

INM JAHRESBERICHT 2014 / INM ANNUAL REPORT 2014

 **JAHRESBERICHT 2014**
ANNUAL REPORT 2014



Inhalt

2 Vorwort / Preface

GRUPPENBERICHTE /
GROUP REPORTS

6	Forschungsfelder / Research Fields
8	Grenzflächenmaterialien / Interface Materials
10	Energie-Materialien / Energy Materials
12	Funktionelle Oberflächen / Functional Surfaces
14	Nanotribologie / Nanotribology
16	Schaltbare Oberflächen / Switchable Surfaces
18	Strukturbildung / Structure Formation
20	Biogrenzflächen / Bio Interfaces
22	Biominalisation / Biomineralization
24	CVD/Biooberflächen / CVD/Biosurfaces
26	Nano Zell Interaktionen / Nano Cell Interactions
28	Nanokomposit-Technologie / Nanocomposite Technology
30	Nanomere / Nanomers
32	Optische Materialien / Optical Materials
34	Querschnittsfeld / Cross Linking Activities
36	Innovative Elektronenmikroskopie / Innovative Electron Microscopy
38	InnovationsZentrum INM / Innovation Center INM
40	Modellierung/Simulation / Modelling/Simulation
42	Servicebereiche / Service Groups
44	Analytik / Analytics
45	Bibliothek, Information & Dokumentation / Library & Information Services
46	Engineering / Engineering
47	Werkstoffprüfung/Pulversynthese / Materials Testing/Powder Synthesis

HIGHLIGHTS

50	Continuous Electrochemical Operation with flow Electrodes
51	INM's Geomer Technology on the Path to Application
52	3D Laser Lithography with Sub-Micro- meter Resolution
53	Nanoparticles in Flow Field-Flow Fractionation: Interactions and Losses
54	Genetic Engineering of Inorganic Crystals
55	Optical Functional Nanocomposites by Pulsed Laser Co-Deposition (PLCD)
56	Quantification of Internalized Silica Nanoparticles via STED Microscopy
57	New Flake-Type Particles as Functional Additives for Composite Coatings
58	Electroplated Nanoparticles as Efficient Targets for LDI-Mass Spectrometry
59	Force Response of Actively Deformed Polystyrene Films and Droplets
60	2nd Conference on In-Situ and Corre- lative Electron Microscopy (CISCEM)
61	Joint Leibniz Workshops in Berlin
62	Focus Projects – a Tool to Strengthen INM's Lead Areas

FAKTEN UND ZAHLEN /
FACTS AND FIGURES

66	Das INM in Zahlen / INM in Figures
68	Kuratorium & Wissenschaftlicher Beirat/ Board of Trustees & Scientific Advisory Board
69	Auszeichnungen / Awards
70	Aktivitäten in Gremien / Activities in Committees
73	Dissertationen / Doctoral Theses
73	Abschlussarbeiten / Theses
75	Doktoranden / Doctoral Students
75	Gastaufenthalte / Visiting Scientists and Students
76	Publikationen / Publications
95	Vorträge / Talks
108	Patente / Patents
109	Lehrveranstaltungen / Teaching
110	Vorträge im INM-Kolloquium / INM Colloquium Talks
112	Veranstaltungen / Events
114	Kooperationen / Cooperations
116	Das INM in den Medien / INM in the Media
118	Organigramm / Organizational Chart



Günter Weber

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Business Director

Prof. Dr. Eduard Arzt

Wissenschaftlicher Geschäftsführer und
Vorsitzender der Geschäftsführung /
Scientific Director and CEO

LIEBE FREUNDINNEN UND FREUNDE DES INM, DEAR FRIENDS OF INM,

2014 war ein besonders erfolgreiches Jahr am INM! Wir freuen uns über Spitzenwerte bei Publikationen in referierten Journalen und bei der Einwerbung von Drittmitteln.

Was hat das Jahr an unserem Institut geprägt? Ein neues Highlight ist sicher das im August gegründete *InnovationsZentrum INM*. Dieses stellt die Verbindung her zwischen der Forschung des INM und den Unternehmen. Schwerpunkte liegen dabei in der Zusammenarbeit mit der Industrie und deren Unterstützung durch Serviceleistungen.

Eine weitere Besonderheit war ein interner Projektwettbewerb: Das Institut förderte sechs Fokusprojekte, um interne Kooperationen sowie die vier Leitthemen des INM zu stärken. Sehen Sie dazu den Artikel „Focus projects – a tool to strengthen INM’s lead areas“.

Neue wissenschaftliche Impulse kommen aus dem Bereich *Strukturbildung* und der Juniorforschungsgruppe *Schaltbare Oberflächen*. Der erste wurde im Rahmen einer erfolgreichen Rufabwehr von einer Juniorforschungsgruppe zu einem Programmbereich ausgebaut, zweitens mit dem Start des ERC Advanced Grants neu eingerichtet. Und unser neuer *INM Fellow* Prof. Dr. Karin Jacobs, Professorin für Experimentalphysik an der Universität des Saarlandes, steuert neue Einsichten zu Polymergrenzflächen bei. Ihre Arbeit stellt sie Ihnen in einem Highlightartikel vor.

Unseren Partnern, Förderern und Freunden danken wir für ihre Unterstützung. Und da Erfolge nur gemeinsam entstehen können, gilt unser Dank besonders den Mitarbeiterinnen und Mitarbeitern unseres Hauses für ihr großes Engagement.

2014 was a particularly successful year at INM! We are pleased to report top values for refereed publications and grant acquisitions.

What was especially good news this year? Certainly one of the highlights was the start of the new *Innovation Center INM* in August. It is designed to create a link from INM’s research to industrial customers, in terms of both technical collaborations and service support.

A significant new feature was an internal project competition: The institute has supported six Focus Projects to intensify cooperation within INM and to strengthen our four lead areas. Please find the article inside on “Focus projects – a tool to strengthen INM’s lead areas”.

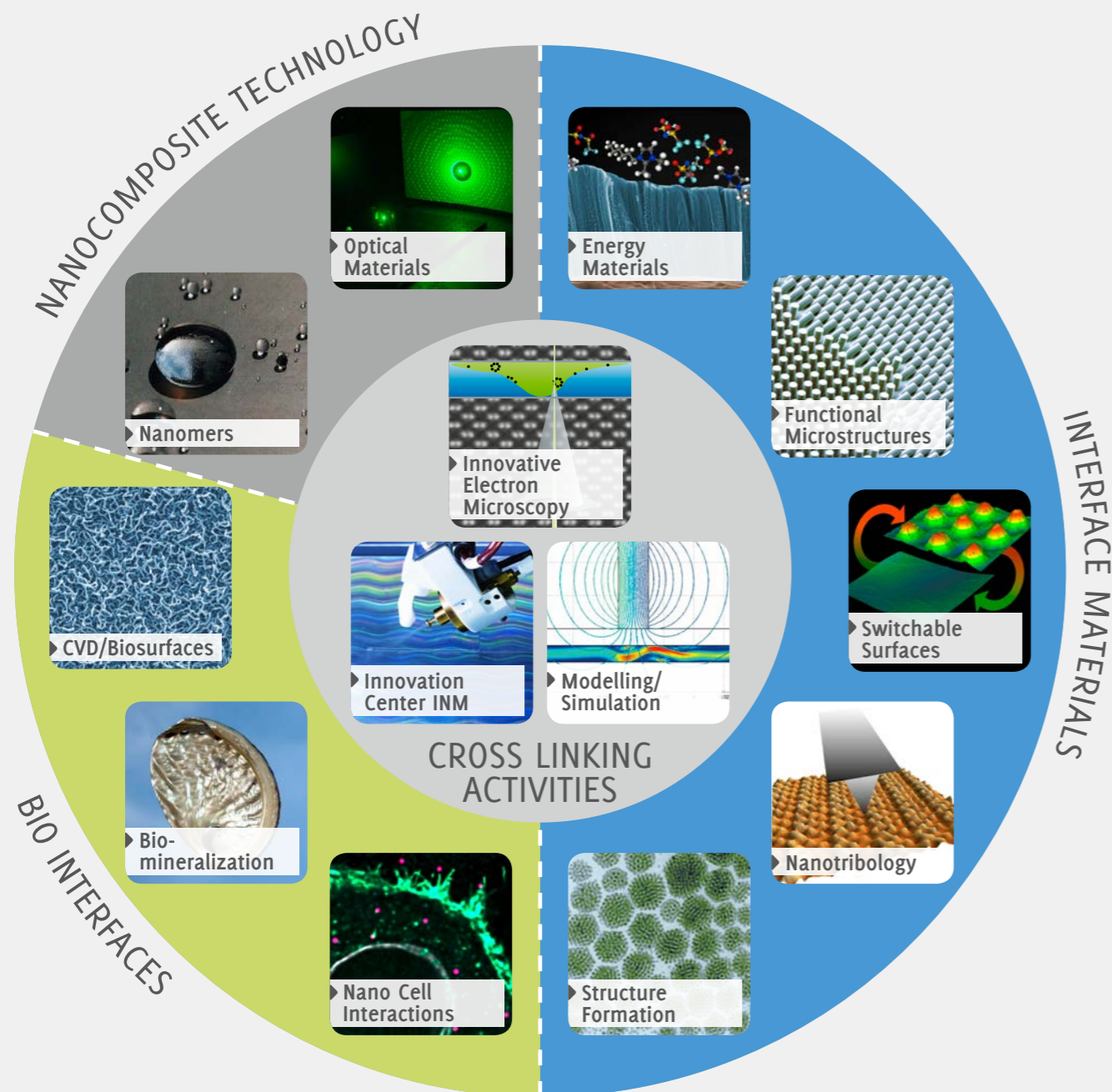
New scientific impulses have emerged, for example, from the former Junior Research Group *Structure Formation* and the new Junior Research Group *Switchable Surfaces*. The former was upgraded to a full-fledged Program Division to counter an honorable outside offer to its leader at INM; the latter is a new group established within the ERC Advanced Grant awarded to the institute in 2014. And our new *INM Fellow*, Prof. Karin Jacobs, Professor for Experimental Physics at Saarland University, now successfully contributes novel insights to polymer interfaces. An introduction to her work is included in this report.

We thank our partners, funding sources and friends for their continued support. As success is always the result of team play, we are deeply grateful to the members of INM for their dedicated work.



▶ GRUPPENBERICHTE /
GROUP REPORTS

► FORSCHUNGSFELDER / RESEARCH FIELDS



DIE FORSCHUNGSFELDER DES INM

Die Arbeiten des Instituts werden in drei Forschungsfelder und ein *Querschnittsfeld* gruppiert, 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. Im Vordergrund stehen u. a. neue Materialien zur Energiespeicherung, steuerbare tribologische und adhäsive Phänomene, flexible Schichten für die Photovoltaik, sowie Wechselwirkungen zwischen strukturierten Oberflächen und Haut.

Biogrenzflächen: Die Arbeiten in diesem Feld konzentrieren sich auf die Schnittstelle zwischen Materialwissenschaft und Biologie bzw. Medizin. Schwerpunkte sind die topographische Steuerung der Wechselwirkung von Zellen mit Oberflächen bis hin zur Zellprogrammierung, Perspektiven der ressourcen- und umweltschonenden Herstellung von Materialien mittels adaptierter Biomineralisation sowie die Interaktionen zwischen Nanopartikeln und Zellen, Geweben und Organen.

Nanokomposit-Technologie: Das Feld widmet sich nichtmetallisch-anorganischen Hybridmaterialien und ihren funktionellen, insbesondere optischen, tribologischen und protektiven, Eigenschaften. Schwerpunkte sind nasschemische Synthesemethoden und die Nutzung funktionalisierter Nanopartikel. Der Fokus der Arbeiten liegt in der Verwendung 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, Multiskalenmodellierung und Simulation. Das neue *InnovationsZentrum INM* gewährleistet den Transfer der Forschungsergebnisse in die Industrie.

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:

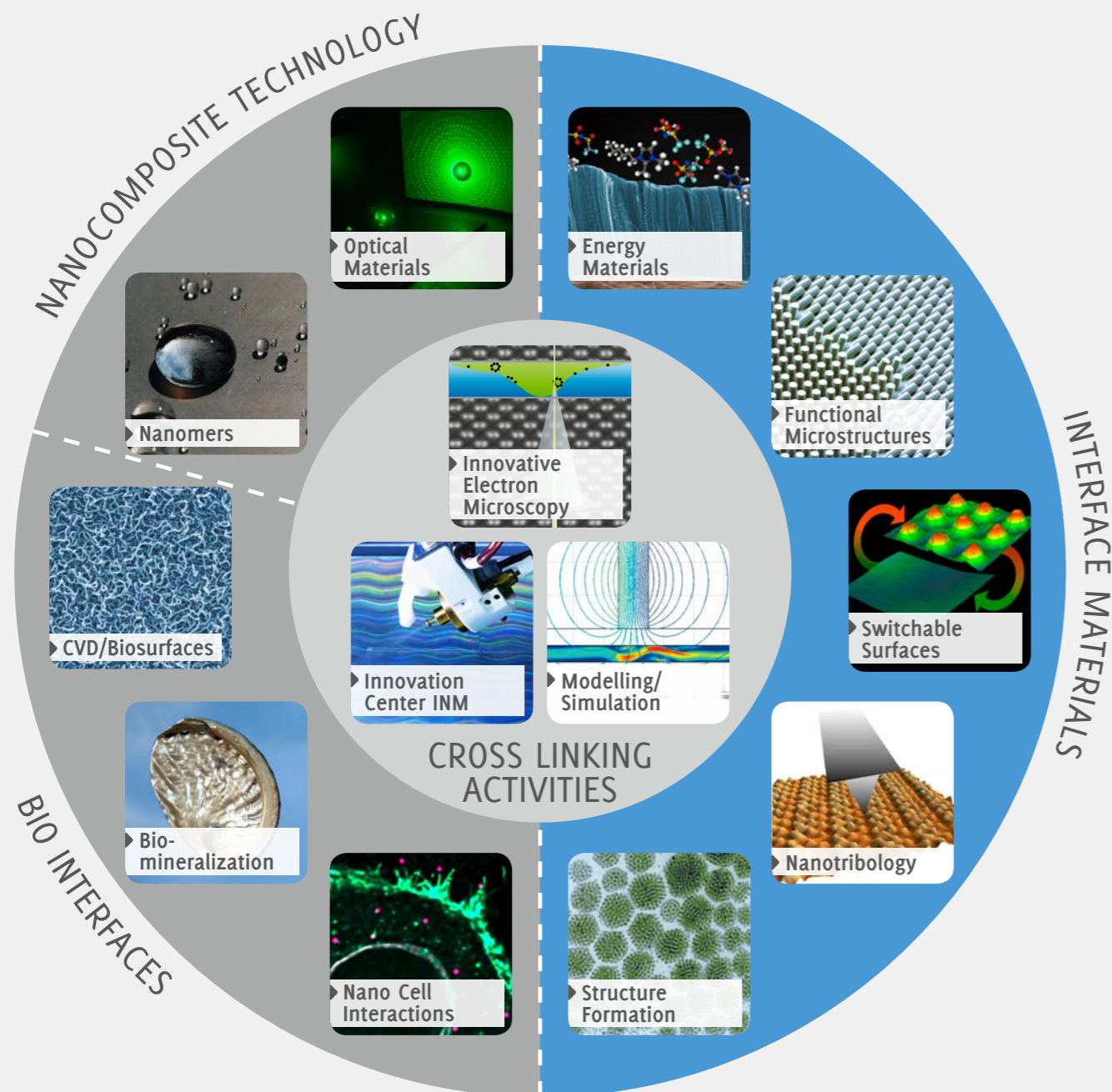
Interface Materials: The research field deals with new methods of surface and interface patterning and investigates especially physical mechanisms at surfaces. It focusses for example on new materials for energy storage, switchable tribologic and adhesive phenomena, flexible coatings for photovoltaics,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

Bio Interfaces: In this research field, the work concentrates on the interface between materials science and biology or medicine. Focus topics comprise the topographic switching of the cell interaction up to cell programming, perspectives of resource- and environmentally friendly syntheses of materials via adapted biomineralization as well as the interaction between nanoparticles and cells, tissues and organs.

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 large 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, multiscale modeling and simulation, and industrial transfer activities.

▶ 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. Im Vordergrund stehen neue Materialien zur Energiespeicherung, steuerbare tribologische und adhäsive Phänomene, flexible Schichten für Elektronik und Photovoltaik sowie Wechselwirkungen zwischen strukturierten Oberflächen und Haut.

Schwerpunktmäßig trägt dieses Forschungsfeld zu den INM-Leitthemen A (Energieanwendungen), B (Medizinische Oberflächen) und C (Tribologische Systeme) bei. Darüber hinaus wird ein Beitrag zum Leibniz-Forschungsverbund Energiewende geleistet (Juniorforschungsgruppe *Energie-Materialien*).

Im Zuge eines bewilligten Advanced Grants wurde im Februar 2014 eine neue Juniorforschungsgruppe *Schaltbare Oberflächen* eingerichtet sowie der vormalige Programmbereich *Funktionelle Oberflächen* in *Funktionelle Mikrostrukturen* erweitert. Des Weiteren wurde im Mai 2014 die Juniorforschungsgruppe *Strukturbildung* in einen Programmbereich umgewandelt. Das Forschungsfeld besteht zum 31.12.2014 somit aus drei Programmbereichen und zwei Juniorforschungsgruppen:

- ▶ Juniorforschungsgruppe *Energie-Materialien*,
Leitung: Jun.-Prof. Dr. Volker Presser
- ▶ Programmbereich *Funktionelle Mikrostrukturen*,
Leitung: Prof. Dr. Eduard Arzt, Dr. René Hensel
- ▶ Programmbereich *Nanotribologie*,
Leitung: Prof. Dr. Roland Bennewitz
- ▶ Juniorforschungsgruppe *Schaltbare Oberflächen*
Leitung: Dr. Elmar Kroner
- ▶ Programmbereich *Strukturbildung*,
Leitung: 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. It focuses for example on new materials for energy storage, switchable tribologic and adhesive phenomena, flexible coatings for photovoltaics, and on the interaction between structured surfaces and skin.

This research area contributes significantly to INM's lead topics A (energy applications), B (medical surfaces) and C (tribological systems). Additionally, it contributes to the Leibniz Research Alliance Energy Transition (Junior Research Group *Energy Materials*).

Within a new ERC Advanced Grant, a new Junior Research Group *Switchable Surfaces* was established and the former Program Division *Functional Surfaces* was extended into *Functional Microstructures*. Furthermore, the Junior Research Group *Structure Formation* was transferred into a Program Division in May 2014. The research field *Interface Materials* consists of three Program Divisions and two Junior Research Groups (as of December 31, 2014):

- ▶ Junior Research Group *Energy Materials*,
Head: Jun.-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 Surfaces*,
Head: Dr. Elmar Kroner
- ▶ Program Division *Structure Formation*,
Head: Dr. Tobias Kraus

Mehr Informationen über
das Forschungsfeld *Grenzflächen-*
materialien finden Sie hier.

More informations about the
research field *Interface Materials*.



► ENERGIE-MATERIALIEN / ENERGY MATERIALS

JUN.-PROF. DR. VOLKER PRESSER

ZIELSETZUNG

Die Juniorforschungsgruppe *Energie-Materialien* erforscht und entwickelt Nanomaterialien für elektrochemische Anwendungen, wie beispielsweise zur elektrochemischen Energiespeicherung oder zur Wasseraufbereitung via kapazitiver Entionisierung. Auf der Materialseite liegt der Schwerpunkt auf hochporösen Kohlenstoffen und Hybridmaterialien, die als Pulver, Kugeln, Schäume oder Nanofasern hergestellt werden. Nanoskalige Hybridisierung wird durch die Implementierung von Metalloxiden, Metallnitriden und Polymeren in Kohlenstoffnanomaterialien erreicht. Hieraus werden auf der Anwendungsseite vor allem Elektroden für Superkondensatoren entwickelt. Ein wichtiges Ziel ist die Kombination von hoher Energie- und Leistungsdichte funktionaler Energiespeicher. Besondere Bedeutung nimmt die Charakterisierung der elektrochemischen Phänomene ein, die mit *in-situ* Methoden detailliert untersucht werden.

MISSION

Research in the Junior Research Group *Energy Materials* is focused on the synthesis, characterization, and application of nanomaterials for electrochemical applications. Our activities center on electrochemical energy storage (supercapacitors) and water treatment using capacitive deionization. Both applications are based on the electrical double-layer which forms at the interface between electrically charged materials and electrolytes with dissolved ionic species. Carbon nanomaterials are the most important electrode material and we utilize non-porous carbon nanoparticles (carbon onions, carbon black) and nanoporous carbons for electrochemical applications. In particular, polymer- and carbide-derived carbons are explored in complex forms (such as beads, fibers, or films). Beyond electrostatic ion electrosorption, Faradaic reactions resulting from nanoscopically implemented metal oxides within the carbon electrode enable to significantly increase the energy density of electrochemical capacitors. 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 WORK

In-operando electrochemical thermoanalysis Supercapacitors are electrochemical devices for an abundance of stationary and mobile applications. Especially the advent of ionic liquids as an advanced electrolyte has brought along the possibility for device operation at elevated temperatures

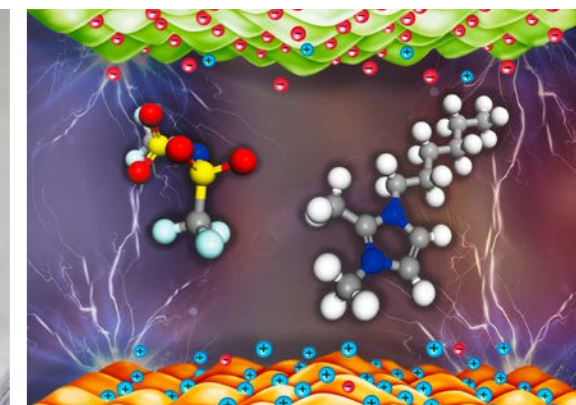
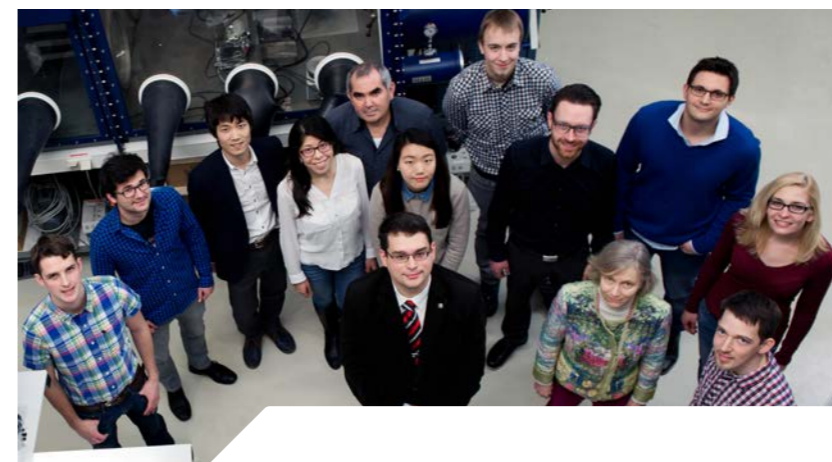
► Jun.-Prof. Dr. Volker Presser



is head of the Junior Research Group *Energy Materials* and Assistant Professor at Saarland University. He received his doctorate in Applied Mineralogy at the Eberhard-Karls University, Tübingen, and worked formerly as Research Assistant Professor at Drexel University, Philadelphia, USA.

(>70°C) without catastrophic device failure. Yet, limited information is available for the low temperature behavior. We have shown that the behavior of ionic liquids in carbon nanopores may be vastly different from that in the bulk and that the carbon surface interaction may severely shift the freezing point. Also, we have shown that the behavior in positively and negatively polarized electrodes differs. For applications, our results show that certain ionic liquids in supercapacitors freeze at much higher temperatures than expected; yet, the initial energy storage capacity can be recovered after re-thawing.

evaluated different conductive additives, namely novel carbon onions and carbon blacks with high or low surface area to establish important guidelines. For one, conductive additives with a high specific surface area should be chosen. Also, admixing any conductive additive is only advisable for high power applications, especially when operating in electrolytes with high viscosity. Separately, we have studied in detail the effect of tuning the electrical conductivity directly, without using conductive additives. Carbon, in general, is a poor electrical conductor and as such shows a strong



► Efficient energy storage via ion electrosorption, for example using ionic liquids as electrolyte.

Green binders

The fabrication of supercapacitor electrodes made from activated carbon relies in the use of fluoropolymer binders, such as polytetrafluoroethylene (PTFE) or polyvinylidene fluoride (PVDF). To avoid the presence of fluorine and to eliminate the need for toxic solvents, we have developed binders based on mixtures of polyvinylpyrrolidone (PVP) and polyvinyl butyral (PVB). PVP has shown to be an excellent binder for organic electrolyte supercapacitors with a performance comparable or better than conventional PTFE or PVDF. An optimized blend of PVP and PVB enables spray coating and drain casting of highly stable, high performance electrodes for aqueous media.

Carbon conductivity

Common supercapacitor electrodes employ carbon black as a conductive additive. Yet, this strategy is not a general solution and requires a more in-depth evaluation of the actual application. We have

dependency of the electrical conductivity on the applied cell voltage, known as electrochemical doping in the literature. Capitalizing on this effect, highly graphitic materials show a strong increase in energy storage capacity at higher cell voltages compared to poorly conducting carbons.

OUTLOOK

In 2015, the *Energy Materials* Group will focus on hybrid metal oxide/carbon nanocomposites for pseudocapacitors with improved energy density and high power handling ability. We will expand our work on flow electrodes for scalable energy storage and water treatment applications for continuous operation. As a novel field, we will also explore energy harvesting with capacitive technologies. Finally, we will advance our *in-situ* electrochemical measurements using a combination of quartz crystal microbalance and electrochemical dilatometry measurements.

► FUNKTIONELLE MIKROSTRUKTUREN / FUNCTIONAL MICROSTRUCTURES

PROF. DR. EDUARD ARZT, DR. RENÉ HENSEL

ZIELSETZUNG

Der Programmbereich *Funktionelle Mikrostrukturen* befasst sich mit der Herstellung und Charakterisierung von funktionsstrukturierten Oberflächen. Durch Mikro- und Nanostrukturierung sowie gezielte Materialauswahl werden spezielle mechanische, optische, thermische und haptische Funktionalitäten erzeugt. Vorbild für die Gestalt der Strukturen und deren Funktionen sind u.a. Konzepte aus der belebten Natur, welche auf künstliche Systeme übertragen werden. Der Fokus der Forschungsarbeiten liegt dabei auf bioinspirierten Haftsyste-men (Figure 1), wobei die Interaktion Gecko-inspirierter Strukturen auf weichen, hautähnlichen Substraten sowie anwendungsrelevante Fragestellungen im Rahmen eines EU-geförderten Projektes (ERC Advanced Grant) im Vordergrund stehen. Dadurch werden, in enger Kooperation mit der medizinischen Fakultät der Universität des Saarlandes, Anwendungen im Bereich medizinische Oberflächen weiter entwickelt sowie Industriekontakte angebahnt bzw. weiter vertieft.

MISSION

The Program Division *Functional Microstructures* works on the fabrication and characterization of micro- and nanopatterned surfaces. A suitable combination of morphology and materials of the surface features can enhance physical properties such as mechanical, adhesive or haptic characteristics. Inspired by the fascinating adhesive properties of natural structures (Figure 1), the group attempts to mimic these attachment organs to improve the adhesion of similar but synthetically produced surface patterns. Presently, we focus on tuning the adhesive forces by external stimuli (switchable adhesion) and on contact mechanisms for adhesive fibrillar structures on soft, compliant surfaces such as skin. In addition to the fundamental research, we support the upscaling of processes to provide a transfer of our findings into industrial applications such as robotic pick and place systems.



► Prof. Dr. Eduard Arzt (Head)

is scientific director and chairman (CEO) of INM as well as professor for new materials at Saarland University. He received his doctorate at the University of Vienna and performed research, amongst others, at Cambridge University (UK), Stanford University and MIT (USA). He was previously director at the Max Planck Institute for Metals Research, Stuttgart.



► Dr. René Hensel (Deputy Head)

studied materials science at Technische Universität Dresden. He was a fellow of a DFG Research Training Group at TU Dresden and completed his doctorate at the Leibniz Institute for 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*.



► Gecomer technology allows handling of highly sensitive objects.

CURRENT WORK

Polydimethylsiloxane-based Composites for High Shear Loads on Tissue Substrates

In an internationally co-advised project, we experimentally explored the development of PDMS-based composite materials by incorporation of submicron polyethylene (PE) particles and parylene coatings (cooperation with Prof. Karp, Harvard Medical School, USA). With these materials, we were able to fabricate pillar structures with mushroom-like tip geometries that exhibited higher bending stiffness than similar structures made out of pure PDMS due to higher elastic moduli. The patterned surfaces were tested regarding their self-fixating capabilities and mechanical interlocking on biological tissues. As a result, these studies offer a novel strategy for hernia repair or other wound closure concepts.

