

The *InnovationCenter INM* is creating an internal network to exploit the relationship between scientific development, engineering, and industrial cooperations to nurture a culture of innovation. The externally funded project Science4KMU will provide strategies to form contacts between INM and the market. An external network will be developed, tested and validated with the aim of fostering trustful partnerships with businesses. The Center analyses the requirements of the SMEs, provides assistance in identifying financing resources for the proposed innovation development and implementation, and applies project management to streamline the process. This "ecosystem" will coalesce talent specific teams from the internal and external networks of information, personnel capacity, resources, and facilities across all Program Divisions to implement and execute projects.

CHEMISCHE ANALYTIK / CHEMICAL ANALYTICS

DR. CLAUDIA FINK-STRAUBE

Die Servicegruppe *Chemische Analytik* verfügt über moderne Verfahren zur Trennung und Analyse von flüchtigen und löslichen organischen Stoffgemischen (GC-MS, LC-MS, GPC), zur Element-Analytik (HR-SF ICP-MS, HR-CS AAS, ICP-OES, CHNOS) und zu Aufschluss- und Präparationstechniken für anorganische und organische Proben (MW, HT Aufschluss, HS, LE, SPE). Die Servicegruppe bietet die Optimierung und Entwicklung analytischer Methoden für neue Probenformulierungen sowie Routinemessungen für alle Gruppen des INM, die Universität und externe Auftraggeber an. Das neue hochauflösende Q-TOF-System zur Strukturaufklärung kleiner Moleküle und empfindlicher Verbindungen mit einer Massengenauigkeit von 1 ppm vervollständigt das Portfolio der chemischen Analytik, um auch den Bedürfnissen der biologisch orientierten Gruppen gerecht zu werden.

PHYSIKALISCHE ANALYTIK / PHYSICAL ANALYTICS

DR. MARCUS KOCH

Die Servicegruppe *Physikalische Analytik* hat die Aufgabe, Proben aus dem INM, der Universität und von externen Auftraggebern mittels röntgendiffraktometrischer und elektronenmikroskopischer Methoden zu charakterisieren. Für einen Teil dieser Proben müssen aufwändige Präparationsverfahren wie z. B. Mikrotomie oder Kryopräparation eingesetzt werden, um einen Blick auf die Nano- und Mikrostruktur des Materials werfen zu können. Darüber hinaus besteht die Möglichkeit für rasterelektronenmikroskopische Untersuchungen unter besonders schonenden Bedingungen (ESEM), z. B. für biologische oder nasse Proben. Beschäftigte, die elektronenmikroskopische Fragestellungen selbständig lösen möchten, werden in die Geräte eingewiesen und bei ihren Arbeiten unterstützt.

ENGINEERING / ENGINEERING

DIPL.-ING. DIETMAR SERWAS

Hauptaufgabengebiet des Servicebereiches *Engineering* mit den Arbeitsbereichen Konstruktion, mechanische Werkstatt und Elektrowerkstatt ist die Entwicklung und Herstellung von wissenschaftlichen Anlagen und Komponenten für die Gruppen des INM. Die Bandbreite der Arbeiten reicht von kleinen Laborgeräten bis zu Pilotanlagen. Aus den Vorgaben werden Konzepte entwickelt und mit CATIA-V5-CAD in Konstruktionen umgesetzt und in den INM-Werkstätten angefertigt. Hierfür steht eine moderne Ausstattung wie ein CAM-System, eine 5-Achs-HSC-Präzisionsfräsmaschine oder eine Funkenerosionsanlage zur Verfügung. Weiterhin werden Servicearbeiten für die anderen Bereiche des INM, sowie im Rahmen einer Kooperation die Werkstattarbeiten für den Lehrstuhl *Technische Physik* der Universität des Saarlandes durchgeführt.

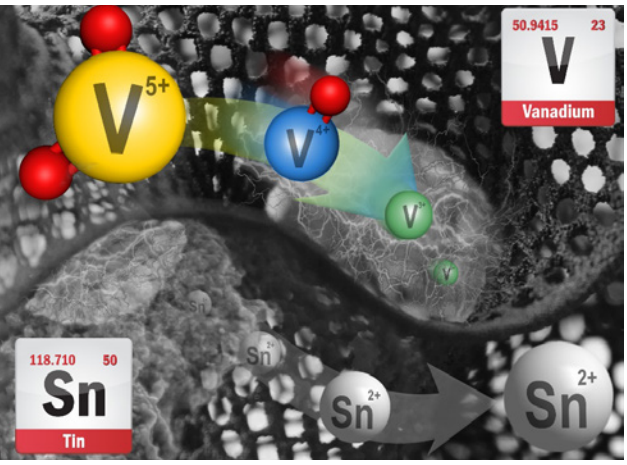
NTNM-BIBLIOTHEK / NTNM LIBRARY

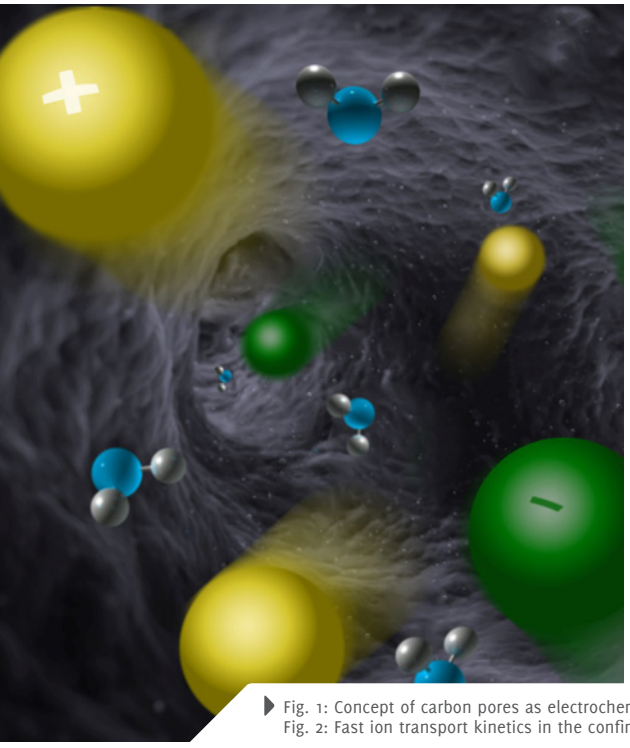
DIPL.-BIBL. ELKE BUBEL

2016 haben die Universität des Saarlandes (UdS) und das INM die Zusammenführung der naturwissenschaftlich-technischen Institutsbibliothek der UdS und der wissenschaftlichen Spezialbibliothek des INM beschlossen. Mit Abschluss des Kooperationsvertrages wurde ein Prozess gestartet, die physischen Bestände beider Bibliotheken zusammenzuführen, sowie Synergieeffekte bei der Erwerbung, Erschließung und Präsentation von Print- und elektronische Medien zu schaffen. Die neue Bibliothek firmiert seitdem als NTNM-Bibliothek und hat ihren Sitz in Gebäude C6 2 auf dem Campus der UdS. Für das INM ist die Bibliothek aktiv vertreten in den Arbeitskreisen Bibliotheken und Open Access der Leibniz-Gemeinschaft. Sie fördert Open Access durch Beratungs- und Serviceangebote und ist zentrale Dokumentationsstelle für die Publikationsdaten im INM.

CARBON PORES AS ENERGY STORAGE NANOREACTORS

J. LEE AND V. PRESSER
ENERGY MATERIALS





Electrical double-layer capacitors (supercapacitors) achieve rapid energy storage and recovery by reversible ion electrosorption. The high-power rates originate from the high mobility of ions dissolved in an electrolyte. In contrast, ion intercalation batteries operate much more slowly, but achieve much higher energy storage capacities. To combine fast rates with high storage capacity, carbon materials can be hybridized with redox-active species. Yet, this often leads to unfavorable power and energy ratings, when compared to supercapacitors and batteries, individually. Our approach is to capitalize on the fast ion transport and rapid charge transfer of dissolved ions via confinement of redox ions in carbon nanopores. With this approach, already-established carbon electrode materials, like activated carbon or carbon cloth, can be readily applied. We have demonstrated the universal character of this promising approach with three systems: iodide, ferricyanide, and vanadyl/tin.

With potassium ferricyanide and potassium iodide, we demonstrated the synergy of redox electrolyte by the dual charge storage mechanisms via double-layer formation and Faradaic redox reaction (enables 10-times higher energy storage capacities than supercapacitors) and the enhanced redox kinetics via the confinement of ions in carbon nanopores (power performance as high as supercapacitors). Particularly attractive is the vanadyl/tin sulfate system with unique cell balance via fluid/solid reaction (tin plating) at the positive electrode and fluid/fluid reactions of vanadium complexes at the negative electrode. This promising redox couple allows to access energy ratings of up to 85 Wh/kg, and adjusting the vanadyl-to-tin sulfate ratio allows to access high power regimes (up to 2 kW/kg).

References:
J. Lee et al., Energ Environ Sci (2016) 9(11) 3392 – 3398.

Fig. 1: Concept of carbon pores as electrochemical nanoreactors for the aqueous vanadyl/tin system.
Fig. 2: Fast ion transport kinetics in the confinement of carbon nanopores.

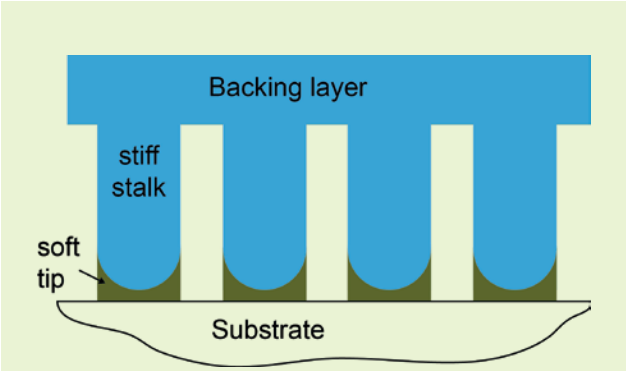
ADHESION OF COMPOSITE FIBRILS TO ROUGH SUBSTRATES

S. C. L. FISCHER, R. G. BALIJEPALLI, R. HENSEL AND E. ARZT
FUNCTIONAL MICROSTRUCTURES

While geckoes and other animals can cling to surfaces of any roughness, good attachment for artificial adhesion devices requires smooth countersurfaces. We demonstrated that artificial fibrillar microstructures can be designed to cling to surfaces of finite roughness. This concept is important for the practical applicability of INM's Gecomer technology.

We designed composite pillar structures composed of a mechanically stiff stalk and a soft terminal layer with a tunable interface between both (Fig. 1). We performed experiments on macroscopic structures to establish a proof-of-principle and analyzed the interfacial stress distribution by finite element simulations. The soft terminal layer of the pillar structures provided high adaptability to the substrate and hence led to a better stress distribution. The stresses were higher in the center of the fibril and lower at the perimeter, where conventional pillars start to detach due to the edge stress intensities. With this design, only small reductions in adhesion stress were recorded when compared to smooth surfaces. In addition, the design enables manufacturing of high aspect ratio structures with straight sidewalls without the instability present in mushroom microstructures.

Based on these results, we aim to transfer this principle to smaller structures. This development will enable new applications, such as novel skin adhesives (Fig. 2). Our modeling activities on this topic are supported by R. McMeeking (UC Santa Barbara), A. Kossa (Budapest University of Technology & Economics), and M. Müser (Saarland University). By combining experiment and theory, we will develop a full image of the complex adhesion mechanisms in fibrillary structures and refine their design for targeted applications.



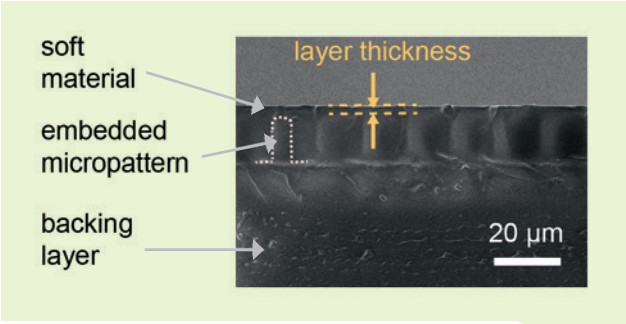
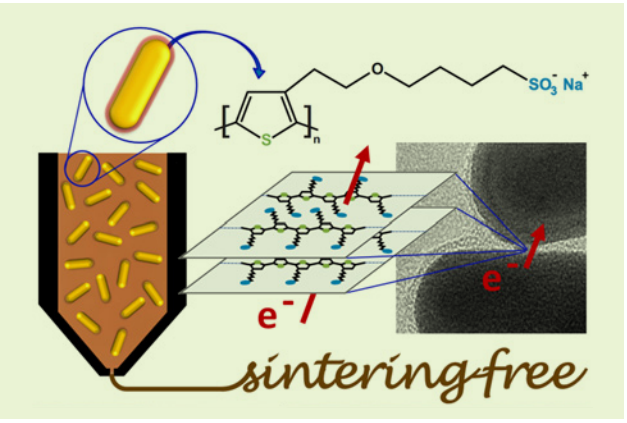


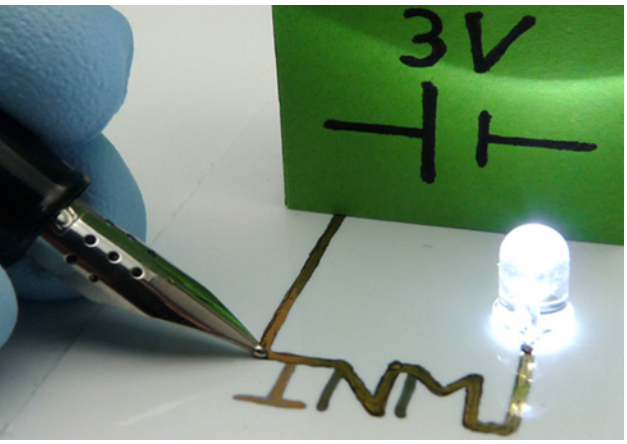
Fig. 1: Scheme of cylindrical composite pillars composed of mechanically stiff stalk and soft tip.
Fig. 2: Scanning electron micrograph of a composite micropillar array.

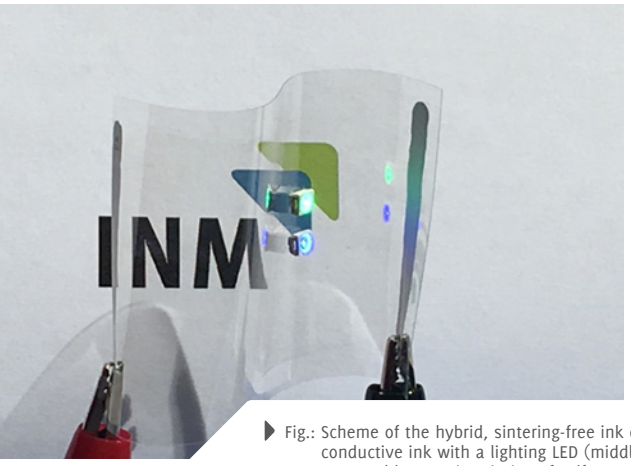
References:
S. C. L. Fischer et al., ACS Appl. Mater. & Interfaces, 9 (2017), 1036–1044
R. G. Balijepalli et al., J. Mech. Phys. Solids, 99 (2017) 357-378

HYBRID INKS: MATERIALS FOR THE FUTURE OF PRINTED ELECTRONICS

L. GONZALEZ-GARCIA, B. REISER, J. H. M. MAURER, I. KANELIDIS AND T. KRAUS
STRUCTURE FORMATION







The next generation of electrics poses new challenges for material scientists in which printing of electronics allows for new designs, substrates, and applications. Printing requires inks that contain conductive polymers, metals, or semiconductors in solution or suspension. Creating stable inks that can be printed into high-performance electronic structures is a formidable challenge.

The Structure Formation Group has developed "hybrid particle inks" containing inorganic cores with organic shells. The combination is synergistic: a soft polymer provides stability and mechanical flexibility; an inorganic core lends the printed material stability and good electronic properties.

One of the hybrid inks for inkjet printing is based on gold cores and a soft polythiophene shell. It becomes electrically conductive immediately after drying without any further treatment. The metal cores dominate the conductivity of the printed layers, while the polymer shells act as stabilizers, form conductive bridges and establish electrical contact during drying. We currently investigate properties such as shelf life, particle agglomeration, and the electrical properties of printed patterns.

We are currently developing self-organizing inks that contain highly anisotropic inorganic cores with an organic shell which directs their arrangement during printing to ensure the formation of well-defined, thin, and continuous lines. Future inks may contain mixtures of various materials which are spontaneously arranging to form electronic junctions and other functional parts directly after printing.

References:
B. Reiser, L. González-García, I. Kanelidis, J. H. M. Maurer, T. Kraus, Chemical Science 7 (2016) 41904196
J. H. M. Maurer, L. González-García, B. Reiser, I. Kanelidis, T. Kraus, Nano Letters 16 (2016) 29212925

Fig.: Scheme of the hybrid, sintering-free ink concept (top), picture of a conductive path using our conductive ink with a lighting LED (middle), and picture of a transparent conductive mesh prepared by nanoimprinting of self-organizing ink (bottom).