Transfer of the Gecomer Technology to Industry

The Gecomer Technology is the result of long-term research at INM, allowing for reliable and reversible adhesion on a wide range of substrate materials. The technology is energy-efficient compared to conventional systems such as vacuum or Bernoulli grippers and, by contrast, extends adhesive capabilities to vacuum environment, where applications in industry are manifold. In 2014, we consulted with more than 40 industrial companies and a first industry project was successfully completed. New, portable demonstrator robots (Gecobots) were designed and constructed, giving us the opportunity

to present the Gecomer Technology at international exhibitions and directly at the company sites. At the same time, the patent portfolio is being extended.

OUTLOOK

The Program Division *Functional Microstructures* will continue its transfer activities by further exploring new application fields for the Gecomer technology. Fundamental research will continue to focus, within the ERC Advanced Grant, on contact mechanisms of fibrillar structures on soft substrates. New material concepts for the surface patterns will be explored. In collaboration with the Junior Research Group *Switchable Surfaces*, new approaches on switchable adhesives will be developed. In the field of biomedical applications, the collaboration with Prof. Schick (Saarland University Hospital, Homburg) will enter the stage of biocompatibility testing; new collaborations will include Prof. Spatz (MPI Stuttgart/Heidelberg). In collaboration with Prof. McMeeking (UCSB) complementary modeling based on finite element methods will be applied to improve the understanding of soft surfaces. The research on hierarchical adhesion systems within the DFG SPP1420 will be completed in 2015.

▶ NANOTRIBOLOGIE / NANOTRIBOLOGY

PROF. DR. ROLAND BENNEWITZ

ZIELSETZUNG

Der Programmbereich *Nanotribologie* forscht an der Entwicklung neuer Materialien mit besonderen mechanischen 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. Außerdem nutzen wir neue experimentelle Methoden, um mechanische Eigenschaften insbesondere biologischer Materialien auf verschiedenen Längenskalen zu untersuchen. Zu den herausragenden Ergebnissen des Jahres 2014 gehören die Untersuchung von Reibung und Verschleiß der Periostracum genannten Proteinschicht auf Muschelschalen, die Messung nanoskaliger Reibungsphänomene auf molekularen Lagen einer ionischen Flüssigkeit und der Nachweis der Schutz- und Schmierwirkung einer molekularen Graphen-Lage auf einem Platinkristall.

▶ Prof. Dr. Roland Bennewitz



is the Head of the *Nanotribology* group and Honorary Professor of Experimental Physics at Saarland University. He obtained his PhD 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 an understanding of microscopic mechanisms in friction and wear. Our experimental projects rely on our expertise in the field of high-resolution force microscopy, which we apply in ultra-high vacuum, in liquids and under electrochemical control. Furthermore, we have developed new experimental methods for mechanical testing on different length scales. The methods and results of fundamental nanotribology are applied in collaborations, in particular within the INM and with Saarland University. Examples are joint projects with the Program Division *Modeling* and the Program Division *Functional Surfaces* on friction and haptics, with the INM Fellow Prof. Karin Jacobs on friction in thin polymer films, with Prof. Martin Müser on correlations in ionic liquids, and with the research group of Prof. Gerhard Wenz on friction control through macromolecular functionalization.

CURRENT RESEARCH

Surviving the turf: The tribomechanical properties of the periostracum of blue mussels. We investigated the friction and wear behavior as well as the mechanical properties of the periostracum, the protein layer on the shell, of blue mussels. Tribological properties were determined with a home-built microtribometer as shown in Figure 1. Measurements were performed in dry and wet conditions. Microscopic *ex-situ* analysis indicated that dry periostracum wore rather rapidly by plowing and fatigue, while it exhibited a high wear resistance when immersed in salt water.

It was found that, in wet state, viscous behavior plays a significant role in the mechanical response of the periostracum. Our results strongly indicate that the periostracum can provide an important contribution to the overall wear resistance of the mussel shell.

Force microscopy of layering and friction in an ionic liquid

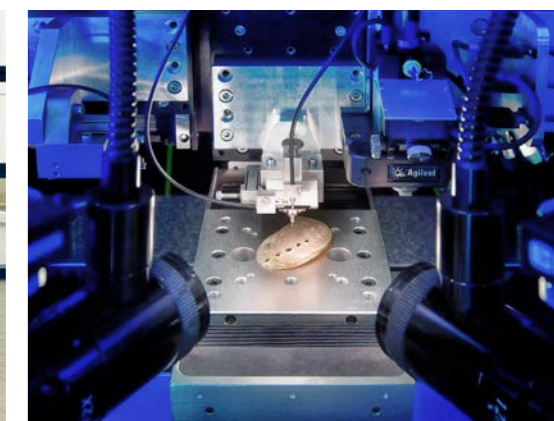
The mechanical properties of an ionic liquid in confinement between an AFM tip and a gold surface were investigated under electrochemical control. Up to 12 layers of ion pairs could be detected through force measurements while approaching the tip of the AFM to the surface. The particular shape of the force versus distance curve can be explained by a model for the interaction between tip, gold surface and ionic liquid, which assumes an exponentially decaying oscillatory force originating from bulk liquid density correlations. Jumps in the tip-sample distance upon approach correspond to jumps of the compliant force sensor between branches of the oscillatory force curve. In contrast to recently reported experiments using the surface forces apparatus, frictional force between the laterally moving tip and the surface is detected only after partial penetration of the last interfacial layer between tip and surface. These results contribute to the intense discussion about a possible role of ionic liquid layering in lubrication.

Atomic-scale mechanisms of friction reduction and wear protection by graphene

We have studied nanoindentation and scratching of graphene-covered platinum surfaces in experiments and in computer simulations performed by our collaborators at the IWM Fraunhofer Institute in Freiburg. We found elastic response at low load, plastic deformation of platinum below the graphene at intermediate load, and eventual rupture of the graphene at high load. While graphene substantially enhances the load carrying capacity of the platinum substrate, the substrate's intrinsic hardness and friction are recovered upon graphene rupture.

OUTLOOK

We will continue to investigate the mechanisms which link the structure and dynamics of surfaces to friction and wear in new materials. Our current funded projects include studies of friction on clean metals, the role of surface structure and chemistry for friction and wear in metallic glasses, and macromolecular functionalization for the control of adhesion and friction. A collaborative project within the INM addresses the neural response to friction against the fingertip. In a new project together with the TU Kaiserslautern we investigate the scratch mechanisms in polymers across length scales. In general, we aim to apply our insights into friction mechanisms to the development of new materials in collaborations within the INM, across the campus of Saarland University, and with external industrial and academic partners.



▶ Investigation of friction and wear of the periostracum on a blue mussel by means of the home-built microtribometer.

► SCHALTBARE OBERFLÄCHEN / SWITCHABLE SURFACES

DR. ELMAR KRONER

ZIELSETZUNG

Viele Eigenschaften biologischer Materialien werden durch deren Oberflächenstruktur bestimmt. Beispiele dafür sind Farben von Schmetterlingen, Reflexionseigenschaften von Mottenaugen, Adhäsion von Gecko-Füßen oder das Benetzungsverhalten von Lotusblättern. In der Juniorforschungsgruppe *Schaltbare Oberflächen* beschäftigen wir uns mit der Herstellung und Charakterisierung von bioinspirierten Oberflächen. Der Fokus liegt auf der Entwicklung schaltbarer Materialsysteme, deren Topographie und damit zusammenhängenden Oberflächeneigenschaften durch einen externen Stimulus schaltbar sind. Zur Herstellung solcher schaltbarer Oberflächenstrukturen nutzen wir aktive Materialien wie beispielsweise Formgedächtnis-Metalle und flüssig-kristalline Polymere, oder wir erzeugen Verbunde aus mikro- und nanostrukturierten passiven Materialien, welche in unterschiedlicher Weise auf einen externen Stimulus reagieren, beispielsweise Hydrogel/Elastomer-Komposite.

► Dr. Elmar Kroner



studied Materials Science at the University of Stuttgart and the Max-Planck-Institute for Metals Research. After completing his PhD at INM and Saarland University he became Deputy Head of the Functional Surfaces Group at INM. Since 2014 he leads the Junior Research Group *Switchable Surfaces*.

MISSION

In February 2014 the *Switchable Surfaces* Group was established within the ERC project. The mission of this Group is to investigate, fabricate and characterize material systems with surface topographies that can be switched by applying an external stimulus, such as temperature, humidity, and electric or magnetic fields. To reversibly change a surface topography, we either use active materials or we combine materials which respond differently to external stimuli. The switching of the topography is generated or amplified by specifically engineered micro- and nanostructures.

Three milestones were achieved in the first year, namely (i) establishment of new 3D patterning method, (ii) exploration of new active materials, and (iii) start of new collaborations.

- i. A novel 3D patterning method based on 3D laser writing was established. 3D structures with sub- μm -resolution were successfully fabricated from various materials. The patterning method was successfully integrated into the existing patterning and replication techniques at INM.
- ii. New active materials with the capability to switch their topography were evaluated. The previously established nickel-titanium shape memory material system was utilized to obtain switchable surface properties, for example switchable adhesives. Further, first experiments with liquid crystal polymers were carried out to investigate the interaction of the liquid crystals with micro- and nanopatterned surfaces.

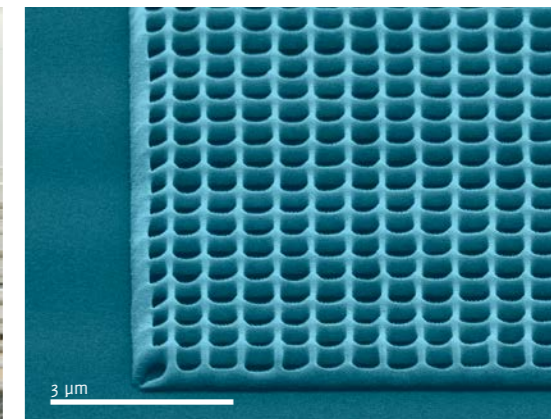
A third material system, electroactive polymeric membranes, is currently examined for its suitability as active material for switchable surface topographies.

- iii. We have established close collaborations to several scientific research groups. We are currently working together with specialists in the field of liquid crystal polymers to develop optical surfaces with switchable topography. Furthermore, we are closely co-operating with experts in the field of biological surfaces. Joint projects are planned with all collaboration partners.

Material development and characterization are carried out in close collaboration with the University of Eindhoven.

Surfaces for Cells

We develop a tool box to control interactions between cells and surfaces. We focus on combining (switchable) micro- and nanopatterned surfaces with electrospun polymeric materials to obtain improved surface-cell interactions. Such surfaces are necessary for the development of next generation smart implant materials and are investigated in collaboration with the Program Division *Nano Cell Interactions*.



► The electron microscopy micrograph shows a photoresist structure on a glass plate. The newly established direct 3D laser writing system allows writing of submicrometer structures of almost any geometry.

CURRENT RESEARCH

Switchable Adhesives

Patterned adhesives inspired by the climbing abilities of geckos are combined with active materials to achieve a switchable adhesive. In addition, new functionalities such as a multi-step switchable adhesive, which allows precise control of adhesive forces, are currently under investigation. The work is conducted in close collaboration with the *Functional Microstructures* Group within the ERC Advanced Grant Switch2Stick.

Switchable Optics

Structure-based optical materials such as anti-reflective surfaces and structure induced colors are fabricated and characterized. The optical properties will be modified by switching the surface topography using, for example, liquid crystal elastomers.

OUTLOOK

The future goals of the Junior Research Group are the extension and improvement of micro- and nanofabrication capabilities. Also, new responsive material systems will be established which allow to switch surface topographies. After first fundamental studies, close collaboration with industry is planned in cooperation with the *Innovation Center INM*. The focus areas are optics, energy applications and biomedical surfaces. In 2015, the new field of research "Switchable Microfluidics" will be started within the BMBF funded Leibniz Research Cluster (LRC).

► STRUKTURBILDUNG / STRUCTURE FORMATION

DR. TOBIAS KRAUS

ZIELSETZUNG

Im Jahr 2014 ging die Juniorforschungsgruppe *Struktur- bildung auf kleinen Skalen* im neuen Programmbereich *Struktur- bildung auf kleinen Skalen* auf. Der Programmbereich untersucht, wie sich Moleküle, Polymere und kolloidale Partikel zu größeren Einheiten verbinden. Er erforscht die grundlegenden Mechanismen der Strukturbildung und wendet sie an, um neue Materialien aus flüssigen Vorstufen herzustellen.

Wir ermitteln experimentell, wie die Eigenschaften von Komposit- und Hybridmaterialien von ihrer Mikrostruktur abhängen und wie man sie verändern kann. Dazu variieren wir systematisch Größe, Geometrie, chemische Zusammensetzung und Anordnung der Materialbestandteile. Wir beobachten, wie Mikrostruktur und innere Grenzflächen entstehen und Materialeigenschaften bestimmen. Diese Methode wenden wir zum Beispiel an auf transparent leitfähige Schichten aus metallischen Nanopartikeln für die Elektronik, Komposite leitfähiger Polymere mit optisch aktiven Partikeln für Sensoren und auf Suprapartikel aus optisch aktiven Nanopartikeln.

► Dr. Tobias Kraus



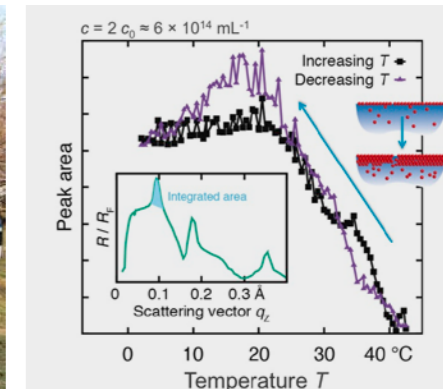
is a chemical engineer trained at TU Munich, MIT, and the University of Neuchatel. He obtained his PhD at ETH Zurich and the IBM Research Laboratory. His interests span physical chemistry, surface science and process engineering. He has recently been appointed Deputy Head of *Innovation Center INM*.

MISSION

The Program Division *Structure Formation* emerged from the Junior Research Group *Structure Formation at Small Scales* in 2014. It investigates how molecules, polymers and colloidal particles join to form larger units. It studies fundamental processes of structure formation and applies them to prepare new materials from liquid precursors. We study how the properties of composite and hybrid materials depend on their microstructures and how we can change them by controlling microstructure. To this end, we systematically vary size, geometry, chemical composition, and arrangement of the materials' constituents. We observe how microstructures and interfaces form and affect material properties. We apply this approach to transparent conductive layers of metal nanoparticles for electronics, to composites of conductive polymers with optically active particles for sensors and to supraparticles that, for example, contain optically active nanoparticles.

Interfaces are at the center of our work: the surface of particles that interacts with the solvent; the interfaces between particles that rule electrical conductivity and optical properties; the interface between liquid "paint" and air during coating. We study under which conditions particles and molecules accumulate at this interface and how this can be applied in new materials.

Experimentally, we study structure formation in controlled coating equipment – miniaturized, controlled versions of technologically relevant coating processes. We observe structure formation directly through *in situ* analytics. A combination of light- and x-ray scattering, electron microscopy, optical spectroscopy and intensive thinking helps us explaining how materials form in the coater.



► Particles assembly and disassemble at a gas-liquid interface upon temperature change. See Born et al., *Langmuir*, 2014, for details.

CURRENT RESEARCH

Flexible electronics with nanoparticles

Metals are excellent electrical conductors but not transparent. Metal nanoparticles can be transparent, but are not usually electrically conductive. We use our expertise to arrange metal nanoparticles into layers that are both transparent and electrically conductive. This research work is supported by the BMBF in the NanoMatFutur project "NanoSpekt". In 2014, particle synthesis and deposition started. We can now prepare suitable particles in sufficient quantities, deposit them, and analyze the layers' conductivity and structure (using SAXS and microscopy). In collaboration with the Program Division *Optical Materials*, Siemens, and many other partners, we also worked on x-ray detectors based on particle-polymer composites.

Particle assembly at gas-liquid interfaces

Liquid coating always involves gas-liquid interfaces. In 2014, we published surprising results on their role in structure formation. Depending on temperature, gold nanoparticles formed mono- and even multilayers (Fig.). Future work will analyze how to exploit this effect in the deposition of thin defined layers.

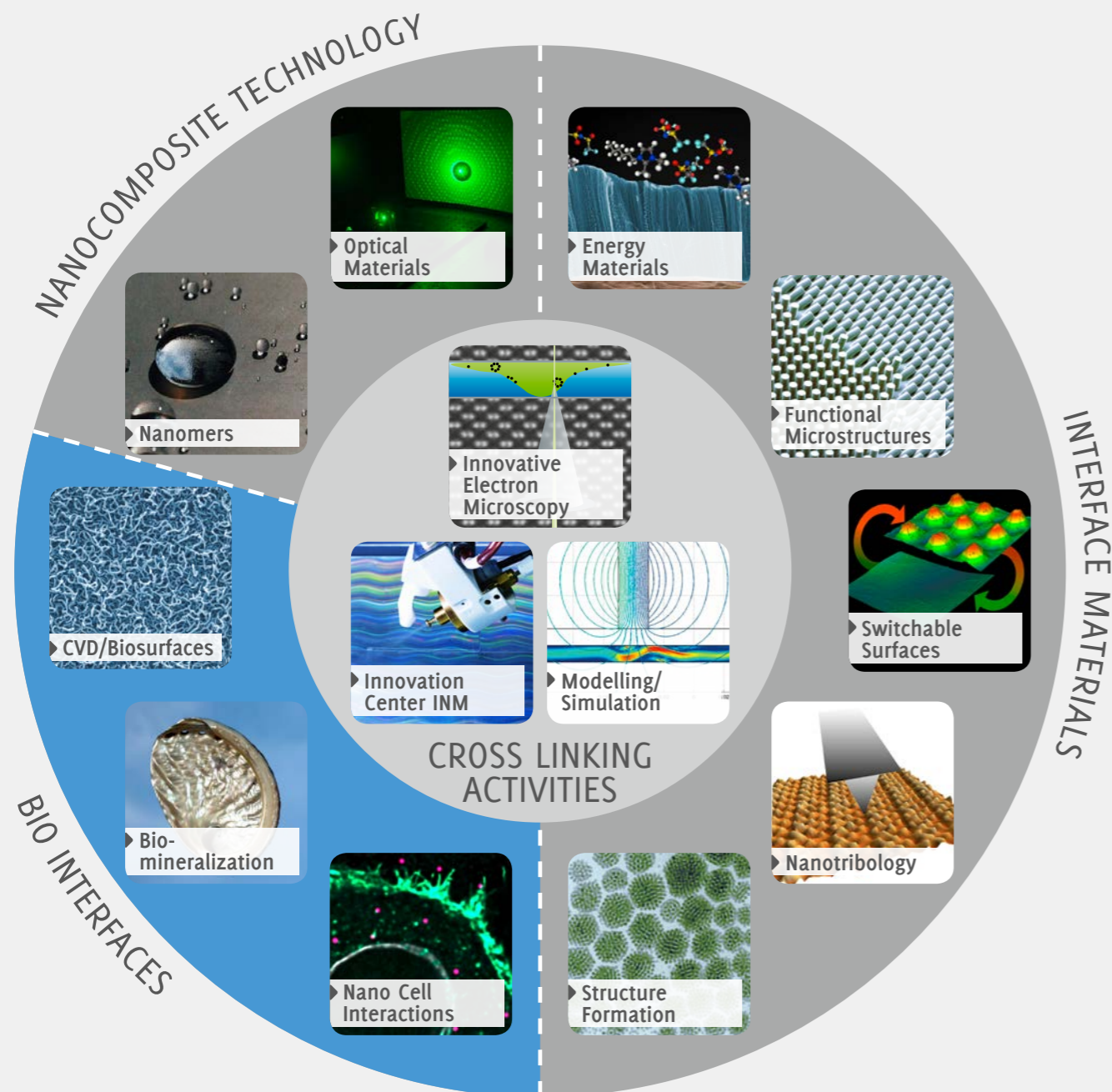
Protein-nanoparticle hybrid clusters

Proteins are the body's "nanoparticles" – complex molecules that perform vital tasks in all organs. They are similar in size with inorganic "engineered" nanoparticles. The interaction between proteins and nanoparticles are important: nanoparticles are used in medicine. A typical interaction is agglomeration, where nanoparticles and proteins clump into larger structures. We collaborate with the Program Division *Nano Cell Interactions* in an INM focus project (see highlight article) to study the formation of such clusters.

OUTLOOK

New electronic materials will remain an important activity of the group. Expansion into photovoltaic layers is planned for 2015. A DAAD-funded exchange grant with Prof. Paul Mulvaney in Melbourne (Australia) will foster collaboration on this topic. Composites with demanding functionality require functional components. The division investigates new routes to synthesize functional nanoparticles like nanowires and to combine functional particles into complex, defined "supraparticles". Transferring new materials from the laboratory to production requires scaleable synthesis processes. Liquid coating is a central technology of INM. Transfer requires intermediate coating scales that allow us to coat macroscopic areas but require small ink volumes. The division will extend its infrastructure and expertise for such transfer in the next years.

► BIOGRENZFLÄCHEN / BIO INTERFACES



DAS FORSCHUNGSFELD *BIOGRENZFLÄCHEN*

Das Forschungsfeld *Biogrenzflächen* entstand im Januar 2014 aus dem vormaligen Forschungsfeld *Materialien in der Biologie*. Im Forschungsfeld werden Forschungs- und Entwicklungsarbeiten betrieben, deren Themen sich auf die Schnittstelle zwischen Materialwissenschaft und Biologie bzw. Medizin konzentrieren. Schwerpunkte sind die topographische Steuerung der Wechselwirkung von Zellen mit Oberflächen bis hin zur Zellprogrammierung, neue Perspektiven der ressourcen- und umweltschonenden Herstellung von Materialien mittels adaptierter Biomineralisation sowie die Interaktionen zwischen nanopartikulären Substanzen und Zellen, Geweben und Organen.

Das Forschungsfeld trägt schwerpunktmäßig zu den INM-Leitthemen B (Medizinische Oberflächen) und D (Nanosicherheit/Nano-Bio) bei. Im Forschungsfeld wird zudem der Leibniz-Forschungsverbund Nanosicherheit koordiniert (Programmbereich *Nano Zell Interaktionen*).

Das Forschungsfeld besteht zum 31.12.2014 aus drei Programmbereichen:

- Programmbereich *Biomineralisation*,
Leitung: PD Dr. Ingrid Weiss
- Programmbereich *CVD/Biooberflächen*,
Leitung: Dr. Cenk Aktas
- Programmbereich *Nano Zell Interaktionen*,
Leitung: Dr. Annette Kraegeloh

THE RESEARCH FIELD *BIO INTERFACES*

In January 2014, the research field *Bio Interfaces* emerged from the former research field *Materials in Biology*. In this research field, the research and development activities concentrate on the interface between materials science and biology or medicine. Focus areas include the impact of topographic features on cells and cell programming, new perspectives of resource- and environmentfriendly synthesis of materials by adapted biomineralization as well as the interactions between nanoparticles and cells, tissues and organs.

The research field contributes especially to INM's lead topics B (Medical surfaces) and D (Nanosafety/Nano-Bio). Furthermore, the Leibniz Research Alliance Nanosafety is coordinated within this research field (Program Division *Nano Cell Interactions*).

The research field *Bio Interfaces* consists of three Program Divisions (as of December 31, 2014):

- Program Division *Biomineralization*,
Head: PD Dr. Ingrid Weiss
- Program Division *CVD/Biosurfaces*,
Head: Dr. Cenk Aktas
- 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*.



► BIOMINERALISATION / BIOMINERALIZATION

PD DR. INGRID M. WEISS

ZIELSETZUNG

Der Programmbereich *Biomineralisation* stellt sich der Herausforderung, die Prinzipien komplex aufgebauter Materialien lebender Organismen auf technologisch herstellbare Multifunktions-Materialien zu übertragen. Im Laufe der Evolution wurden molekulare Grundlagen gelegt, um beispielsweise mechanische Stabilität mit Beständigkeit gegenüber Chemikalien und Witterungseinflüssen zu kombinieren. Basierend auf den Erkenntnissen über diese Materialien lassen sich nun auch neue Wege im Hinblick auf die Nutzung natürlicher Ressourcen verfolgen. Im Jahr 2014 gelang es uns erstmals, einen anorganischen Selbstorganisationsprozess gezielt auf biotechnologischem Wege zu beeinflussen, ähnlich wie Organismen organisch-anorganische Mineralkomposite zu erzeugen. Einen weiteren Schwerpunkt unserer Forschung bildet die kostengünstige Nutzung natürlicher Ressourcen in ökologischen Stoffkreisläufen, um umwelt- und sozialverträgliche Wertschöpfungsketten zu generieren.

MISSION

The Program Division *Biomineralization* focuses on fundamental molecular phenomena associated with the understanding of complex materials formed by living organisms. Whereas, in classical materials science, the path from the recipe for a new composite material is first developed and then processed, natural materials formed by biological entities carry the recipe for their formation inherently within their evolutionary history. They even use biogenic additives to guide and fine-tune mineralization. Our aim is to mimic these additives in order to transfer them effectively into materials science. In 2014, the first proof-of-concept was achieved that a genetically engineered additive specifically interferes with inorganic self-organization processes. The biotechnologically produced additive alters the lattice of a synthetic crystal in a way similar to natural biomineralization. Based on such fundamental insights, we will be able to generate a wide variety of such functional additives for fine-tuning new materials and for establishing ecologically compatible synthesis routes.

CURRENT RESEARCH

Bioinspired materials

The last decade has brought many new insights into the molecular features of biomolecules associated with natural solid-state materials, though their functionality in interfacial interactions still remains unknown in many cases. Especially the dynamic interaction of biomolecules with inorganic crystals is difficult to quantify because there are often too many parameters interfering when crystals are grown in the presence of additives. Microfluidic surface acoustic wave biosensors are used to

► PD Dr. Ingrid M. Weiss



received her doctorate in biophysics at the TU Munich. After a postdoctoral stay at The Weizmann Institute of Science, Israel, she performed her Habilitation at the University of Regensburg. She is Privatdozent of biochemistry at the University of Regensburg and has led the Program Division at the INM since 2008.

observe organic peptides interfering with mineral deposition on a surface, as demonstrated for the first time using bioinspired cationic peptides. The efficiency, high sensitivity and reliability of this analytical method create major advantages for the elucidation of biomolecular functions in biomineralization. This will be of particular importance when bioengineered proteins will increasingly be used to fine-tune crystal structures of inorganic functional materials. As recently demonstrated in collaboration with the Technion Haifa, Israel, a fusion protein consisting of the nacre protein perlucin and the bioluminescent Green Fluorescent Protein (GFP) from the "crystal jelly" *Aequorea victoria*, the famous jelly fish, interferes directly with the mineral phase. This phenomenon was not observed for the GFP alone and has never been demonstrated before for biotechnologically produced biomineralization-inspired composite crystals.

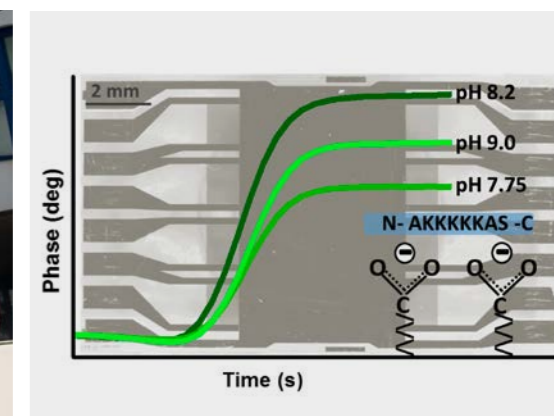
Structure-function relationships in natural biomineral composites

We recently identified a physiological response to mechanical stimuli using genetically distinct inbred lines of *Sorghum* plants. One such inbred line was particularly sensitive to the mechanical stimulation and produced more stable, hierarchically structured cellulose/lignin composite stems upon stimulation. This observation is very important for plant breeders and the entire biomass sector with major consequences for our research towards new materials from renewable resources. Our insights were obtained by conventional biological and bio-

chemical techniques in combination with mechanical bending tests established for freshly harvested *Sorghum* plant material.

OUTLOOK

The Program Division *Biomineralization* combines inspiration from two fundamentally different directions: From the formation mechanisms of biological materials such as pearls or peacock feathers, and from current materials science approaches such as micro- and nanostructured interface materials. We use our expertise in molecular biology and biochemistry to develop unique design strategies towards tunable biomolecular additives for the generation of new composite materials. Our goal is to achieve biotechnological engineering of polymer-based and inorganic composite materials based on fundamental insights into bio-inspired model systems. This knowledge complements current research at the INM towards biotechnologically produced new materials.