CONTROLLING LIQUID DISTRIBUTION IN LIQUID-LIKE STATES

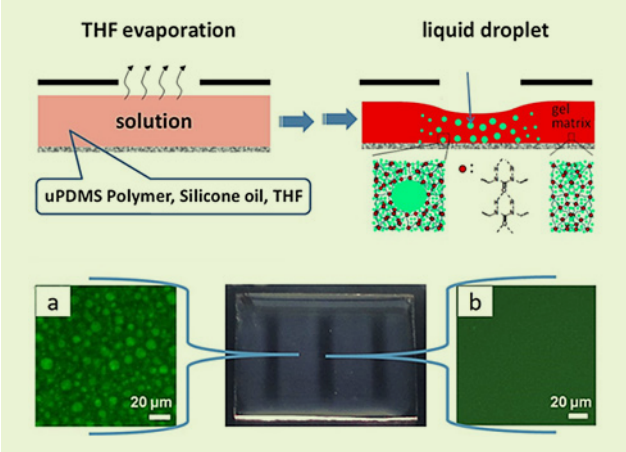
J. CUI
SWITCHABLE MICROFLUIDICS

Embedding fluid in a solid matrix is essential for providing coatings various functions such as self-recovery, delivery, and secretion, or tuning surface properties, mechanical performance or others. Localizing the liquid-inclusions allow these capabilities acting in a spatial control mode for targeted delivery and fine mediation of surface properties.

To this end, we developed a facile approach to control the localization of liquid droplets in dynamic polymer matrices for the first time. Our strategy is based on evaporative lithography, a novel technique to control particle migration in the liquid phase during drying by mediating solvent evaporation with masks. This technique can induce an asymmetric distribution of liquid compositions in solution where in a combined interaction of surface tension, the Marangoni flow, controls the mass transport. Nonvolatile liquid is enriched in the region of free evaporation and then undergoes a phase separation to create liquid droplets which are further fixed by gelation (Fig. 1). We demonstrated that resulting patterned coatings display remarkable difference in secretion property from droplet-embedded region to droplet-free region, which allows for the control of the directional movement of water drops (Fig. 2).

Our method was demonstrated by using simple three-composition systems. The general principle could be applied to various material systems for localizing many material functions such as slipperiness, self-healing ability, fouling resistance etc. These functions have wide potential applications in drug delivery, material fabrication, thermal transport, coatings on medical devices to name only a few.

References:
H. Zhao et al., Angew Chem Int Ed (2016) 55(36) 10681 – 10685.



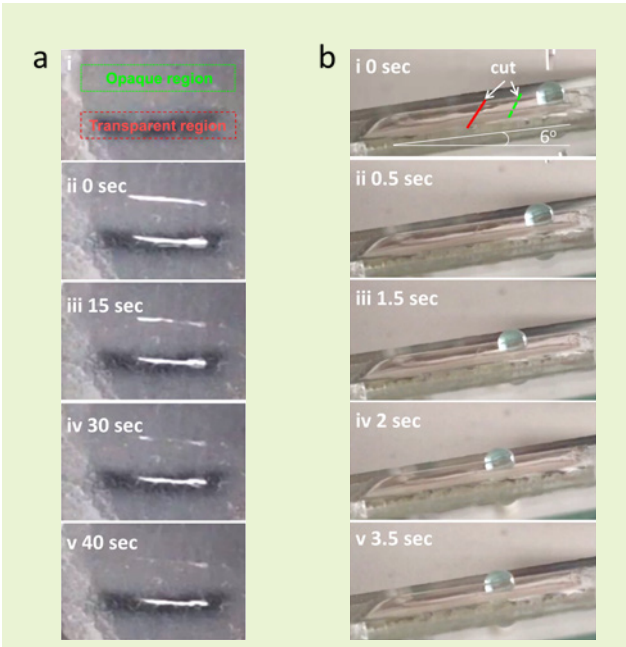
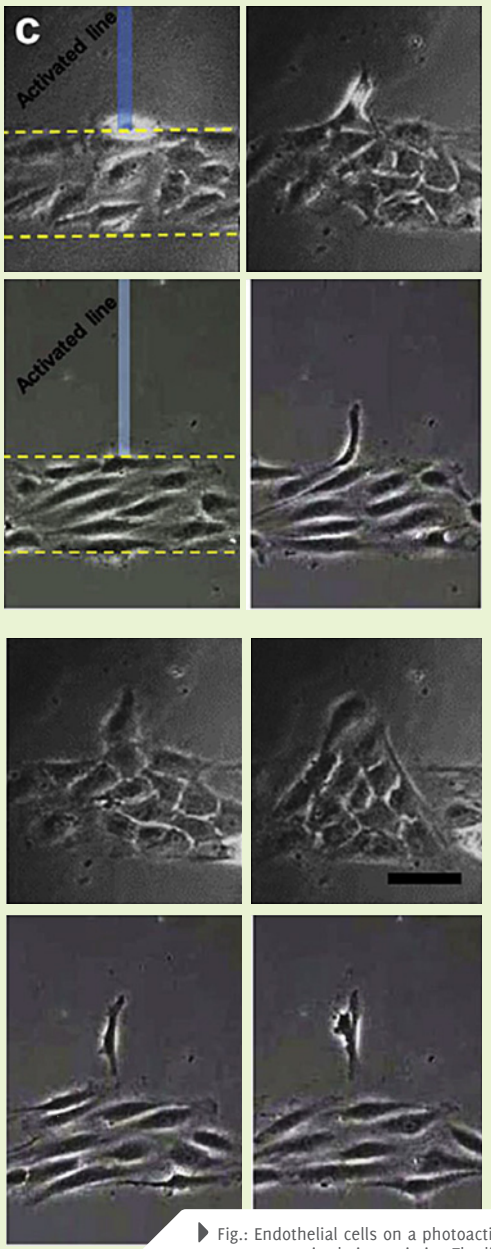


Fig. 1: Controlling the localization of droplets in dynamic polymer gel systems by evaporative lithography.
Fig. 2: Localized recovery and water drop sliding on a damaged patterned coating with manual knife cuts.
(a) Optical images of coating before damage (i) and after damage at various times (ii-v).
(b) Optical images of a water droplet (10 µL) on damaged coating at various times (i-v).
Solid and dashed lines show damages made in transparent and opaque regions, respectively.

LIGHT-GUIDED ANGIOGENESIS

DYNAMIC BIOMATERIALS



Endothelial cells form the linings of our blood vessels. These cells have a remarkable capacity to adjust in number and arrangement and to migrate, extend and remodel the vascular network in our tissues. Endothelial cells are indispensable for tissue growth and repair, but also for the growth of tumors and the progression of cancer.

The critical factors that motivate endothelial cells to migrate out of their endothelial monolayer to grow new vessels remain unclear. Migration studies suggest that the morphological parameters of the extracellular matrix, the natural scaffold to which cells attach, are key variables for cell migration behavior. One possible relevant parameter is the size of the collagen fibers in the tissue, to which cells attach and along which endothelial cells move. During regeneration processes and in tumor development collagen fibers reshape and reorganize, and these changes could provide stimulatory cues for the motility of embedded cells.

Researchers in the Program Division *Dynamic Biomaterials* have developed biomaterials with reconfigurable adhesive spaces mimicking the fibrillar structure of collagen in natural tissues. Using photoactivatable cell adhesive molecules and a scanning laser, migration patterns of various geometries were in situ generated. Endothelial cells adopted various migration modes (single vs collective, and amoeboid vs mesenchymal migration) depending on the spatial constraint. Cells adapted their body shape to the geometry of the migration track, which could trigger phenotypic changes. Our results provide relevant guidance for the design of biomaterials that actively support the growth of new vessels. It also helps to design new therapeutic concepts to remodel collagen fibers in tumor tissue to prevent vascularization of tumors and stop their growth.

References:
M. J. Salierno et al., Biomaterials (2016) 82, 113 – 123.

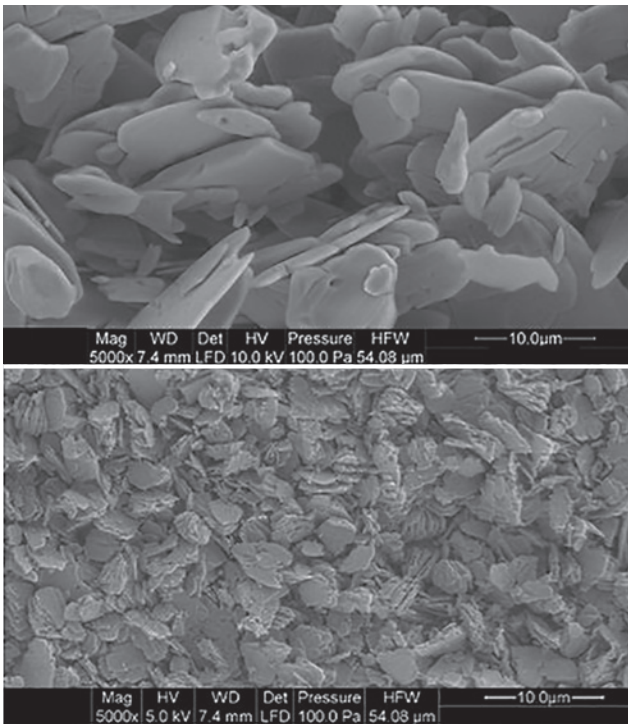
Fig.: Endothelial cells on a photoactivatable biomaterial escape out of a monolayer when adhesive lines of certain widths appear in their proximity. The line width determines if the migratory process occurs individually or collectively.

SHAPE-CONTROLLED ZINC-MANGANESE PHOSPHATE PARTICLES AS NEW CORROSION PROTECTION ADDITIVES FOR STEEL

C. BECKER-WILLINGER, E. PERRE AND S. ALBAYRAK
NANOMERS

Zinc phosphates and metal phosphates are commonly known to show an interesting protection effect against corrosion on steel. The underlying mechanisms are still under discussion. Barrier properties against diffusion, passivation of the steel surface, shielding and anti-cathodic disbonding abilitiy were reported. The protection effect was limited and difficult to demonstrate using accelerated corrosion tests because conventional zinc phosphates consist of particles with spherical shape and show only low solubility in water.

For this reason, we followed two approaches to achieve an enhanced solubility: synthesizing crystalline particles with a flake-type morphology having a higher surface to volume ratio than corresponding spheres, and introducing manganese as a second metal into zinc phosphate. All the synthesized metal phosphate particles present a flake-like morphology. The zinc manganese phosphate flakes with a molar ratio of Zn:Mn 0.3:0.7 were much thinner and smaller than the zinc phosphate. The flake-like morphology was expected to lead to an improved reactivity of the particles. It should lead to an increased solubility from the edges of the particles when a corrosive electrolyte gets in contact. In order to evaluate the protective behavior of the different metal phosphate particles, they were dispersed in various testing electrolytes that could be used to immerse mild steel samples. Additionally, polarization and electrochemical impedance spectroscopy in dependence on the particles' morphology and the molar ratio of zinc to manganese were applied. Finally, the particles were tried as active fillers in Nanomer coatings and could be oriented more or less parallel to the surface of the metal, thus increasing the barrier properties by a roof-tile arrangement.



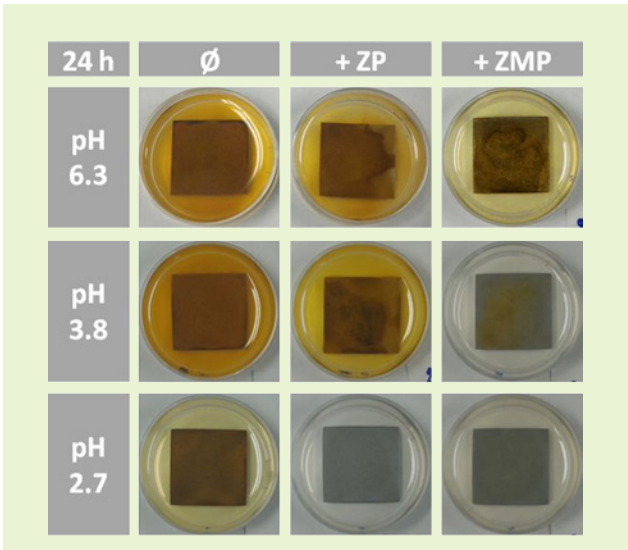
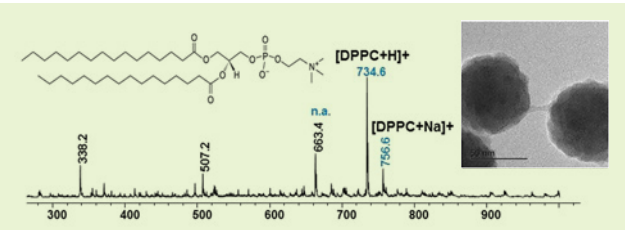


Fig. 1: Morphologies of the synthesized metal phosphate particles: zinc phosphate (top) and zinc manganese phosphate (middle).
Fig. 2: Steel plates immersed for 24 h in 3 different electrolytes (0.5 % NaCl in H_2O at pH 6.3, 3.8, and 2.7) containing no particles, zinc phosphate (+ZP), and zinc-manganese phosphate (+ZMP).

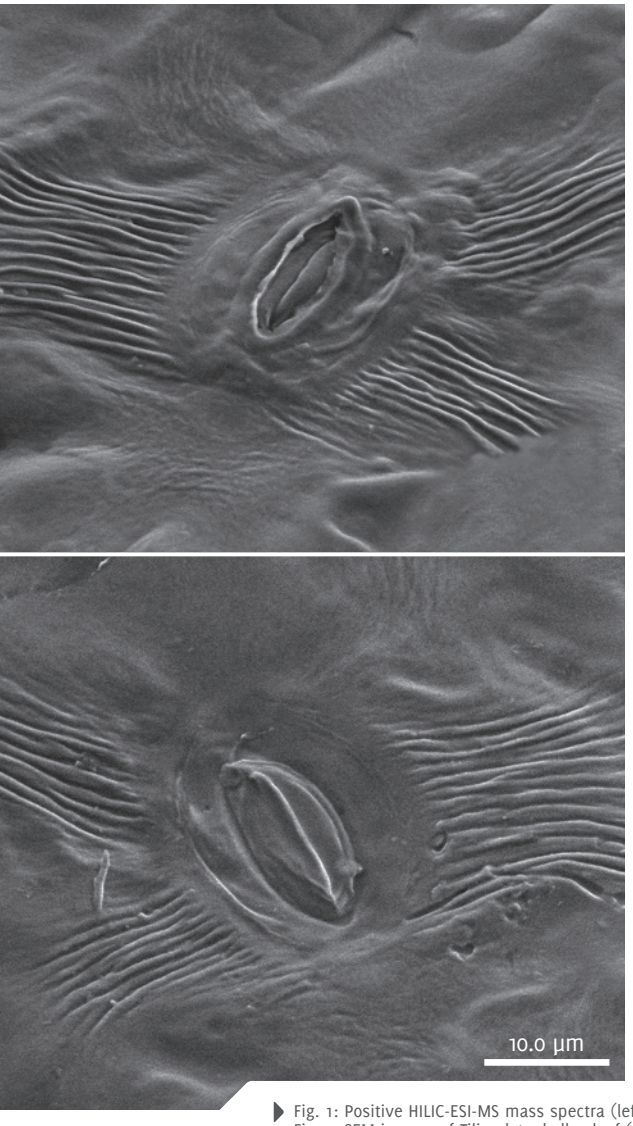
HIGHLIGHTS FROM OUR SERVICE GROUPS



INTERACTIONS BETWEEN LUNG SURFACTANT AND AMORPHOUS SIO_2-NPS

Y. E. SILINA, J. WELCK, A. KRAEGELOH, M. KOCH, C. FINK-STRAUBE
CHEMICAL ANALYTICS, NANO CELL INTERACTIONS, PHYSICAL ANALYTICS

In this study, we showed how two sizes of amorphous Silica Nanoparticles (SiO_2-NPs) at different concentrations interact with dipalmitoylphosphatidylcholine (DPPC) as main component of lung surfactant. For the experiments, we have used a combination of solid phase extraction (SPE) with hydrophilic interaction mass spectrometry (HILIC-ESI-MS). The assay was used to investigate the concentration-dependent sorption of DPPC to two-sizes of amorphous SiO_2-NPs in a MeOH:H_2O (50/50 v/v) mixture and in cell culture medium.



A NOVEL METHOD FOR THE REPLICATION OF MICROSCOPIC SURFACE MORPHOLOGY

W. WU*,R. M. GUIJT*, Y.E. SILINA, M. KOCH, A. MANZ*
*KOREAN INSTITUTE OF SCIENCE AND TECHNOLOGY (KIST EUROPE),
CHEMICAL ANALYTICS, PHYSICAL ANALYTICS

A simple method for the replication of the microscopic surface morphology of plant leaves was developed at KIST. INM performed a detailed microscopy study by ESEM and confirmed replication accuracies down to 500 nm in PDMS. The chemical stability of the PDMS castings was analyzed by HS-GC-MS studies. The replication technique was applied to leaves from over ten different species, covering the most common reticulate, accurate, pinnate, parallel and palmate venation patterns.

The methodology provides access to a large number of fluidic structures, with an even bigger variety in functionality provided by the presence and location of micro- and nanometer scaled structures caused by stomata or trichomes.

Fig. 1: Positive HILIC-ESI-MS mass spectra (left) and TEM image (right) of conditioned medium extract after implemented SPE.
Fig. 2: SEM images of Tilia platyphyllos leaf (top) and corresponding PDMS replica (bottom).

INTERNATIONAL ERC WORKSHOP "ENGINEERING OF BIO-INSPIRED MATERIALS"

E. ARZT AND R. HENSEL
FUNCTIONAL MICROSTRUCTURES

In a two-day workshop, INM gathered an outstanding group of international experts in materials science and related fields for presentations on new materials concepts. More than 100 researchers discussed recent findings on materials inspired by nature and their potential for emerging applications in industry and biomedical sectors. The workshop was held from June 7-8, 2016, in the festive auditorium of Saarland University in Saarbrücken within the framework of the ERC Advanced Grant awarded to Prof. Arzt.