► Surface-acoustic-wave-data show strong influence of the pH on the molecular interaction between a carboxy-terminated monolayer and peptides from an enzyme involved in the biomineralization of mollusc shells and confirms structure-formation hypotheses. Image courtesy: A. Pohl

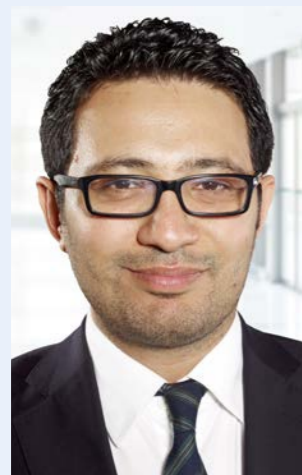
► CVD/BIOBERFLÄCHEN / CVD/BIOSURFACES

DR. CENK AKTAS

ZIELSETZUNG

Im Programmbereich *CVD/Biooberflächen* werden funktionelle, strukturierte Nanomaterialien hergestellt und u.a. für biomedizinische Anwendungen untersucht. Im Bottom-Up-Prinzip werden metallorganische Precursor-Moleküle synthetisiert und durch CVD- oder PVD Gasphasenabscheidung zu dünnen Schichten umgesetzt. Eine 2D oder 3D Strukturierung der dünnen Schichten erfolgt mit verschiedenen Laserverfahren. Zur anwendungsspezifischen Funktionalisierung werden auch nasschemische Methoden eingesetzt, bei denen auf eine umfangreiche Expertise zur Sol-Gel-Chemie am INM zurückgegriffen werden kann. Die Untersuchung und Charakterisierung der neuen mikro- und nanostrukturierten Oberflächen für potentielle Anwendungen nimmt einen großen Umfang ein. Das Hauptinteresse liegt dabei auf dem Einsatz als intelligente Oberflächen auf medizinischen Implantaten. 2014 wurden im Programmbereich zudem mehrere interdisziplinäre Forschungs- und Weiterbildungsprojekte durchgeführt.

► Dr. Cenk Aktas



studied materials science at the University of Kiel and completed his post-graduate studies in bionanotechnology at Kaiserslautern Technical University. He was awarded his doctorate at INM and Saarland University. Since 2010, he has been head of the Program Division *CVD/Biosurfaces*.

MISSION

The Program Division *CVD/Biosurfaces* specializes in bottom-up synthesis and characterization of nanomaterials. The main focus of the research is the development of functional nanomaterials through gas phase synthesis methods. In addition to this "molecule to material" approach, the research group combines plasma and laser assisted materials processing with INM's strong background in wet-chemical synthesis. Another aim is to understand bio/physicochemical interactions at the nano-bio interface. The group specializes in nanotopography driven cellular adhesion, proliferation and differentiation.

CURRENT WORK

We investigate the basic principles of nanotopography driven cellular adhesion, proliferation and differentiation. In recent studies, we focused on the detailed analysis of complex nanoporous surfaces using 3D FIB tomography. Three dimensional characterization of complex nanostructure systems, such as 1D Al/Al₂O₃ nanostructure assemblies, provide more detailed information about the inner structure and morphology rather than simple 2D analysis. Additionally, 3D surface analysis can lead to a better understanding of the interaction between cells and nanostructured surfaces. In collaboration with the Saarland University Medical Center (Prof. Pohlemann) we successfully showed that cell density and cell area were not affected by nanoporosity, whereas metabolic activity was reduced and formation of actin-fibres and focal adhesions was impaired when compared to uncoated glass control. Induction of osteogenic differentiation was demonstrated via

up-regulation of alkaline phosphatase, bone sialoprotein, osteopontin and Runx2 at the mRNA level. This kind of nanoporous surfaces show potential to improve the osseointegration of permanent implants.

The research group developed a new concept for dental implants in collaboration with the Saarland University Medical Center (Prof. Nothdurft and Prof. Hannig). We modified the surface of a medical grade titanium alloy (Ti-6Al-4V) using a pulsed laser to alter the topography and wetting characteristics. Anisotropic surface patterning is combined with a

professional trade shows like JEC Europe, Composites Europe, Texcomp, etc. More than 2500 people participated in our activities on the Education & Training Platform aimed at providing free access to transnational and collaborative training resources on composite technologies. Online training courses in E-Learning format, a database of training institutions and courses related to composite materials and an overview of education systems in partner countries of the +Composites project were successfully implemented by the research group.



► "Composite International Forum" in Luxembourg.

nitride process which improves the protection of dental implants against corrosion and wear. This dual-treatment leads to a homogenous nitride layer and a surface topography composed of both micro- and nano-structures. This specific surface topography induces anisotropy in wetting which is desired in next generation implant applications such as nature-analogue anisotropic dental restoration.

The group completed a four-years' EU funded project "+Composites". The main objective of this project was to encourage the technology transfer from the composite materials networks to SMEs in North West Europe. +Composites supported SMEs wishing to make the transition to composite technologies, in accordance with the rules of sustainability. During four years of field activity +Composites offered 54 events and inter-professional seminars. Together with other project partners the group participated in more than 12 regional and international exhibitions including

OUTLOOK

The Program Division *CVD/Biosurfaces* plans to expand its studies in the field of cell-surface interactions. One of the new research directions will be the development of omniophobic surfaces to study blood-surface interactions. In this context, the group will support on *in vivo* studies in the Saarland University Faculty of Medicine. In addition to biomedical applications, the Program Division plans to use its expertise in synthesis of nanocomposite thin films for industrial applications. In this context, a recently implemented co-sputtering hybrid method which combines physical and chemical deposition will be used for synthesis of multilayer/nanocomposite thin films.

▶ NANO ZELL INTERAKTIONEN / NANO CELL INTERACTIONS

DR. ANNETTE KRAEGELOH

ZIELSETZUNG

Im Programmbereich *Nano Zell Interaktionen* geht es vor dem Hintergrund einer möglichen Toxizität technisch hergestellter nanoskaliger Partikel um die Wechselwirkungen zwischen diesen Materialien und Zellen menschlicher Herkunft. Ziel ist es aufzuklären, welche Mechanismen die Aufnahme und Lokalisation der Partikel vermitteln und welche Parameter die Struktur und Biochemie der Zellen beeinflussen. Als Untersuchungsobjekt werden Nanopartikel aus anorganischen Materialien gezielt hergestellt und charakterisiert. Besondere Aufmerksamkeit wird den Partikeleigenschaften unter experimentell relevanten Bedingungen gewidmet. Zur Lokalisation von Partikeln und Zellstrukturen werden vor allem lichtmikroskopische Techniken eingesetzt. Eine Besonderheit der Gruppe ist hierbei der Einsatz der hochauflösenden Stimulated Emission Depletion (STED)-Mikroskopie. Zur Analyse der Zellantwort werden darüber hinaus chemische, biochemische und molekularbiologische Techniken verwendet.

MISSION

Motivated by the potential toxicity of nanomaterials, the Program Division *Nano Cell Interactions* explores the interactions between cells of human origin and engineered nanoparticles (NPs). The aim of the research is to elucidate mechanisms that affect uptake or location of particles and to define parameters influencing structure and biochemistry of the cells. For this reason, well-defined inorganic NPs are prepared and characterized, addressing also their interactions with biologically relevant molecules. In order to localize particles and cellular structures, light microscopy is applied. In particular, the application of super high resolution Stimulated Emission Depletion (STED) microscopy for “nanotoxicological” questions is a distinctive feature of the group. Cellular responses are analyzed by chemical, biochemical, and molecular biology techniques.

CURRENT WORK

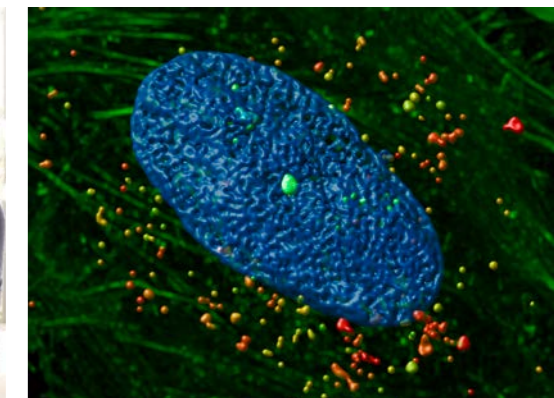
Quantification of nanoparticle uptake in alveolar epithelial cells

Engineered nanoparticles (NPs) are of increasing importance for technical and biomedical applications. The development of safe nanomaterial applications requires a detailed understanding of their interaction mechanisms on a cellular level. The quantification of NP internalization is crucial to predict the potential impact of intracellular NP doses, providing essential information for risk assessment as well as for drug delivery applications. Recently, the internalization of 25 nm and 85 nm silica particles exposed to A549 lung epithelial cells was compared using equal particle number concentrations. Beyond particle sedimentation, studied

▶ Dr. Annette Kraegeloeh



The graduate biologist received her doctorate at the University of Bonn. After joining the Life Science group at INM in 2004, she has been head of the Program Division *Nano Cell Interactions* since 2008. She is presently a habilitation candidate at Saarland University.



▶ Reconstruction of a 3d image stack of a lung epithelial cell (A549). Actin cytoskeleton (green), cellular nucleus (blue) and 24 nm silica nanoparticles (colored).

by implementation of an *in vitro* sedimentation and diffusion model, no intracellular accumulation of particles above the extracellular level adjacent to the cells was observed.

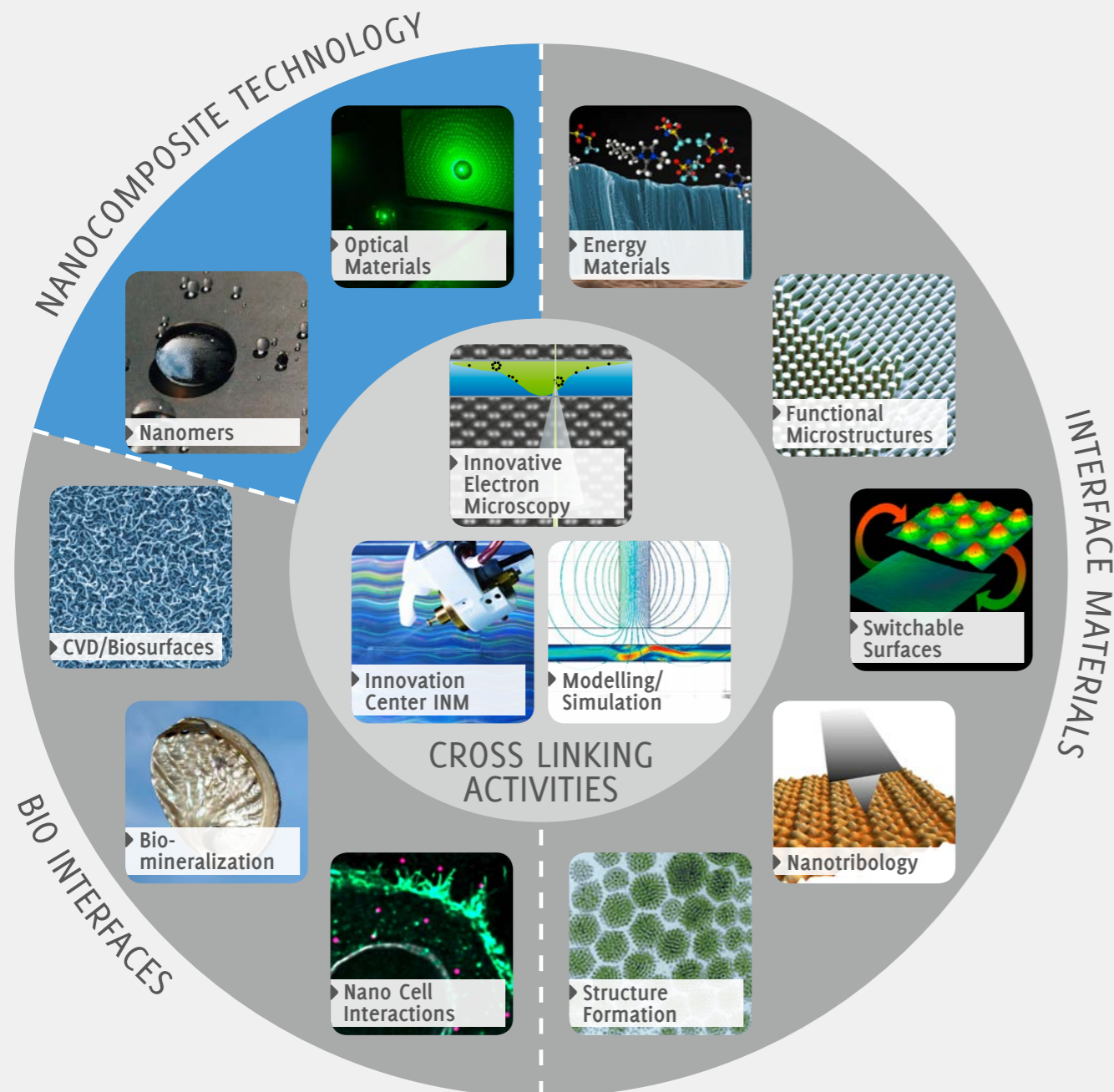
Nanoparticle uptake in enterocytes

In order to analyze the internalization of nanoparticles and their cellular effects under realistic conditions, the usage of well-defined cellular models is necessary. For example, cells of the gastro-intestinal tract form a tight cell layer with barrier function only in the differentiated state. The aim of this study was to compare internalization and effects of nanoparticles on differentiated and undifferentiated Caco-2 cells. We utilized three types of quantum dots (QD) composed of a core-shell of cadmium selenide-zinc sulfide (CdSe-ZnS) and functionalized with various polymer coatings (carboxyl, amino, and PEG). Cells were treated with each type of QD to assess cytotoxicity and QD uptake. Two assays were performed to determine the effects of QD on cell viability: a live-dead assay and the WST-1 assay indicating metabolic activity of the cells. Samples were analyzed by confocal laser scanning microscopy to determine internalization efficiency. Initial results indicate that the various QD types are taken up in different amounts. Furthermore, in comparison to differentiated cells, the undifferentiated cells appeared to take up higher amounts of nanoparticles.

OUTLOOK

Future studies aim to elucidate the correlation between initial signaling events involved in cellular responses relevant for chronic or long-term particle effects and particle location relative to proteins and organelles involved in these signaling events. In addition, the effects of nanoparticles on the functionality of type II alveolar epithelial cells will be evaluated by microscopy and expression analyses. In this context, a mechanical strain will be applied to alveolar cells in their physiological environment. A special focus will be set on the penetration of nanoparticles into the cellular nucleus in relation to the properties of the particles as well as on the elucidation of the penetration mechanisms. Two-channel STED microscopy will be applied for colocalization analysis on nanoparticle location.

NANOKOMPOSIT-TECHNOLOGIE / NANOCOMPOSITE TECHNOLOGY



DAS FORSCHUNGSFELD NANOKOMPOSIT-TECHNOLOGIE

Das Forschungsfeld *Nanokomposit-Technologie* entstand im Januar 2014 aus dem vormaligen Forschungsfeld *Chemische Nanotechnologie*. Es widmet sich nichtmetallisch-anorganischen Hybridmaterialien, vorwiegend in Form von Beschichtungen, und ihren funktionellen Eigenschaften. Schwerpunkte sind nasschemische Synthesemethoden und die Nutzung von funktionalisierten Nanopartikeln. Der Fokus der Arbeiten liegt in der Verwendung der Konzepte für konkrete industrielle Anwendungen. Die Materialien werden für den Einsatz beispielsweise in den Bereichen Elektronik, Medizintechnik, Optik, Automobil, Displays, erneuerbare Energien sowie Maschinenbau und Elektrotechnik entwickelt.

Dieses Forschungsfeld trägt schwerpunktmäßig zu den INM-Leitthemen A (Energieanwendungen), C (Tribologische Systeme) und D (Nanosicherheit/Nano-Bio) bei. Es vertritt zudem das INM im Forschungscampus caMPlusQ, einer Gemeinschaftsinitiative der Ingenieurwissenschaften der Universität des Saarlandes und ihrer benachbarten außeruniversitären Forschungsinstitute (Programmbereich *Nanomere*).

Das Forschungsfeld besteht zum 31.12.2014 aus zwei Programmbereichen:

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

THE RESEARCH FIELD NANOCOMPOSITE TECHNOLOGY

In January 2014, the research field *Nanocomposite Technology* emerged from the former research field *Chemical Nanotechnology*. This 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. The materials are developed for applications, for example, in electronics, medicine, optics, automotive, display technology, renewable energies as well as construction and electrical engineering.

This research field contributes significantly to INM's lead topics A (Energy applications), C (Tribology) and D (Nanosafety/Nano-Bio). Furthermore, it represents INM in the Forschungscampus caMPlusQ, a joint initiative of the engineering sciences at Saarland Universities and its neighboring non-university research institutes (Program Division *Nanomers*).

The research field *Nanocomposite Technology* consists of two Program Divisions (as of December 31, 2014):

- ▶ 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

ZIELSETZUNG

Der Programmbereich *Nanomere* erforscht Struktur-Eigen-schaftsbeziehungen in Komposit- sowie Nanokompositma-terialien und entwickelt daraus multifunktionelle, vielfältig einsetzbare Werkstoffe. Funktionelle Submikrometer- und Nanopartikel werden dabei gezielt verwendet, um neue Werkstoffeigenschaften beispielsweise in organischen Poly-meren und organischen-anorganisch Hybridpolymeren möglichst maßgeschneidert einzustellen. Die eingebrachten, meist anorganischen Partikel ermöglichen die ihnen inne-wohnenden Eigenschaften durch geeignete Dispergierung in beschichtungsfähige Systeme oder auch kompakte Mate-rialien zu integrieren. Die Verarbeitbarkeit der erhältlichen Mischungen orientiert sich an industriell etablierten Tech-niken, was den Transfer in spezifische Anwendungen er-heblich erleichtert. Erzielbare Funktionen sind die Kontrolle von Reibung, Korrosionsschutz, anti-mikrobielle Wirkung oder auch Abriebfestigkeit kombiniert mit Transparenz und Gasdiffusionsbarriere.

MISSION

The research and development activities of the Program Division *Nanomers* comprise basic studies to determine structure – property relationships in polymer matrix composite coatings and bulk materials as well as application oriented projects in co-operation with industrial partners. Functions that can be realized in the area of wet chemical coatings are control of friction, corrosion protection, anti-microbial effects or wear resistance combined with transparency and barrier proper-ties. Fields of application are electronics, medical applications, optics, automotive, mechanical and electrical engineering.

CURRENT WORK

The development of corrosion protection coatings for steel and other corroding metals is one important research topic. Two different principles are cur-rently being pursued on this technology platform: Diffusion barrier layers based on highly structured composite materials showing excellent adhesion and abrasion resistance and hybrid nanocomposite coatings derived from sol-gel processes which form bonds to the metal surface with higher sta-bility than metal oxide (rust) bonds. Appropriate patent applications by INM are used as a basis for collaborative projects with industry. Fields of ap-plication can be found in the automotive as well as in the construction industry. In this context an EU-project from FP7 called WELDAPRIME (“Self-repairable Zinc-free Weldable Anti-corro-sion Primer for the Steel Protection”) started in February 2014. The main topic is the development of zinc free weldable primers for steel, which are to provide intermediate corrosion protection

▶ Dr.-Ing. Carsten Becker-Willinger



studied chemistry at the Albert-Ludwigs-University in Freiburg majoring in macromolecular chemistry. From 1993 to 1998, he worked at the INM on his doctoral thesis on thermo-plastic nanocomposites. In 2001, he became head of the Program Division *Nanomers*.

during transportation and storage immediately after production of the parts. In addition, the Pro-gram Division also developed particulate additives demonstrating active corrosion protection mech-anisms in coatings. A patent application was filed in 2014 protecting specially structured metal phos-phate nanoparticles that show corrosion inhibiting capability on mild steel. The corrosion behavior was investigated with standardized weathering tests as well as Scanning Kelvin Probe (SKP), Scanning Vibration Electrode (SVET) and Electrochemical Impedance Spectroscopy (EIS). A protective coat-ing was successfully developed with an industry partner for the use on electronic parts to prevent corrosion of the metallic conductor lines. The tech-nology in this project was transferred in mid-2014 to the *Innovation Center INM* to up-scale the syn-thesis process for eventual implementation at the industry partner site.

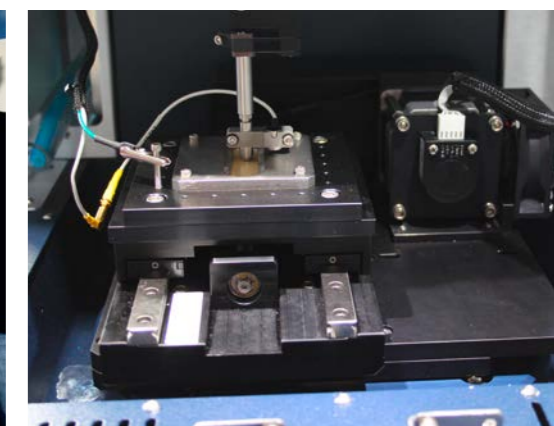
Abrasion resistant low friction coatings with combined corrosion protection are another im-portant research topic. Within the frame work of INM’s internal competitive call, the focus project FLAKELUB contributed fundamental investigations on tribological coatings for dry lubrication representing new composite mor-phologies with finely structured layers. It was conducted jointly between the Program Divi-sions *Nanomers* and *Nanotribology*. The final re-

sults indicate that the fine structured morphology achieved when platelets are added to classical low friction coatings is responsible for the ob-served synergistic lubrication effect. Applications of these types of coatings are envisaged for the area of mechanical engineering.

A doctoral thesis was finalized dealing with the development of new types of transparent powder coatings with improved scratch resistance.

OUTLOOK

Future work in the Program Division *Nanomers* will be concerned with hygienic coatings used in med-ical applications. The work will be based on two INM patent applications filed in 2013. A new project supported by the BMBF deals with development of self-disinfecting medical devices that are bio dis-posable. The results of FLAKELUB will be applied to parts with three-dimensional surfaces in co-operation with *Innovation Center INM*. Furthermore, the influence of particle density and processing parameters on the platelet filler particle orien-tation in the composites to achieve high-barrier properties and high mechanical strength will be further investigated.



▶ New tribometer established at INM to investigate stick-slip and long distance friction behavior at macroscopic scale.

▶ OPTISCHE MATERIALIEN / OPTICAL MATERIALS

DR. PETER WILLIAM DE OLIVEIRA

ZIELSETZUNG

Der Programmbereich *Optische Materialien* erforscht neue Beschichtungswerkstoffe mit besonderen Eigenschaften, deren Funktion auf der Wechselwirkung mit elektromagnetischer Strahlung beruht. Die Entwicklung von neuen optischen Beschichtungen umfasst Materialsynthese sowie Applikations- und Strukturierungstechniken. In nationalen und internationalen Kooperationen wurden im Jahr 2014 die folgenden Themen bearbeitet: Entwicklung lichtabsorbierender Schichten durch Einbau von Nanopartikeln in glasartige Matrices, Fotoabscheidung von Silber- und Kupferschichten, biokompatible und photochrome Komposite, Verschiebung der Plasmonenresonanz durch Gasadsorption in Goldrubinglasmaterial, Untersuchung der elektrischen Permittivität von dreischichtigen Mischperowskit-Keramikbändern sowie Herstellung von Leuchtpartikeln mit Zusammensetzungen der Mischkristallreihe $(Y,Gd)_2O_3:Eu$ (in Kooperation mit dem Programmbereich *Strukturbiologie*).

MISSION

The Program Division *Optical Materials* develops composite materials for functionalization of glass, ceramic and polymeric substrates to interact with electromagnetic radiation. The expertise in wet chemical syntheses of organic-inorganic matrices combined with experience in the production of nanoparticles with specific chemical modifications allows the development of new optical materials for coating applications. Also we fine-tune the chemical and physical properties of the new materials to fulfill the requirements of specific products and processes.

CURRENT RESEARCH

In 2014, several projects on fundamental aspects of nanoparticle production have contributed to the development of materials for printed electronics, lighting, and solar energy. Advanced industrial projects in the area of touch screens, optical filters, glass and ceramic composites have created alternative products and/or production processes for the optical industry.

Project INSIGHT

The European project *Insight* focused on the development of new instrumentation for nanometrology. Its aim was the determination of characteristic data like shape, size and composition of nanoparticles *inline* during the manufacturing process. In order to obtain the data, improved and new detection principles like ultrasound, direct visualization of the particles etc. were established. It was possible to implement an innovative probe combining ultrasonic and ultra-optical microscopy. The data obtained from the various measurements were integrated in a joint user interface.

▶ Dr. Peter William de Oliveira

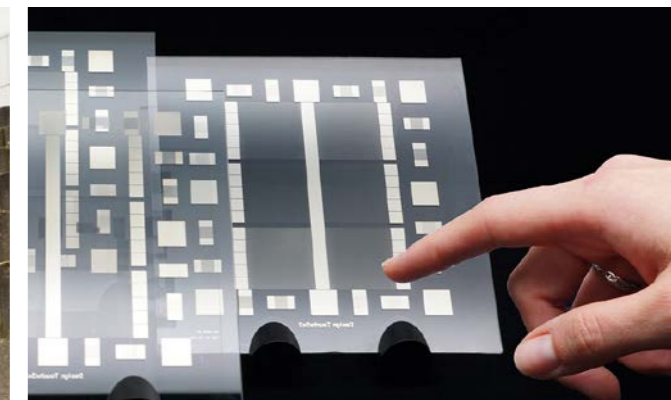


has been head of the Program Division *Optical Materials* since 2005. He studied physics in Brazil and came to INM after obtaining his diploma and master degree. He also heads the new *Innovation Center INM*.

Electrical permittivity of layered ceramic tapes

The electrical permittivity of trilayered $BaTiO_3/BaTi_{1-x}Zr_xO_3/BaTiO_3$ ceramic tapes was studied. The samples were produced by sintering stacked homogeneous tapes composed of nanometric $BaTi_{1-x}Zr_xO_3$ dispersed in a water-based, environmentally friendly binder system. The thermal mismatch between the layers increases with the amount of Zr^{4+} substituting Ti^{4+} . The internal stress developed during sintering affected the electrical permittivity. Despite limited diffusion between the layers, a simple mixture rule fails in predicting the electrical permittivity of the trilayered samples.

subsequent transformation to Janus character, the synthesis was reduced to one step. In contrast to the different locally confined modifications, controlled growth of different particle compartments was achieved during particle synthesis. The focus was on silica particles with a huge variety of possible applications. For preparation, various silanes were used to build up different compartments. The particles were characterized by SEM and EDX to determine their shape and elemental composition. With this approach, the wax in water emulsion and the problematic slow reactivity of the silica particles can be avoided.



▶ Production of a touch sensor through photo-metallization process.

Photodeposition of copper with UV light

Continued investigation on the photochemistry of copper complexes has led to the determination of 275 nm as reaction wavelength for the deposition of metallic copper. $Cu(F_6Acac)_2$ and $Cu(Acac)_2$ with Benzophenone in 2-Propanol and $CuPyr_2$ 4-TBC with Acetone in Ethanol are systems that deposit metallic copper. $CuPyr_2$ 4-TBC, designed and synthesized at INM, deposited copper more homogeneously, in significantly higher quantity and at higher speed when compared with commercial complexes.

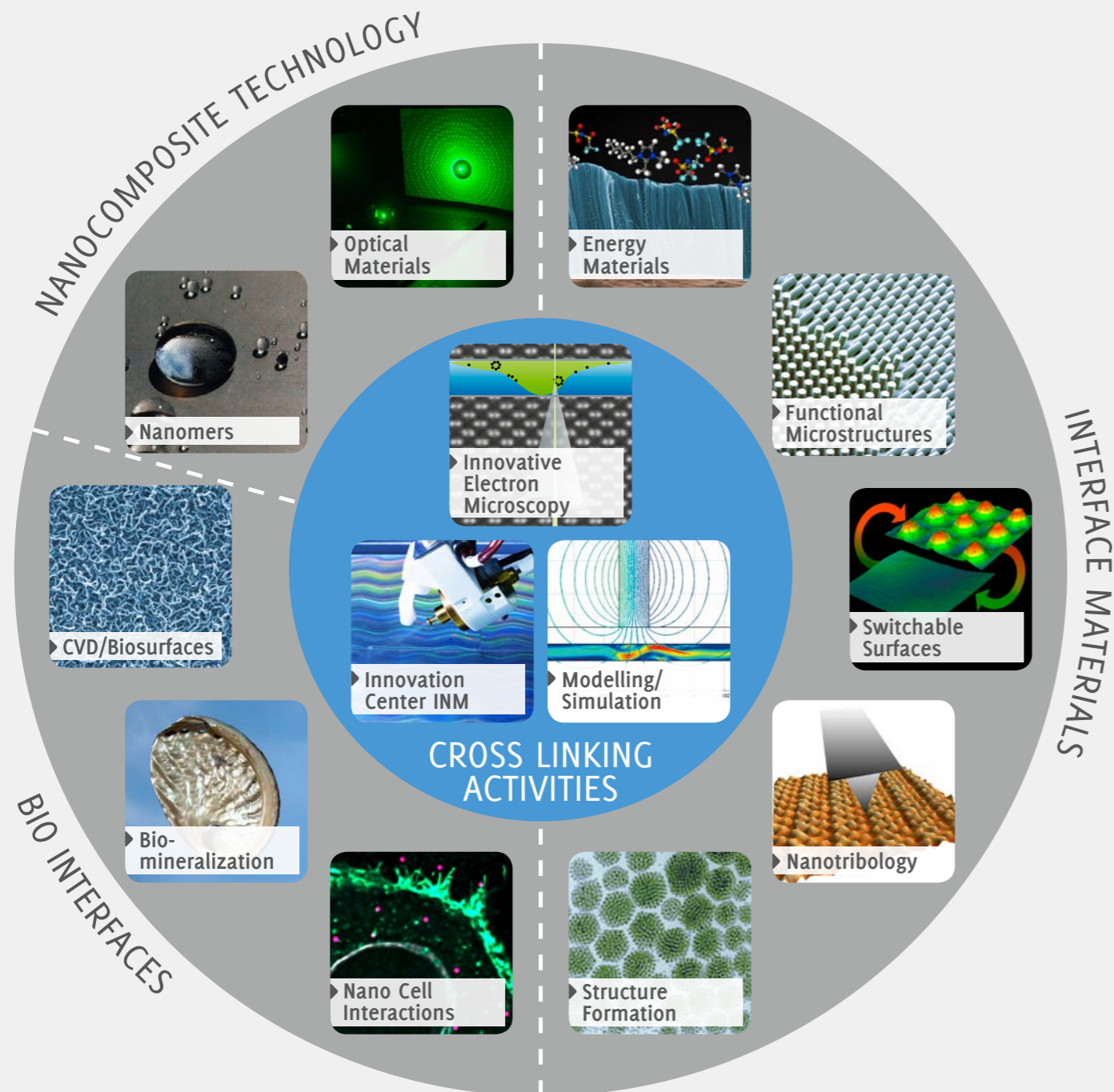
Janus nanoparticles and their self-assembly in polymers and on surfaces

In the synthesis of Janus particles, a new strategy was tested: Instead of preparing particles with

OUTLOOK

The combination of optical effects, material development and processing has been a core strategy of the Program Division *Optical Materials*. It has contributed to the sustainability of the technological platform and the balance between basic and applied research. Our long term goal is to understand how material development can be used to access new optical effects as a basis for new products and to transfer these technologies to the market.

▶ QUERSCHNITTSFELD / CROSS LINKING ACTIVITIES



DAS QUERSCHNITTSFELD

Im *Querschnittsfeld* sind übergreifende Forschungs- und Entwicklungsthemen zusammengefasst, die neben eigener Forschung die Arbeit der anderen Programmbereiche unterstützen. So wendet der Programmbereich *Innovative Elektronenmikroskopie* die elektronenmikroskopische Methodik auf neu materialwissenschaftliche und biologische Fragestellungen an. Die Arbeiten des Programmbereichs *Modellierung/Simulation* zielen auf Forschungsarbeiten, die methodische Beiträge zu anderen Forschungsfeldern leisten.

Im August 2014 wurde das *InnovationsZentrum INM* eingerichtet, das die Wissenschafts- und Technologiebasis des INM mit Industrieunternehmen verbindet. Es koordiniert Kooperationsprojekte mit der Industrie und setzt diese um, zusätzlich bietet es Beratung und analytische Serviceleistungen an.

Das *Querschnittsfeld* besteht somit zum 31.12.2014 aus drei Programmbereichen:

- ▶ Programmbereich *Innovative Elektronenmikroskopie*, Leitung: Prof. Dr. Niels de Jonge
- ▶ Programmbereich *InnovationsZentrum INM*, Leitung: Dr. Peter W. de Oliveira, stv. Leitung: Dr. Tobias Kraus
- ▶ Programmbereich *Modellierung/Simulation*, Leitung: N.N.

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 work of the Program Division *Modelling/Simulation* aims at research providing a methodic contribution to other Program Divisions.

In August 2014, the *Innovation Center INM* was implemented. The *Innovation Center INM* connects the scientific and technological basis of INM with industry. It coordinates cooperation projects with industry and implements them. Additionally, it offers consulting and analytical services.

The *cross linking activities* area consists of three Program Divisions (as of December 31, 2014):

- ▶ Program Division *Innovative Electron Microscopy*, Head: Prof. Dr. Niels de Jonge
- ▶ Program Division *Innovation Center INM*, Head: Dr. Peter W. de Oliveira, deputy head: Dr. Tobias Kraus
- ▶ Program Division *Modelling/Simulation*, Head: N.N.

Mehr Informationen über das *Querschnittsfeld* finden Sie hier. ▶

More informations about the *cross linking activities* area.



▶ INNOVATIVE ELEKTRONENMIKROSKOPIE / INNOVATIVE ELECTRON MICROSCOPY

PROF. DR. NIELS DE JONGE

ZIELSETZUNG

Eine nanometergenaue Materialcharakterisierung ist unabdingbar für die Weiterentwicklung der modernen Nanotechnologie, der Energiewissenschaft und der Biologie. Der Programmbereich *Innovative Elektronenmikroskopie* (IEM) betreibt interdisziplinäre Forschung an der Schnittstelle von Bio-Nanotechnologie, Materialwissenschaft, Zellbiologie, Physik der Elektronenmikroskopie und Bildverarbeitung. Zur dreidimensionalen Atomstrukturanalyse und zur chemischen Materialanalyse sowie für die Untersuchung von biologischen Systemen und funktionellen Materialien in Flüssigkeit stehen dem Programmbereich ein hochmodernes Rastertransmissionselektronenmikroskop (JEOL ARM200F) und weitere Mikroskope wie ein ESEM (FEI Quanta) und ein Fluoreszenzmikroskop (Leica, DMI6000) zur Verfügung. Es bestehen vielfältige Forschungsk Kooperationen innerhalb des INM sowie mit verschiedenen Universitäten und der Industrie.

▶ Prof. Dr. Niels de Jonge



is a biophysicist working on biological electron microscopy and nanotechnology. He has been head of the Program Division since 2012. He is Honorary Professor of Experimental Physics at the Saarland University and Adjunct Assistant Professor of Biophysics at the Vanderbilt University School of Medicine, USA.

MISSION

Characterization of matter with nanometer precision is indispensable for the progress of nanotechnology and biology. The Program Division *Innovative Electron Microscopy* conducts research at the interface of bio-nanotechnology, materials science, cell biology, physics of electron microscopy, and image processing. For atomic structure and chemical material analysis as well as for the investigation of biological systems and materials in liquids we have a state-of-the-art scanning transmission electron microscope (JEOL ARM200F) and other microscopes available such as an ESEM (FEI Quanta) and a fluorescence microscope (Leica, DMI6000). We sustain multiple cooperations within INM and with universities and industrial partners.

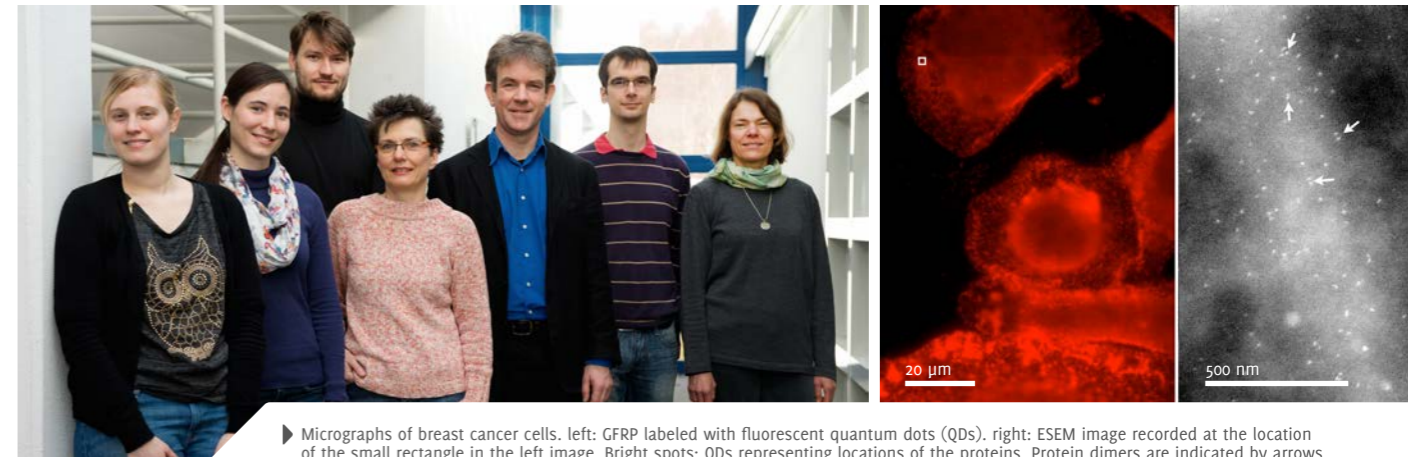
CURRENT WORK

Aberration-corrected STEM

The group conducts research using an aberration-corrected scanning transmission electron microscope (STEM, ARM200, JEOL). Several projects have been initiated in the areas of functional nanomaterials, whose properties are related to the atomic structure and to crystal dislocations. Aberration-corrected STEM is capable of atomic-resolution elemental mapping, such that rows of single atoms can be studied.

3D STEM

The currently used method for investigating the 3D organization of cellular structures is tilt-series TEM. This technique is limited due to the high tilt-angles of up to 70° and the challenge to image samples of several micrometers thickness, i.e. those containing whole cells. For this purpose,



▶ Micrographs of breast cancer cells. left: GFRP labeled with fluorescent quantum dots (QDs). right: ESEM image recorded at the location of the small rectangle in the left image. Bright spots: QDs representing locations of the proteins. Protein dimers are indicated by arrows. Dimerisation of the receptor may lead to cancer cell growth.

we develop a novel 3D STEM technique capable of high-resolution 3D imaging without a tilt stage. In a manner similar to confocal light microscopy, the sample is scanned layer-by-layer and a focal series is recorded. Nanoscale 3D resolution results from the high beam convergence. We improve the vertical resolution by combining focal- and tilt-series STEM. This project involves new algorithms for 3D reconstruction which are being developed at the German Research Center for Artificial Intelligence (DFKI).

Liquid electron microscopy of membrane proteins on intact cells

Our central project is the application and optimization of a new technology for *in situ* STEM, named Liquid STEM. Whole eukaryotic cells in liquid are enclosed in a micro-fluidic chamber with a thickness between 0.5 and 5 µm contained between two ultra-thin, electron-transparent windows. On account of the atomic number (Z) contrast, nanoparticles of a high-Z material can be detected against a low-Z liquid. Nanoparticles specifically attached to proteins can thus be used to study protein distributions in whole cells in liquid. It is also possible to operate Liquid STEM using ESEM at the thin edges of cells. This setup allows studying tens of cells to obtain statistics of a cell culture. One current project involves the area of cancer research. We are studying growth factor receptor proteins (GFRP) at the single molecular level, including effects of drugs targeting these receptors. This project is conducted in cooperation with the German Cancer Research Center (DKFZ).

Liquid electron microscopy of nanomaterials

The method described above is also used to study nanomaterials in liquid. Currently we are exploring *in situ* electron microscopy of self-assembly and growth processes of metallic nanoparticles investigating the motion of nanoparticles in close proximity to a solid material. We also study materials relevant for biomineralization and dental applications.

OUTLOOK

The Program Division is well situated to conduct research at the forefront of electron microscopy in biology/biophysics and materials science. One of our aims is to study processes in eukaryotic cells, to develop a new characterization method for membrane proteins in cancer cells, and to combine liquid STEM with high resolution fluorescence microscopy. With this novel method we explore new phenomena not visible with existing microscopy methods.

▶ INNOVATIONSZENTRUM INM / INNOVATION CENTER INM

DR. PETER WILLIAM DE OLIVEIRA, DR. TOBIAS KRAUS

ZIELSETZUNG

Das 2014 gegründete *InnovationsZentrum INM* verbindet die Wissenschafts- und Technologiebasis des INM mit der Wirtschaft. Zu seinen Hauptaufgaben zählen die Koordination und die Umsetzung von Kooperationen zwischen dem INM und der Industrie. Hierzu gehören nicht nur Kooperationsvorhaben und Beratungsleistungen, sondern auch Angebote für chemische und physikalische Analysen. Starker Wettbewerb und zunehmend verkürzte Produktzyklen von High-Tech-Produkten erfordern eine kontinuierliche und effiziente Umsetzung neuer Ideen. Dazu ist die Begleitung der Materialentwicklung durch Anpassung des Produktionsprozesses unerlässlich. Expertise in verschiedensten Disziplinen und das breite Forschungsportfolio des INM eröffnen eine Fülle an Entwicklungsmöglichkeiten und Anknüpfungspunkte für industrielle Applikationen.

MISSION

The *Innovation Center INM (InnovationsZentrum INM)* was established in 2014 to link INM's scientific and technological base with industry. INM's impact on industrial production depends on close links with industrial partners, and the *Innovation Center INM* supports all members of INM in the acquisition of industrial projects through professional science-to-business marketing. The center develops coherent innovation strategies and actively presents them at trade fairs and conferences. The INM conducts research into customized micro and nanostructured materials and surfaces, for example in the areas of energy efficiency, printed electronics, medical surfaces, optical applications, and applications in the oil and consumer goods industries. The *Innovation Center INM* adapts these technology platforms to cater for the particular requirements of industry. The *Innovation Center INM* has the staff, facilities and equipment required for upscaling, process development, plant development, and quality assurance.



▶ Dr. Peter William de Oliveira

has been head of the Program Division *Optical Materials* since 2005. In 2014, he took on the additional task as head of the newly formed *Innovation Center INM*.



▶ Dr. Tobias Kraus

has been head of the Program Division *Structure Formation* since 2014. Additionally, he is deputy head of the *Innovation Center INM* and responsible for the analytical services offered by the *Innovation Center INM*.

CURRENT WORK

The *Innovation Center INM* performs development projects at the highest professional standards and ensures the proprietary character of all collaborations. We list below some generic recent developments.

Barrier coating for electronic parts

A barrier coating for the protection of electronic devices was developed, thoroughly tested, and optimized. The upscaling step was performed in collaboration with a manufacturer of coating systems and

Gecomer Adhesives

The Gecomer technology results from long-term fundamental research in the field of micropatterning and contact mechanics at INM. The Program Division *Functional Microstructures* collaborates closely with *Innovation Center INM* in order to test and scale-up micro-structured polymer surfaces for industrial purposes. A first outcome of this co-operation is the development of a new testing device. The topic continues to receive strong commercial interest and has been the subject of a feasibility study for industry.



▶ The *Innovation Center INM* is the bridge between INM's research fields and industry.

helped establish a stable large-scale production. The entire upscaling process was conducted jointly with the Program Division *Nanomers*.

Colored coatings

Glass-like and glass-ceramic hybrid coatings are well established at INM. These materials combine corrosion protection with wear resistance and are stable up to high temperatures. In this project, the *Innovation Center INM* built on research results of previous years to create high temperature stable color pigments for decorative purposes that can fulfill the requirements of commercial partners. Both matte coatings with significant amounts of pigments in the wet film and glossy coatings with an additional layer were developed. The project serves as an example of how the *Innovation Center INM* successfully transfers INM's technology base to industrial partners.

OUTLOOK

Research at INM during the last years has brought remarkable progress in emerging areas such as particle self-assembly into electronic structures, bio-inspired mineralization of functional composites, nanotribology, advanced bio-inspired adhesion systems, materials for energy storage, new barriers to prevent gas diffusion and corrosion, and materials for new optical devices. The mission of the *Innovation Center INM* is to intensify the collaboration with industrial partners and to successfully transfer INM's innovations into novel products.

► MODELLIERUNG/SIMULATION / MODELLING/SIMULATION

N.N.

ZIELSETZUNG

Die Aufgabe des Programmbereichs ist die Erstellung theoretischer Modelle und Simulationen für am INM untersuchte Materialien und Phänomene. Im Jahr 2014 wurde eine Reihe theoretischer Fragestellungen durch Kooperationen mit Externen und in enger Verzahnung mit anderen Programmbereichen bearbeitet.

Das Projekt „TriboBrain“, in Zusammenarbeit zwischen Prof. Dr. Dr. Daniel Strauss (HTW Saarbrücken/Universität des Saarlandes) und dem Programmbereich *Nanotribologie*, befasste sich mit der Identifizierung und Analyse hirnelektrischer Antwortpotentiale, die im Zuge tribologischer Experimente zwischen dem menschlichen Finger und unterschiedlichen Materialien gewonnen wurden.

In einer Arbeit in Kooperation zwischen Prof. Robert McMeeking (University of California), Prof. Norman Fleck (University of Cambridge) und dem Programmbereich *Funktionelle Mikrostrukturen* wurde ein geschlossenes Modell für die Mechanik der Ablösung von Mikrosäulen von einem Substrat etabliert. Die Studie soll das experimentelle Design adhäsiver Oberflächenmikrostrukturen erleichtern und beschleunigen.

MISSION

The Program Division is designed to construct theoretical models and simulations for materials and phenomena which are under investigation at INM. Several theoretical issues were treated in close cooperation with other Program Divisions and external partners in 2014.

CURRENT RESEARCH

TriboBrain – Identifying neural response to tribological stimuli

The sense of touch, from an evolutionary point of view, is the first sense developed in the human fetus. Surprisingly, the scientific quantification of touch is still in its infancy when compared with the other senses. Recent research on friction between surface materials and human skin mostly can be grouped into two topical areas: materials science and tribology studies and psychophysical investigations on tactile perception. The purpose of our work at INM is to study neurophysiological events and evaluate whether their appearance can be correlated to tribological signals and ultimately to the surface structure. For this purpose, a fingertip tribometer linked to an electroencephalographic (EEG) recording stage was built. In the signal processing step, a key challenge is the separation of stimuli related neural activity from the EEG background. Despite the defined trigger signal related to the event (contact fingertip-surface), sophisticated analysis schemes are required. A two-dimensional de-noising procedure (cyclic variational de-noising) inspired by image processing was applied to enhance the characteristic alpha waves. In calculating the correlation between the latency, i.e. the delay of the event-related potential, and the magnitude of the friction force immediately after first contact, we observed that stronger friction stimuli cause earlier neural responses as expressed in the measured brain waves. This project is carried out in cooperation between Prof. Dr. Dr. Daniel Strauss (HTW Saarbrücken/Saarland University) and the Program Division *Nanotribology*.

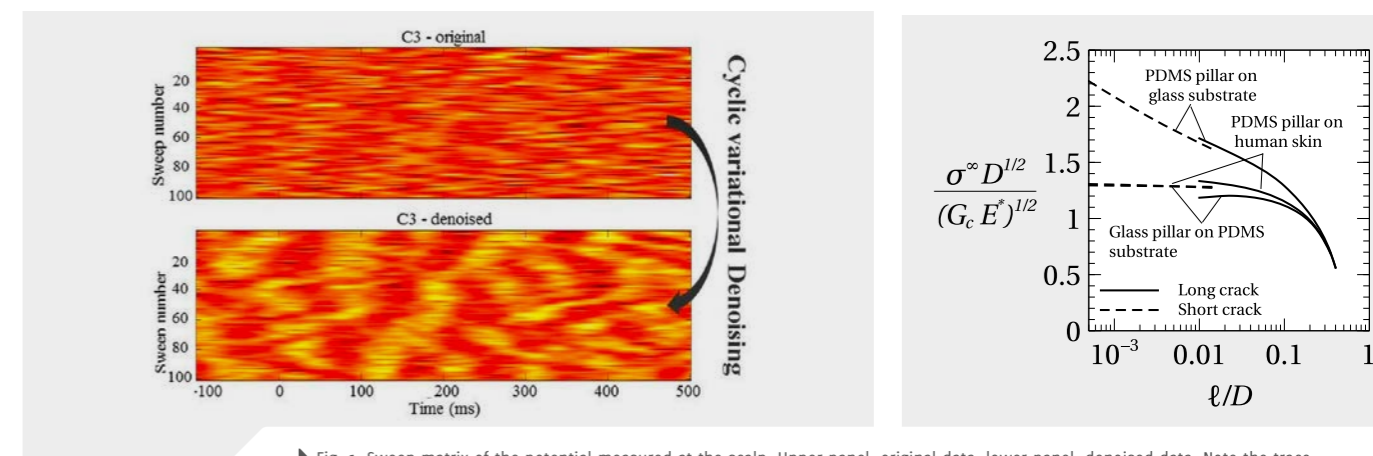
Modeling of Micropillar Detachment from a Dissimilar Substrate

INM's micropatterned dry adhesive surfaces are currently at the brink of commercialization (Gecomer technology). For the rational optimization of such surfaces, a full understanding of the micromechanical detachment mechanisms and the role of the governing parameters is required. To some approximation, the problem can be reduced to the detachment of a single elastic pillar from an elastic substrate. In our recent studies, we explored the sensitivity of the pull-off stress to the flaw size and the degree of elastic material mismatch. We found optimum designs for bonding to either stiffer or more compliant substrates. Our analysis highlights the fact that a stiff pillar on a compliant substrate gives a smaller pull-off stress than a compliant pillar on a stiff substrate; this result is highly relevant for biomedical

applications of micropatterned adhesives. This work was carried out in cooperation between Prof. Robert McMeeking (University of California), Prof. Norman Fleck (University of Cambridge) and the Program Division *Functional Microstructures*.

OUTLOOK

Modeling and simulation will remain an essential element of material optimization. We plan to continue and intensify the existing research projects. New research topics will be carried out, subject to the future staffing of the Program Division. An important goal is to establish an independent research profile which is at the same time compatible with the strategy of the experimental Program Divisions.



► Fig. 1: Sweep matrix of the potential measured at the scalp. Upper panel: original data, lower panel: denoised data. Note the trace starting around 250 ms for trial #1 and shifting towards shorter delays of ca. 120 ms for trial #100.
Fig. 2: Theoretical normalized pull-off stress for different material combinations, as function of relative crack length. Note the predicted difference between PDMS pillars on glass and on skin (J. Mech. Phys. Solids 2015).

▶ SERVICEBEREICHE / SERVICE GROUPS



SERVICEBEREICHE

Die Forschungsfelder werden in ihrer Arbeit von vier Servicebereichen unterstützt:

Der Servicebereich *Analytik* unterstützt die Programmbereiche durch ein breites Spektrum analytischer Dienstleistungen, etwa in der Atomspektrometrie, Chromatographie und hochauflösenden Kernresonanz-Spektroskopie (NMR). Die Arbeiten umfassen neben Routinemessungen die Optimierung von Messmethoden und die Entwicklung komplexer Analysemethoden.

Die *Bibliothek* des INM erbringt Serviceleistungen im Bereich Information, Dokumentation, Recherche und Dokumentlieferung. Hauptaufgabe ist die effektive Literatur- und Informationsversorgung der Beschäftigten des INM. Daneben ist sie zentrale Dokumentationsstelle, pflegt die INM-Publikationsdatenbank und gibt jährlich die INM-Jahresbibliographie heraus.

Der Servicebereich *Engineering* entwickelt und stellt Anlagen und Komponenten für die Programmbereiche her. In enger Kooperation mit den wissenschaftlichen Bereichen werden die Konzepte entwickelt, die Umsetzung erfolgt in den Werkstätten durch weitestgehend eigene Produktion. Dabei reicht die Bandbreite von kleinen Laborgeräten bis zu großen Pilotanlagen.

Die *Werkstoffprüfung* ermittelt Werkstoffkenngrößen unter mechanischen, thermischen oder chemischen Beanspruchungen. Neben mechanischen Charakterisierungsverfahren werden thermische Charakterisierungsverfahren und Infrarotspektroskopie angeboten. Im Bereich der *Pulversynthese* stehen die Synthese von Nanopartikeln sowie das Up-Scaling bis in den Technikumsmaßstab im Vordergrund.

SERVICE GROUPS

Four Service Groups support the research fields in their work:

The Service Group *Analytics* supports the research fields by providing analytical tools and knowledge. For this purpose a variety of methods for preparation and analysis are available, such as chemical extraction techniques, element analysis, chromatography and structure determination with high-resolution NMR spectroscopy. The tasks range from standard characterization procedures to the optimization of characterization methods and the development of complex new analysis routes.

The *Library* of the INM provides services in the area of information and documentation. Its main task is the supply of information to the INM's employees. At the same time it is also the center for documentation of the publications and presentations by the staff, and edits INM's annual bibliography.

The Service Group *Engineering* deals with the development and construction of devices and components for the program divisions. In close cooperation with the scientific departments the concepts are developed, based on which the constructions are carried out. The implementation is in most cases performed in the institute's own workshop. The output of the group ranges from small laboratory scale equipment to pilot plant scale devices.

The Service Group *Materials Testing/Powder Synthesis* investigates parameters of material samples under mechanical, thermic or chemical loads. Besides mechanical characterization, thermal characterization techniques and infrared spectroscopy are available. In the field of *powder synthesis* the syntheses of nanoparticles as well as the up-scaling to pilot plant scale are in the focus of the activities.

▶ ANALYTIK / ANALYTICS

DR. CLAUDIA FINK-STRAUBE



- ▶ Elementanalytik: CHNS, ICP-OES, Flammen- und Graphitrohr-HR-CS AAS.

ARBEITEN 2014

Neben den analytischen Fragestellungen für die wissenschaftlichen Programmbereiche des Institutes wurde im Berichtszeitraum die Evaluierung verschiedener ICP-MS-Geräte anhand von INM-Probenmaterialien angegangen, um das analytische Leistungsspektrum zu erweitern.

Beispiele aus bearbeiteten Forschungsarbeiten und Projekten:

- ▶ Analyse von Fettsäuren und Triglyzeriden durch Massenspektrometrie auf Pd-Nanopartikelbeschichteten Stahlsubstraten (SALDI-MS).
- ▶ Entwicklung einer Screeningmethode zur Klassifizierung von Pflanzenölen mit GC-MS.
- ▶ Quantitative Nukleotid-Bestimmung in Humanzellen mit LC-ESI-MS.
- ▶ Spurenanalyse von PVP-Gehalten in Wasser mit HPLC.
- ▶ Untersuchungen zu Elementverteilungen in Hirsepflanzen nach unterschiedlicher Stimulation während des Wachstums mit ICP-OES.
- ▶ Ermittlung der Ba- und Gd-Verteilung in Mäuseorganen nach Kontrastmittelgabe mit ICP-OES.

AUSBLICK

2015 wird der Fokus der analytischen Arbeiten auf der Etablierung der neuen ICP-MS-Technik und der Entwicklung von Methoden, z.B. für die Quantifizierung der Silber-Nanopartikelaufnahme in Humanzellen, liegen.

AUFGABEN

Der Servicebereich *Analytik* hat die Aufgabe, die wissenschaftlichen Programmbereiche des INM durch die Bereitstellung leistungsfähiger analytischer Methoden zu unterstützen. Diese analytischen Dienstleistungen sind für ein erfolgreiches Erforschen neuer Materialien von entscheidender Bedeutung und erfordern zum einen das Vorhandensein modernster Analysegeräte, zum anderen deren Betreuung durch erfahrenes Laborpersonal. In direkter Abstimmung mit den Auftraggebern werden die erforderlichen analytischen Messmethoden erarbeitet und an die konkreten Fragestellungen angepasst.

Derzeit stehen folgende Präparations- und Analysemethoden zur Verfügung:

- ▶ Aufschlusstechniken: Mikrowellenaufschluss und Hochdruckaufschluss.
- ▶ Gas- und Flüssig-Chromatographie mit Massenspektrometrie: GC-MS, LC-MS, GPC.
- ▶ Hochauflösende Kernresonanz-Spektroskopie (NMR).

▶ BIBLIOTHEK, INFORMATION & DOKUMENTATION / LIBRARY & INFORMATION SERVICES

ELKE BUBEL

AUFGABEN

Die *Bibliothek* des INM erbringt Serviceleistungen im Bereich Information und Dokumentation für die Wissenschaftler am Institut. Sie ist zentrale Dokumentationsstelle für Publikationen des INM sowie Anlaufstelle für die Umsetzung von Open Access im INM. Die Bibliothek steht auch Externen zur Nutzung offen.

Die *Bibliothek* des INM ist aktiv eingebunden in den Arbeitskreis Bibliotheken und Informationseinrichtungen der Leibniz-Gemeinschaft. Ziel des Arbeitskreises ist die Vernetzung der Leibniz-Bibliotheken, die Bündelung von Ressourcen und Schaffung von Synergieeffekten zum Nutzen aller beteiligten Bibliotheken.

ARBEITEN 2014

- ▶ Erwerbung, Erschließung und Präsentation von Print- und elektronischen Medien für die Wissenschaftlerinnen und Wissenschaftler des INM. Einführung eines umfangreichen eBook-Angebotes. Prüfung, Verlängerung und Neuabschluss von DFG-geförderten Allianz-Lizenzen, Leibniz-Konsortialangeboten sowie bilateralen Verlagsangeboten (Neuzugänge 2014: 5.666).
- ▶ Dokumentation der INM-Publikationen sowie Berichterstattung für Datenerhebungen.
- ▶ Realisierung von Open Access-Publikationen.
- ▶ Administration und Redaktion aller INM-spezifischen Websites.

- ▶ Leitung des AK Bibliotheken und Informationseinrichtungen der Leibniz-Gemeinschaft. Organisation der Jahrestagung, Mitwirkung bei der Bildung von Einkaufsgemeinschaften für elektronische Informationsprodukte innerhalb der Leibniz-Gemeinschaft.