The list of invited speakers included top researchers from prestigious institutions, e.g. the University of Cambridge in the UK, the Weizmann Institute in Israel, the Max Planck Institutes for Intelligent Systems (Stuttgart) and for Iron Research (Düsseldorf), the Karlsruhe Institute of Technology, as well as from renowned universities such as Harvard University, Stanford University, Brown University, University of California, University of Massachusetts, the Massachusetts Institute of Technology, University of Pennsylvania, Johns Hopkins University, Seoul National University, Université Pierre et Marie Curie in Paris, University of Freiburg and Montanuniversität Leoben. Their lectures spanned topics from sea dwellers and plants as models for new materials, novel 3D microarchitectures, to the fundamentals of modern care products and ultrasoft materials and machines. Fibrillar surface structures played a central role in the lively discussions, as they are an important subject of ongoing research at INM.

The "Engineering of Bio-Inspired Materials" workshop was organized by Eduard Arzt and Roland Bennewitz (INM), Oliver Kraft (Karlsruhe Institute of Technology), and Ralph Spolenak (ETH Zürich). The conference was made possible by the financial support of the European Research Council.

3RD CONFERENCE ON *IN SITU* AND CORRELATIVE ELECTRON MICROSCOPY (CISCEM)

N. DE JONGE AND C. HARTMANN
INNOVATIVE ELECTRON MICROSCOPY

From Oct. 11–12, 2016, INM hosted the 3rd Conference on In Situ and Correlative Electron Microscopy (CISCEM) which brought together an interdisciplinary group of scientists from the fields of materials science, chemistry, biology, geology, and physics to discuss future directions of in situ electron microscopy from different "viewing angles".

The conference was organized by Niels de Jonge (INM), Kristian Mølhave (Denmark Technical University) and Damien Alloyeau (Université Diderot Paris). Financially, it was supported by the European Microscopy Society, the Deutsche Gesellschaft für Elektronenmikroskopie, and by twelve sponsors from industry. Located in the Aula of the Saarland University, the conference attracted 90 participants from 14 countries.

Highlight was the keynote lecture of Prof. Frances M. Ross, IBM, Yorktown Heights, USA, who spoke about liquid-cell transmission electron microscopy for imaging electrochemical processes. The topics of the oral and poster presentations included nanoscale studies of biological samples and functional materials under realistic or near realistic conditions, e.g., in gaseous environments, at elevated temperatures, and in liquid. It was shown how dynamical processes are studied by including the time domain in electron microscopy, while taking into account the electron beam effects. The wide variety of materials and dynamical phenomena investigated demonstrated the rapidly growing interest of the international scientific community in characterization at the nanometer length scale using in situ approaches, transforming electron microscopes from merely imaging devices into multi-parameter experimental platforms. The extended abstracts have been published online as supplementary section of the journal Microscopy and Microanalysis.

INM AS FAMILY-FRIENDLY EMPLOYER – RENEWED CERTIFICATE "AUDIT BERUFUNDFAMILIE"

C. FINK-STRAUBE AND C. SAUER

Since 2012, INM has been certified as a family-friendly employer within the "audit berufundfamilie". After three successful years, the institute decided to continue its efforts and received the renewed certification "audit berufundfamilie" in 2015/16. With that step, the INM has committed itself to the implementation of further family-oriented and health-conducive measures within the following three years.

INM's company agreement "Working Time", adopted in 2012, was an important step in the first audit period. It allows all employees a flexible working time regulation and includes flexible working conditions for short-term family matters.

A central topic in our work has been the balance between work and life with children, especially younger ones. A "Parent Child Room" and a Baby Nursing and Changing Room were installed; additionally, we cooperate with a family child care facility near the institute. We also built up a cooperation with Saarland University, giving our employees access e.g. to its day care centers, online data base for babysitters or holiday camps. INM events are family-friendly scheduled and we organize a childcare service for internal events.

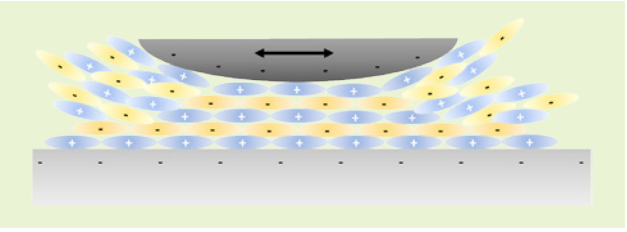
We placed another focus on caring for and nursing relatives. A member of our audit and equality team provides advice and information, such as statutory regulations or external support offers, and organized two events on this topic.

With the renewed certification, INM wants to further support its employees in creating their own work-life-balance. We will focus on two topics: the career-development for young female scientists with respect to family-issues and the balance of work and care for relatives. Recently, INM set up a laboratory without hazardous materials to allow pregnant women to work and is preparing a company agreement on "Care".

Fig. 1: Impression from INM's summer barbecue.
Fig. 2: INM's audit and equality team, consisting of the Equal Opportunities Officers and three other members from the institute.

FOCUS PROJECTS – A TOOL TO STRENGTHEN INTERNAL COOPERATION

Since 2013, INM performs an internal project competition to strengthen the cooperation between its groups. These so called Focus projects are selected for a one year funding period. In 2016 the following projects were operative:



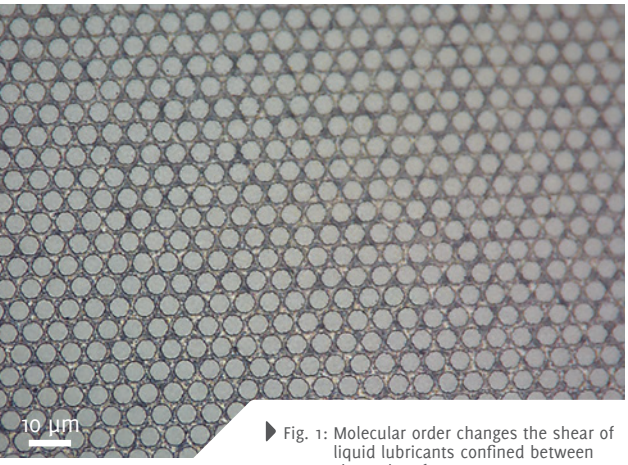


Fig. 1: Molecular order changes the shear of liquid lubricants confined between charged surfaces.
Fig. 2: Optical microscope image of photodeposited silver on a structured TiO_2 film.

LIQUID LAYER LUBRICATION
Nanotribology

In lubrication, liquids reduce friction and wear by separating sliding surfaces. In separation gaps of only few nanometers, the liquid develops a molecular layer structure which changes its load bearing capacity and its shear properties. In the project *Liquid Layer Lubrication* by the Program Division *Nanotribology* we have shown by force microscopy experiments that this phenomenon is not only found for simple model liquids but for all constituents of engine oils, such as poly-alpha olefins and esters. The results have led to projects with two industrial partners on the role of surface charges for lubrication and on additives in confined lubricants.

PROCESSABILITY OF PHOTOMETALLIZATION
Optical Materials, Structure Formation and InnovationCenter INM

In this focus project of the Program Divisions *Optical Materials and Structure Formation* with the *InnovationCenter INM* the photometallization process is used to produce transparent conductive films. Silver is photocatalytically deposited on top of a titaniumdioxide (TiO_2) layer. By doping with nitrogen and carbon we achieved a reduction of the band gap of the TiO_2. Thus, a faster deposition and the use of visible light for the silver deposition was enabled. Via a nano-imprint technique as well as by using polystyrene beads as template the doped TiO_2 layer could be structured. Transparent, conductive structures were achieved by photometallization (Fig. 2). Transparency could be improved by illumination through a mask.

IZICAP – ENERGY STORAGE POUCH CELLS

Energy Materials, Optical Materials and Nanomers

Transferring our know-how on electrode design, we scaled-up spraying and casting of carbon film electrodes with polymer binder to pouch cell level. This enables us to benchmark novel materials and electrolytes on a 100-fold larger scale than previous coin cell testing. We succeeded in adapting binders with enhanced environmental friendliness (i.e., without sulfur, chlorine, and fluorine) and established a quantitative model to correlate pore size and energy storage capacity. Our accompanying work identified certain mixtures of carbon and additives to contribute to accelerated cell aging.

GECOMER TECHNOLOGY – TRANSFER TO INDUSTRIAL APPLICATIONS

Functional Microstructures and InnovationCenter INM

Gecomer Technology is the success of a decade of research into attachment in nature. Due to the immense industrial interest, our development work focuses on application relevant topics for many industrial sectors. New polymeric materials are investigated for use in adhesive micropatterns, which are tested by accelerated durability and fatigue tests with > 100,000 pick-and-place cycles. Suitable testing devices were developed and constructed. A Quality Management (QM) system was established including Standard Operation Procedures (SOPs) for the microstructure production. The results of these studies are directly used in the design of optimized adhesives for targeted applications.

Fig. 3: INM IZIcap supercapacitor pouch cell.
Fig. 4: Endurance testing devices developed and built in this project.

FAKTEN UND ZAHLEN / FACTS AND FIGURES

DAS INM IN ZAHLEN / INM IN FIGURES

DAS INM IN ZAHLEN

Im Jahr 2016 betrug der **Gesamtumsatz** des INM 22,92 Mio. Euro.

Institutionelle Förderung (gemeinsame Finanzierung durch Bund und Länder): 18,04 Mio. €
- davon für Personal- und Sachaufwendungen: 13,8 Mio. €,
- und für Investitionen: 4,26 Mio. €

Erlöse aus Drittmittelvorhaben: 5,58 Mio. €
- davon 3,67 Mio. € aus öffentlichen Projektförderungen,
- und 1,91 Mio. € aus Vereinbarungen mit Industrieunternehmen.

Sonstige betriebliche Erträge: 0,26 Mio €

Das INM hatte zum 31.12.2016 **241 Beschäftigte** (122 m, 119 w), davon

- 74 Wissenschaftler/innen (42 m, 32 w),
- 41 Promovierende (25 m, 16 w),
- 54 Beschäftigte (28 m, 26 w) in den Bereichen Labor, Technik und Service,
- 34 Beschäftigte (8 m, 26 w) in der Verwaltung und den Sekretariaten,
- 32 Hiwis (17 m, 15 w) und 6 Auszubildende (2 m, 4 w).

INM IN FIGURES

In 2016, the **total turnover** of INM added up to 22.92 million €.

Joint financial support (by the federal government and the federal states): 18.04 million €.
- including expenses for personnel and materials: 13.8 million €,
- and for investments: 4.26 million €.

Proceeds from **third party funding:** 5.58 million €
- including 3.67 million € from public grants,
- and 1.91 million € from industrial contacts.

Other operating income: 0.26 million €

As of December 31, 2016, **241 employees** (122 m, 119 f) worked at INM including:

- 74 scientists (42 m, 32 f),
- 41 doctoral candidates (25 m, 16 f),
- 54 employees (28 m, 26 f) in the laboratories and technical services,
- 34 employees (8 m, 26 f) working in the administration and secretarial offices,
- 32 graduate assistants (17 m, 15 f) and 6 apprentices (2 m, 4 f).

m = männlich, w = weiblich / m = male, f = female

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Stand / As of: 31.12.2016

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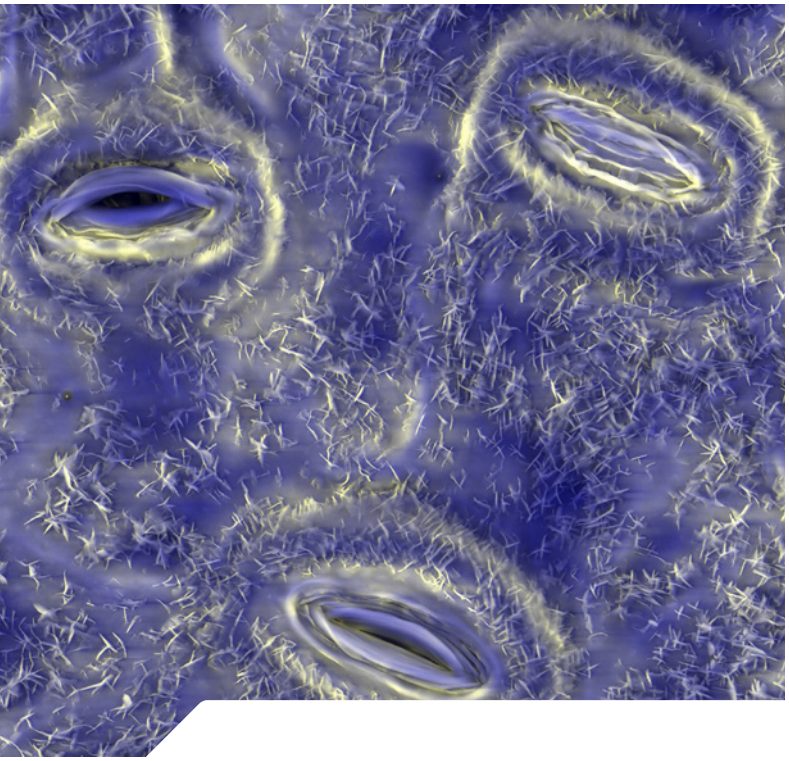
AUSZEICHNUNGEN / AWARDS



Eduard Arzt
KRICT Anniversary Lecture, Korea Research Institute of Chemical Technology, Daejon, Südkorea, 12.10.2016

Eduard Arzt
Yunchuan Aisinjioro-Soo Distinguished Lecture, University of Illinois at Urbana Champaign, Urbana Champaign, 03.11.2016

Indra Backes
Bester Masterabschluss im Fach Materialchemie, Universität des Saarlandes, Saarbrücken, 02.12.2016

Javier Diez Sierra
Saarlandstipendium, StudienStiftungSaar

Jana Fleddermann und Henrike Peuschel
Posterpreis, NanoMeetsFuture 2016, Saarbrücken, 16.09.2016

Lola Gonzáles-García
Aufnahme in das Leibniz-Mentoring-Programm, Leibniz-Gemeinschaft, Berlin

Nicolas Jäckel
DAAD-Stipendium für Doktorandinnen und Doktoranden, Deutscher Akademischer Austauschdienst, Bonn

Niels de Jonge, Frances Ross (IBM) und Chongmin Wang (Pacific Northwest National Laboratory PNNL)
MRS Innovation in Materials Characteristic Award, Materials Research Society

Niels de Jonge
European Microscopy Award, European Microscopy Society, Lyon, Frankreich, 01.09.2016

Marcus Koch
3. Preis Fotowettbewerb Nano-Bio-Momente 2016, Deutscher Verband Nanotechnologie und Netzwerk cc-NanoBioNet e. V., Saarbrücken, 16.09.2016

Tobias Kraus
Ruf auf eine W3-Professur (abgelehnt), Universität Bayreuth

Tobias Kraus
Ruf auf eine W3-Professur (angenommen), Universität des Saarlandes, Saarbrücken

Benjamin Krüner
Reisestipendium für die 1. Jahrestagung der Fachgruppe Chemie und Energie, Gesellschaft Deutscher Chemiker (GDCh)

Bin Li
Postdoctoral Fellowship, Alexander von Humboldt-Stiftung

Volker Presser
Auswahl zur „Woche der Umwelt" des Bundespräsidenten, Berlin

Julia Purtov
GradUS global Grant, Universität des Saarlandes, Saarbrücken

Marco Zeiger
Auswahl zum 66th Lindau Nobel Laureate Meeting, Lindau Nobel Laureate Meetings, Lindau

Yijun Zheng
Aufnahme in das Leibniz-Mentoring-Programm, Leibniz-Gemeinschaft, Berlin

AKTIVITÄTEN IN GREMIEN / ACTIVITIES IN COMMITTEES

Dr. Jennifer Atchison
Reviewer für Zeitschriften: *Sensors, Progress in Materials Science*

Prof. Dr. Eduard Arzt
Professor für Neue Materialien, Universität des Saarlandes, Saarbrücken

Mitglied der Nationalen Akademie der Wissenschaften Leopoldina

Korrespondierendes Mitglied der Österreichischen Akademie der Wissenschaften

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Mitglied, Wissenschaftlicher Beirat der Alfried Krupp von Bohlen und Halbach Stiftung, Essen

Mitglied, Beirat der ProcessNet Fachgruppe Nanotechnologie, DECHEMA

Mitglied, International Scientific Advisory Board (ISAB), COMET K2 Zentrum für Integrated Research in Materials, Processing and Product Engineering, Leoben

Mitglied, Doktorandenauswahlgremium, Deutsche Telekom-Stiftung, Bonn

Vorsitz, Leibniz-Netzwerk Nano, Leibniz-Gemeinschaft

Sprecher, Leibniz-Forschungsverbund Nano-Sicherheit, Leibniz-Gemeinschaft

Mitglied, Energiebeirat, Ministerium für Wirtschaft, Arbeit, Energie und Verkehr des Saarlandes

Mitglied, Advisory Board des FIT (Freiburger Zentrum für interaktive Werkstoffe und bioinspirierte Technologien), Albert-Ludwigs-Universität Freiburg

Editor-in-Chief der Reviewzeitschrift "Progress in Materials Science", Oxford, UK

Mitglied im Editorial Board / Advisory Board der Zeitschriften: *Advanced Engineering Materials, International Journal of Materials Research, Materials Science and Engineering C: Materials for Biological Applications, Journal of Surfaces and Interfaces in Materials, American Scientific Publishers*