AUSBLICK

Publizieren im Open Access (OA) hat im Berichtsjahr an Bedeutung gewonnen. Aufgrund von Open Access-Mandaten in öffentlichen Förderprogrammen, der Änderung des Urheberrechtsgesetzes bezüglich des Zweitveröffentlichungsrechtes sowie sich ändernder Verlagsgeschäftsmodelle sind neue Möglichkeiten entstanden, Forschungsergebnisse Open Access zu publizieren. Die Etablierung eines Workflows zur systematischen Umsetzung von OA für INM-Publikationen wird 2015 neben den bestehenden anderen Aufgaben einen Schwerpunkt der Arbeit der *Bibliothek* bilden.



▶ ENGINEERING / ENGINEERING

DIETMAR SERWAS



AUFGABEN

Mit der Entwicklung und der Herstellung wissenschaftlicher Anlagen und Komponenten für die Grundlagenforschung und im Rahmen von Projekten ist die Servicegruppe *Engineering* schwerpunktmäßig Dienstleister für die Programmbereiche des INM. Die Bandbreite der Arbeiten reicht hierbei von kleinen Laborgeräten bis hin zu großen Pilotanlagen. Aus den Vorgaben der Forschung werden in enger Verzahnung mit den wissenschaftlichen Bereichen die Konzepte entwickelt, aus denen die Konstruktionen erstellt werden. Die Umsetzung erfolgt in den Werkstätten durch weitestgehend eigene Produktion. Dies beinhaltet sowohl die Fertigung der Einzelteile in der mechanischen Werkstatt, als auch in der Elektrowerkstatt die Entwicklung von Steuerungen und Software bis hin zum Zusammenbau zur kompletten Anlage. Ein weiteres Arbeitsgebiet ist die Messwerterfassung zur Charakterisierung elektrischer Materialeigenschaften. Zur Bewerksstellung dieser Arbeiten stehen als Ausrüstungen unter anderem CATIA-V5-CAD/CAM-Arbeitsplätze, eine 5-Achs-HSC-Präzisionsfräs-

maschine sowie SPS-Programmiergeräte zur Verfügung. Im Rahmen einer Kooperation ist eine weitere Aufgabe die Durchführung der Werkstattarbeiten für den Lehrstuhl „Technische Physik“ der Universität des Saarlandes. Außerdem hat die Ausbildung einen hohen Stellenwert in unserem Bereich, was sich im Auszubildendenanteil in der Gruppe von 20% widerspiegelt.

ARBEITEN 2014

- ▶ Planung, Bau und Programmierung einer multifunktionalen Anlage zum Beschichten, Aushärten und Prüfen dreidimensionaler Strukturen.
- ▶ Bau eines Beschichtungskopfes für eine inverse Beschichtungsanlage.
- ▶ Messeinrichtung mit Vakuumdurchführung in einer Ultrapräzisionszentrifuge.
- ▶ Umgestaltung des Werkstattbereichs zur Verbesserung der Arbeits- und Fertigungsbedingungen.
- ▶ Unter Beibehaltung der bisherigen Fertigungsdimensionen wurde Ende des Jahres die Palette der Fertigungsmöglichkeiten durch die Anschaffung einer Mikrofräsfunkenerosionsanlage von SARIX erweitert.

AUSBLICK

Im Jahr 2015 wird die Hauptaufgabe darin bestehen, die Umgestaltung der Werkstatt zu beenden, die Inbetriebnahme der Funkenerodieranlage abzuschließen und in die Fertigungsprozesse zu integrieren sowie das erforderliche Know-how in der Mikrofräserosionstechnologie zu erarbeiten.

▶ WERKSTOFFPRÜFUNG/PULVERSYNTHESE / MATERIALS TESTING / POWDER SYNTHESIS

KARL-PETER SCHMITT, ROBERT DRUMM

AUFGABEN

Die *Werkstoffprüfung* umfasst die mechanischen Prüfverfahren, mit denen die Werkstoffkenngrößen von Werkstoffproben oder Bauteilen unter mechanischen, thermischen oder chemischen Beanspruchungen ermittelt werden. Diese dienen zur Charakterisierung der Festigkeit, des Verformungs- und Bruchverhaltens sowie der Härte und des Verschleißwiderstandes. Neben Spindelprüfmaschinen stehen auch servohydraulische Prüfsysteme zur Charakterisierung unter zyklischer Beanspruchung in einem Temperaturbereich von -100 bis 600 °C zur Verfügung. Zur Ermittlung von Härte und plastischem/ elastischem Verhalten an dünnen Schichten finden registrierende Härteprüfverfahren Verwendung. Daran können mit Scratchtestern Kratz- und Haftfestigkeiten ermittelt werden. Tribologische Eigenschaften werden im Gleit- und Schwingverschleiß bestimmt. Außer den mechanischen Charakterisierungsverfahren werden thermische Charakterisierungsverfahren wie Dilatometrie, DTA/DSC sowie die Simultane Thermo-Analyse (STA), eine Kombination von Thermogravimetrie mit DTA/DSC sowie gekoppelter Massenspektrometrie und Infrarotspektroskopie (FTIR), angeboten.

ARBEITEN 2014

Im Rahmen einer Kooperation mit dem Programmbereich *Optische Materialien* wurden nanodisperse Pigmentmischungen zur Herstellung optischer Neutralfilter entwickelt bzw. in Form agglomeratfreier, lösungsmittelbasierter Dispersionen hergestellt. Die Dispersionen zeichnen sich trotz hoher Feststoffgehalte durch ein niedrigviskoses Fließverhalten sowie ein nahezu wellenlängenunabhängiges Absorptionsverhalten (im Bereich von 400 – 650 nm) aus.

Das in 2013 entwickelte Konzept einer „inversen“ Tauchbeschichtung, basierend auf einer Universalprüfmaschine, wurde erfolgreich umgesetzt. Erste Flachglasscheiben bis 1,7 m Länge konnten mit wenigen Millilitern Beschichtungssol homogen einseitig beschichtet werden. Die laufenden Arbeiten konzentrieren sich auf die Optimierung des Beschichtungskopfes bei gleichzeitiger Reduzierung der Fehler in Größe und Häufigkeit.

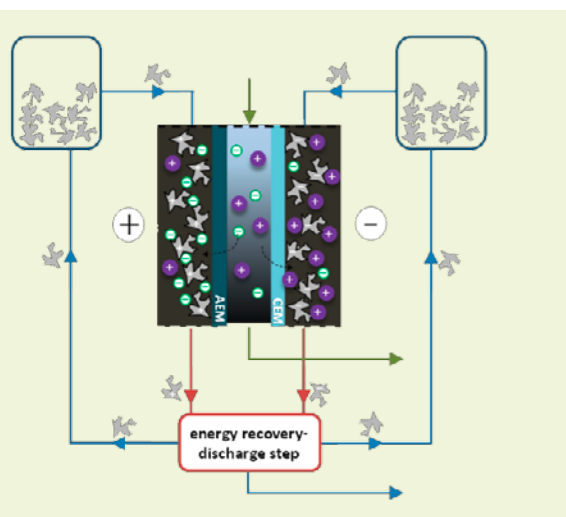




▶ HIGHLIGHTS

▶ CONTINUOUS ELECTROCHEMICAL OPERATION WITH FLOW ELECTRODES

V. PRESSER, D. WEINGARTH, J. LEE, S. PORADA
ENERGY MATERIALS

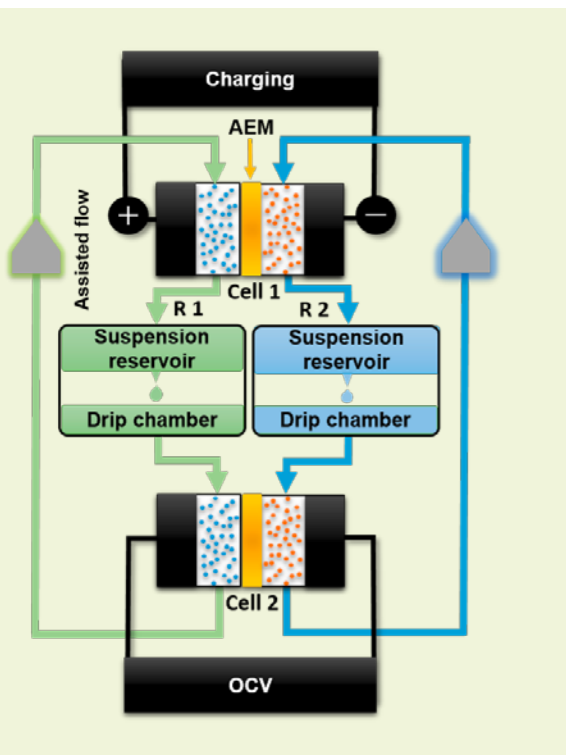


Ion electrosorption at the interface between electrically charged carbon electrodes and liquid electrolytes is a versatile technology enabling highly efficient energy storage, water desalination, or energy harvesting. While tremendous research activities were spawned by the discovery of novel carbon materials, very little variation of the electrode architecture was explored.

Energy storage. A major limitation to electrical double-layer capacitors (supercapacitors) is the high cost per unit of stored energy. One approach for large scale systems is to employ flow electrodes instead of polymer-bound film electrodes. Flow capacitors provide facile scaling of system metrics: a larger tank with flow electrode liquid enables more energy storage and the number and size of charge/discharge cells determines the power performance. This way, the amount of housing, current collector, and separator membranes can be significantly reduced.

Energy harvesting. Modifying the ion concentration between two flow electrode compartments enables the extraction of capacitive mixing energy allowing us to tap, in otherwise, inaccessible energy reservoirs. For example, it enables energy extraction from gradients of salinity or concentration of dissolved CO_2 .

Water treatment. Capacitive deionization is an attractive technology with the severe drawback of intermittent system operation: durations of ion electrosorption are interrupted with mandatory ion release for electrode regeneration. Flow electrodes continuously discharged outside the electrochemical cell enable a continuous operation for highly efficient water desalination.



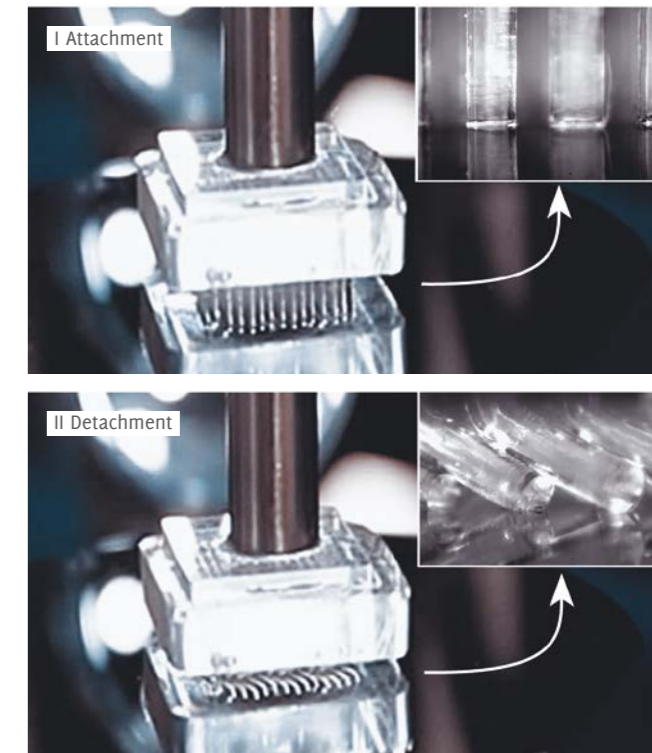
▶ Fig. 1: Concept of capacitive deionization (CDI) via flow electrodes for facile water treatment.
Fig. 2: Concept of the electrochemical flow capacitor (EFC) for energy storage.

▶ INM'S GECOMER® TECHNOLOGY ON THE PATH TO APPLICATION

K. MOH, R. HENSEL, E. ARZT
FUNCTIONAL MICROSTRUCTURES

INM's Gecomer technology is coming of age: the transfer of the gecko principle from fundamental research to industrial applications is making rapid progress. Gripping systems play an important role in production and handling processes for various industrial branches. When featured with our gecko-inspired micropatterned surfaces, a novel platform of energy-efficient pick and place systems is established; such systems can handle highly sensitive and delicate surfaces in industrial process lines. The adhesion mechanism is based on Van der Waals forces that also exist in vacuum, where conventional vacuum or Bernoulli grippers fail. The fibrillar design of the novel structures further allows switching of the adhesion strength in a controlled manner by changing the effective contact area between substrate and adhesive structure (Fig. 1). The patented attachment and detachment mechanism is purely based on contact mechanics and works without any externally applied energy, enabling energy conservation in production lines.

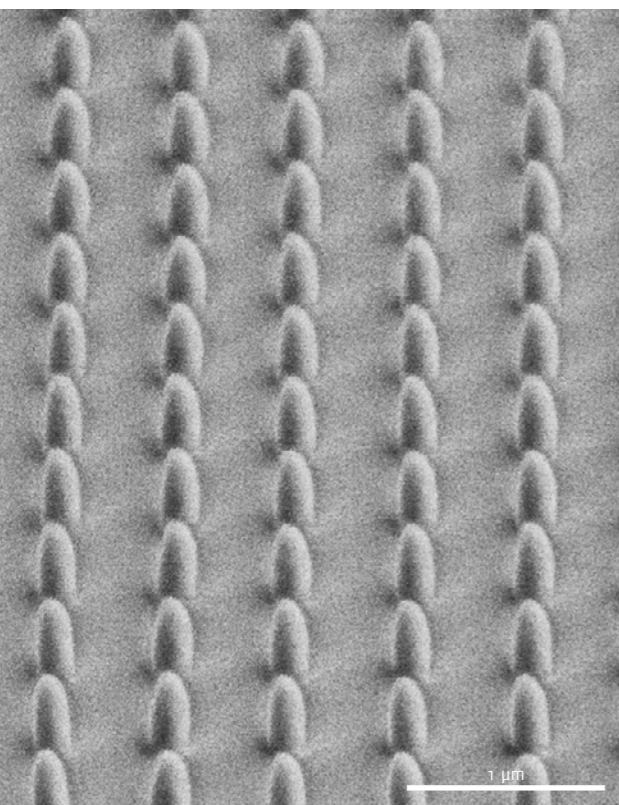
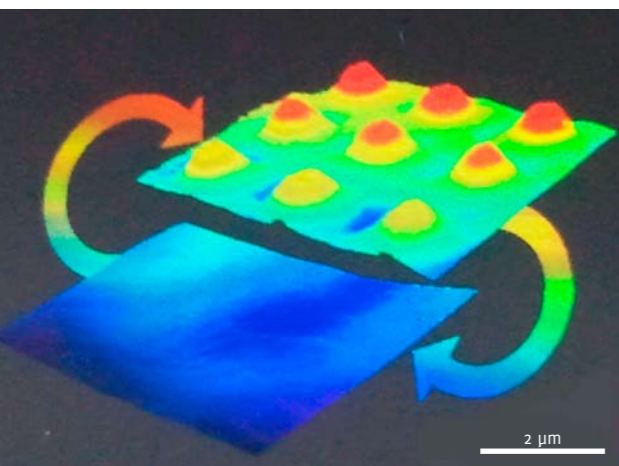
In 2014, a commercial 6-axis robot was equipped with our bio-inspired adhesives (Fig. 2). It drew much attention at the TechConnect World Exhibition in Washington, DC, by demonstrating the versatility of the Gecomer Technology in a repeating pick-and-place sequence. As a result, more than 40 consultations with industrial companies have been made. A first industrial feasibility study was successfully completed in 2014. Stimulated by the numerous industrial demands on substrate materials, process environments or other specifications, we now elaborate novel templates and new materials for the next generation of the Gecomer Technology.



▶ Fig. 1: INM's Gecobot demonstrating switchability of the adhesion strength for utilization in pick and place operations has drawn much industrial interest: switching by fiber re-orientation.
Fig. 2: Commercial 6-axis robot equipped with lab-produced Gecomer technology.

▶▶ 3D LASER LITHOGRAPHY WITH SUB-MICROMETER RESOLUTION

J. PURTOV, E. KRONER
SWITCHABLE SURFACES



With the recently installed 3D Laser Lithography system, a new surface patterning method was established in the Junior Research Group *Switchable Surfaces*. The method is based on two-photon polymerization of UV curable materials and allows to directly “write” arbitrary 3D structures. An infrared femtosecond pulsed laser with a wavelength of 780 nm is focused on a small spot. The high intensity in the center of the focus point increases the probability of simultaneous excitation of photoactive materials by two photons, equivalent to the excitation with a single photon of half the wavelength, respectively 390 nm. Several materials which cure close to this wavelength can thus be cross-linked with this technique. By moving the focal point, complex geometries can be cured into liquid photoresist. As the highest intensity is reached only in the very center of the focal spot, a very high resolution in writing can be achieved. In our first experiments we achieved structures with a resolution below 150 nm in the *x-y*-plane and below 500 nm in the *z*-plane.

Fig. 1 shows a photograph of a photonic crystal representing our group logo written by the 3D Laser Lithography system. For each color, a respective point distance was defined. The pixels of the original graphic were transferred into fields of pillar arrays using the software Photonic Color. Every pillar field with equidistant pillars reflects only specific wavelengths of light depending on the angle of observation. This results in a colored picture. Fig. 2 shows a scanning electron microscopy image of a typical pillar array. The pillars have diameters of approximately 200 nm and a height of 500 nm.

The 3D Laser Lithography system is a key technique for rapid prototyping of bio-inspired surfaces with sub-micrometer resolution. The tool will allow the preparation of bio-inspired samples with various surface functionalities, such as anti-reflective moth-eye surfaces, structural opal-color formation, lotus-like wetting behavior or gecko-inspired adhesion.

▶ Fig. 1: Photonic crystal written by 3D laser lithography, each color pixel consists of an array of pillars.
▶ Fig. 2: Electron microscopy image of an array of pillars.

▶▶ NANOPARTICLES IN FLOW FIELD-FLOW FRACTIONATION: INTERACTIONS AND LOSSES

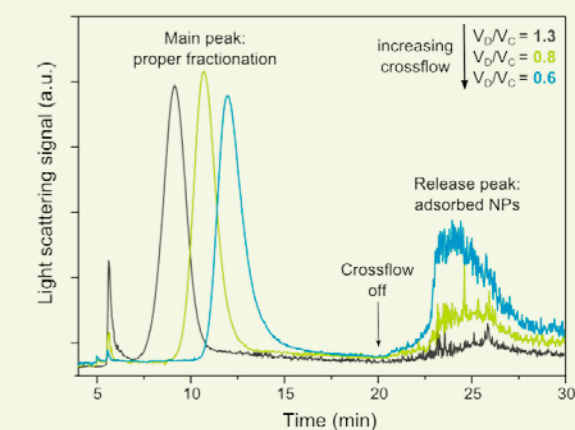
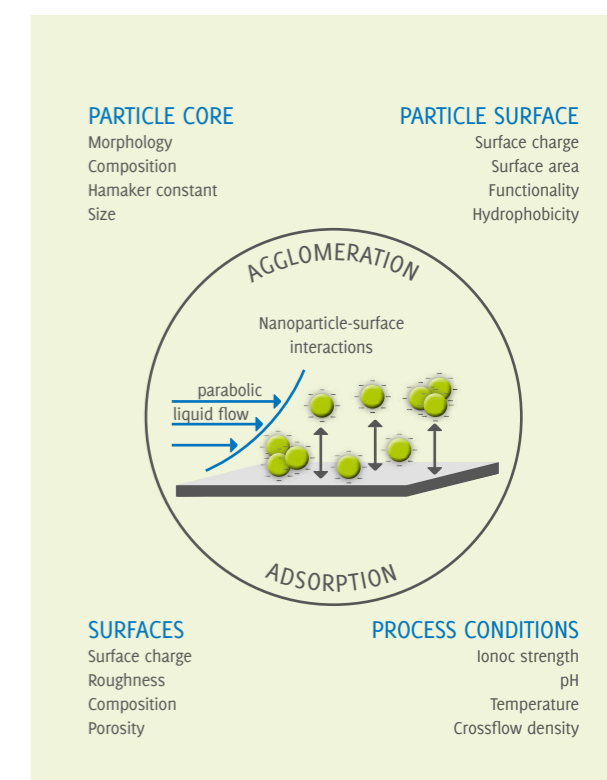
A.-R. JOCHEM, G. N. ANKAH, T. KRAUS
STRUCTURE FORMATION

Asymmetric Flow Field-Flow Fractionation (AF4) is a field-driven separation and sizing technique that reminds of chromatography with a laminar flow in place of a stationary phase. Recently, AF4 has become a method of choice for the detection of nanoparticles in complex matrices. Today, recovery ratios for nanoparticles in AF4 are below the recovery ratios reached for macromolecules. In this project, we aim to improve the particle recovery by identifying and suppressing the main particle loss mechanisms.

During AF4, a liquid “crossflow” moves perpendicular to the main flow direction in a thin slit-like channel and drives the analytes towards an ultrafiltration (UF) membrane. Particles are separated by size. Due to differences in the diffusion coefficient the particles accumulate in distinct regions of the main flow, which have different flow velocity. Hence, particles of different size leave the channel at different times and can be characterized downstream by attached detectors.

AF4 has no stationary phase, but unwanted particle-surface interactions still occur and can lead to particle loss and biased results. Materials and process conditions (Fig. 1) influence the degree of particle adsorption on internal surfaces, such as the tubing, valves, detector windows, and in particular the UF membrane. The closely related agglomeration of nanoparticles, which occurs easily in nanoparticle dispersions, depends sensitively on surfaces and concentrations, and is very likely to affect adsorption phenomena.

We investigated the particle loss during AF4 using gold nanoparticles modified with different ligands as a well-defined model system. Preliminary results suggest that adsorption on the membrane is an important loss mechanism (Fig. 2). In an ongoing systematic study of the particle loss mechanisms, we assess effects of different particle types, sizes and measurement conditions.



▶ Fig. 1: Major parameters influencing particles losses due to NP-surface interactions.
▶ Fig. 2: Fractograms of Au-citrate nanoparticles with increasing crossflow rate.

► GENETIC ENGINEERING OF INORGANIC CRYSTALS

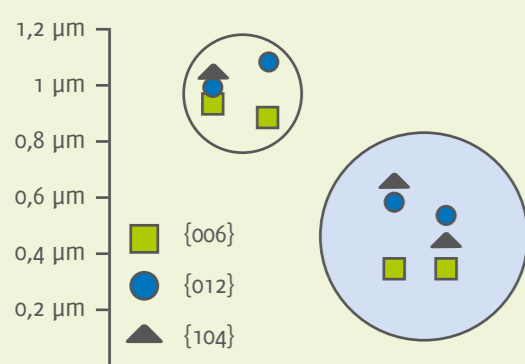
I. M. WEISS
BIOMINERALIZATION



Pure mineral crystals are commonly obtained from salt solutions. In many cases, the morphologies and microstructures of such crystals can be predicted only under precisely controlled conditions of crystallization. When it occurs in presence of organic additives, the morphologies of the crystals are unpredictable. Yet, the atomic structures of such synthetic crystal composites are usually the same as in the pure mineral phase.

In natural biominerals, outer morphologies and atomic structures of composite crystals are extremely well defined. It still remains a mystery how such crystals form in the presence of biomolecules, or how crystals are even directed by them. One would expect that proteins act as “impurities”, disturb the ordered alignment of nanoparticle precursors, and interfere with crystallization.

In 2014, it was demonstrated that genetically engineered proteins derived from nacre induce directional lattice distortions in synthetic calcite crystals [1]. A few micrograms of the protein GFP-perlucin (Fig. 1) were sufficient to also reduce the grain size of the composite material (Fig. 2). The observed phenomenon represents a first unequivocal case study which revolutionizes the functional classification of so-called biomineralization proteins opening up a new era for “applied biomineralization” in view of bioinspired crystal engineering and materials science. In combination with new analytical tools [2], biomolecular crystal engineering has become a method that enables new ways of fine-tuning the internal characteristics of advanced organic-inorganic interfaces at atomic length scales.



► Fig. 1: Computational overlay model of recombinant mollusc shell proteins, inducing lattice distortions in inorganic crystals.
Fig. 2: Comparison of grain sizes in minerals precipitated in presence of various concentrations of control protein (green circle) and mollusc shell protein (blue circle). Schematically reproduced from Ref. [1].

► OPTICAL FUNCTIONAL NANOCOMPOSITES BY PULSED LASER CO-DEPOSITION (PLCD)

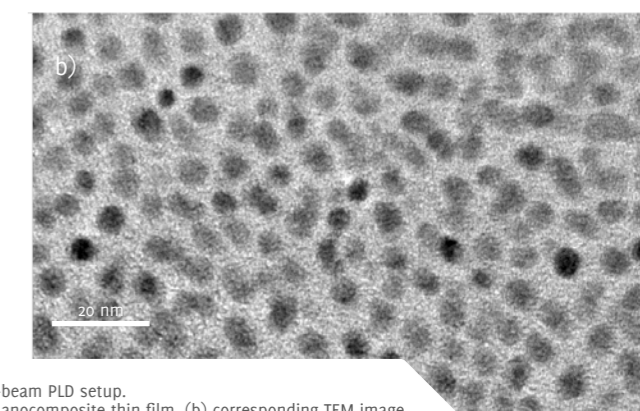
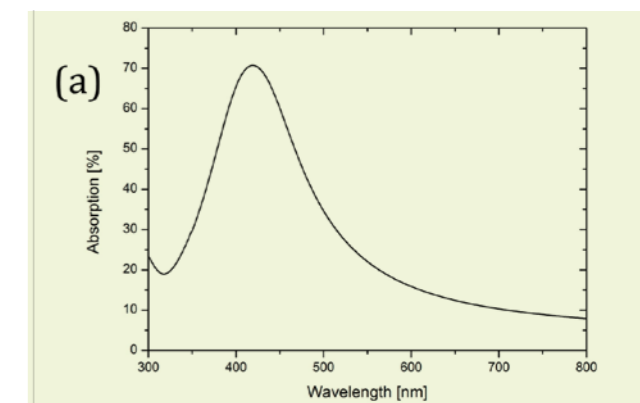
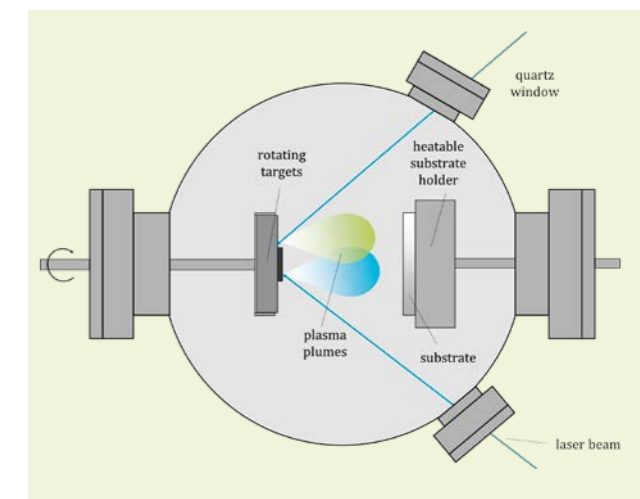
M. LAMBERT, J. STAUDT, A. MAY, M. KOCH, O. C. AKTAS
CVD / BIOSURFACES

Metal-dielectric nanocomposite thin films are of interest for many applications such as solar absorbers, photovoltaic cells and optical filters. Pulsed Laser Deposition (PLD), employing a high-energy pulsed laser for the evaporation of a solid target material in nanoseconds, offers to deposit materials with extremely high melting temperature (T_M) while maintaining precise stoichiometric transfer.

An Ag/Al₂O₃ nanocomposite thin film was prepared by PLD using a two-laser-beam configuration as shown in Fig. 1. Both components were simultaneously deposited from a custom-made rotating composite target, which was prepared by embedding Ag pellets in the center of a circular Al₂O₃ target. Third harmonic generation of a Nd:YAG laser (355 nm) with a pulse length of 10 ns and a repetition rate of 10 Hz was used. The laser energy input on the targets was 600 mW and 500 mW. The deposited layers were characterized using UV-VIS spectroscopy and TEM.

The prepared Ag/Al₂O₃ thin film showed an absorption peak around 420 nm, which is attributed to the plasmon resonance of the Ag nanoparticles (Fig. 2a). Such a plasmon resonance depends on particle size, shape and surrounding matrix material. The TEM image of the deposited thin film is shown in Fig. 2b. The Ag nanoparticles are of uniform size and shape, as well as homogeneously distributed in the matrix.

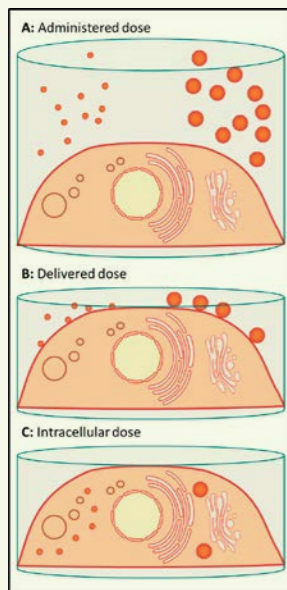
The presented method can be used as a versatile tool for the deposition of ultra-thin nanocomposite layers for various applications. In a recent work, nanoparticles of a FeNiCo alloy could be embedded in an Al₂O₃ matrix showing applicability of this technique for the deposition of more complex multi-component materials.



► Fig. 1: Scheme of a custom-made two-laser-beam PLD setup.
Fig. 2: (a) UV-VIS spectrum of the Ag/Al₂O₃ nanocomposite thin film, (b) corresponding TEM image.