Gutachtertätigkeit für (Auswahl): Universität Freiburg, Swiss National Science Foundation, Telekom-Stiftung, Alfried Krupp von Bohlen und Halbach-Stiftung, Alexander von Humboldt-Stiftung, BBSRC, ÖAW (Erwin-Schrödinger-Preis), DAAD, University of Pennsylvania, University of Southern California, University of Illinois, University of Cambridge

Reviewer für Zeitschriften (Auswahl): *Journal of the Royal Society Interface, Langmuir (American Chemical Society), International Journal of Materials Research, PNAS, ACS Nano*

Dr. Carsten Becker-Willinger
Vertreter des INM, caMPlusQ – Forschungscampus für Materialien, Prozesse und Qualifizierung

Mitglied im DGM-Fachausschuss „Funktionalisierung von Oberflächen mittels Mikro-/Nano-Strukturierungsverfahren"

Prof. Dr. Roland Bennewitz
Honorarprofessor, Universität des Saarlandes, Saarbrücken

Mitglied, Beirat der Evangelischen Studierendengemeinde Saarbrücken

Deutsches Mitglied, Management Committee des EU COST Network „Nanotribology"

Mitglied, Advisory Board, DFG-Graduiertenkolleg „In situ Mikroskopie mit Elektronen, Röntgenstrahlen und Rastersonden" (GRK 1896), Universität Erlangen

Mitglied im Editorial Board: *Tribology Letters*

Gutachtertätigkeit für: Deutsche Forschungsgemeinschaft, Swiss National Science Foundation, Israel Science Foundation, Netherland's Science Foundation

Reviewer für Zeitschriften: *ACS Applied Materials, Physical Review E, Beilstein Nano, Tribology letters, Nanoscale, Langmuir*

Elke Bubel
Sprecherin, Arbeitskreis Bibliotheken und Informationseinrichtungen der Leibniz-Gemeinschaft

Vorsitzende, Landesgruppe Saarland des Berufsverbandes Information Bibliothek e. V. (BIB)

Prof. Dr. Aránzazu del Campo
Professorin für Materialsynthese und Werkstoffentwicklung, Universität des Saarlandes

Mitglied im Editorial Board: *Scientific Reports*

Mentor in Mentoring Network SciMento und Mentoring Network CheMento

Deutsches Mitglied, Management Committee des EU COST Network „Bioadhesion"

Gutachtertätigkeit für: Deutsche Forschungsgemeinschaft, Alexander von Humboldt Foundation

Reviewer für Zeitschriften: *Advanced Materials, Angewandte Chemie, Nature Materials, ACS Chemical Surfaces & Interfaces, Langmuir, Biomacromolecules*

Dr. Claudia Fink-Straube
Mitglied, Netzwerk der Leibniz-Gemeinschaft zum audit berufundfamilie

Dr. Sabine Heusing
Reviewer für Zeitschriften: *Solar Energy Materials and Solar Cells*

Prof. Dr. Niels de Jonge
Honorarprofessor, Universität des Saarlandes, Saarbrücken

Mitglied im Editorial Board: *Microscopy and Microanalysis*

Member of the Advisory Board for the project on soft materials headed by Prof. A. Särkkä, Department of Mathematical Sciences, Chalmers University of Technology and University of Gothenburg, Sweden.

Gutachtertätigkeit für: Deutsche Forschungsgemeinschaft, Dutch Ministry of Economic Affairs NWO; ERC grants EU; Dutch Technology Foundation STW; The Danish Agency for Science, Technology and Innovation; National Institute of Health, USA

Reviewer für Zeitschriften: *ACS Nano, Advanced Structural and Chemical Imaging, Applied Physics Letters, Advanced Materials, Biophysical Journal, ChemComm, Journal of the American Chemical Society, Journal of Applied Physics, Journal of Biophotonics, Journal of Microscopy, Journal of Structural Biology, Journal of Visualized Experiments, Lab Chip, Langmuir, Microelectronic Engineering, Microscopy and Microanalysis, Nano Letters, Nature, Nature Communications, Nature Materials, Nature Methods, Nature Nanotechnology, Nature Reviews Materials, Optics Express, Plos One, Science, Science, Scientific Reports, Small, Ultramicroscopy*

Dr. Annette Kraegeloh
Koordinatorin, Leibniz-Forschungsverbund Nanosicherheit

Mitglied, Dechema-Arbeitskreis „Responsible Production and Use of Nanomaterials“

Mitglied, NanoPharm ZIM Netzwerk des NanoBionet

Reviewer für Zeitschriften: *Nature Communications, Nature Nanotechnology, Nanomedicine by Future Medicine, Journal of Biomaterials Applications, Journal of Nanomedicine and Nanotechnology*

Prof. Dr. Tobias Kraus
Professor für Kolloid- und Grenzflächenchemie, Universität des Saarlandes, Saarbrücken

Guest Editor, *Physica Status Solidi*

Gutachtertätigkeiten für: Deutsche Forschungsgemeinschaft, ETH Zürich, The Australia & Pacific Science Foundation, Baden-Württemberg Stiftung GmbH

Reviewer für Zeitschriften: *Langmuir, Advanced Materials, ACS Nano, Nanoscale, Nanotechnology, Journal of Physical Chemistry C, Physical Chemistry Chemical Physics, ACS Applied Materials & Interfaces, RSC Advances, Chemistry of Materials, Biomaterials, Coatings, Journal of Colloid and Interfacial Science, RSC Chemical Science, Colloid and Polymer Science, Materials*

Dr. Thomas Müller
Reviewer für Zeitschriften: *Journal of Sol-Gel Science and Technology*

Dr. Peter W. de Oliveira
Gutachtertätigkeit: Deutsche Forschungsgemeinschaft, INCT – Institutos Nacionais de Ciência e Teconologia, Brasilien

Prof. Dr. Volker Presser
Professor für Energie-Materialien, Universität des Saarlandes, Saarbrücken

Mitglied, Feodor Lynen Auswahlgremium, Alexander von Humboldt-Stiftung

Gutachtertätigkeit für: Alexander von Humboldt-Stiftung, Hessisches Ministerium für Wissenschaft und Kunst, Deutscher Akademischer Austauschdienst, US Department of Energy, Deutsche Bundesstiftung Umwelt, European Research Council, South African National Research Foundation, University of Twente

Reviewer für Zeitschriften: *ACS Applied Materials & Interfaces, ACS Nano, Advanced Energy Materials, Advanced Materials Interfaces, AIP Advances, Angewandte Chemie – International Edition, Applied Surface Science, Carbon, ChemElectroChem, ChemSusChem, Desalination, Desalination and Water Treatment, Electrochemistry Communications, Electrochimica Acta, Energy and Environmental Science, Environmental Science: Water Research & Technology, Environmental Science & Technology Letters, Journal of Applied Electrochemistry, Journal of Materials Chemistry A, Journal of Power Sources, Materials Chemistry and Physics, Nano Energy, Nature Communications, Nature Nanotechnology, NPG Asia Materials, Scientific Reports, Separation and Purification Technology, Water Research*

Dr. Mario Quilitz
Koordinator, Leibniz-Netzwerk Nano

Reviewer für Zeitschriften: *Materials Chemistry and Physics, Solid State Ionics*

Dr. Yuliya Silina
Reviewer für Zeitschriften: *Nanomaterials, Analytical Chemistry, Current Analytical Chemistry, Journal Current Radiopharmaceuticals (CRP), Journal of Analytical Atomic Spectrometry (JAAS)*

Günter Weber
Mitglied, Kuratorium der Elterninitiative krebskranker Kinder im Saarland e. V., Homburg

PD Dr. habil. Ingrid Weiss
Privat-Dozentin für Biochemie, Universität Regensburg

Stellvertretende Leiterin, Arbeitskreis „Vom Gen zum Material“ im Fachausschuss „Bioinspirierte & Interaktive Materialien“, Deutsche Gesellschaft für Materialkunde (DGM)

Advisory Board Member, EPSRC – Engineering and Physical Sciences Research Council, UK

Gutachtertätigkeit für: DoE / Department of Energy, EPSRC (UK), NSF

Reviewer für Zeitschriften: *Adv Healthcare Mat, ChemBioChem, Colloids and Surfaces A: Physicochemical and Engineering Aspects, FEBS Journal, Journal of Structural Biology, Marine Biotechnology*

Marco Zeiger
Reviewer für Zeitschriften: *Carbon*

DISSERTATIONEN / DOCTORAL THESES

Balijepalli, Ramgopal
Numerical Analysis of Interfacial Stress Distributions and Adhesion Behavior of Fibrillar Surfaces
Universität des Saarlandes, Saarbrücken,
Prof. Dr. E. Arzt

Blass, Johanna
Dynamic adhesion and friction mediated by supramolecular bonds
Universität des Saarlandes, Saarbrücken,
Prof. Dr. R. Bennewitz

Frensemeier, Mareike
Switchable Microtopographies based on the Two-Way Shape Memory Effect in Nickel-Titanium Alloys
Universität des Saarlandes, Saarbrücken,
Prof. Dr. E. Arzt

Gerstner, Dominik
Ligand Influence on Nanoparticle Agglomeration in Flow
Universität des Saarlandes, Saarbrücken,
Prof. Dr. E. Arzt

Bauer, Christina
Preparation and Characterization of Hierarchical Patterned Adhesives
Universität des Saarlandes, Saarbrücken,
Prof. Dr. E. Arzt

Torrents Abad, Oscar
Size effects in small-scale structures of body-centered cubic of small-scale metal structures
Universität des Saarlandes, Saarbrücken,
Prof. Dr. E. Arzt

ABSCHLUSSARBEITEN / THESES

BACHELORARBEITEN / BACHELOR THESES

Faust, Stefanie
Geometrie von Geckostrukturen
Hochschule Kaiserslautern, Kaiserslautern
Prof. Dr. M. K. Baller, Prof. Dr. E. Arzt

Krämer, Kevin
Performance evaluation of supercapacitors employing nanoporous carbon materials
Universität des Saarlandes, Saarbrücken
Prof. Dr. V. Presser

Wühr, Christian
Herstellung von Neutraldichtefilter mit dem Sol-Gel Prozess
Hochschule Kaiserslautern, Kaiserslautern
Prof. Dr. R. Burk, Prof. Dr. G. Grun,
Dr. M. H. Jilavi

MASTERARBEITEN / MASTER THESES

Backes, Indra
Large area nanoimprint of ultrathin gold nanowires
Universität des Saarlandes, Saarbrücken
Prof. Dr. G. Kickelbick, Dr. T. Kraus

Bareiro Ferreira, Oscar
Development of coated acoustic sensors for the structural health monitoring of structures using guided waves
Universität des Saarlandes, Saarbrücken
Prof. Dr. C. Boller, Dr. J. Adam

Díez Sierra, Javier
Heteroatom-doped carbon onions and their use in supercapacitors
Universität des Saarlandes, Saarbrücken
Prof. Dr. V. Presser

Emmerich, Franziska
Adhäsion und Reibung an polymer-funkionalisierten Oberflächen
Universität des Saarlandes, Saarbrücken
Prof. Dr. R. Bennewitz

Engel, Jona
Aligning Gold Nanorods
Universität des Saarlandes, Saarbrücken
Prof. Dr. R. Birringer, Dr. T. Kraus

Engel, Philipp
Development of a detachment testing method for cells with AFM
Universität des Saarlandes, Saarbrücken
Prof. Dr. E. Arzt

Fleischmann, Simon
Atomic layer deposition of vanadium oxide on carbon substrates for hybrid energy storage devices
Universität des Saarlandes, Saarbrücken
Prof. Dr. V. Presser

Groß, Katja
Untersuchung adhäsiver Eigenschaften von dreidimensionalen, mikroskopischen Saugnapfstukturen in Abhängigkeit von Geometrie und Material
Universität des Saarlandes, Saarbrücken
Prof. Dr. E. Arzt

Hubertus, Jonas
Embedding a temperature sensitive dispersion into a solid
Universität des Saarlandes, Saarbrücken
PD Dr. G. Falk, Dr. T. Kraus

Meyer, Lars-Arne
Agglomeration behavior of aqueous PEG and ß-CD coated gold nanoparticle dispersions
Universität des Saarlandes, Saarbrücken
Prof. Dr. G. Wenz, Dr. T. Kraus

Müller, Anke
Analyse und Optimierung des Sinterverfahrens zur Herstellung poröser Dämpferkörper aus UHMW-PE
Universität des Saarlandes, Saarbrücken
Prof. Dr. E. Arzt

Schmitz, Carmen
Multi-Walled Carbon Nanotubes – In Vitro Toxicity and Correlative Microscopy
Hochschule Kaiserslautern, Kaiserslautern
Prof. Dr. K.-H. Schäfer, Dr. A. Kraegeloh

Simic, Dino
Bestimmung der lokalen mechanischen Eigenschaften von Polymeren mittels Nanoindentation
Universität des Saarlandes, Saarbrücken
Prof. Dr. R. Bennewitz

DOKTORANDEN / DOCTORAL STUDENTS

Ali, Awadelkareem, Prof. Dr. Dr. h.c. M. Veith, Universität des Saarlandes
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Farrukh, Aleeza, Prof. Dr. A. del Campo
Feng, Jun, Prof. Dr. A. del Campo
Fischer, Sarah, Prof. Dr. E. Arzt
Fleischmann, Simon, Prof. Dr. V. Presser
Hegetschweiler, Andreas, Prof. Dr. E. Arzt
Jäckel, Nicolas, Prof. Dr. V. Presser
Jiang, Qiyang, Prof. Dr. A. del Campo
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Kister, Thomas, Prof. Dr. E. Arzt
Krämer, Günther, Prof. Dr. R. Bennewitz
Kümper, Alexander, PD Dr. K. Unfried, Universität Düsseldorf
Kunnas, Peter, Prof. Dr. N. de Jonge
Lee, Juhan, Prof. Dr. V. Presser
Ma, Haoran, Prof. Dr. R. Bennewitz
Maurer, Johannes, Prof. Dr. R. Bennewitz
Özgün, Novaf, Prof. Dr. Dr. D. J. Strauss, Universität des Saarlandes / HTW Saar
Purtov, Julia, Prof. Dr. E. Arzt
Reiser, Beate, Prof. Dr. E. Arzt
Rittgen, Kai, Prof. Dr. R. Bennewitz
Srimuk, Pattarachai, Prof. Dr. V. Presser
Staudt, Jana, Prof. Dr. E. Arzt
Támara Florez, Juan Carlos, Prof. Dr. G. Kickelbick, Universität des Saarlandes
Tinnemann, Verena, Prof. Dr. E. Arzt
Tolosa Rodriguez, Aura Monserrat, Prof. Dr. V. Presser
Ustahüseyin, Oya, Prof. Dr. A. del Campo
Villiou, Maria, Prof. Dr. A. del Campo
Welck, Jennifer, Prof. Dr. A. Kiemer, Universität des Saarlandes
Xiong, Xinhong, Prof. Dr. A. del Campo
Xue, Lulu, Prof. Dr. A. del Campo
Zeiger, Marco, Prof. Dr. V. Presser
Zhang, Jingnang, Prof. Dr. A. del Campo
Zhao, Shifang, Prof. Dr. A. del Campo
Zhou, Xiaozhuang, Prof. Dr. A. del Campo

GASTAUFENTHALTE / VISITING SCIENTISTS AND STUDENTS

Alcantar, Samuel Benjamin, USA
Altube, Dr. Ainhoa, Spanien
Busom Descarrega, Josep, Spanien
Choi, Hyeongseon, Südkorea
Díez Sierra, Javier Àlvaro, Spanien
Edongue, Dr. Hervais, Kamerun
Kaasik, Friedrich, Estland
Kim, Daekyu, Südkorea
Kim, Geun, Südkorea
Kim, Jun Min, Südkorea
Li, Dr. Bin, China
Lin, Hei Tung, Portugal
Ma, Guoqiang, China
Massuti-Ballester, Pau, Spanien
Moreira Lana, Gabriela, Brasilien
Piché, Dominique, Großbritannien
Prada, Gabriela, Brasilien
Ries, Lucie, Frankreich
Rivera, Dr. Angel, Spanien
Schlossberg, Sarah Mae, USA
Sethuraman, Sathyamoorthi, Indien
Tekeli, Mehmet Can, Türkei
Zhao, Dr. Huaixia, China

REFERIERTE PUBLIKATIONEN / PEER-REVIEWED PUBLICATIONS

Im Jahr 2016 wurden insgesamt 144 Publikationen veröffentlicht, davon 110 Publikationen in referierten Zeitschriften und 34 sonstige Publikationen. (Stand: 31.03.2017) Eine Liste aller Publikationen finden Sie unter http://www.leibniz-inm.de/publikationen

In 2016, 144 publications were published, including 110 publications in peer-reviewed journals and 34 other publications. (As of 31.03.2017) A list of all publications are available on our website http://www.leibniz-inm.de/en/publications

GRENZFLÄCHENMATERIALIEN / INTERFACE MATERIALS

Energie-Materalien / Energy Materials

M. Aslan, M. Zeiger, N. Jäckel, I. Grobelsek, D. Weingarth and V. Presser
Improved capacitive deionization performance of mixed hydrophobic/hydrophilic activated carbon electrodes
J Phys: Condens Matter 2016, 28, (11), 114003 [02.209 (2015)]
doi:10.1088/0953-8984/28/11/114003