▶ QUANTIFICATION OF INTERNALIZED SILICA NANOPARTICLES VIA STED MICROSCOPY

T. RUCKELSHAUSEN, H. PEUSCHEL, C. CAVELIUS, A. KRAEGELOH
NANO CELL INTERACTIONS



In nanosafety, dosimetry is an important parameter for the understanding of nanoparticle (NP) induced effects on a cellular scale as well as for risk assessment. Not only *in vivo* but also for *in vitro* experiments, it is critical to have information about the *administered NP dose* initially added, the *delivered dose*, comprising the particles reaching the cells, and the *intracellular dose*, internalized by the cells (Fig. 1). When comparing various NP sizes, it is important to recognize that at equal mass concentrations larger numbers of smaller NPs are present. Therefore, appropriate analyses of NP internalization efficiencies need to consider other measures, i.e. NP number concentrations.

In this study, the internalization of 25 nm and 85 nm silica NPs in A549 cells, a model for type II alveolar epithelial cells, was quantified. Cells were exposed to equal initial NP number concentrations (9.2×10^{10} NPs ml^{-1}) of each particle size. Sedimentation was calculated to cause an increase in the NP number concentration immediately surrounding the cells (2.3×10^{12} NPs ml^{-1} , delivered dose).

The number of internalized NPs was extracted from 3D super-resolution STED (stimulated emission depletion) image stacks of entire cells (Fig. 2) via image processing. STED images revealed that particles of both sizes entered the cells after 5 h incubation in serum supplemented medium. The particles appeared to be distributed throughout the cells, but were not detected in the nucleus. Taking the formation of small agglomerates that could not be resolved by STED in case of the 25 nm NPs into account, the number of internalized NPs was estimated to be in the same range ($2.5 \cdot 10^{11}$ – $4.8 \cdot 10^{12}$ NPs ml^{-1} cell volume) at both particle sizes, with the 25 nm NPs only slightly stronger accumulated. The intracellular NP concentration did not significantly exceed the delivered NP dose within 5 h. The experiments were performed at non-cytotoxic NP concentrations, excluding an influence of cytotoxicity on NP uptake.

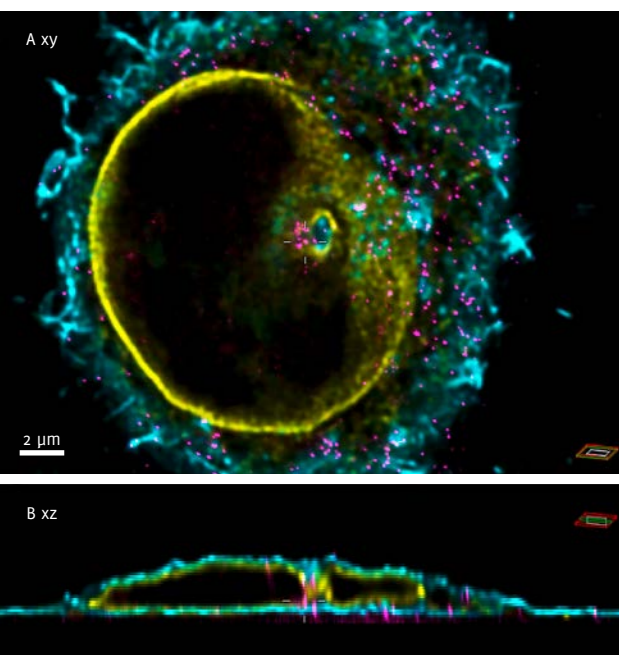


Fig. 1: Measures in NP dosimetry.
Fig. 2: Image of a single A549 cell (cell membrane: cyan, nuclear membrane: yellow, confocal) after exposition to 85 nm-silica NPs (magenta, STED). A) 2D section (xy) and B) orthogonal section (xz).

▶ NEW FLAKE-TYPE PARTICLES AS FUNCTIONAL ADDITIVES FOR COMPOSITE COATINGS

E. PERRE, S. ALBAYRAK, D. BENTZ, C. BECKER-WILLINGER
NANOMERS

Corrosion protection coatings are required to exhibit active anti-corrosion properties without using heavy-metal based compounds. The addition of pigments in these types of coatings improves corrosion protection in various ways depending on the type of pigment used. Chromium based pigments offer a chemical protection by decreasing the activity of the metal surface (active effect), and have reached exceptional effectiveness. However, their use is now banned because of their high toxicity. Over the last decades, the best performance of replacements was obtained with zinc and zinc-metal phosphate pigments. The corrosion inhibition mechanism of the zinc phosphate pigments involves the partial dissolution of phosphate and the formation of complexes on the metal surface.

In this direction, a synthesis method for zinc phosphate and zinc-metal phosphate has been developed that allows the control of the obtained particle shape and the formation of flake-type morphology. The anisotropic shape of the particles is mainly controlled by the amount of a complexing agent added during the synthesis. Zinc phosphate flakes, with aspect ratio as high as 30, can be produced. The flakes, homogeneously dispersed in a polymer matrix, are expected to provide a high corrosion inhibition effect as their thicknesses in the nanometer range will permit fast distribution in the matrix while their lengths in the micrometer range allow for an extended coverage of the metal surface when oriented parallel to the surface.

Preliminary corrosion inhibition experiments show that the zinc phosphate particles, dispersed in a corrosive electrolyte, lead to protection of uncoated mild steel substrates. In a dispersion containing about 0.75 wt.-% zinc phosphate flakes, the corrosion current is decreased by a factor of 10 whereas the charge transfer resistance is enhanced over 2500 %. The quality of dispersion and the control of orientation of the particles in a matrix are under current development. (Patent application is pending.)

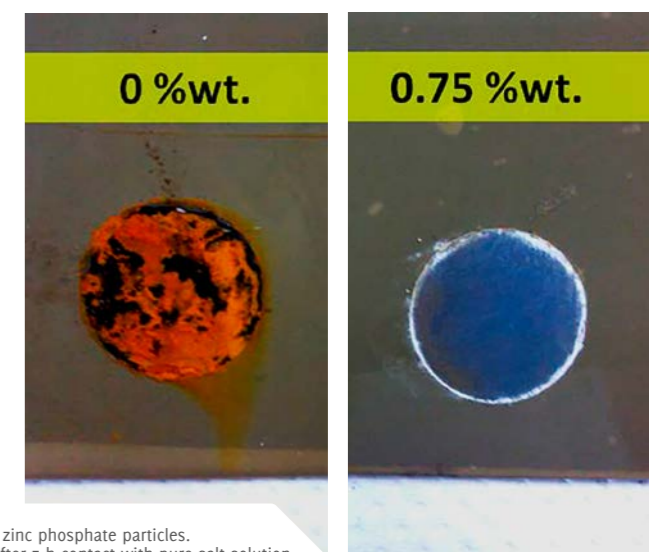
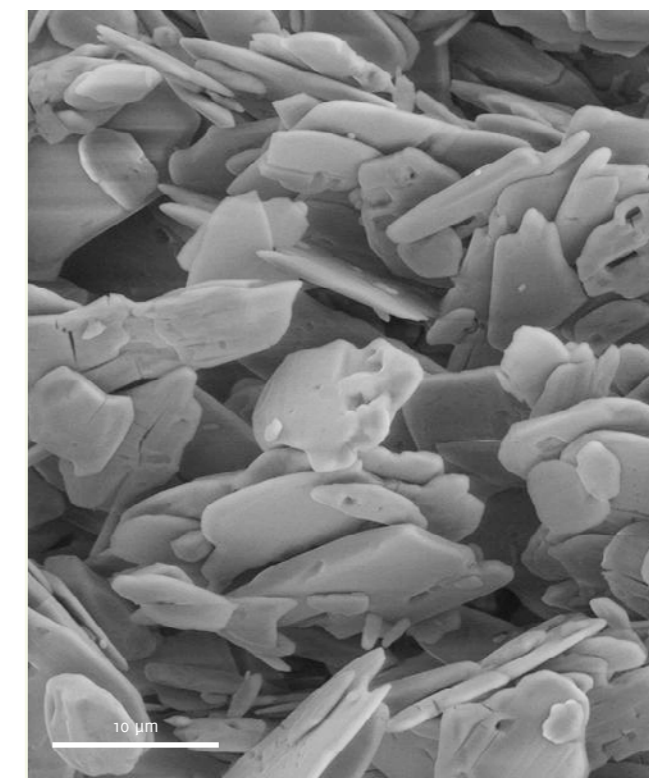
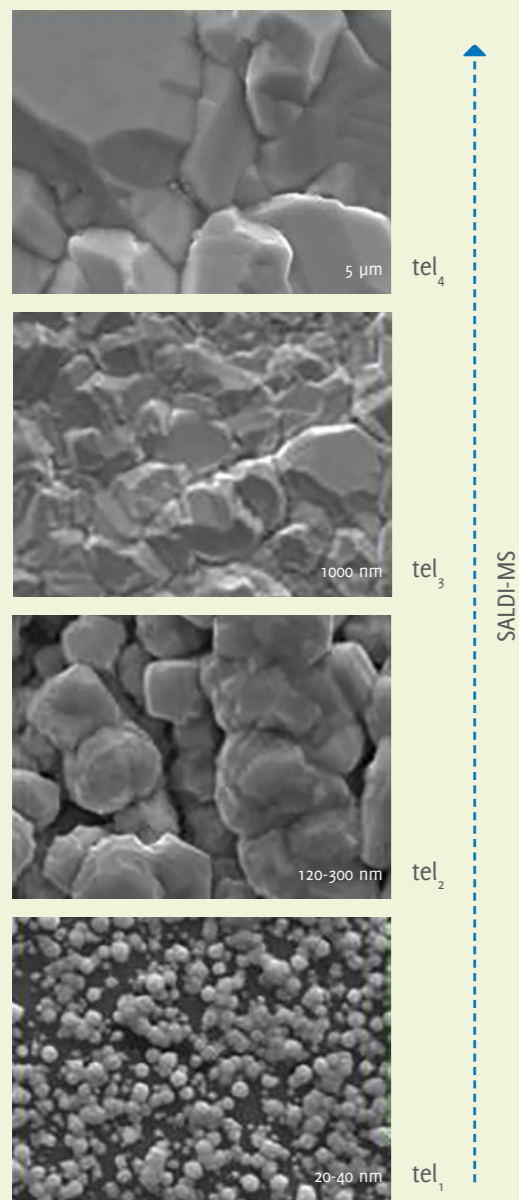


Fig. 1: Scanning electron microscopy (SEM) analysis of flake-type zinc phosphate particles.
Fig. 2: Corrosion protection effect on mild steel: Bare mild steel after 7 h contact with pure salt solution (left) and with salt solution containing 0.75 wt.-% zinc phosphate flakes (right).

▶ ELECTROPLATED NANOPARTICLES AS EFFICIENT TARGETS FOR LDI-MASS SPECTROMETRY

Y. E. SILINA, M. KOCH
ANALYTICS



Unique surface effects of metal nanoparticles (NPs) mixed with glycerol have been successfully utilized to enhance laser desorption/ionization mass-spectrometry (LDI-MS) of analytes for over 20 years. The LDI activity of these materials is mainly determined by thermal conductivity, size-dimensional factors and optical penetration depth. However, such suspension-type method suffer from an inhomogeneous analyte distribution, resulting in low reproducibility and problems with vertical mounting of the sample holders.

In this regard, a simple approach for the synthesis of Pd and Ag nanostructures with readily adjustable morphologies was developed using electrochemical deposition for application to surface-assisted laser desorption/ionization (SALDI) of small biological molecules. Analyte cations were generated from the galvanic surfaces upon UV laser irradiation such as potassium for a film thickness < 100 nm and Pd and Ag cluster ions for films with thickness > 120 nm.

A range of fatty acids, triglycerides, carbohydrates and antibiotics were investigated and their LDI behavior compared to conventional organic matrix-assisted laser desorption/ionization (MALDI) analyses. Importantly, the galvanic nanostructures did not exhibit detrimental matrix interferences in the low m/z range as usually seen for MALDI. The films exhibited self-organizing abilities and morphologies adjustable by changing electrochemical parameters, e.g. electrolysis time or current (Fig. 1).

Electroplated NP targets based on Ag and Pd did not require any stabilizing agents, were inexpensive and easy to produce. LDI analysis showed that the materials were stable under ambient conditions and analytical results with excellent reproducibility and detection sensitivity similar to parallel MALDI experiments were obtained.

▶ Fig. 1: Adjustable morphology of Ag galvanic nanostructure.

▶ FORCE RESPONSE OF ACTIVELY DEFORMED POLYSTYRENE FILMS AND DROPLETS

J. HEPPE, J. D. MCGRAW¹, R. BENNEWITZ, K. JACOBS^{1,2}

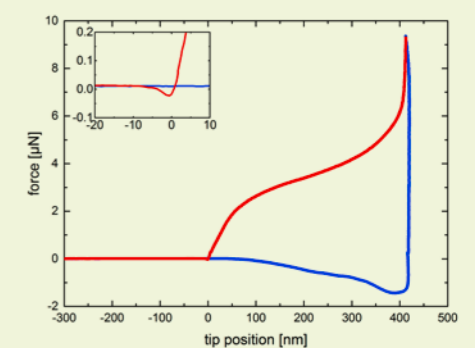
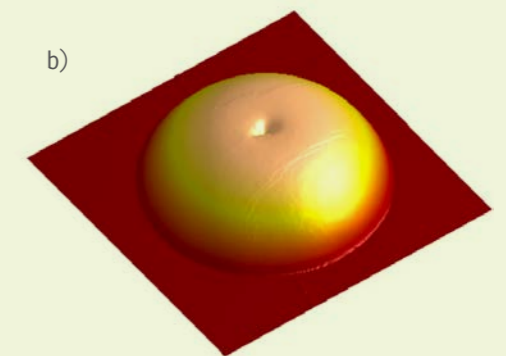
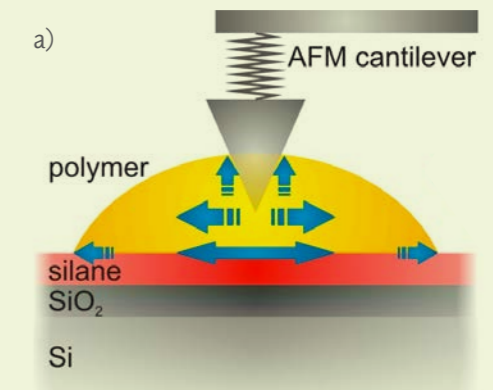
¹Saarland University, Experimental Physics; ²INM Fellow since 2014

An oil film lubricating a piston is usually designed to perfectly wet the surfaces in order to reduce the (otherwise dry) friction between the moving interfaces. Lubricant molecules in direct vicinity of the solid surface are at rest. This is the classic 'no slip' boundary condition first described by C. Navier in 1823. But what would happen, if there was a slip condition? If – in other words – there was a relative movement between the piston and the lubricant molecules close to the piston? Wouldn't that make a better lubricant?

To test this hypothesis we set up a model system where a 'nearly full slip' as well as a 'nearly no slip' condition can be achieved: a liquid polymer on a Si wafer that is functionalized according to the desired slip condition. To induce friction and test the influence of the slip/no slip condition, an atomic force microscope (AFM) tip indents the polymer. Fig. 1 depicts a situation where the tip indents into a liquid polymer droplet. After reaching a certain depth, the tip is retracted again. Measuring the forces acting on the AFM tip as a function of the tip position lets us infer the work needed to induce motion, cf. Fig. 2, and the area between the approach and the retract curve gives the dissipated energy. Possible sources of energy dissipation are indicated by blue arrows in Fig. 1: slip and contact line movement (CLM) between tip and polymer, viscous dissipation by flow as well as slip and CLM between polymer and substrate.

Depending on the slip condition, we indeed recorded differences in the dissipated energy. Furthermore, we found that indentation speed and indented depth have a systematic influence on the work. Comparing droplets and films of the same thickness/height, it turned out that the confinement of the polymer and the existence of a contact line increased the required indentation forces. Further goals will be to separate the influence of CLM on the dissipation and increase the contact size using microindenters.

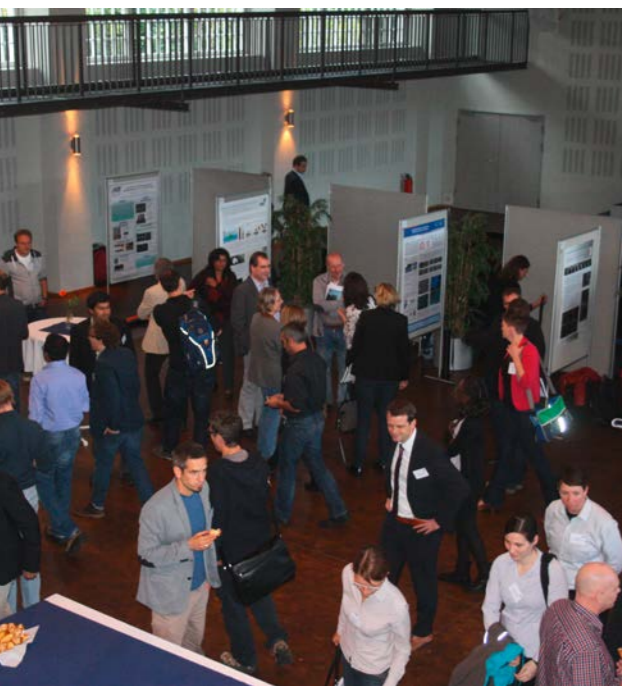
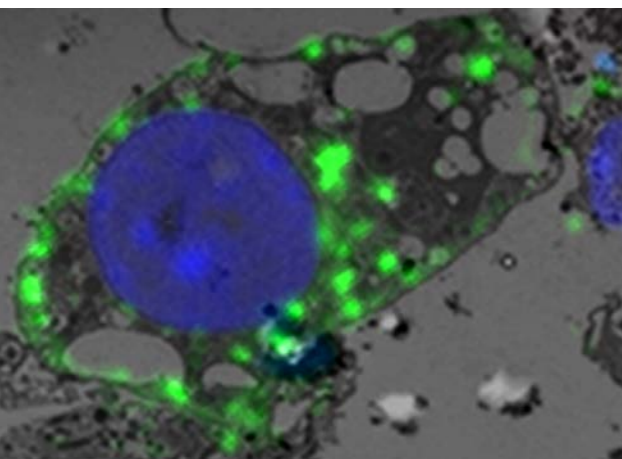
▶ Fig. 1: a) Indentation on droplet and possible mechanisms of dissipation (blue arrows). b) 3D AFM height image of polystyrene droplet (h: 500 nm) on a functionalized substrate shortly after indentation. Fig. 2: Force/distance curve by indenting a PS droplet on functionalized substrate until substrate is reached (red: approach, blue: retraction). Inset: 'snap-in' region at top of droplet on approach of AFM tip.



► 2ND CONFERENCE ON IN-SITU AND CORRELATIVE ELECTRON MICROSCOPY (CISCHEM)

N. DE JONGE

INNOVATIVE ELECTRON MICROSCOPY



Following the very successful 1st conference in 2012, the INM Program Division *Innovative Electron Microscopy* organized a 2nd *International Conference on In-Situ and Correlative Electron Microscopy* (CISCHEM). It was held from October 14-15, 2014 in the festive auditorium of Saarland University in Saarbrücken.

The conference with more than 100 participants brought together an interdisciplinary group of scientists from the fields of biology, materials science, chemistry, and physics to discuss future directions of *in-situ* electron microscopy from different angles. One of the highlights was a presentation of Dr. James De Yoreo, Pacific Northwest National Lab, Richland, USA, who showed atomic-resolution movies of growth processes of minerals. Keynote speaker Prof. Wolfgang Baumeister, Max Planck Institute of Biochemistry, Martinsried, Germany, gave a broad overview of *in-situ* electron microscopy of proteins and cells embedded in amorphous ice. The topics of the oral and poster presentations involved correlative and *in-situ* electron microscopy in biology, *in-situ* observation of biomineralization processes, design of *in-situ* experiments, high-temperature and other *in-situ* experiments and *in-situ* TEM of catalytic nanoparticles.

The meeting encouraged inspiration in cross-disciplinary thinking and provided a comprehensive overview of the latest advances in *in-situ* electron microscopy. Selected abstracts will be published in the book series *Advances in Imaging and Electron Physics* in 2015.

CISCHEM was scientifically supported by Prof. Kristian Mølhave, Denmark Technical University, Lyngby, Denmark. The following sponsors are greatly acknowledged: DGE (Deutsche Gesellschaft für Elektronenmikroskopie); EMS (European Microscopy Society); JEOL Germany; Protochips Inc., Raleigh, USA; FEI, Eindhoven, NL; EA Fischione Instruments, Horley, UK; Gatan GmbH, München, DE; DENSSolutions, Delft, NL; CEOS GmbH, Heidelberg, DE.

► Fig. 1: Correlative light and electron microscopy image of a cell (reproduced from Hodgson L., Tavaré, J., Verkade, P., 2014. *Protoplasma*, 251, 403-416).
Fig. 2: Impression of the conference.

► JOINT LEIBNIZ WORKSHOPS IN BERLIN

M. QUILITZ, A. KRAEGELOH, E. ARZT

After the successful 1. LeibnizNetworkNano(LNN) Workshop in 2012, the second workshop was combined with a first workshop of the Leibniz Research Alliance (LRA) Nanosafety. It took place at the headquarters of the Leibniz Association in Berlin on July 16 and 17, 2014.

The LNN with now fifteen institutes links the knowledge and experience of most Leibniz institutes conducting research in nanotechnology. It mainly aims at the exchange of information and contacts between the partners.

The LRA Nanosafety with now six institutes addresses the safe development and application of nanomaterials and -products. Central topics are understanding of nanoparticle-induced cellular effects, development of safe nanomaterials and explaining questions in the context of nanosafety.

The agenda started with a keynote lecture given by Prof. Dr. Nicole Grobert, Oxford, on nanomaterials by design. The following 11 talks covered the topics Nanostructuring and -effects, Functional Surfaces, Nanoelectronics/-sensorics/-optics, and -analytics. The variety of topics impressively illustrated the large diversity of “nano” research within the Leibniz Association.

The morning of the second day was devoted to nanosafety issues, including presentations of invited speakers, members of the Alliance, and doctoral students. It was concluded by a poster session with over 30 posters covering a broad variety of topics.



► Impressions from the joint workshops.

► FOCUS PROJECTS – A TOOL TO STRENGTHEN INM'S LEAD AREAS

In 2013, INM established an internal project competition to strengthen the cooperation between the groups and contribute to the four INM lead areas on energy applications, medical surfaces, tribological systems and nanosafety. Focus projects were selected for a one year funding:

AGGLOTOX – DEFINED PARTICLE AGGLOMERATES FOR NANOTOXICITY STUDIES

Structure Formation, Nano Cell Interactions

Agglomerated nanoparticles differ from single particles in intracellular uptake and cytotoxic effects. We studied the self-terminated agglomeration of gold nanoparticles (AuNP) in protein solutions and established protocols for the formation of microscopic AuNP clusters with controllable sizes to be used in cytotoxicity assays. We found that AuNP agglomerate via a kinetic process and are eventually stabilized by a protein layer that stops agglomeration. (Fig. 1)

ELECTRIC – ELECTROCHEMICAL TRANSPARENT INTEGRATED CAPACITORS

Energy Materials, Optical Materials

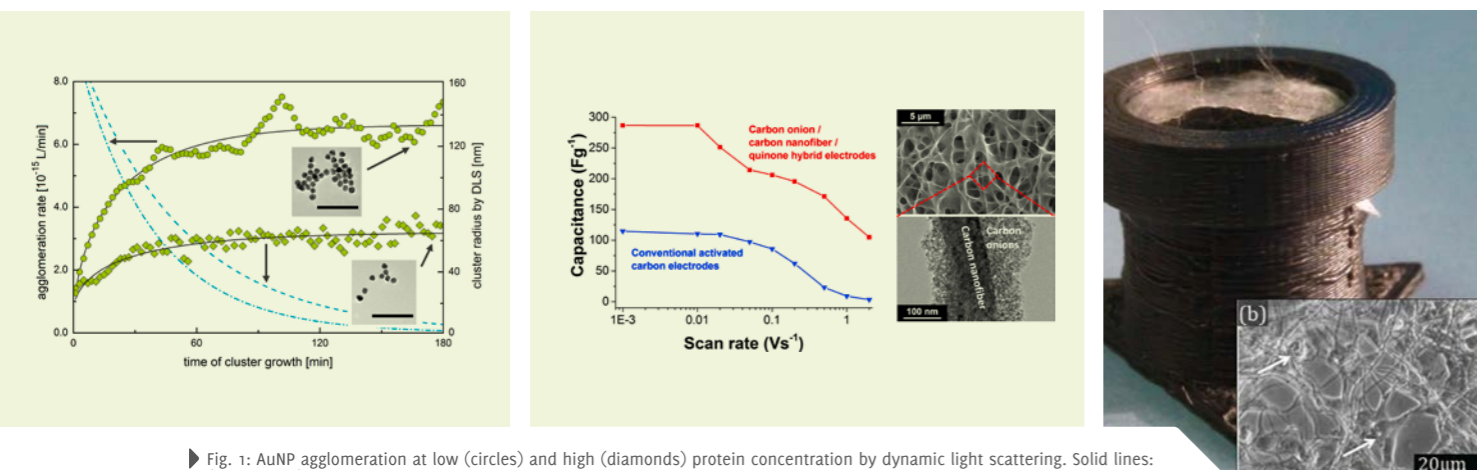
We explored electrochemical *in situ* spectroscopy to enable high energy performance of supercapacitors via redox reactions

in aqueous media and protic ionic liquids. Using carbon onions and nanofibers, a novel electrode design was developed with 10-fold improved electrical conductivity and energy density was improved 3-fold by employing the reversible pseudocapacitance of quinones. (Fig. 2)

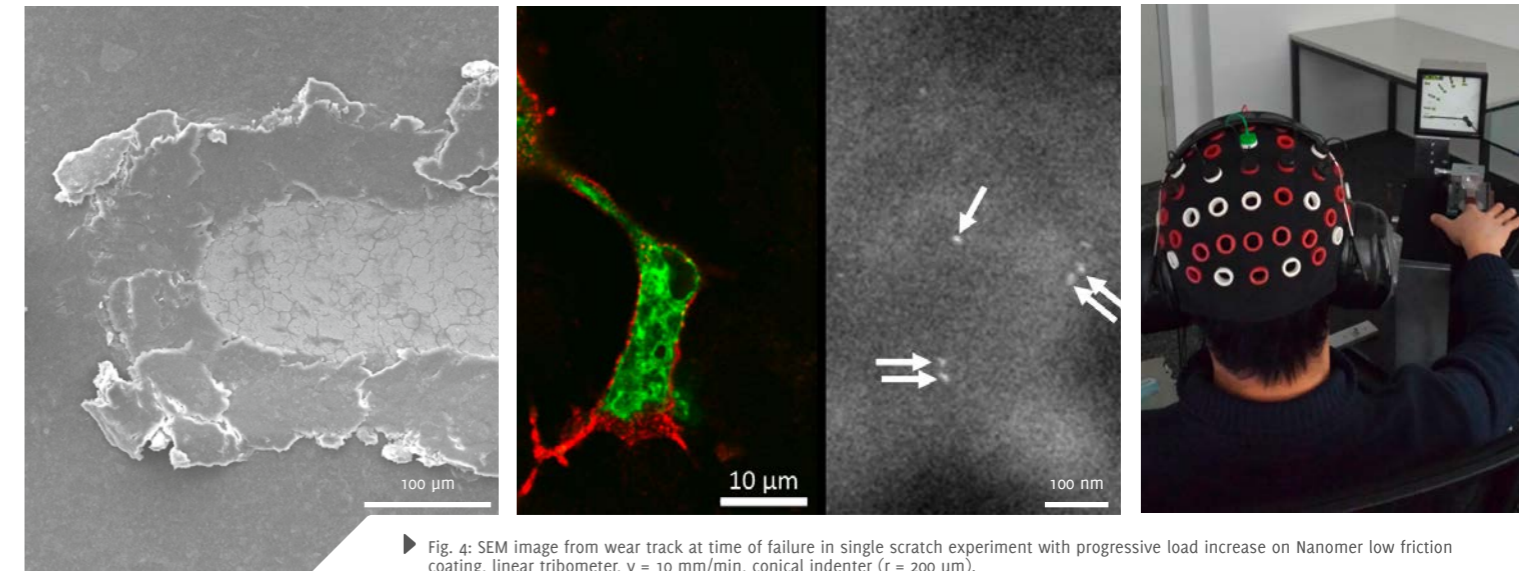
ENVISION: MULTISCALE TEXTURED BIOMATERIAL MEMBRANES FOR VASCULAR SYSTEM IMPLANTS

Energy Materials, Nano Cell Interactions, Switchable Surfaces

A toolkit for electrospinning biocompatible polymer fiber membranes with biofunctional surfaces and associated cell culturing protocols was developed. The membranes can potentially be used for applications in tissue engineering and regenerative medicine, for example as scaffolds for venous valve leaflet implants. The project resulted in a prototype scaffold support that fits into a 12 well plate and successful culturing of HUVEC and mouse fibroblasts on poly (L-lactide-co-caprolactone) scaffolds. (Fig. 3)



► Fig. 1: AuNP agglomeration at low (circles) and high (diamonds) protein concentration by dynamic light scattering. Solid lines: fits to modified Smoluchowski model, dashed lines: agglomeration rate. TEM images: stable clusters. Scale bars: 100 nm.
Fig. 2: Novel carbon onion / carbon nanofiber / quinone electrodes for supercapacitor electrodes.
Fig. 3: Well plate insert to stabilize membrane scaffold. Inset (b) shows HUVEC cells cultured on fibrous scaffold.