J. Busom, A. Schreiber, A. Tolosa, N. Jäckel, I. Grobelsek, N. J. Peter and V. Presser
Sputtering of sub-micrometer aluminum layers as compact, high-performance, light-weight current collector for supercapacitors
J Power Sources 2016, 329, 432-440 [06.333 (2015)]
doi:10.1016/j.jpowsour.2016.08.084

S. Fleischmann, N. Jäckel, M. Zeiger, B. Krüner, I. Grobelsek, P. Formanek, S. Choudhury, D. Weingarth and V. Presser
Enhanced electrochemical energy storage by nanoscopic decoration of endohedral and exohedral carbon with vanadium oxide via atomic layer deposition
Chem Mater 2016, 28, (8), 2802-2813 [09.407 (2015)]
doi:10.1021/acs.chemmater.6b00738

N. Jäckel, B. Krüner, K. L. Van Aken, M. Alhabeb, B. Anasori, F. Kaasik, Y. Gogotsi and V. Presser
Electrochemical in Situ Tracking of Volumetric Changes in Two-Dimensional Metal Carbides (MXenes) in Ionic Liquids
ACS Appl Mater Inter 2016, 8, (47), 32089-32093 [07.145 (2015)]
doi:10.1021/acsami.6b11744

N. Jäckel, M. Rodner, A. Schreiber, J. Jeongwook, M. Zeiger, M. Aslan, D. Weingarth and V. Presser
Anomalous or regular capacitance? The influence of pore size dispersity on double-layer formation
J Power Sources 2016, 326, 660-671 [06.333 (2015)]
doi:10.1016/j.jpowsour.2016.03.015

N. Jäckel, P. Simon, Y. Gogotsi and V. Presser
Increase in Capacitance by Subnanometer Pores in Carbon
ACS Energy Lett 2016, 1, (6), 1262-1265 [-]
doi:10.1021/acsenergylett.6b00516

N. Jäckel, D. Weingarth, A. Schreiber, B. Krüner, M. Zeiger, A. Tolosa, M. Aslan and V. Presser
Performance evaluation of conductive additives for activated carbon supercapacitors in organic electrolyte
Electrochim Acta 2016, 191, 284-298 [04.803 (2015)]
doi:10.1016/j.electacta.2016.01.065

B. Krüner, J. Lee, N. Jäckel, A. Tolosa and V. Presser
Sub-micrometer novolac-derived carbon beads for high performance supercapacitors and redox electrolyte energy storage
ACS Appl Mater Inter 2016, 8, (14), 9104-9115 [07.145 (2015)]
doi:10.1021/acsami.6b00669

J. Lee, S. Choudhury, D. Weingarth, D. Kim and V. Presser
High Performance Hybrid Energy Storage with Potassium Ferricyanide Redox Electrolyte
ACS Appl Mater Inter 2016, 8, 23676-23687, S1-S7 [07.145 (2015)]
doi:10.1021/acsami.6b06264

J. Lee, N. Jäckel, D. Kim, M. Widmaier, S. Sathyamoorthi, P. Srimuk, C. Kim, S. Fleischmann, M. Zeiger and V. Presser
Porous carbon as a quasi-reference electrode in aqueous electrolytes
Electrochim Acta 2016, 222, 1800-1805 [04.803 (2015)]
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J. Lee, B. Krüner, A. Tolosa, S. Sathyamoorthi, D. Kim, S. Choudhury, K.-H. Seo and V. Presser
Tin/vanadium redox electrolyte for battery-like energy storage capacity combined with supercapacitor-like power handling
Energy Environ Sci 2016, 9, (11), 3392-3398 [25.427 (2015)]
doi:10.1039/c6ee00712k

J. Lee, D. Weingarth, I. Grobelsek and V. Presser
Use of surfactants for continuous operation of aqueous electrochemical flow capacitors
Energy Technol 2016, 4, (1), 75-84 [02.483 (2015)]
doi:10.1002/ente.201500243

M. D. Levi, L. Daikhin, D. Aurbach and V. Presser
Quartz Crystal Microbalance with Dissipation Monitoring (EQCM-D) for in-situ studies of electrodes for supercapacitors and batteries: A mini-review
Electrochem Commun 2016, 67, 16-21 [04.569 (2015)]
doi:10.1016/j.elecom.2016.03.006

S. Porada, G. Feng, M. E. Suss and V. Presser
Capacitive deionization in organic solutions: case study using propylene carbonate
RSC Adv 2016, 6, (7), 5865-5870 [03.289 (2015)]
doi:10.1039/c5ra20786j

N. Shpigel, M. D. Levi, S. Sigalov, D. Aurbach, L. Daikhin and V. Presser
Novel in situ multiharmonic EQCM-D approach to characterize complex carbon pore architectures for capacitive deionization of brackish water

J Phys: Condens Matter 2016, 28, (11), 114001 [02.209 (2015)]
doi:10.1088/0953-8984/28/11/114001

N. Shpigel, M. D. Levi, S. Sigalov, O. Girshevitz, D. Aurbach, L. Daikhin, P. Pikma, M. Marandi, A. Jänes, E. Lust, N. Jäckel and V. Presser
In situ hydrodynamic spectroscopy for structure characterization of porous energy storage electrodes
Nat Mater 2016, 15, (5), 570-575 [38.891 (2015)]
doi:10.1038/nmat4577

N. Souza, F. Lasserre, A. Blickley, M. Zeiger, S. Suarez, M. Duarte, V. Presser and F. Muecklich
Upcycling spent petroleum cracking catalyst: pulsed laser deposition of single-wall carbon nanotubes and silica nanowires
RSC Adv 2016, 6, (76), 72596-72606 [03.289 (2015)]
doi:10.1039/c6ra15479d

P. Srimuk, F. Kaasik, B. Kruner, A. Tolosa, S. Fleischmann, N. Jackel, M. C. Tekeli, M. Aslan, M. E. Suss and V. Presser
MXene as a novel intercalation-type pseudocapacitive cathode and anode for capacitive deionization
J Mater Chem A 2016, 4, (47), 18265-18271 [08.262 (2015)]
doi:10.1039/c6ta07833h

P. Srimuk, L. Ries, M. Zeiger, S. Fleischmann, N. Jackel, A. Tolosa, B. Kruner, M. Aslan and V. Presser
High performance stability of titania decorated carbon for desalination with capacitive deionization in oxygenated water
RSC Adv 2016, 6, (108), 106081-106089 [03.289 (2015)]
doi:10.1039/c6ra22800c

A. Tolosa, B. Kruner, S. Fleischmann, N. Jäckel, M. Zeiger, M. Aslan, I. Grobelsek and V. Presser
Niobium carbide nanofibers as a versatile precursor for high power supercapacitor and high energy battery electrodes
J Mater Chem A 2016, 4, (41), 16003-16016 [08.262 (2015)]
doi:10.1039/c6ta06224e

A. Tolosa, B. Krüner, N. Jäckel, M. Aslan, C. Vakifahmetoglu and V. Presser
Electrospinning and electrospraying of silicon oxycarbide-derived nanoporous carbon for supercapacitor electrodes
J Power Sources 2016, 313, 178-188 [06.333 (2015)]
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M. Widmaier, B. Krüner, N. Jäckel, M. Aslan, S. Fleischmann, C. Engel and V. Presser
Carbon as Quasi-Reference Electrode in Unconventional Lithium-Salt Containing Electrolytes for Hybrid Battery/Supercapacitor Devices
J Electrochem Soc 2016, 163, (14), A2956-A2964 [03.014 (2015)]
doi:10.1149/2.0421614jes

M. Zeiger, T. Ariyanto, B. Kruner, N. J. Peter, S. Fleischmann, B. J. M. Etzold and V. Presser
Vanadium pentoxide/carbide-derived carbon core-shell hybrid particles for high performance electrochemical energy storage
J Mater Chem A 2016, 4, (48), 18899-18909 [08.262 (2015)]
doi:10.1039/c6ta08900c

M. Zeiger, S. Fleischmann, B. Kruner, A. Tolosa, S. Bechtel, M. Baltes, A. Schreiber, R. Moroni, S. Vierrath, S. Thiele and V. Presser
Influence of carbon substrate on the electrochemical performance of carbon/manganese oxide hybrids in aqueous and organic electrolytes
RSC Adv 2016, 6, (109), 107163-107179 [03.289 (2015)]
doi:10.1039/c6ra24181f

M. Zeiger, N. Jäckel, V. N. Mochalin and V. Presser
Review: Carbon onions for electrochemical energy storage
J Mater Chem A 2016, 4, (9), 3172-3196 [08.262 (2015)]
doi:10.1039/C5TA08295A

Funktionelle Mikrostrukturen / Functional Microstructures

R. Balijepalli, M. R. Begley, N. A. Fleck, R. M. McMeeking and E. Arzt
Numerical simulation of the edge stress singularity and the adhesion strength for compliant mushroom fibrils adhered to rigid substrates
Int J Solids Struct 2016, 85-86, 160-171 [02.081 (2015)]
doi:10.1016/j.ijsolstr.2016.02.018

V. Barreau, R. Hensel, N. K. Guimard, A. Ghatak, R. M. McMeeking and E. Arzt
Fibrillar elastomeric micropatterns create tunable adhesion even to rough surfaces
Adv Funct Mater 2016, 26, (26), 4687-4694 [11.382 (2015)]
doi:10.1002/adfm.201600652

S. A. Brinckmann, M. Frensemeier, C. M. Laursen, H. J. Maier, D. Britz, A. S. Schneider, F. Mücklich and C. P. Frick
Effect of indentation temperature on nickel-titanium indentation-induced two-way shape-memory surfaces
Mat Sci Eng A 2016, 675, 253-261 [02.647 (2015)]
doi:10.1016/j.msea.2016.08.036

D. Brodoceanu, C. T. Bauer, E. Kroner, E. Arzt and T. Kraus
Hierarchical bioinspired adhesive surfaces—a review
Bioinspiration & Biomimetics 2016, 11, (5), 051001 [02.891 (2015)]
doi:10.1088/1748-3190/11/5/051001

Y. Cui, O. Torrents Abad, F. Wang, P. Huang, T.-J. Lu, K.-W. Xu and J. Wang
Plastic deformation modes of CuZr/Cu multilayers
Sci Rep 2016, 6, 23306 [05.228 (2015)]
doi:10.1038/srep23306

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BIOGRENZFLÄCHEN / BIO INTERFACES

Biomineralisation / Biomineralization

M. Eder, M. Koch, C. Muth, A. Rutz and I. M. Weiss
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A. A. Ali, V. Huch, C. Aktas and M. Veith
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NANOKOMPOSIT-MATERIALIEN / NANOCOMPOSITE MATERIALS

Optische Materialien / Optical Materials

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QUERSCHNITTSBEREICHE / CROSS LINKING ACTIVITIES

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InnovationsZentrum INM / InnovationCenter INM

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Modellierung/Simulation / Modelling/Simulation

M. Bacca, J. A. Booth, K. L. Turner and R. M. McMeeking
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PROGRAMMBEREICHSUNGEBUNDEN / NOT LINKED TO A PROGRAM DIVISION

Chemische Analytik / Chemical Analytics

C. T. T. Le, T. Brumbarova, R. Ivanov, C. Stoof, E. Weber, J. Mohrbacher, C. Fink-Straube and P. Bauer
Zinc finger of arabidopsis thaliana12 (ZAT12) interacts with fer-like iron deficiency-induced transcription factor (FIT) linking iron deficiency and oxidative stress responses
Plant Physiol 2016, 170, (1), 540-557 [06.280 (2015)]
doi:10.1104/pp.15.01589

H. Peuschel, T. Ruckelshausen, S. Kiefer, Y. E. Silina and A. Kraegeloh
Penetration of CdSe/ZnS quantum dots into differentiated vs undifferentiated Caco-2 cells
J Nanobiotechnol 2016, 14, (1), Art. no 70 [04.240 (2015)]
doi:10.1186/s12951-016-0222-9

Y. E. Silina, C. Fink-Straube, R. G. Hanselmann, H. Peuschel and D. A. Volmer
p-Coumaric acid, a novel and effective biomarker for quantifying hypoxic stress by HILIC-ESI-MS
J Chromatogr B 2016, 1020, 6-13 [02.687 (2015)]
doi:10.1016/j.jchromb.2016.03.005

Y. E. Silina, T. A. Kychmenko and M. Koch
Nanoporous anodic aluminum oxide films for UV/vis detection of noble and non-noble metals
Anal Methods 2016, 8, (1), 45-51 [01.915 (2015)]
doi:10.1039/c5ay02498f

Y. E. Silina, J. Welck, A. Kraegeloh, M. Koch and C. Fink-Straube
Interactions between DPPC as a component of lung surfactant and amorphous silica nanoparticles investigated by HILIC-ESI–MS
J Chromatogr B 2016, 1029–1030, 222-229 [02.687 (2015)]
doi:10.1016/j.jchromb.2016.07.014

W. Wu, R. M. Guijt, Y. E. Silina, M. Koch and A. Manz
Plant leaves as templates for soft lithography
RSC Adv 2016, 6, (27), 22469-22475 [03.289 (2015)]
doi:10.1039/c5ra25890a

Physikalische Analytik / Physical Analytics

M. Eder, M. Koch, C. Muth, A. Rutz and I. M. Weiss
In vivo modified organic matrix for testing biomineralization-related protein functions in differentiated Dictyostelium on calcite
J Struc Biol 2016, 196, (2), 85-97 [02.570 (2015)]
doi:10.1016/j.jsb.2016.03.015

S.H. Mousavi, T.S. Müller, R. Karos, P.W. de Oliveira
Faster synthesis of CIGS nanoparticles using a modified solvothermal method
J Alloy Comp 2016, 659, 178-183 [03.014 (2015)]
doi:10.1016/j.jallcom.2015.10.261

S. Shafaei, D. Van Opdenbosch, T. Fey, M. Koch, T. Kraus, J. P. Guggenbichle and C. Zollfrank
Enhancement of the antimicrobial properties of orthorhombic molybdenum trioxide by thermal induced fracturing of the hydrates
Mat Sci Eng C 2016, 58, 1064-1070 [03.420 (2015)]
doi:10.1016/j.msec.2015.09.069

Y. E. Silina, T. A. Kychmenko and M. Koch
Nanoporous anodic aluminum oxide films for UV/ vis detection of noble and non-noble metals
Anal Methods 2016, 8, (1), 45-51 [01.915 (2015)]
doi:10.1039/c5ay02498f

Y. E. Silina, J. Welck, A. Kraegeloh, M. Koch and C. Fink-Straube
Interactions between DPPC as a component of lung surfactant and amorphous silica nanoparticles investigated by HILIC-ESI–MS
J Chromatogr B 2016, 1029–1030, 222-229 [02.687 (2015)]
doi:10.1016/j.jchromb.2016.07.014

W. Wu, R. M. Guijt, Y. E. Silina, M. Koch and A. Manz
Plant leaves as templates for soft lithography
RSC Adv 2016, 6, (27), 22469-22475 [03.289 (2015)]
doi:10.1039/c5ra25890a

INM Fellows und Weitere / INM Fellows and others

M. Albrecht, L. Lin and A. K. Schlarb
Experimental investigation, modeling and simulation of the deformation behavior of vibration welded nanocomposites
Zeitschrift Kunststofftechnik/Journal of Plastics Technology~ 2016, 2016, (3), 184-204 [-]
doi:10.3139/o999.03032016

L. Lin and A. K. Schlarb
Effect of the varied load conditions on the tribological performance and the thermal characteristics of PEEK-based hybrid composites
Tribol Int 2016, 101, 218-225 [02.259 (2015)]
doi:10.1016/j.triboint.2016.04.025

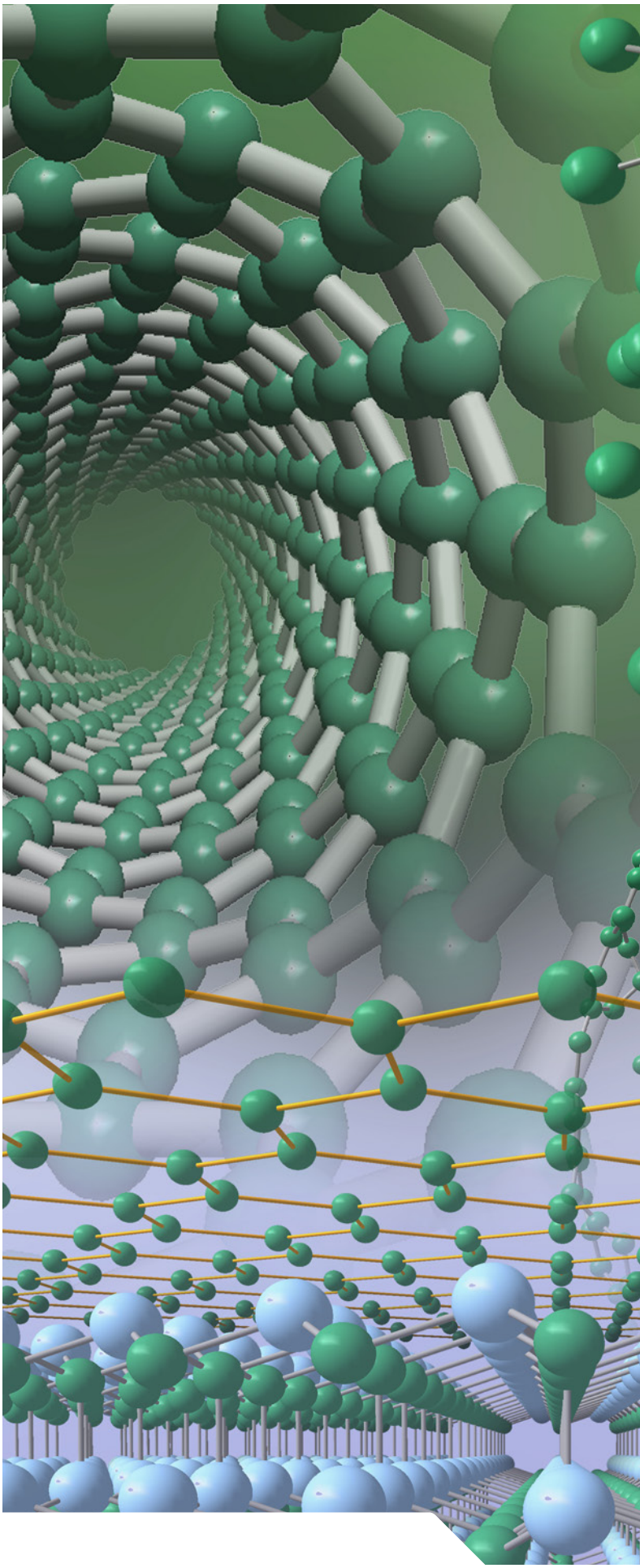
L. Lin and A. K. Schlarb
Improved weld strength of vibration welded polyoxymethylene/multiwalled carbon nanotubes hybrid nanocomposites
Polym Eng Sci 2016, 56, (6), 636-642 [01.719 (2015)]
doi:10.1002/pen.24289

J. D. McGraw, T. S. Chan, S. Maurer, T. Salez, M. Benzaquen, E. Raphaël, M. Brinkmann and K. Jacobs
Slip-mediated dewetting of polymer microdroplets
P Natl Acad Sci USA 2016, 113, (5), 1168-1173 [09.423 (2015)]
doi:10.1073/pnas.1513565113

Z. Mortezapouraghdam, R. C. Wilson, L. Schwabe and D. J. Strauss
Bayesian modeling of the dynamics of phase modulations and their application to auditory event related potentials at different loudness scales
Front Comput Neurosci 2016, 10, Article 2 [02.653 (2015)]
doi:10.3389/fncom.2016.00002

N. Müller, C. Heinrich, K. Abersfelder and G. Kickelbick
Janus-Partikel
Chem Unserer Zeit 2016, 50, (6), 392-399 [0.258 (2015)]
doi:10.1002/ciuz.201600730

B. Suksut and A. K. Schlarb
Influence of TiO_2 nanoparticles on nonisothermal crystallization of PP in a wide range of cooling rates analyzed by fast scanning DSC
J Appl Polym Sci 2016, 133, (37), 43944 [01.866 (2015)]
doi:10.1002/app.43944



EINGELADENE VORTRÄGE / INVITED TALKS

Im Jahr 2016 wurden insgesamt 256 Vorträge gehalten, davon 91 eingeladene wissenschaftliche Vorträge und 165 sonstige Vorträge. Eine Liste aller Vorträge finden Sie unter http://www.leibniz-inm.de/publikationen

In 2016, 256 talks were given, including 91 invited talks and 165 other talks. A list of all talks are available on our website http://www.leibniz-inm.de/en/publications

GRENZFLÄCHENMATERIALIEN / INTERFACE MATERIALS

Energie-Materialien / Energy Materials

S. Choudhury, M. Stamm, L. Ionov and V. Presser
Litium-sulfur batteries: an emerging energy technology towards the smart car concept
January 4, 2016; Indian Institute of Technology Kharagpur (IIT Kharagpur) <Kharagpur, India>

N. Jäckel, M. Zeiger, D. Weingarth and V. Presser
Nanodiamond-derivced carbon onions as conductive additive and active electrode material for double layer capacitors
Spring meeting of the Materials Research Society (MRS); March 28 - April 01, 2016; Phoenix <AZ, USA>

J. Lee and V. Presser
Performance and optimization of a flow capacitor with surfactants under continuous flow operation
Workshop on Interfaces and Fluid Electrodes: New Condeptual Explorations; February 26, 2016; Barcelona <Spain>

C. Prehal, C. Koczwara, R. T. Lechner, H. Amenitsch, V. Presser and O. Paris
In-operando SAXS for energy applications
ICTP - SAXS on nanosystems: current trends and perspectives; October 10-12, 2016; Trieste <Italy>

V. Presser
Nanoporous carbons and double-layer capacitance: a dynamic duo to store and generate energy and to clean water
Friedrich Schiller University; January 21, 2016; Jena <Germany>

V. Presser
Capacitive deionization – an emerging water treatment technology
Montanunversität Leoben <Leoben, Austria>; March 1, 2016;

V. Presser
Capacitive deinoization - an emerging water treatment technology
April 8, 2016; Wacker Chemie AG <Burghausen, Germany>

V. Presser
Redox-enabling supercapacitors for high performance energy storage
April 28, 2016; Max Planck Institute of Colloids and Interfaces <Potsdam, Germany>

V. Presser
Redox-enabling supercapacitors for high performance energy storage
July 20, 2016; INP - Leibniz Institute for Plasma Science and Technology <Greifswald, Germany>

V. Presser
Design of capacitive nanoporous carbon electrods for water desalination via capacitive deionization
67th Annual Meeting of the International Society of Electrochemistry (ISE); August 21-26, 2016; The Hague <NL>

V. Presser
Carbons – Energy Storage – Sustainability
October 6, 2016; Justus Liebig University <Gießen, Germany>

A. Tolosa, M. Zeiger, N. Jäckel and V. Presser
Electrospinning of supercapacitor and hybrid energy storage electrodes
Electrospinning for Energy Conference (ELEN2016); June 22-24, 2016; Montpellier <France>

M. Zeiger, N. Jäckel and V. Presser
Spicy energy storage: electrochemical applications of nanodiamond-derived carbon onions
Spring meeting of the Materials Research Society (RS); March 28 - April 1, 2016; Phoenix <AZ, USA>

M. Zeiger, J. Lee, N. Jäckel and V. Presser
Beyond the double layer: advanced supercapacitors and redox hybrids for electrochemical energy storage
Spring Meeting Arbeitskreis Kohlenstoff (AKK) of the German Ceramic Society (DGK); April 25-26, 2016; Meitingen <Germany>

Funktionelle Mikrostrukturen / Functional Microstructures

E. Arzt
Antrieb und Haftung: Podiumsdiskussion
Spark Nights by Audi; Audi City Lab
January 21, 2016; Berlin <Germany>

E. Arzt
Microstructure to modulate adhesion: from science to product
IUTAM Symposium on Filling Gaps in Material Property Space; Cambridge University
March 13-16, 2016; Cambridge <UK>

E. Arzt
Bioinspird patterned adhesives: from science to product development
MRS Spring Meeting
March 30, 2016; Phoenix <AZ, USA>

E. Arzt
Engineering of bioinspired functional surfaces
Stanford University, Department of mechanical Engineering
April 19, 2016; Stanford <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
Stanford University, Department of Materials, Science and Engineering
April 21, 2016; Stanford <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
Amazon Lab 126
April 26, 2016; Sunnyvale <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
Apple Inc.
April 28, 2016; Cupertino <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
University of California, Department of Mechanical and Aerospace Engineering
May 17, 2016; Santa Barbara <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
University of California, Department of Engineering Materials
May 18, 2016; Santa Barbara <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
University of California, Materials Department, College of Engineering
May 19, 2016; Santa Barbara <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
University of California, Mechanics of microscale Systems Lab
May 19, 2016; Santa Barbara <CA, USA>

E. Arzt
Engineering of bioinspired functional surfaces
Thermec, Inaugural Distinguished Plenary Lecture;
May 30, 2016; Graz <Austria>

E. Arzt
Bioinspired patterned surfaces: simulation-guided development of new functionalities
Yunchuan Aisinjioro-Soo Distinguished Lecture; University of Illinois
November 3, 2016; Champaign <IL, USA>

E. Arzt
Bioinspired surfaces – from science to application
12th IPF Colloquium; IPF Leibniz-Institut für Polymerforschung e. V.
November 10, 2016; Dresden <Germany>

R. Hensel
Engineering of biomimetic adhesives
Nanobrücken 2016: A Nanomechanical Testing Workshop & Hysitron User Meeting
March 02-04, 2016; Saarbrücken <Germany>

R. Hensel, K. Moh and E. Arzt
Innovative Greifsysteme auf Basis schaltbarer Oberflächen, 38. Ulmer Gespräch
May 13, 2016; Neu-Ulm <Germany>

NANOTRIBOLOGIE / NANOTRIBOLOGY

R. Bennewitz
The surface science of friction: how molecular films affect sliding and plowing, DPG Spring Meeting
March 7-11, 2016; Regensburg <Germany>

R. Bennewitz
Molecular mechanisms in lubrication
Seminar talk, Department of Physics; McGill University
July 4, 2016; Montreal <Quebec, Canada>

R. Bennewitz
Molecular control of friction
University of Toronto / Department of Mechanical and Industrial Engineering
July 05, 2016; Toronto <Ontario, Canada>

R. Bennewitz
Observing molecules at charged surfaces - force and dissipation microscopy
CAESR-Tech seminar, Schulich School of Engineering; University of Calgary
July 07, 2016; Calgary <Alberta, Canada>

R. Bennewitz and J. Blass
Controlling friction and adhesion with supramolecular bonds
COST Workshop on Reversible control of Surface Interactions; University of Oxford
September 15, 2016; Oxford <UK>

H. Choi, X. Pei and R. Bennewitz
Multiple scratch studies on PEEK using different steel indenters
Nanobrücken 2016: a nanomechanical testing workshop and Hysitron user meeting
March 2-4, 2016; Saarbrücken <Germany>

A. Colak, H. Wormeester, H. J. W. Zandvliet and B. Poelsema
Investigation of parameters influencing the adhesion force in flat-on-flat and flat-on-rough contact geometries
611. WE-Heraeus-Seminar: Mechanisms of Tribology, Physikzentrum
March 29, 2016 - April 01, 2016; Bad Honnef <Germany>

D. Krass and R. Bennewitz
Microscopic mechanisms in lubrication revealed by force microscopy
20th International Colloquium Tribology
January 12-14, 2016; Stuttgart <Germany>

K. T. Rittgen, A. Caron and R. Bennewitz
Surface oxidation of metallic glass surfaces and its effect on nanotribology
Nanobrücken 2016: a nanomechanical testing workshop & Hysitron user meeting
March 02-04, 2016; Saarbrücken <Germany>

K. T. Rittgen, A. Caron and R. Bennewitz
Surface oxidation of metallic glass surfaces and its effect on nanotribology
80. Jahrestagung der DPG und DPG Frühjahrstagung
March 06-11, 2016; Regensburg <Germany>

Schaltbare Mikrofluidik / Switchable Microfluidics

J. Cui
Multifunctional gel materials made of dynamic polymers
Colloquium of Soft Mater Materials; Peking University
March 10, 2016; Beijing <PR China>

J. Cui
When Mr. Bioinspired idea meet Miss Dynamic polymers: synthesis, characterization, and application
GCCD Workshop for Polymer; Max Planck Institute for Polymer Research (MPIP)
March 19, 2016; Mainz <Germany>

J. Cui
Dynamic polymer materials to make multifunctional gels
Academic Forum for Graduate Students; Nanjing University
June 22, 2016; Nanjing <PR China>

J. Cui
Localization of liquid droplets in polymer matrices by evaporative lithography
Academic Forum fro 120th Birthday of Sichuan University
June 23, 2016; Chengdu <PR China>

J. Cui
Liquid droplets-embedded polymer materials
Korea Institute of Science and Technology (KIST)
July 05, 2016; Saarbrücken <Germany>

J. Cui
Localization of liquid droplets in polymer matrixes by evaporative lithography
Sino-German Youth Symposium "Functional Interfaces: Preparation and Characterization"; Peking University
November 07, 2016; Beijing <PR China>

Strukturbildung / Structure Formation

T. Kraus
Nanostrukturierte Beschichtungen: Materialien, Prozesse und Skalierung
DECHEMA-Workshop „Industrielle Produktion von Nanomaterialien";
February 11, 2016; Frankfurt a. M. <Germany>

T. Kraus
Mobile Nanopartikel für aktive Nanokomposite
AWT – VDI – Arbeitskreis Werkstofftechnik Bremen; Stiftung Institut für Werkstofftechnik
February 24, 2016; Bremen <Germany>

T. Kraus
Particle-based inks for electronics
University of Wuppertal, Faculty of Electrical, information, and Media Engineering
April 25, 2016; Wuppertal <Germany>

T. Kraus
Nanocomposites as functional materials
Bayreuth International Summer School "Colloids and Polymers in Energy and Life Science"
July 4-15, 2016; Bayreuth <Germany>

T. Kraus
Sol-gel coating and particle assembly
Bayreuth International Summer School "Colloids and Polymer in Energy and Life Science"
July 4-15, 2016; Bayreuth <Germany>

T. Kraus
Wet coating techniques
Bayreuth International Summer School "Colloids and Polymers in Energy and Life Science"
July 4-15, 2016; Bayreuth <Germany>

T. Kraus
Bioinspirierte Materialstrukturierung
EDGAR-LÜSCHER-LECTURES;
September 29, 2016; Dillingen an der Donau <Germany>

T. Kraus
Hybrid inks and ultrathin self-organizing nanowires: new materials for flexible and transparent printed electronics
Netzwerktreffen nanoInk - Selbstorganisierende Nano-Tinten & Netzwerk nanoInk; Technische Hochschule
September 29, 2016; Nürnberg <Germany>

T. Kraus
Controlling nanoparticle agglomeration for materials synthesis
1st Sino-German Young Scientist Symposium on "Interfaces: Construction, Characterization and Functionalization";
November 9-14, 2016; Beijing <PR China>

BIOGRENZFLÄCHEN / BIO INTERFACES

Dynamische Biomateralien / Dynamic Biomaterials

A. del Campo
Bioinspirierte Strategien für Antifouling-Beschichtungen
8. Biotechnologietag, „Biofilme – Fluch oder Segen?"
January 21, 2016; Bingen <Germany>

A. del Campo
Guiding cell-materials interactions with light
Soft Matter+ Colloquium; University of Twente
February 04, 2016; Enschede <Netherlands>

A. del Campo
Guiding cell-materials inateractions iwht light
HIPS Talks; Helmholtz Institute for Pharmaceutical Research
February 16, 2016; Saarbrücken <Germany>

A. del Campo
Guiding cell-biomaterials communication with light
SFB894 Seminar, Universitätskliniken Homburg, 2016
February 18, 2016; Homburg / Saar <Germany>

A. del Campo
Guiding cell interactions with biomaterials with light
3rd International Winterschool on bioelectronics BioEL, 2016
March 12-19, 2016; Kirchberg in Tirol <Austria>

A. del Campo
Guiding cell-materials interactions with light
IPHT Colloquium; Leibniz-Institut für Photonische Technologien, IPH
April 12, 2016; Jena <Germany>

A. del Campo
Light tuning morphology and composition in biomaterials and the consequences for embedded cells
15th Dresden Polymer Discussion, 2016
April 17-20, 2016; Dresden <Germany>

A. del Campo
Optoregulating cellular decisions
HYBER Symposium 2016; Aalto University
May 12-13, 2016; Helsinki <Finland>

A. del Campo
Biomaterial that talk to cells with molecular precision
SFB1176 Seminar 2016, KIT Karlsruher Institut für Technologie
July 05, 2016; Karlsruhe <Germany>

A. del Campo
Directing cells with light
Biointerfaces International 2016
August 23-25, 2016; Zuerich <Switzerland>

A. del Campo
Cell-interactive materials with light
Roche-Symposium Molecular Monitoring on a Chip: Tailoring Surfaces for Bioassays, 2016
August 28-30, 2016; Risch <Switzerland>

A. del Campo
Guiding cell interactions with biomaterials with light
E-MRS Fall Meeting, 2016 : Symposium B, Bioinspired and biointegrated materials as frontiers nanomaterials VI
September 18-21, 2016; Warsaw <Poland>

A. del Campo
How to become a female scientist? An experience report
Symposium for Female Scientists "From Dedication to Success – How to Manage your Career in Science" 2016
September 29, 2016; Saarbrücken <Germany>

A. del Campo
Photoresponsive biosurfaces
International Symposium Functional Biointerfaces 2016
October 04-05, 2016; Berlin <Germany>

A. del Campo
The role of hard nanofibers in frog's soft adhesive micro-structures
MRS Fall Meeting 2016;
November 26 – December 02, 2016; Boston <MA, USA>

Nano Zell Interaktionen / Nano Cell Interactions

A. Kraegeloh
Focus on Nano Cell Interactions
Jahrestagung der Deutschen Gesellschaft für Zytometrie – DGfZ
October 5-7, 2016; Berlin <Germany>

NANOKOMPOSIT-MATERIALIEN / NANOCOMPOSITE MATERIALS

Nanomere / Nanomers

C. Becker-Willinger
Neue nanostrukturierte Zinkphosphat- und Zin-Metall-Mischphosphat-Plättchen als funktionelle Additive
GfKORR Workshop Nanoskalige Korrosionsschutzsysteme
June 2-3, 2016; Frankfurt a.M. <Germany>

Optische Materialien / Optical Materials

M. Amlung
Development, characterization and biological evaluation of novel glass-like coatings for cardiovascular implants
2nd International Conference and Expo on Ceramics and Composite Materials
July 26-27, 2016; Berlin <Germany>

M. Amlung
Development and evaluation of glass-like coatings for cardiovascular implant applications such as stents
Advanced Ceramics and Applications V: New Frontiers in Multifunctional Material Science and Processing
September 21-23, 2016; Belgrade <Serbia>