► Fig. 4: SEM image from wear track at time of failure in single scratch experiment with progressive load increase on Nanomer low friction coating, linear tribometer, $v = 10$ mm/min, conical indenter ($r = 200$ μ m).
Fig. 5: Transgenic cells expressing Siglec proteins at cell surface (left: CLSM image, green: GFP tag, red: immunostaining; right: ESEM-STEM image of cells on Si_3N_4 membrane TEM chips – Qdot@-655 labelling, arrows).
Fig. 6: Simultaneous measurement of fingertip friction and neural response in EEG.

FLAKELUB – LUBRICATION BY COATINGS CONTAINING CHEMICALLY FUNCTIONALIZED FLAKES

Nanomers, Nanotribology

Simultaneous friction reduction and corrosion protection in composite coatings is obtained by combination of inorganic solid state lubricant flakes and high aspect ratio platelets dispersed in polymeric matrices. This project addressed the roles of various components in modifying the tribological performance of the coatings. Specific combinations led to an ordered spatial arrangement of flakes and platelets with a low coefficient of friction. (Fig. 4)

SiglecCellTEM – WHOLE CELL TEM INVESTIGATIONS OF SIGLEC RECEPTOR PATTERN FORMATION ON TISSUE SURFACES INDUCED BY TAILORED NANOPARTICLES

Innovative Electron Microscopy, Biomineralization

The project aimed to visualize structural regulation of Siglec proteins using correlative high-resolution microscopy. The obtained insights into the distribution of this class of proteins on the outer cell surface will help to target cell-materials interactions for developing novel biomaterial design strategies. (Fig. 5)

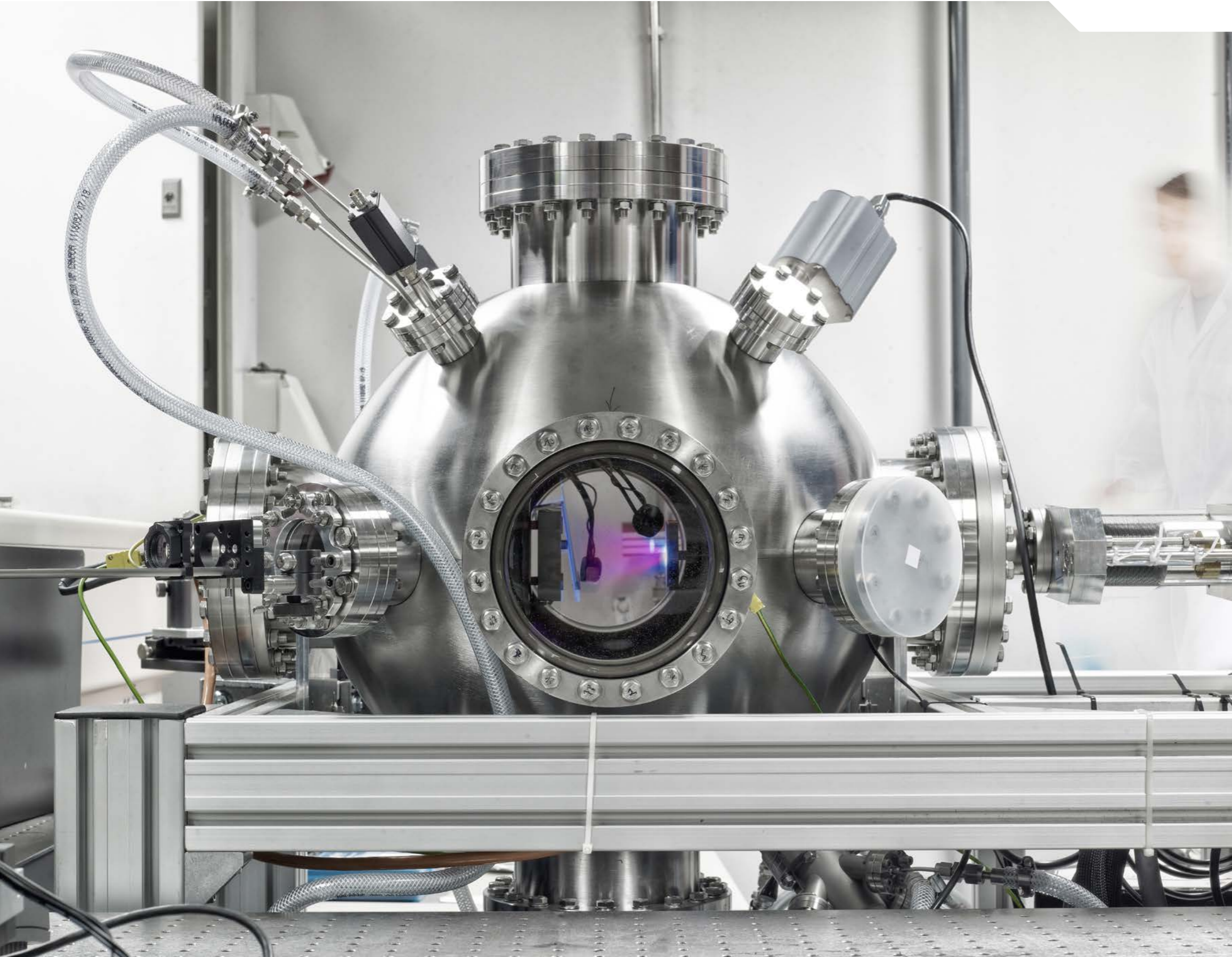
TRIBOBRAIN – IDENTIFYING NEURAL RESPONSE TO TRIBOLOGICAL STIMULI

Nanotribology, Modeling/Simulation, Functional Surfaces

We combined friction measurements between the human fingertip and structured materials with the recording of event-related EEG potentials. The goal was to establish an objective method in the emerging research area of haptics. Friction and potentials were correlated by employing advanced statistical methods of neural engineering. First results indicate a correlation between the strength of friction and the delay of a characteristic neural response. (Fig. 6)

OUTLOOK

With their positive results, the focus projects proved to be an efficient tool for intensifying the synergy between the research groups of INM by working on strategically significant questions. Therefore, the institute will fund four projects aiming at transferring basic research results into application oriented approaches in 2015.



▶ FAKTEN UND ZAHLEN /
FACTS AND FIGURES

▶ DAS INM IN ZAHLEN / INM IN FIGURES

FINANZ- UND ERTRAGSLAGE / VERMÖGENSLAGE DER GESELLSCHAFT

Als Forschungseinrichtung der Leibniz-Gemeinschaft hat das INM auch im Haushaltsjahr 2014 eine gemeinsame Förderung durch den Bund und die Länder erhalten. Diese belief sich auf 16.811 T€; hiervon 13.289 T€ zur Finanzierung von Personal- und Sachaufwendungen, sowie 3.522 T€ für erforderliche Neu- und Ersatzinvestitionen. Entsprechend der Beschlusslage der Gemeinsamen Wissenschaftskonferenz erfolgte gegenüber dem Vorjahr eine Erhöhung des Kernhaushalts um 5%.



2014 erzielte das INM eigene Erlöse aus Forschung und Entwicklung sowie sonstige betriebliche Erträge in Höhe von 4.775 T€. Im Rahmen öffentlicher Projektfinanzierungen erzielte das Institut Erlöse in Höhe von 3.306 T€. Die Industrieerlöse aus Forschung und Entwicklung sowie aus Lizenzvereinbarungen beliefen sich auf 1.173 T€. Sonstige Erlöse und betriebliche Erträge in Höhe von 297 T€ resultierten überwiegend aus der Weiterbelastung von Gebäude-, Patent- sowie sonstigen Kosten, im Übrigen aus Beauftragungen für Service- und sonstige Dienstleistungen.

Der Gesamtumsatz 2014 der Gesellschaft liegt mit 21.521 T€ deutlich höher als im Vorjahr. Neben der Erhöhung der eigenen Erlöse aus Forschung und Entwicklung sowie sonstiger betrieblicher Erträge stiegen die Erlöse aus der gemeinsamen Zuwendung durch den Bund und die Länder (2014 = 16.745 T€ - Vorjahr = 15.197 T€) deutlich an. Hier standen aus dem Vorjahr noch Zuwendungsmittel zur Verfügung.

Die Bilanzsumme der Gesellschaft zum 31. Dezember 2014 beträgt 25.811 T€; gegenüber dem Vorjahr eine Erhöhung um 491 T€. Für den Bereich des Anlagevermögens ist gegenüber dem Bilanzstichtag des Vorjahres eine deutliche Erhöhung feststellbar; die Investitionstätigkeit der Gesellschaft (4.650 T€) überstieg auch im Geschäftsjahr 2014 die Abschreibungen in Höhe von 3.355 T€. Dem gegenüber sind die Werte des bilanzierten Umlaufvermögens gegenüber den Vorjahreswerten geringer (-804 T€). Die Verbindlichkeiten der Gesellschaft beliefen sich zum Bilanzstichtag auf 2.439 T€, gegenüber dem Vorjahr eine Reduzierung um 601 T€. Hierfür sind die geringeren Verbindlichkeiten gegenüber der öffentlichen Hand ausschlaggebend.

PERSONALENTWICKLUNG

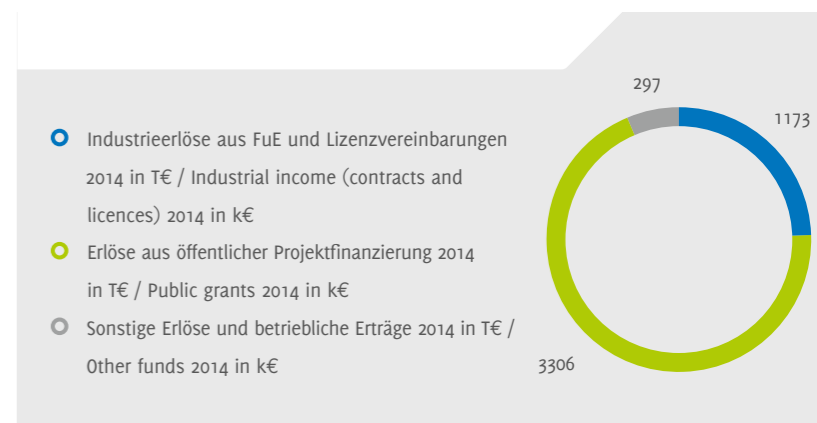
Die Anzahl der Beschäftigten belief sich im Durchschnitt des Jahres 2014 auf 212 Mitarbeiterinnen und Mitarbeiter. Hiervon waren 71 wissenschaftliche und graduierte Mitarbeiter/innen, 24 Doktoranden und Doktorandinnen, 51 Beschäftigte in den Bereichen Labor, Technik und Service sowie 25 Hilfswissenschaftler/innen. In den Bereichen Verwaltung und Sekretariate waren 32 Mitarbeiter/innen beschäftigt. Des Weiteren befanden sich im Jahresdurchschnitt 2014 neun Azubis in der Ausbildung.

FINANCIAL AND INCOME SITUATION OF THE CORPORATION

As a research institute of the Leibniz Association, INM obtained common financial support from the federal government and the federal states in the financial year 2014. This amounted to 16,811 k€; 13,289 k€ of those were used for financing personnel and materials expenses and 3,552 k€ for necessary new and replacement investments. According to the Joint Science Conference (GWK – Gemeinsame Wissenschaftskonferenz), the core budget increased by 5% compared to the previous year.

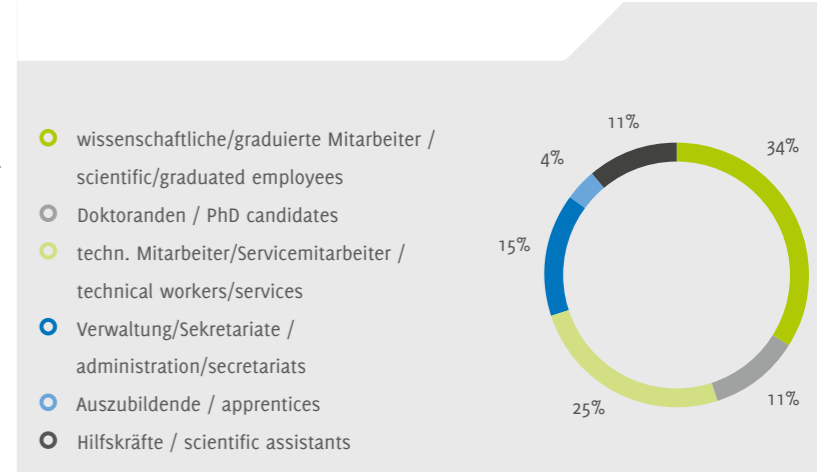
In 2014, the total turnover of the corporation added up to 21,521 k€ and is therefore slightly higher than the total turnover of the previous year. Apart from the increase of the own proceeds from research and development as well as other operating income, the proceeds from the joint funding by the federal government and the federal states rose significantly (2014 = 16,745 k€ - 2013 = 15,197 k€). Funding from the previous year was still available.

The balance sheet total of the corporation is 25,811 k€ on 31 December 2014, which is an increase of 491 k€ compared to the preceding year. Compared to the balance sheet date of the previous year, the field of the fixed assets rose significantly; the investment activity of the corporation (4,650 k€) exceeded again the write-offs amounting to 3,355 k€ in the financial year 2014. In contrast, the values of the current assets are lower compared to the values of the previous year (-804 k€). The liabilities of the corporation amounted to 2,439 k€ on the balance sheet date, showing a reduction of 601 k€ compared to the previous year. This is mainly based on the lower liabilities towards the public authorities.



PERSONNEL DEVELOPMENT

The average number of employees totalled 212 in 2014. This included 71 scientific and graduate employees, 24 doctoral candidates and 51 employees in the laboratories and the technical services as well as 25 graduate assistants. 32 employees worked in the administration and secretarial offices. Furthermore, nine apprentices were in vocational education in the course of the year 2014.



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Universität des Saarlandes, Saarbrücken

AUSZEICHNUNGEN / AWARDS

Cenk Aktas, Dieter Anshütz, Ayman Ahmad Haidar, Karin Löw and Marina Martinez-Miró (mit D.V. Pecina, H. Eichler, H. Abdul-Khalik)

Posterpreis, 46. Jahrestagung der DGPK, Weimar,
October 6, 2014.

Jennifer Atchison,

INWES (International Network of Women in Engineer-
ing and Science) Service Award, ICWES 16, Los
Angeles, USA, October 23 – 25, 2014.

Annika Diehl

Posterpreis „Undergraduate“, International Poster
Symposium 2014, Saarbrücken, August 14, 2014.

Sarah Fischer

1. Preis – Lecture Award, DGM Student Session,
MSE – Materials Science Engineering, Darmstadt,
September 23 – 25, 2014.

Sarah Fischer

2. Preis – Poster Award, Junior Euromat 2014, Lausanne,
Switzerland, July 21 – 25, 2014.

Sarah Fischer

3. Preis – Poster Award, Doktorandentag der Natur-
wissenschaftlich-Technischen Fakultät, Universität
des Saarlandes, Saarbrücken, November 12, 2014.

Ayman Ahmad Haidar

DAAD-Preis für hervorragende Leistungen ausländi-
scher Studierender, DAAD, Universität des Saarlandes,
Saarbrücken.

René Hensel

Auswahl, 6. DFG-Nachwuchsakademie im Fachgebiet
Materialwissenschaft und Werkstofftechnik, DFG,
Essen, October 6 – 10, 2014.

René Hensel (mit IPF Dresden)

VDI International Bionic-Award 2014, VDI Verein
Deutscher Ingenieure e. V.

René Hensel (mit IPF Dresden),

2. Preis Kategorie Community Award,
3. Preis Kategorie Substanz, Wettbewerb „fast forward
science“.

René Hensel (mit IPF Dresden)

Finalteilnehmer, Wettbewerb „nanospots – Das
Nano-Kurzfilm-Festival“, Martin-Luther-Universität
Halle-Wittenberg / science2public – Gesellschaft für
Wissenschaftskommunikation.

Judith Hoth

Masterarbeitspreis, Stiftung ME Saar des Metall- und
Elektroindustrie-Verbands.

Tobias Kraus

Ruf auf die W2-Professur für Materialwissenschaft
(Dünnschichttechnologie) im Exzellenzcluster EAM (abge-
lehnt), Friedrich-Alexander-Universität Erlangen-
Nürnberg.

Juhann Lee

1st Place Category „Materials Science“, Poster Award,
EU-Korea Conference on Science and Technology
2014, Vienna, Austria, July 23 – 25, 2014.

Marie-Louise Lemloh

Auswahl, 6. DFG-Nachwuchsakademie im Fachgebiet
Materialwissenschaft und Werkstofftechnik, DFG,
Essen, October 6 – 10, 2014.

Marina Pfaff

3. Preis – Fotowettbewerb „Nano-Momente 2014“,
Deutscher Verband Nanotechnologie und Kompe-
tenznetzwerk cc-NanoBioNet e. V., December 2, 2014.

Slawomir Porada

Postdoctoral Fellowship, Alexander von Humboldt-
Stiftung.

Volker Presser

Preisträger – Beste Innovatoren unter 35,
Technology Review.

Volker Presser

Wahl – Top 40 unter 40, Kategorie Wissenschaft,
Wirtschaftszeitschrift „Capital“.

Marco Zeiger

Posterpreis „PhD student“, International Poster
Symposium 2014, Saarbrücken, August 14, 2014.

▶ AKTIVITÄTEN IN GREMIEN / ACTIVITIES IN COMMITTEES

Dr. Jens Adam

Reviewer für Zeitschriften: ACS Applied Materials & Interfaces

Dr. Jennifer Atchison

Reviewer für Zeitschriften: Sensors, Progress in Materials Science

Dr. Cenk Aktas

Mitglied im Editorial (Guest Editor) Board: Biomed Research International

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Mitglied im Editorial Board: *Niche: Journal of Cellular Therapy and Regenerative Medicine*

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

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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

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

Mitglied, Scientific Committee for the International Conference on the Mechanics of Biomaterials and Tissues, Hawaii, December 6 – 10, 2015

Session Chair, ICONN 2014, February 3, 2014, Adelaide, Australia

Session Chair, Materials Today Asia 2014, December 10, 2014, Hong Kong

Herausgeber/Editor 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*

Gutachtertätigkeit für (Auswahl): Alexander-von-Humboldt-Stiftung, Alfried Krupp von Bohlen und Halbach-Stiftung, Austrian Science Fund (FWF), Centre de Recherche Public Gabriel Lippmann, Luxemburg, EPFL Schweiz, Helmholtz-Gemeinschaft Deutscher Forschungszentren e.V., Junge Akademie, Nationale Akademie der Wissenschaften Leopoldina, Royal Society/UK, Swiss National Science Foundation, Tel Aviv University, Telekom-Stiftung, Universität Freiburg, University of Cambridge/UK

Reviewer für Zeitschriften (Auswahl): *JBBM, Langmuir, PNAS, Sensors & Actuators: A. Physical, Journal of the Royal Society Interface, Nature*

Dr. Carsten Becker-Willinger

Vertreter des INM, caMPlusQ – Forschungscampus für Materialien, Prozesse und Qualifizierung

Mitglied, DGM-Fachausschuss „Funktionalisierung von Oberflächen mittels Mikro/Nano Strukturierungsverfahren“

Prof. Dr. Roland Bennewitz

Honorarprofessor der Universität des Saarlandes, Saarbrücken

Mitglied der Kommission zur Erarbeitung einer Internationalisierungsstrategie der Universität des Saarlands

Mitglied des Beirats der Evangelischen Studierenden-gemeinde Saarbrücken

Deutsches Mitglied des Management Committee des EU COST Network „Nanotribology“

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

Gutachtertätigkeit für: Deutsche Forschungsgemeinschaft, Deutsch-Französische Hochschule, Swiss National Science Foundation

Reviewer für Zeitschriften: *Physical Review B, Physical Review Letters, Beilstein Nano, Friction, Tribology letters, ACS Nano, Langmuir, Nature, Journal of Physics*

Elke Bubel

Sprecherin Arbeitskreis Bibliotheken und Informationseinrichtungen der Leibniz-Gemeinschaft

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

Sarah Fischer

Mitglied im DGM-Ausbildungsausschuss

Dr. Sabine Heusing

Reviewer für Zeitschriften: *Solar Energy Materials and Solar Cells*

Prof. Dr. Niels de Jonge

Adjoint Assistant Professor of Biophysics, Department of Molecular Physiology and Biophysics, Vanderbilt University School of Medicine, Nashville, TN, USA

Honorarprofessor der Universität des Saarlandes, Saarbrücken

Mitglied im Editorial Board von *Microscopy and Microanalysis*

Juror beim Schülerwettbewerb „Exciting Physics“, Wissenschaftsfestival „Highlights der Physik“, 27.09. – 02.10.14, Saarbrücken

Gutachtertätigkeit für: Dutch Ministry of Economic Affairs

Reviewer für Zeitschriften: *ACS Nano, Chemistry of Materials, Journal of Visualized Experiments, Microscopy and Microanalysis, Microscopy Research and Technique, Nano Letters Scientific Reports, Ultramicroscopy, Journal of Structural Biology, Nature Methods, Optics Express, Langmuir*

Dr. Annette Kraegeloh

Koordinatorin, Forschungsverbund Nanosicherheit der Leibniz-Gemeinschaft

Mitglied des Dechema-Arbeitskreises: Responsible Production and Use of Nanomaterials

Organisation, 1. Workshop Leibniz-Forschungsverbund Nanosicherheit, July 17, 2014, Berlin

Gutachtertätigkeit für: Leopoldina – Nationale Akademie der Wissenschaften

Reviewer für Zeitschriften: *Journal of the Royal Society Interface, Beilstein Journal of Nanotechnology, Nanomedicine and Nanotechnology, Toxicology Letters*

Dr. Tobias Kraus

Ko-Vorsitzender des Arbeitskreises „Grenzflächen: statisch und dynamisch“ im Fachausschuss Bioinspirierte und interaktive Materialien der Deutschen Gesellschaft für Materialkunde

Reviewer für Zeitschriften: *Langmuir, Advanced Materials, ACS Nano, Soft Matter, Nanoscale, Nanotechnology, Journal of Physical Chemistry C, Particles and particle systems characterization, Physical Chemistry Chemical Physics, ACS Applied Materials & Interfaces, RSC Advances*

Dr. Elmar Kroner

Gutachtertätigkeit für: Deutsche Forschungsgemeinschaft – DFG

Reviewer für Zeitschriften: *ACS – Applied Materials & Interfaces, Advanced Functional Materials, Advanced Materials, Applied Surface Science, International Journal of Molecular Sciences, Small*

Dr. Marie-Louise Lemloh

Substitute Management Committee Member, EU COST Action TD0903, Understanding and manipulating enzymatic and proteomic processes in biomineralization - towards new biomimetic strategies, the creation of tailored nano-scale architectures and environmental monitoring

Reviewer für Zeitschriften: *ICE Journal - Bioinspired, Biomimetic and Nanobiomaterials*

Dr. Peter W. de Oliveira

Gutachtertätigkeit: Deutsche Forschungsgemeinschaft, INCT – Institutos Nacionais de Ciência e Tecnologia, Brasilien

Jun.-Prof. Dr. Volker Presser

Juniorprofessor für Nanotechnologie Funktionaler Energiespeichermaterialien

Mitglied, AG LIESA – Landesinitiative Energieinnovation Saar

Vertreter des INM, Leibniz-Forschungsverbund Energiewende

Vize-Vorsitzender, Internationale Arbeitsgruppe „Capacitive deionization and electrosorption“

Conference Chair, Capacitive Deionization (CDI) 2015, Saarbrücken, Germany, October 26 – 29, 2015

Mitglied, Scientific Committee of IAP 2014 – International Conference on Interfaces against Pollution, Leeuwarden, Netherlands, May 25 – 28, 2014

Co-organizer, Symposium „Electrochemical Energy Conversion and Storage: Capacitors“, 65th Annual Meeting of the International Society of Electrochemistry (ISE), Lausanne, Switzerland, August 31 – September 5, 2014

Session Chair “Functional Surfaces”, 2. Workshop Leibniz-Netzwerk Nano, July 17, 2014, Berlin

Session Chair “Structural Characterization”, International Conference on Modern Materials & Technologies (CIMTEC), Montecatini Terme, Italy, 2014

Session Chair “New Materials”, Interfaces Against Pollution (IAP) 2014, Leeuwarden, the Netherlands, 2014

Gutachtertätigkeit: Estonian Research Council, Alexander-von-Humboldt-Stiftung, National Centre of Science and Technology Evaluation Kazakhstan, Qatar University, Studienstiftung des Deutschen Volkes, National Research Foundation South Africa, Baden-Württemberg Stiftung

Reviewer für Zeitschriften: *ACS Applied Materials & Interfaces*, *ACS Nano*, *Advanced Energy Materials*, *Advanced Engineering Materials*, *Advanced Functional Materials*, *Advanced Materials Interfaces*, *Angewandte Chemie – International Edition*, *Carbon*, *ChemSusChem*, *Desalination*, *Desalination and Water Treatment*, *Electrochemistry Communications*, *Electrochimica Acta*, *Energy and Environmental Science*, *Environmental Science & Technology*, *Environmental Science & Technology Letters*, *Journal of Applied Electrochemistry*, *Journal of Bio- and Tribo-Corrosion*, *Journal of Electroanalytical Chemistry*, *Journal of Materials Chemistry A*, *Journal of Power Sources*, *Materials Chemistry and Physics*, *Nano Energy*, *Nature Communications*, *Nature Nanotechnology*, *Progress in Materials Science*, *Solid State Sciences*, *Water Research*

Dr. Mario Quilitz

Koordinator des Leibniz-Netzwerk Nano

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

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

Advisory Board Member, EPSRC – Engineering and Physical Sciences Research Council, U.K.