QUERSCHNITTSBEREICHE / CROSS LINKING ACTIVITIES

Innovative Elektronenmikroskopie / Innovative Electron Microscopy

I. N. Dahmke
Effekte von Curcumin auf (Krebs-) Zellen in Mäusen und Menschen
Malayalee-Deutsches Forum Stuttgart
October 1-3, 2016; Untermarchtal <Germany>

N. de Jonge
Studying growth factor receptors in intact cells using correlative fluorescence- and electron microscopy
LUMC Leiden University Medical Center, Section Electron Microscopy
January 18, 2016; Leiden <Netherlands>

N. de Jonge
Electron microscopy of growth factor receptros in intact cancer cells in liquid
Analytica Conference 2016;
May 10-12, 2016; München <Germany>

N. de Jonge
Electron microscopy of cells, membrane proteins, and nano materials in liquid
GSS Schummer School 2016 der Ruhr Universität Bochum (RUB)
May 17-20, 2016; Bochum <Germany>

N. de Jonge
Imaging of biological specimen with liquid STEM, 3D STEM, in situ STEM, and aberration corrected STEM. Resolving the locations of individual proteins within the context of intact cells
ISM Golden Jubilee 2016
May 23-June 2, 2016; Haifa <Israel>

N. de Jonge
Scanning transmission electron microscopy of whole cells and nanomaterials in liquid
Kolloquium des Geoforschungsinstituts Potsdam
June 16, 2016; Potsdam <Germany>

N. de Jonge
Scanning transmission electron microscopy of whole cells and nanomaterials in liquid
Environmental Electron Microscopies, Pre-Congress of the European Microscopy Congress
2016 August 25-26, 2016; Lyon <France>

N. de Jonge
Scanning transmission electron microscopy of eukaryotic cells in liquid
European Microscopy Congress 2016
August 29 – September 2, 2016; Lyon <France>

N. de Jonge
Future directions and application areas of liquid-phase electron microscopy
Workshop on Scientific Directions for Future Transmission Electron Microscopy; Forschungszentrum Jülich
October 24-26, 2016; Jülich <Germany>

N. de Jonge and D. B. Peckys
Studying membrane proteins in intact cells using nanoparticle labels and liquid-phase electron microscopy
European Microscopy Congress 2016
August 29 – September 2, 2016; Lyon <France>

N. de Jonge, F. M. Ross and C. Wang
Transmission electron microscopy of specimens and processes in liquid
Lecture for Innovation in Materials Characterization Award, MRS
March 28 – April 1, 2016; Phoenix <AZ, USA>

PROGRAMMBEREICHSUNGEBUNDEN / NOT LINKED TO A PROGRAM DIVISION

Chemische Analytik / Chemical Analytics

Y. E. Silina and M. Koch
Nanoporous anodic aluminum oxide films: from solid phase micro-extraction to subscequent test-analysis
EMN Meeting on Mesoporous Materials
June 13-17, 2016; Prague <Czech Republik>

Physikalische Analytik / Physical Analytics

M. Koch
Das ESEM: Gestern – Heute – Morgen
Institute of Electron Microscopy and Nanoanalysis of the TU Graz (FELMI) – Graz Centre for Electron Microscopy (ZFE – Graz)
December 19, 2016; Graz <Austria>

Y. E. Silina and M. Koch
Nanoporous anodic aluminum oxide films: from solid phase micro-extraction to subscequent test-analysis
EMN Meeting on Mesoporous Materials
June 13-17, 2016; Prague <Czech Republik>

INM Fellows und weitere / INM Fellows and others

K. Jacobs
Provoking fluids to slide
DFG Frühjahrstagung
March 10, 2016; Regensburg <Germany>

K. Jacobs
Van der Waals interactions in wetting, adhesion, adsorption and friction experiments
IAS focused Program on Casimir and Van der Waals Forces
April 26, 2016; Hong Kong <HK>

K. Jacobs
Concave drops and hungry droplets. fluids in confinement
CECAM-Workshop "non-equilibrium dynamics of thin films – solids, liquids and bioactive materials"
September 23, 2016; Lausanne <Switzerland>

K. Jacobs
Influence of the slip boundary condition on the flow of (polymer) films
Liquids @ Interfaces
October 18, 2016; Paris <France>

LEHRVERANSTALTUNGEN / TEACHING

WINTERSEMESTER 2015 / 2016

Arzt, Eduard
INM-Kolloquium
Universität des Saarlandes, Kolloquium, 2 SWS

Arzt, Eduard und Mitarbeiter/innen
NanoBioMaterialien-P
Universität des Saarlandes, Praktikum, 4 SWS

Arzt, Eduard und Mitarbeiter/innen
NanoBioMaterialien-1
Universität des Saarlandes, Vorlesung / Übung, 2 SWS

Arzt, Eduard und Mitarbeiter/innen
Einführung in die Materialwissenschaft für (Studierende der) Mikrotechnologie und Nanostrukturen
Universität des Saarlandes, Vorlesung / Übung, 5 SWS

Becker-Willinger, Carsten
Technologie der Polymere und Komposite
Universität des Saarlandes, Vorlesung, 1 SWS

Becker-Willinger, Carsten
NDT Master: Polymer Materials Part 1
Dresden International University, Blockvorlesung, 1 SWS

Bennewitz, Roland
Gute Wissenschaftliche Praxis
Universität des Saarlandes, Blockseminar, 1 SWS

Bennewitz, Roland
Technische Physik
Universität des Saarlandes, Vorlesung / Übung, 4 SWS

Jonge, Niels de (mit Lautenschläger, Franziska)
Mikroskopie
Universität des Saarlandes, Vorlesung / Übung, 5 SWS

Jonge, Niels de
Experimentalphysik I (EP I): Mathematische Ergänzungen
Universität des Saarlandes, Vorlesung, 2 SWS

Kraegeloh, Annette
(mit Bernhardt, Rita, Wittmann, Christoph)
Biochemie I
Universität des Saarlandes, Vorlesung, 1 SWS

Kraus, Tobias
Functional Coatings
Universität des Saarlandes, Vorlesung, 2 SWS

Weiss, Ingrid M.
Protein-/Enzymreinigung
Universität Regensburg, Kurs / Seminar, 4 SWS

SOMMERSEMESTER 2016

Arzt, Eduard
INM-Kolloquium
Universität des Saarlandes, Kolloquium, 2 SWS

Arzt, Eduard, Kraegeloh, Annette und Mitarbeiter/innen
NanoBioMaterialien-2
Universität des Saarlandes, Vorlesung / Übung, 2 SWS

Bennewitz, Roland
Gute Wissenschaftliche Praxis
Universität des Saarlandes, Blockseminar, 1 SWS

Presser, Volker
Grundlagen der Thermodynamik
Universität des Saarlandes, Vorlesung / Übung, 4 SWS

Presser, Volker (mit Wenz, Gerhard)
Smart Materials and Polymers
Universität des Saarlandes, Vorlesung, 2 SWS

Presser, Volker (mit Hempelmann, Rolf, Universität des Saarlandes)
Werkstoffe für effiziente Energienutzung
Universität des Saarlandes, Vorlesung, 2 SWS, Praktikum, 6 SWS

del Campo, Aránzazu und Mitarbeiter/innen
Ausgewählte Kapitel der Chemie (Junior- und Starterstudenten): Klebstoffe im Alltag und in der Natur
Universität des Saarlandes, Vorlesung, 0,5 SWS

WINTERSEMESTER 2016 / 2017

Arzt, Eduard
INM-Kolloquium
Universität des Saarlandes, Kolloquium, 2 SWS

Arzt, Eduard, Kraegeloh, Annette und Mitarbeiter/innen
NanoBioMaterialien-1
Universität des Saarlandes, Vorlesung / Übung, 2 SWS

Arzt, Eduard, Kraegeloh, Annette und Mitarbeiter/innen
NanoBioMaterialien-P
Universität des Saarlandes, Praktikum, 4 SWS

Arzt, Eduard und Mitarbeiter/innen
Einführung in die Materialwissenschaft für (Studierende der) Mikrotechnologie und Nanostrukturen
Universität des Saarlandes, Vorlesung / Übung, 5 SWS

Becker-Willinger, Carsten
Technologie der Polymere und Komposite
Universität des Saarlandes, Vorlesung, 2 SWS

Becker-Willinger, Carsten
NDT Master: Polymer Materials Part 1
Dresden International University, Blockvorlesung, 1 SWS

Jonge, Niels de
Mikroskopie
Universität des Saarlandes, Vorlesung, 4 SWS

Jonge, Niels de (mit Becher, Christoph)
Experimentalphysik
Universität des Saarlandes, Vorlesung / Übung, 6 SWS

Kraegeloh, Annette
Nanostrukturen in der Biologie – von Anwendungen bis Zellinteraktionen
Universität des Saarlandes, Vorlesung, 2 SWS

Kraus, Tobias
Beschichtungen (Functional Coatings)
Universität des Saarlandes, Vorlesung, 2 SWS

PATENTE / PATENTS

Im Jahr 2016 erfolgten fünf Patentanmeldungen, die noch nicht offengelegt wurden. Dem Institut wurden 20 Patente erteilt. Acht Patentanmeldungen erfolgten im Rahmen einer europäischen Anmeldung in insgesamt 56 Mitgliedsstaaten, 12 Patente wurden im außereuropäischen Ausland zugeteilt. Es wurden somit 68 nationalisierte Schutzrechte im Jahr 2016 erteilt; zum Ende des Geschäftsjahres 2016 unterhielt das Institut insgesamt 73 Patentfamilien.

In 2016, INM has filed five new patent applications which are not yet published. 20 patents have been granted. Eight of these patents are granted in Europe and twelve in other foreign countries. The INM – Leibniz Institute for New Materials has 73 active patent families.

ERTEILTE EUROPÄISCHE PATENTE / PATENTS GRANTED IN EUROPE

Europäischen Patent Nr. 0981583 B1
Titel: *„Nanostrukturierte Formkörper und Schichten sowie Verfahren zu deren Herstellung“*
Erfinder: Ertugrul Arpac, Peter de Oliveira, Herbert Krug, Peter Müller, Helmut Schmidt, Stefan Sepeur, Bettina Werner

Europäisches Patent Nr. 1718405 B1
Titel: *„Amphiphile Nanopartikel erhältlich durch partielle Hydrolyse von metallorganischen Verbindungen“*
Erfinder: Murat Akarsu, Ertugrul Arpac, Helmut Schmidt

Europäisches Patent Nr. 2059932 B1
Titel: *„Zusammensetzung zur Beschichtung elektrischer Leiter und Verfahren zur Herstellung einer solchen Zusammensetzung“*
Erfinder: Oral Cenk Aktas, Sener Albayrak, Carsten Becker-Willinger, Michael Veith

Europäisches Patent Nr. 2794769 B1
Titel: *„Pigmentiertes, feinstrukuriertes tribologisches Kompositmaterial“*
Erfinder: Carsten Becker-Willinger, Frank Hollmann, Christoph Kasper

Europäisches Patent Nr. 2931937 B1
Titel: *„Verfahren zur Herstellung von Metall-Nanopartikel-Arrays“*
Erfinder: Daniel Brodoceanu, Tobias Kraus, Cheng Fang, Nicolas Hans Völcker

Europäisches Patent Nr. 2519471 B1
Titel: *„Synthese von Nanopartikeln mittels ionischer Flüssigkeiten“*
Erfinder: Peter de Oliveira, Hechun Lin, Michael Veith

Europäisches Patent Nr. 2590757 B1
Titel: *„Verfahren zur Herstellung von feinstrukturierten Oberflächen“*
Erfinder: Eduard Arzt, Elmar Kroner, Peter de Oliveira, Ebru Devrim Sam Parmak, Florian Büsch, Dieter Urban, Reinhold Schwalm, Benedikt Bläsi, Michael Nitsche, Hannes Spiecker, Claas Müller

Europäisches Patent Nr. 2798013 B1
Titel: *„Antireflexionsbeschichtung“*
Erfinder: Peter de Oliveira, Elisabete Menezes, Mohammad Jilavi

ERTEILTE INTERNATIONALE PATENTE / PATENTS GRANTED INTERNATIONALLY

Chinesisches Patent Nr. 103003721
Titel: *„Verfahren zur Herstellung von Beschichtungen mit Antireflexionseigenschaften“*

Erfinder: Peter de Oliveira, Mohammad Jilavi, Sakthivel Shanmugasundaram, Michael Veith

Japanisches Patent Nr. 5973912
Titel: *„Verfahren zur Herstellung von Beschichtungen mit Antireflexionseigenschaften“*
Erfinder: Peter de Oliveira, Mohammad Jilavi, Sakthivel Shanmugasundaram, Michael Veith

US Patent Nr. 9507320
Titel: *„Verfahren zum Übertragen von Oberflächenstrukturierungen, wie Interferenzschichten, Hologrammen und anderen hochbrechenden optischen Mikrostrukturen“*
Erfinder: Peter de Oliveira, Christine Faller-Schneider, Bruno Schäfer, Michael Veith

US Patent Nr. 9371411
Titel: *„Abriebbeständige und alkalibeständige Beschichtungen oder Formkörper mit Niedrigenergieoberfläche“*
Erfinder: Murat Akarsu, Ertugrul Arpac, Helmut Schmidt

Japanisches Patent Nr. 5889294
Titel: *„Highly structured composite material and process for the manufacture of protective coatings for corroding substrates”*
Erfinder: Carsten Becker-Willinger, Douglas Espin, Frank Hollmann, Marlon Jochum, Michael Opsölder, Sabine Schmitz-Stöwe

Kolumbianisches Patent Nr. 6669
Titel: *„Highly structured composite material and process for the manu-facture of protective coatings for corroding substrates”*
Erfinder: Carsten Becker-Willinger, Douglas Espin, Frank Hollmann, Marlon Jochum, Michael Opsölder, Sabine Schmitz-Stöwe

Norwegisches Patent Nr. 338846
Titel: *„Konsolidierungsmittel und dessen Verwendung zur Konsolidierung von Formkörpern und geologischen Formationen aus porösen oder partikulären Materialien“*
Erfinder: Klaus Endres, Bernd Reinhard, Helmut Schmidt

Japanisches Patent Nr. 5963762
Titel: *„Verfahren zur Herstellung von metallischen Strukturen“*
Erfinder: Eduard Arzt, Peter de Oliveira, Karsten Moh, Sarah Schumacher

Japanisches Patent Nr. 5926817
Titel: *„Pigmentiertes, feinstrukuriertes tribologisches Kompositmaterial“*
Erfinder: Carsten Becker-Willinger, Frank Hollmann, Christoph Kasper

Japanisches Patent Nr. 5889294
Titel: *„Verfahren zur Herstellung von feinstrukturierten Oberflächen“*
Erfinder: Eduard Arzt, Elmar Kroner, Peter de Oliveira, Ebru Devrim Sam Parmak, Florian Büsch, Dieter Urban, Reinhold Schwalm, Benedikt Bläsi, Michael Nitsche, Hannes Spiecker, Claas Müller

Koreanisches Patent Nr. 101588910
Titel: *„Optische Elemente mit Gradientenstruktur“*
Erfinder: Peter de Oliveira, Marcus Geerkens, Hechun Lin, Peter Rogin, Michael Veith

US Patent Nr. 9290678
Titel: *„Vorrichtung mit steuerbarer Adhäsion“*
Erfinder: Eduard Arzt, Robert McMeeking

VORTRÄGE IM INM-KOLLOQUIUM / INM COLLOQUIUM TALKS

Prof. Dr. Gerhard Busse, Institut für Kunststofftechnik und Institut für Flugzeugbau, Universität Stuttgart
Principle and Application of some Innovative NDE-Methods
January 6, 2016, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Tanja Schilling, Theory of Soft Condensed Matter, Université du Luxembourg
Percolation in Colloidal Model Systems
January 13, 2016, Host: Dr. Tobias Kraus

Jun-Prof. Dr. Franziska Lautenschläger, Saarland University, Saarbrücken
From suspended cells to a lab-on-a-chip-system for testing the immune response of cells
January 14, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Peter Elsner, KIT Karlsruhe and Fraunhofer ICT Pfinztal
Quartz-like coatings with microwave generated plasma enhanced chemical vapor deposition (PECVD)
January 20, 2016, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Manuel Salmeron-Sanchez, Chair of Biomedical Engineering, University Glasgow, UK
Interfaces that harness growth factors to modulate stem cell fate
January 27, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Anke Krueger, Institut für Organische Chemie, Universität Würzburg
News from the Carbon Universe – Nanodiamond, a Material for many Applications
February 10, 2016, Host: Prof. Dr. Volker Presser

Prof. Dr. Longjian Xue, Wuhan University, Hubei, China
Bioinspired adhesion regulated by water
February 26, 2016, Host: Prof. Dr. Aranzázu del Campo

Dr. Shrikrishnan Sankaran, University of Twente, The Netherlands
Supramolecular Bacterial Systems
February 29, 2016, Host : Prof. Dr. Aranzázu del Campo

Dr. Jan Pilch, Institut für Klinische Hämostaseologie und Transfusionsmedizin, Universitätsklinikum des Saarlandes, Homburg
Role of Blood Clotting for Metastasis and Inflammation
March 3, 2016, Host : Prof. Dr. Aranzázu del Campo

Assoc. Prof. Dr. Mustafa Ö. Güler, National Nanotechnology Research Center (UNAM), Bilkent University, Ankara, Turkey
Self-Assembled Peptide Nanostructures for Functional Materials
March 9, 2016, Host: Prof. Dr. Aránzazu del Campo

Dr. David Labonte, Department of Engineering, University of Cambridge, UK
Sticky Feet of Climbing Animals – Mechanisms of Attachment, Size-Dependence and how to Make them Fail
April 6, 2016, Host: Prof. Dr. Eduard Arzt

Dr. Peter J. Lu
Applied Physics, Harvard University, Cambridge, USA
Universal Gelation of Particles with Short-ranged Attraction
April 13, 2016, Host: Dr. Tobias Kraus

Prof. Dr. Niels Holten-Andersen, Department of Materials Science & Engineering
Massachusetts Institute of Technology, Cambridge, USA
Bio-Inspired Metal-Coordination Dynamics: A Unique Tool for Engineering Soft Matter Mechanics
April 27, 2016, Host: Prof. Dr. Aránzazu del Campo

Dr. Elke Neu, Experimentalphysik, Universität des Saarlandes
Color Centers in Diamond: Sensors to See the Nanoworld
May 5, 2016, Host: Prof. Dr. Volker Presser

Prof. Dr. Heiko Rieger, Statistische Physik und der Physik der kondensierten Materie, Universität des Saarlandes
Biophysics of Killing – Theory and Experiment
June 14, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. James Kirkpatrick, Institute of Pathology, University Medical Center, Johannes Gutenberg University Mainz
Developing Cellular Models in vitro for Regenerative Medicine
June 21, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Oskar Paris, Institut für Physik, Montanuniversität Leoben, Austria
Sorption Induced Deformation of Nanoporous Materials: From Basic Experiments to Potential Applications
July 13, 2016, Host: Prof. Dr. Volker Presser

Dr. Jan Torgersen, Stanford University, USA
Two Photon Polymerization and Atomic Layer Deposition for Combining Shape and Functionality
July 14, 2016, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Anand Jagota, Lehigh University, Bethlehem (PA), USA
Effect of Surface Roughness on Adhesion and Friction Enhancement of Film-Terminated Biomimetic Structures
July 19, 2016, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Xinhua Wan, College of Chemistry and Molecular Engineering, Peking University
Optically Active Helical Polymers: Design, Synthesis, and Chiroptical Properties
July 21, 2016, Host: Dr. Jiaxi Cui

Prof. Dr. Dominik Eder, Technische Universität Wien, Austria
Interfacial dynamics in nanocarbon-inorganic hybrid photocatalysts
July 27, 2016, Host: Dr. Peter W. de Oliveira

Dr. Teresa Lopez-Leon, CNRS & ESPCI Paris, France
Towards the Realization of Artificial Mesoscopic Atoms by Using Liquid Crystals
September 22, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Andrés J. García, Georgia Institute of Technology, Atlanta, USA
BioArtificial Hydrogels for Regenerative Medicine
September 27, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Ben Fabry, Zentrum für Medizinische Physik, FAU Erlangen-Nürnberg
Collagen Mechanics and its Implications for Cell-Matrix Interactions
October 25, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Christine Peter, Theoretical and Computational Chemistry, Universität Konstanz
Developing Simulation Approaches for Mineralization Processes
November 15, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Lutz Mädler, IWT Foundation Institute of Materials Science, Universität Bremen
High-throughput for toxicology and material discovery with particle technology
November 22, 2016, Host: Dr. Tobias Kraus

Prof. Dr. Pascal Jonkheijm, University of Twente, The Netherlands
Dynamic Cell-Material Interactions
November 30, 2016, Host: Prof. Dr. Aránzazu del Campo

Prof. Dr. Thilo Pompe, Institute of Biochemistry, Universität Leipzig
Biopolymer-Based Approach to Study Dynamic Cell Behaviour in Cytokine Gradients and at Tissue Boundaries in vitro
December 6, 2016, Host: Prof. Dr. Roland Bennewitz

Prof. Dr. Stephan Roth, Deutsches Elektronen-Synchrotron DESY, Hamburg
Tailoring the Nanostructure of Metal-Polymer Thin Films
December 13, 2016, Host: Dr. Tobias Kraus

VERANSTALTUNGEN / EVENTS

Nano Tech 2016
Stand, Exponate
Eduard Arzt, Karsten Moh, Thomas Müller und Fan Wu
Tokio, Japan, 27.-29.01.2016

ERC-Workshop "Contact Mechanics and Upscaling Technologies of Bioinspired Adhesives"
Organisation, Ausrichtung
Eduard Arzt, Christine Hartmann, René Hensel und Karsten Moh
Saarbrücken, 25.-26.02.2016

Nanobrücken 2016 – Workshop on Nanomechanical Testing
Organisation, Ausrichtung
Roland Bennewitz, Christine Hartmann und Dominik Hell
Saarbrücken, 02.-04.03.2016

611. WE-Heraeus-Seminar: Mechanisms of Tribology
Organisation
Roland Bennewitz und Christine Hartmann
Bad Honnef, 29.03.-01.04.2016

LOPEC – 7. Internationale Fachmesse für gedruckte Elektronik
Stand, Exponate
Lola Garcia-Gonzalez, Michael Opsölder und Wolfram Seitz
München, 06.-07.04.2016

Hannover Messe 2016
Stand, Exponate
Joachim Blau, Mareike Frensemeier, Marlon Jochum, Michael Opsölder, Anna Schreiber, Jana Staudt und Wolfram Seitz
Hannover, 25.-29.04.2016

Girls' Day: „Warum Geckos kleben und wie Zellen wandern"
Organisation, Ausrichtung
Christina Sauer-Hormann und Silke Zeiter-Semmet
Saarbrücken, 28.04.2016

Besuch einer Delegation des Institute for Basic Science, Daejeon, Korea
Organisation, Präsentationen
Mario Quilitz
Saarbrücken, 10.05.2016

Delegationsbesuch des Korea Institute for Advancement of Technology (KIAT), Seoul, Korea
Organisation (zusammen mit KIST Europe), Präsentationen
Mario Quilitz
Saarbrücken, 17.05.2016

„Woche der Umwelt" beim Bundespräsidenten
Stand, Exponate
Volker Presser und Günter Weber
Berlin, 07.-08.06.2016

ERC-Workshop "Engineering of Bio-Inspired Materials"
Organisation, Ausrichtung
Eduard Arzt, Roland Bennewitz, Christine Hartmann und Dominik Hell
Saarbrücken, 07.-08.06.2016

Tag der offenen Tür an der Universität des Saarlandes
Vorträge, Experimentierstationen
Christine Hartmann, Markus Koch, Annette Kraegeloh, Tobias Kraus, Volker Presser, Mario Quilitz und weitere
Saarbrücken, 09.07.2016

Schülerpraktikum
Vortrag, Führungen, Praktikum
Niels de Jonge und Mitarbeiter/innen
Saarbrücken, 12.07.2016

Delegationsbesuch der Kyung Hee University, Seoul, Korea
Organisation (zusammen mit KIST Europe), Präsentationen
Mario Quilitz
Saarbrücken, 02.08.2016

17. Jahrestagung des Arbeitskreises Bibliotheken und Informationseinrichtungen der Leibniz-Gemeinschaft
Organisation (zusammen mit Sprecherrat des AK)
Elke Bubel
Mannheim, 14.-16.09.2016

Besuch von Teilnehmerinnen des Mento MINT Programms der Universität des Saarlandes
Organisation (mit Universität des Saarlandes), Präsentationen
Sarah Fischer, Christine Hartmann und Jana Staudt
Saarbrücken, 15.09.2016

Nano meets Future 2016 – Die Zukunft liegt im Kleinen
Stand, Exponate, Poster
Mario Quilitz
Saarbrücken, 15.-16.09.2016

From dedication to success – how to manage your career in science
Workshop für Wissenschaftlerinnen
Ausrichtung, Organisation (mit Gleichstellungsbüro der Universität des Saarlandes)
Christina Sauer-Hormann und Silke Zeiter-Semmet
Saarbrücken, 29.09.2016

theIJC.com - 3rd Annual InkJet Conference 2016
Exponate und Vortrag
Lola Garcia-Gonzalez, Tobias Kraus und Beate Reiser
Düsseldorf, 05.-06.10.2016

MOTEC – 7. Internationale Fachmesse für gedruckte Elektronik
Stand, Exponate
Joachim Blau, Karsten Moh und Wolfram Seitz
Stuttgart, 10.-13.10.2016

BMBF Ferienpraktikum Nano- und Werkstofftechnologie 2016
Organisation (mit VDI), Präsentationen, Praktika
Britta Abt, Anja Altpeter, Kira Fries, Gisela Heppe, Marcus Koch, Thomas Müller, Carmen Schmitz, Sarah Schumacher, Silke Siegrist und Mario Quilitz
Saarbrücken, 10.-14.10.2016

CISCEM 2016 – 3rd International Conference on In-Situ and Correlative Electron Microscopy
Organisation, Ausrichtung
Niels de Jonge, Christine Hartmann und Dominik Hell
Saarbrücken, 11.-12.10.2016

FUNKT – Ferien-Uni-Natur-Kinder-Tage
Lisa Becker, Julia Purtov, Mario Quilitz, Verena Tinnemann und Andreas Verch
Saarbrücken, 13.10.2016.

Kick-Off Meeting zum Projekt Science4KMU
Marcus Geerkens, Michael Busse, Peter W. d. Oliveira und Julia Mohrbacher
Saarbrücken, 03.11.2016.

Delegationsbesuch der Tianjin University (TJU), Tianjin, PR China
Organisation (mit M. Springborg, Universität des Saarlandes), Präsentationen
Mario Quilitz
Saarbrücken, 24.11.2016

Workshop „Particle based materials“
Tobias Kraus und Dominik Hell
Würzburg, 30.11.2016

Festveranstaltung zur Vertragsunterzeichnung der NTNM-Bibliothek
Elke Bubel, Christine Hartmann
Saarbrücken, 18.11.2016

KOOPERATIONEN / COOPERATIONS

KOOPERATIONEN MIT NATIONALEN INSTITUTIONEN (AUSWAHL) / COOPERATION WITH NATIONAL INSTITUTIONS (SELECTION)

Albert-Ludwigs Universität Freiburg / Freiburg

Deutsches Elektronensynchrotron DESY / Hamburg

Deutsches Forschungszentrum für Künstliche Intelligenz / Saarbrücken

Deutsches Krebsforschungszentrum / Heidelberg

Deutsches Museum / München

Eberhard-Karls-Universität Tübingen / Tübingen

Ferdinand-Braun-Institut Leibniz-Institut für Höchstfrequenztechnik (FBH) / Berlin

Forschungszentrum Borstel, Leibniz Zentrum für Medizin und Biowissenschaften (FZB) / Borstel

Fraunhofer Institut für Werkstoffmechanik (IWM) / Freiburg i.Br.

Fraunhofer Institut für Zerstörungsfreie Prüfverfahren (IZFP) / Saarbrücken

Heinrich-Heine-Universität / Düsseldorf

Helmholtz-Institut für pharmazeutische Forschung Saarland (HIPS) / Saarbrücken

Hochschule für Technik und Wirtschaft des Saarlandes (HTW) / Saarbrücken

Johannes Gutenberg-Universität / Mainz

Karlsruhe Institute of Technology / Karlsruhe

KIST Europe / Saarbrücken

Leibniz-Institut für Analytische Wissenschaften (ISAS) / Dortmund und Berlin

Leibniz Institut für Arbeitsforschung an der TU Dortmund (IfADo) / Dortmund

Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW) / Dresden

Leibniz-Institut für Informationsinfrastruktur (FIZ) / Karlsruhe

Leibniz-Institut für Innovative Mikroelektronik (IHP) / Frankfurt (Oder)

Leibniz-Institut für Interaktive Materialien (DWI) / Aachen

Leibniz-Institut für Katalyse (LIKAT) / Rostock

Leibniz-Institut für Kristallzüchtung (IKZ) / Berlin

Leibniz-Institut für Naturstoff-Forschung und Infektionsbiologie (HKI) / Jena

Leibniz-Institut für Oberflächenmodifizierung (IOM) / Leipzig

Leibniz-Institut für Pflanzenbiochemie (IPB) / Halle

Leibniz-Institut für Plasmaforschung und Technologie (INP) / Greifswald

Leibniz-Institut für Polymerforschung (IPF) / Dresden

Leibniz-Institut für umweltmedizinische Forschung (IUF) / Düsseldorf

Leibniz-Institut für Wissensmedien (IWM) / Tübingen

Max-Planck-Institut für Polymerforschung / Mainz

Paul-Drude-Institut für Festkörperelektronik (PDI) / Berlin

Ruprecht-Karls-Universität / Heidelberg

Technische Universität Braunschweig / Braunschweig

Technische Universität Dresden / Dresden

Technische Universität Kaiserslautern / Kaiserslautern

Universität des Saarlandes / Saarbrücken

Universität Münster / Münster

Universität Regensburg / Regensburg

Universitätsklinikum des Saarlandes / Homburg

Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS) / Berlin

ZeMA – Zentrum für Mechatronik und Automatisierungstechnik gGmbH / Saarbrücken

KOOPERATIONEN MIT INTERNATIONALEN INSTITUTIONEN (AUSWAHL) / COOPERATION WITH INTERNATIONAL INSTITUTIONS (SELECTION)

Adolphe Merkle Institute / Fribourg, Switzerland

Al Azhar University / Gaza, Palestine

Bio21 Institute of the University of Melbourne / Melbourne, Australia

Budapest University of Technology and Economics / Budapest, Hungary

Centro Technologico de Minas Gerais CETEC / Belo Horizonte, Brasil

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Drexel University / Philadelphia, USA

Eidgenössische Technische Hochschule / Zurich, Switzerland

Eindhoven University / Eindhoven, Netherlands

EMPA – Swiss Federal Laboratories for Material Science and Technology / St. Gallen, Switzerland

EMPA – Swiss Federal Laboratories for Materials Science and Technology / Thun, Switzerland

Georgia Institute of Technology / Atlanta, GA, USA

Harvard University / Cambridge, MA, USA

IBEC, Institute for Bioengineering of Catalonia / Barcelona, Spain

IBM Zurich Research Laboratory / Rüschlikon, Switzerland

Indian Institute of Technology / Kanpur, India

Institute for Integrated Cell-Material Sciences (iCeMS) / Kyoto, Japan

Iowa State University / Ames, USA

KIST (Korea Institute of Science and Technology) / Seoul, Republic of Korea

KRIBB (Korea Research Institute of Bioscience and Biotechnology) / Daejeon, Republic of Korea

KRICT (Korea Research Institute of Chemical Technology) / Seoul, Republic of Korea

KRISS (Korean Research Institute of Standards and Science) / Daejeon, Republic of Korea

Laboratoire de PHysico-chimie des Electrolytes et Nanosystèmes InterfaciauX PHENIX / Paris, France

Monash University / Melbourne, Australia

Montanuniversität Leoben / Leoben, Austria

Museum of Cultural History, University of Oslo / Oslo, Norway

Riga Technical University / Riga, Latvia

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Universidade Sao Paulo / Sao Paulo, Brasil

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Utrecht University / Utrecht, Netherlands

Voronesh State University / Voronesh, Russia

Wuhan University / Wuhan, China

Xiamen University / Xiamen, China

ZHAW – Zurich University of Applied Sciences / Zurich, Switzerland

DAS INM IN DEN MEDIEN / INM IN THE MEDIA


tanken bei der Batterieforschung
WENN KRATZER IM AUTOLACK VON SELBST VERSCHWINDEN
Eine Antifouling-Kur für den Wärmeübertrager
Lack ab – nicht mit
Autolack repariert sich selbst
Von der Schulbank in die Uni-Labo
Für ein Forschungspraktikum nach Kalifornien
Leibniz-Institut für Neue Materialien vergibt jedes Jahr zwei Stipendien für Santa Barbara
Autolack aus Maisstärke soll Kratzer von selbst reparieren
saarisi

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Shareholder's Meeting
Saarland/Saarland University

MANAGEMENT BOARD

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Prof. Dr. Eduard Arzt -500

InnovationCenter INM / Chemical Engineering
Head: Dr. Peter W. de Oliveira -148
Deputy Head: Prof. Dr. Tobias Kraus -389

Energy Materials	*Prof. Dr. Volker Presser*	PD -177
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Nanotribology	*Prof. Dr. Roland Bennewitz*	PD -213
Structure Formation	*Prof. Dr. Tobias Kraus*	PD -389
Switchable Microfluidics	*Dr. Jiaxi Cui*	JRG -350

Optical Materials	*Dr. Peter W. de Oliveira*	PD -148
Innovative Electron Microscopy	*Prof. Dr. Niels de Jonge*	PD -313
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Günter Weber -290

Dynamic Biomaterials PD
Prof. Dr. Aránzazu del Campo -510

Nano Cell Interactions PD
Dr. Annette Kraegeloh -440

Nanomers® PD
Dr. Carsten Becker-Willinger -196

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Bernd Rus -304

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Dr. Marcus Geerkens -227

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Wolfgang Türk -154

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Dietmar Serwas -103

Stand: 31.12.2016 / As of: 31.12.2016

IMPRESSUM / IMPRINT

Nanomer und Gecomer sind vom INM eingetragene Markennamen.

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Layout / Satz:	FBO GmbH – Agentur für Marketing und Neue Medien, Saarbrücken
Druck:	Kern GmbH, Bexbach
Fotos:	INM; Uwe Bellhäuser, das bilderwerk; Henrik Ollmann
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rechts unten:	Cross section of a corrosion protection layer containing zinc-phosphate flakes. (© INM)

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im Kleinen.

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ISSN: 1864-255x