Mitglied im Editorial Board der Zeitschriften: *Bioinspired Materials*, *Structural Biology*, *PeerJ*

Reviewer für Zeitschriften: *Acta Biomaterialia*, *American Journal of Botany*, *BMC Genomics*, *ChemBioChem*, *Chemistry of Materials*, *Comparative Biochemistry and Physiology*, *Crystal Growth & Design*, *Current Biology (Cell Press)*, *FEBS Journal*, *Journal of Plant Research*, *Journal of Structural Biology*, *Marine Biotechnology*, *Marine Drugs (MDPI)*, *PLOS ONE*, *PNAS*, *Polymers (MDPI)*, *Progress in Materials Science*

Gutachtertätigkeit für: Alexander von Humboldt-Stiftung, EU-H2020: Marie Skłodowska-Curie Individual Fellowships, NSF Graduate Research Fellowship Program, Universität Bremen

▶ DISSERTATIONEN / DOCTORAL THESES

Sahin, Fadime

Neue Arten von Alumosiloxanen durch Reaktion der bicyclischen Verbindung $Al_2[(OSiPh_2)_2O]_3 \cdot 2 O(C_2H_5)_2$ mit Wasser in Gegenwart von Donor-Liganden
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Dr. h.c. Michael Veith

Akkan, Cagri Kaan

Micro/nano modification of PEEK surface for possible medical use
Universitätsklinikum des Saarlandes, Homburg,
Prof. Dr. Dr. Mohamad Hammadeh

Nadig, Sandra

Die Reaktion eines molekularen Alumopolysiloxans mit Lewis-Säuren
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Dr. h.c. Michael Veith

Busse, Michael

Modeling the effects of nanoparticles on neuronal cells: From ionic channels to network dynamics
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Dr. Daniel J. Strauss

Lacava, Johann

Assembly of gold nanoparticles into regular clusters inside emulsion droplets
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Eduard Arzt

Jochem, Marlon

Entwicklung eines kratzfesten, transparenten Pulverlackes
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Dr. h.c. Michael Veith

▶ ABSCHLUSSARBEITEN / THESES

BACHELORARBEITEN AM INM / BACHELOR THESES AT INM**Ingremeau, Marina**

Investigation on a potential post-translational modification on a Pinctada protein expressed in the extracellular matrix of the social amoeba Dictyostelium discoideum
Universität des Saarlandes, Saarbrücken / Université de Strasbourg, Straßburg, France
Prof. Dr. Manfred J. Schmitt, PD Dr. Ingrid Weiss / Prof. Dr. François Bernier

VON INM-WISSENSCHAFTLERN BETREUTE BACHELORARBEITEN / BACHELOR THESES SUPERVISED BY INM SCIENTISTS**Al-Zouba, Osamah Mohammed**

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Globisch, Steven

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Grasborn, Anna-Lena

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Heitfeld, Marina

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Kube, Max

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Mohseni-Tehrani, Darius

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Schäfer, Patrick

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Schebsdat, Erik

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

Steinbach Alexander

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D.J. Strauss

MASTERARBEITEN AM INM / MASTER THESES AT INM

Agarwal, Neha

Laser-assisted micro-nano structuring of TiAl_{0.5}V₄ for dental implant
TU Chemnitz, Chemnitz,
PD Heidemarie Schmidt, Dr. O. Cenk Aktas

Denezhkin, Polina

Charakterisierung mechanisch stimulierter Pflanzen am Beispiel von Sorghum bicolor
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Rita Bernhardt, PD Dr. Ingrid Weiss

Diehl, Annika Sarina

Kraftmikroskopie im Ultrahochvakuum bei erhöhten Temperaturen
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Roland Bennewitz

Fischer, Sarah

Development of a multi-molding technique to manufacture medically relevant microstructures
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Eduard Arzt

Hoth, Judith

Kraftmikroskopie und Nanotribologie in ionischer Flüssigkeit
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Roland Bennewitz

Lambert, Marcel

Synthesis of optical functional metal/metaloxide nanocomposite thin films by PVD
Universität des Saarlandes, Saarbrücken,
Prof. Dr. David Scheschkewitz, Dr. O. Cenk Aktas

Lee, Juhan

Static and continuous operation of an electrochemical flow capacitor
Universität des Saarlandes, Saarbrücken,
Jun.-Prof. Dr. Volker Presser

Maurer, Johannes

Nanoplasticity of metallic glasses by AFM- and CR-AFM-indentation
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Eduard Arzt, Prof. Dr. Roland Bennewitz

Medina Clavijo, Bentejui

Characterization of steel by nanoindentation
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Eduard Arzt

Pohl, Anna

Charakterisierung von Grenzflächenphänomenen in fluidischen Biosensor-Systemen

Universität des Saarlandes, Saarbrücken,
Prof. Dr. Andreas Schütze, PD Dr. Ingrid Weiss

Rau, Christoph

Entwicklung von Verfahren zur quantitativen Partikelanalyse durch chemische Extraktion in hochfesten niedriggekohlten mikrolegierten Stählen
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Eduard Arzt

Sans Palacios, Gerard

Electrode design and cell operation of a capacitive deionization system
Universität des Saarlandes, Saarbrücken / Universität Politècnica de Catalunya, UPC, Barcelona, Spain
Jun.-Prof. Dr. Volker Presser

Tolosa Rodriguez, Aura Monserrat

Novel processing route to obtain ultra-fine SiOC fibers by electrospinning
Universität des Saarlandes, Saarbrücken,
Jun.-Prof. Dr. Volker Presser

Yagüe Isla, Paula

Bioinspired switchable adhesives with two-step controlled pull-off force
Universität des Saarlandes, Saarbrücken,
Prof. Dr. Eduard Arzt

Zeiger, Marco

Synthesis and properties of onion-like carbons and their use in supercapacitors
Universität des Saarlandes, Saarbrücken,
Jun.-Prof. Dr. Volker Presser

VON INM-WISSENSCHAFTLERN BETREUTE MASTERARBEITEN / MASTER THESES SUPER- VISED BY INM SCIENTISTS

Bekiesch, Katrin

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D. J. Strauss

Herrmann, David Peter

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D. J. Strauss

Klauke, Isabelle

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D. J. Strauss

Salafzoon, Narsis

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D. J. Strauss

van Bellen, Janine

HTW Saar, Saarbrücken,
Prof. Dr. Dr. D. J. Strauss

▶ DOKTORANDEN / DOCTORAL STUDENTS

Balijepalli, M.Sc. Ram Gopal, Prof. Dr. E. Arzt

Barreau, M.Sc. Viktoriia, Prof. Dr. E. Arzt

Bauer, Dipl. Biophys. Christina, Prof. Dr. E. Arzt

Blass, Dipl. Biophys. Johanna, Prof. Dr. R. Bennewitz

Brörmann, M.Sc. Katrin, Prof. Dr. R. Bennewitz

Brunke, M.Sc. Jessica, Prof. Dr. G. Kickelbick,
Universität des Saarlandes

Ferreira Lopes, M.Sc. Isabela Maria, Prof. Dr. R. M. R. Junqueira, Universidade Federal de Ouro Preto, Brazil

Fischer, M.Sc. Sarah, Prof. Dr. E. Arzt

Frensemeier, M. Sc. Mareike, Prof. Dr. E. Arzt

Gerstner, Dipl.-Phys. Dominik, Prof. Dr. E. Arzt

Haas, M.Sc. Beate, Prof. Dr. E. Arzt

Hegetschweiler, M.Sc. Andreas, Prof. Dr. E. Arzt

Heppe, M.Sc. Jonas Raphael, Prof. Dr. K. Jacobs,
Universität des Saarlandes

Jochem, M.Sc. Aljosh-Rakim, Prof. Dr. E. Arzt

Jung, M.Sc. Jennifer, Prof. Dr. A. Kiemer, Universität des Saarlandes

Kaiser, Dipl.-Ing. (FH), M.Sc. Jessica, Prof. Dr. E. Arzt

Kister, M.Sc. Thomas, Prof. Dr. E. Arzt

Kümper, M.Sc. Alexander, PD Dr. Klaus Unfried,
Universität Düsseldorf

Lee, M.Sc. Juhan, Jun.-Prof. Dr. V. Presser

Martins Amaral, M.Sc. Thiago, Prof. Dr. A. C. Hernandez, University of Sao Paulo, Brazil

Maurer, M.Sc. Johannes, Prof. Dr. R. Bennewitz

Özgün, M.Sc. Novaf, Prof. Dr. Dr. D. Strauss, HTW Saar

Purtov, M.Sc. Julia, Prof. Dr. E. Arzt

Rittgen, Dipl.-Phys. Kai, Prof. Dr. R. Bennewitz

Soorali Ganeshamurthy, M. Sc. Balakrishna, Prof. Dr. R. Bennewitz

Támara Florez, M. Sc. Juan Carlos, Prof. Dr. E. Arzt

Tinnemann, M.Sc. Verena, Prof. Dr. N. de Jonge

Tolosa Rodriguez, M.Sc. Aura Monserrat, Jun.-Prof. Dr. V. Presser

Torrents Abad, M.Sc. Oscar, Prof. Dr. E. Arzt

Zeiger, M.Sc. Marco, Jun.-Prof. Dr. V. Presser

▶ GASTAUFENTHALTE / VISITING SCIENTISTS AND STUDENTS

Agarwal, Neha, Indien

Al Hmoud, Hashim Ziad R., Jordanien

Alejo Rodriguez, Omar Andrés, Kolumbien

Broitman, Prof. Dr. Esteban Daniel, Argentinien

Burgeson, Eric, USA

Dela Paz, Gabriel, Philippinen

Ferreira Lopes, Isabela Maria, Brasilien

Ingremeau, Marina Anais, Frankreich

Jeon, Jeongwook, Südkorea

Kang, Sang-Jun, Südkorea

Khatri, Dr. Om Prakash, Indien

Lee, Hae Ri, Südkorea

Levi, Prof. Mikhael D., Russland

Makgopa, Katlego, Südafrika

Medina Clavijo, Bentejui, Spanien

Park, Euiyoung Caroline, USA

Porada, Dr. Slawomir, Polen

Reppert, Timothy, USA

Sans Palacios, Gerard, Spanien

Trusty, Joshua, USA

Verma, Satish Chandra, Indien

Villafria, Niccolo, USA

Völcker, Prof. Dr. Nicolas Hans, Australien

Wirix, Dr. Maarten, Belgien

Wu, Fan, China

Yagüe Isla, Paula, Spanien

Zecevic, Dr. Jovana, Serbien

PUBLIKATIONEN / PUBLICATIONS

Im Jahr 2014 wurden insgesamt 136 Publikationen veröffentlicht, davon 87 Publikationen in referierten Zeitschriften und 49 sonstige Publikationen. Es wurden 99 Poster präsentiert. (Stand: 31.03.2015)

In 2014, 136 publications were published, therefrom 87 publications in peer-reviewed journals and 49 other publications. 99 posters were shown. (As of 31.03.2015)

REFERIERTE PUBLIKATIONEN / REVIEWED PUBLICATIONS

GRENZFLÄCHENMATERIALIEN / INTERFACE MATERIALS

Energie-Materialien / Energy Materials

A. Al-Kahlout, N. Al-Dahoudi, I. Grobelsek, M. H. Jilavi and P.W. de Oliveira

Synthesis and characterization of aluminum doped zinc oxide nanostructures via hydrothermal route
Journal of Materials 2014, 2014, Article ID 235638, doi:10.1155/2014/235638, online: March 03, 2014 [-]

M. Aslan, D. Weingarh, N. Jäckel, J.S. Atchison, I. Grobelsek and V. Presser

Polyvinylpyrrolidone as binder for castable supercapacitor electrodes with high electrochemical performance in organic electrolytes
J Power Sources 2014, 266, 374-383 [05.211 (2013)]

F. Béguin, V. Presser, A. Balducci and E. Frackowiak
Carbons and electrolytes for advanced supercapacitors
Adv Mater 2014, 26, (14), 2219-2251 [15.409 (2013)]

O.S. Burheim, M. Aslan, J.S. Atchison and V. Presser
Thermal conductivity and temperature profiles in carbon electrodes for supercapacitors
J Power Sources 2014, 246, 160-166 [05.211 (2013)]

A.C. Forse, J.M. Griffin, V. Presser, Y. Gogotsi and C.P. Grey
Ring current effects: factors affecting the NMR chemical shift of molecules adsorbed on porous carbons
J Phys Chem C 2014, 118, (14), 7508-7514 [04.835 (2013)]

M. Golshadi, J. Maita, D. Lanza, M. Zeiger, V. Presser and M.G. Schrlau
Effects of synthesis parameters on carbon nanotubes manufactured by template-based chemical vapor deposition
Carbon 2014, 80, 28-39 [06.160 (2013)]

M.M. Hantel, D. Weingarh and R. Kötz
Parameters determining dimensional changes of porous carbons during capacitive charging
Carbon 2014, 69, 275-286 [06.160 (2013)]

H.H. Hauge, V. Presser and O.S. Burheim
In-situ and ex-situ measurements of thermal

conductivity of supercapacitors
Energy 2014, 78, 373-383 [04.159 (2013)]

N. Jäckel, D. Weingarh, M. Zeiger, M. Aslan, I. Grobelsek and V. Presser

Comparison of carbon onions and carbon blacks as conductive additives for carbon supercapacitors in organic electrolytes
J Power Sources 2014, 272, 1122-1133 [05.211 (2013)]

M. Naguib, O. Mashtalir, M.R. Lukatskaya, B. Dyatkin, C. Zhang, V. Presser, Y. Gogotsi and M.W. Barsoum

One-step synthesis of nanocrystalline transition metal oxides on thin sheets of disordered graphitic carbon by oxidation of MXenes
Chem Commun 2014, 50, 7420-7423 [06.718 (2013)]

S. Porada, J. Lee, D. Weingarh and V. Presser

Continuous operation of an electrochemical flow capacitor
Electrochem Commun 2014, 48, 178-181 [04.287 (2013)]

S. Porada, D. Weingarh, H.V.M. Hamelers, M. Bryjak, V. Presser and P.M. Biesheuvel

Carbon flow electrodes for continuous operation of capacitive deionization and capacitive mixing energy generation
J Mater Chem A 2014, 2, (24), 9313-9321 [- (2013)]

B.B. Sales, O.S. Burheim, S. Porada, V. Presser, C.J.N. Buisman and H.V.M. Hamelers

Extraction of energy from small thermal differences near room temperature using capacitive membrane technology
Env Sci Tech Lett 2014, 1, (9), 356-360, doi:10.1021/ez5002402, online: 22.08.2014 [-]

M. Veith, I. Grobelsek, T. Kirs, O.C. Aktas and C. Dufloux

Oriented aluminum nanocrystals in a one-step process
Thin Solid Films 2014, 564, 128-134 [01.867 (2013)]

D. Weingarh, D. Cericola, F.C.F. Mornaghini, T. Hucke and R. Kötz

Carbon additives for electrical double layer capacitor electrodes
J Power Sources 2014, 266, 475-480 [05.211 (2013)]

D. Weingarh, R. Drumm, A. Foelske-Schmitz, R. Kötz and V. Presser

Electrochemical in situ study of freezing and thawing of ionic liquids in carbon nanopores
Phys Chem Chem Phys 2014, 16, (39), 21219-21224 [04.198 (2013)]

D. Weingarh, M. Zeiger, N. Jäckel, M. Aslan, G. Feng and V. Presser

Graphitization as a universal tool to tailor the potential-dependent capacitance of carbon supercapacitors
Adv Eng Mater 2014, 4, (13), 1400316 [14.385 (2013)]

Funktionelle Mikrostrukturen / Functional Microstructures

E. Camposilvan, O. Torrents Abad and M. Anglada

Small-scale mechanical behavior of zirconia
Acta Mater 2014, 80, 239-249 [03.940 (2013)]

S.R. Ganneboyina and A. Ghatak

Measurement of dynamic surface tension using helical flow of a viscous liquid in a pool of another viscous liquid inside a micro-channel
Microfluid Nanofluid 2014, 17, (3), 573-580 [02.665 (2013)]

A. Ghatak

Peeling off an adhesive layer with spatially varying topography and shear modulus
Phys Rev E 2014, 89, (3), 032407 [02.326 (2013)]

R. Hensel, A. Finn, R. Helbig, S. Killge, H.-G. Braun and C. Werner

In situ experiments to reveal the role of surface feature sidewalls in the Cassie-Wenzel transition
Langmuir 2014, 30, (50), 15162-15170 [04.384 (2013)]

A. Jantschke, C. Fischer, R. Hensel, H.-G. Braun and E. Brunner

Directed assembly of nanoparticles to isolated diatom valves using the non-wetting characteristics after pyrolysis
Nanoscale 2014, 6, (20), 11637-11645 [06.739 (2013)]

M. Micciché, E. Arzt and E. Kroner

Single macroscopic pillars as model system for bioinspired adhesives: influence of tip dimension, aspect ratio and tilt angle
ACS Appl Mater Inter 2014, 6, (10), 7076-7083 [05.900 (2013)]

J. Mueller, N.K. Guimard, K.K. Oehlenschlaeger, F.G. Schmidt and C. Barner-Kowollik

Sunlight-induced crosslinking of 1,2-polybutadienes: access to fluorescent polymer networks
Polym Chem 2014, 5, (4), 1447-1456 [05.368 (2013)]

D. Paretkar, X. Xu, C.-Y. Hui and A. Jagota

Flattening of a patterned compliant solid by surface stress
Soft Matter 2014, 10, (23), 4084-4090 [04.151 (2013)]

E. Qin, N.J. Peter, M. Frensemeier, C.P. Frick, E. Arzt and A.S. Schneider

Vickers indentation induced one-way and two-way shape memory effect in austenitic NiTi
Adv Eng Mater 2014, 16, (1), 72-79 [01.508 (2013)]

F.C. Wählich, N.J. Peter, O. Torrents Abad, M.V.G. Oliveira, A.S. Schneider, W. Schmahl, E. Griesshaber and R. Bennewitz

Surviving the surf: The tribomechanical properties of the periostracum of Mytilus sp
Acta Biomater 2014, 10, (9), 3978-3985 [05.684 (2013)]

E. Wohlfart, J.O. Wolff, E. Arzt and S.N. Gorb

The whole is more than the sum of all its parts: collective effect of spider attachment organs
J Exp Biol 2014, 217, (2), 222-224 [03.002 (2013)]

Metallische Mikrostrukturen / Metallic Microstructures

A.L. DiRienzo, C.M. Yakacki, M. Frensemeier, A.S. Schneider, D.L. Safranski, A.J. Hoyt and C.P. Frick

Porous poly(para-phenylene) scaffolds for load-bearing orthopedic applications
J Mech Behav Biomed Mater 2014, 30, 347-357 [03.048 (2013)]

E. Qin, N.J. Peter, M. Frensemeier, C.P. Frick, E. Arzt and A.S. Schneider

Vickers indentation induced one-way and two-way shape memory effect in austenitic NiTi
Adv Eng Mater 2014, 16, (1), 72-79 [01.508 (2013)]

M. Zeiger, M. Solioz, H. Edongué, E. Arzt and A.S. Schneider

Surface structure influences contact killing of bacteria by copper
MicrobiologyOpen 2014, 3, (3), 327-332 [-]

Nanotribologie / Nanotribology

S.G. Balakrishna, A.S. de Wijn and R. Bennewitz

Preferential sliding directions on graphite
Phys Rev B 2014, 89, (24), 245440 [03.664 (2013)]

R. Bennewitz and N. Strobach

Do you see atoms? An interdisciplinary class on atomic force microscopy and the philosophy of imaging
J Nano Educ 2014, 6, (1), 30-38 [-]

R.W. Carpick and R. Bennewitz

Friction: Let it slip
Nat Phys 2014, 10, (6), 410-411 [20.603 (2013)]

F. Hausen and R. Bennewitz

Schmierer und schalten mit flüssigen Salzen
Nachr Chem 2014, 62, (6), 620-622 [00.201 (2012)*]

J. Hoth, F. Hausen, M.H. Müser and R. Bennewitz

Force microscopy of layering and friction in an ionic liquid
J Phys: Condens Matter 2014, 26, (28), 284110 [02.223 (2013)]

A. Klemenz, L. Pastewka, S.G. Balakrishna, A. Caron, R. Bennewitz and M. Moseler

Atomic scale mechanisms of friction reduction and wear protection by graphene
Nano Lett 2014, 14, (12), 7145-7152 [12.940 (2013)]

S.V. Madge, A. Caron, R. Gralla, G. Wilde and S.K. Mishra

Novel W-based metallic glass with high hardness and

wear resistance

Intermetallics 2014, 47, 6-10 [02.119 (2013)]

M. Mohr, A. Caron, P. Herbeck-Engel, R. Bennewitz, P. Gluche, K. Brühne and H.-J. Fecht

Young's modulus, fracture strength, and Poisson's ratio of nanocrystalline diamond films

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F. C. Wählich, N. J. Peter, O. Torrents Abad, M. V. G. Oliveira, A. S. Schneider, W. Schmahl, E. Griesshaber and R. Bennewitz

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Environmental scanning electron microscopy for studying proteins and organelles in whole, hydrated eukaryotic cells with nanometer resolution

In: Proceedings of CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken, (2014), pp 10 – 11

D. B. Peckys and N. de Jonge

Neue elektronenmikroskopische Methode

Deutsche Zeitschrift für Klinische Forschung 2014, (6), 27-30 [-]

D. B. Peckys, M. J. Dukes and N. de Jonge

Correlative fluorescence and electron microscopy of quantum dot labeled proteins on whole cells in liquid

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D. B. Peckys, U. Korf and N. de Jonge

Detecting protein complex subunits in whole eukaryotic cells in aqueous environment

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Imaging labeled protein complex subunits in whole eukaryotic cells in their native aqueous environment

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M. Pfaff and N. de Jonge

Investigation of gold nanoparticle movement in liquid by scanning transmission electron microscopy

In: 18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>, (2014), pp CR-ROM, 2 S.,

N. A. J. M. Sommerdijk, M. W. P. van de Put, P. H. H. Bomans, H. Friedrich and N. de Jonge

Writing silica structures in liquid with scanning transmission electron microscopy

In: MRS Fall Meeting, November 30-December 05, 2014, Boston <MA, USA>, (2014), p o.A.

K. Song, H. K. Schmid, V. Srot, E. Gilardi, G. Gregori, K. Du, J. Maier and P. A. van Aken

Cerium reduction at the interface between ceria and yttria-stabilised zirconia and implications for interfacial oxygen non-stoichiometry

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A. Verch, I. Perovic, A. Rao, E. P. Chang, H. Cölfen, J. S. Evans and R. Kröger

Crystallisation of calcium carbonate studied by liquid cell scanning transmission electron microscopy

In: Proceedings of CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken, (2014), pp 27 – 28

InnovationsZenrum INM / Innovation Center INM

L. Lin and A. K. Schlarb

Vibration welding of carbon nanotube reinforced polyoxymethylene: Morphology and mechanical property

In: 16th European Conference on Composite Materials, ECCM 2014, June 22 – 26, 2014, Sevilla <Spain>, (2014), p o.A.

A. K. Schlarb, M. Albrecht and L. Lin

Thermoplastbasierte Nanokomposite: Herausforderungen und Lösungen in der Aufbereitung und Verarbeitung vom Rohstoff bis zum Fertigteil

Jahresmagazin Ingenieurwissenschaften 2014, (2014), 12-14

S. Thanomchat, K. Srikulkit, B. Suksut and A. K. Schlarb

Morphology and crystallization of polypropylene/microfibrillated cellulose composites

KMUTNB: IJAST 2014, 7, (4), 23-34 [-]

Modellierung/Simulation / Modelling/Simulation

C. Bernarding, D. J. Strauss, R. Hannemann, H. Seidler and F. I. Corona-Strauss

Objective assessment of listening effort in the oscillatory EEG: Comparison of different hearing aid configurations

In: Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE, August 26 – 30, 2014, Chicago <IL, USA>, IEEE, (2014), pp 2653 – 2656

L. Haab, Z. Mortezaouraghdam and D. J. Strauss

Modeling prediction of a generalized habituation deficit in decompensated tinnitus sufferers

In: Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE, August 26 – 30, 2014, Chicago <IL, USA>, IEEE, (2014), pp 5691 – 5694

Z. Mortezaouraghdam, L. Haab, G. Steidl and D. J. Strauss

Detection of change points in phase data: A Bayesian analysis of habituation processes

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PROGRAMMBEREICHSUNGEBUNDEN / NOT LINKED TO A PROGRAM DIVISION

Forschungsförderung & Technologietransfer / Project Support & Technology Transfer

M. Geerkens, N. Herrmann and M. Busse

Erarbeitung und Umsetzung eines INM-spezifischen Verwertungskonzeptes (VERWERTUNG+)

Laufzeit des Vorhabens 01.04.2011-31.03.2014, Förderkennzeichen 01SF1129
Schlussbericht, 2014, Saarbrücken, 20 S.

Geschäftsführung / Management Board

INM – Leibniz-Institut für Neue Materialien gGmbH
CISCEM 2014 - 2nd Conference on in-situ and correlative electron microscopy, October 14 – 15, 2014, Saarbrücken, Germany, Conference Proceedings
INM: Saarbrücken, 2014, 72 S.

INM – Leibniz-Institut für Neue Materialien gGmbH
Jahresbericht 2013/Annual report 2013
INM: Saarbrücken, 2014, Vol. 2013, p 109 S.

C. Jung

Wenn neue Phänomene in Anwendungen für Mensch und Maschine münden

Nanotechnologie aktuell 2014, 7, 66-69

M. Quilitz

Leibniz Netzwerk Nano - Ein Netzwerk von Leibniz-Instituten mit Aktivitäten in der Nanotechnologie

In: nano.DE-Report 2013 - Status quo der Nanotechnologie in Deutschland, Bundesministerium für Bildung und Forschung: Paderborn, 2014, pp 93 – 94

INM Fellow / INM Fellow

G. Kickelbick

Introduction to sol-gel nanocomposites

In: Sol-Gel Nanocomposites, M. Guglielmi, G. Kickelbick and A. Martucci Eds., Springer: New York, 2014, pp 1 – 19

Werkstoffprüfung/Pulversynthese / Materials Testing/Powder Synthesis

J. Adam, P. König and R. Drumm

Colloids of fluorescent Y₂O₃:Eu nanoparticles combining good quantum yield and dispersibility properties

In: 17th International Conference on Luminescence and Optical Spectroscopy of Condensed Matter, Book of Abstracts, July 13 – 18, 2014, Wroclaw <Poland>, (2014), pp P-172

POSTER / POSTERS

GRENZFLÄCHENMATERIALIEN / INTERFACE MATERIALS

Energie-Materialien / Energy Materials

E. Burgeson, D. Weingarth and V. Presser

Characterization of graphene grown by chemical vapor deposition

International Poster Symposium, August 14, 2014, Saarbrücken

A. C. Forse, J. M. Griffin, H. Wang, C. Merlet, D. Weingarth, V. Presser, Y. Gogotsi, P. Simon and C. P. Grey

NMR studies of the charge storage mechanism of supercapacitors

65th Annual Meeting of the International Society of Electrochemistry (ISE), August 31-September 05, 2014, Lausanne <Switzerland>

A. C. Forse, J. M. Griffin, H. Wang, C. Merlet, D. Weingarh, V. Presser, Y. Gogotsi, P. Simon and C. P. Grey
NMR studies of the carbon-electrolyte interface in ionic liquid supercapacitors

Carbon in Electrochemistry - Faraday Discussion 172, July 28 – 30, 2014, Sheffield <UK>

N. Jäckel, D. Weingarh, M. Zeiger, M. Aslan and V. Presser
Graphitization as a universal tool to improve the energy density of supercapacitors
International Poster Symposium, August 14, 2014, Saarbrücken

F. Kaasik, I. Must, E. Lust, M. Jürgens, V. Presser, A. Punning, R. Temmer, R. Kiefer and A. Aabloo
Characterization of carbon-polymer composite actuator in different environments

Fourth international conference on Electromechanically Active Polymer transducers & artificial muscles (EuroEAP 2014), June 10 – 11, 2014, Linköping <Sweden>

J. Lee, S. Porada, D. Weingarh and V. Presser
Electrochemical flow capacitor under static and continuous operation

EU-Korea Conference on Science and Technology (EKC) 2014, July 23 – 25, 2014, Wien
1st place in the category „Materials Science“

A. McBride, D. Weingarh, E. Perre, J. S. Atchison and V. Presser

Investigating charge induced swelling of porous carbon electrodes in ionic liquids
National Conference on Undergraduate Research (NCUR) 2014, University of Kentucky, April 03 – 05, 2014, Lexington <KY, USA>

A. McBride, D. Weingarh, E. Perre and V. Presser
Investigating charge induced swelling of porous carbon electrodes in ionic liquids
Harvard College Undergraduate Research Association: National Collegiate Research Conference 2014, January 22 – 25, 2014, Cambridge <MA, USA>

S. Porada, D. Weingarh, H. V. M. Hamelers, M. Bryjak, V. Presser and P. M. Biesheuvel
Continuous performance of double-layer technologies for water desalination and energy harvesting using flow electrodes
Carbon in Electrochemistry - Faraday Discussion 172, July 28 – 30, 2014, Sheffield <UK>

M. Quilitz, T. Kraus, K. Moh, V. Presser and E. Arzt
Innovative Energie-Forschung am INM
1. LIESA Kongress, „Die Energiewende voranbringen: innovativ, vernetzt, saarländisch“, November 19, 2014, Saarbrücken

N. Souza Carmona, V. Presser and F. Mücklich
Laser annealing of single-wall carbon nanotubes

Fifteenth International Conference on the Science and Application of Nanotubes, June 02 – 06, 2014, Los Angeles <CA, USA>

A. M. Tolosa Rodriguez, J. S. Atchison, C. Vatifahmetoglu and V. Presser
Novel processing route to obtain Si-O-C fibers by electrospinning

International Poster Symposium, August 14, 2014, Saarbrücken

M. Zeiger, D. Weingarh, M. Aslan, J. S. Atchison and V. Presser

Carbon onion/nanofiber composites for electrical energy storage
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

M. Zeiger, D. Weingarh, M. Aslan, J. S. Atchison and V. Presser

Carbon onion/nanofiber composites for electrical energy storage
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Poster Award

M. Zeiger, D. Weingarh, M. Aslan, J. S. Atchison and V. Presser

Carbon onion/nanofiber composites for electrical energy storage
Doktorandenforum der Sektion D der Leibniz-Gemeinschaft, July 16 – 18, 2014, Berlin

Funktionelle Mikrostrukturen/ Functional Microstructures

G. N. Ankah, P. Büchele, S. F. Tedde, J. Adam, O. Torrents Abad, D. Brodoceanu, K. Poulsen, M. Koch, C. Gimmler, O. Schmidt and T. Kraus
Structural characterization of organic-inorganic polymer nanocomposites for sensing applications
MRS Spring Meeting & Exhibit, April 21 – 25, 2014, San Francisco <CA, USA>

G. N. Ankah, P. Büchele, S. F. Tedde, J. Adam, O. Torrents Abad, M. Pfaff, K. Poulsen, M. Koch, C. Gimmler, O. Schmidt and T. Kraus
Structural characterization of hybrid-organic nanocomposites via focused ion beam preparation and electron microscopy

18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

C. T. Bauer, E. Kroner, D. Brodoceanu, T. Kraus, N. K. Guimard and E. Arzt

Hierarchical dry adhesives
Nanobrücken 2014 – Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

C. T. Bauer, E. Kroner, N. Fleck and E. Arzt
Hierarchically patterned dry adhesives
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

V. Boiko, N. K. Guimard, E. Kroner and E. Arzt
Adhesion of bioinspired micropillar system on rough surfaces

2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

V. Boiko, N. K. Guimard, E. Kroner and E. Arzt

Adhesion of bioinspired micropatterned systems on rough surfaces
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

D. Brodoceanu, R. Elnathan, N. H. Voelcker, E. Kroner, E. Arzt and T. Kraus

Bioinspired hierarchical structures by replica molding
2nd International School and Conference on Bio-inspired Materials, March 17 – 21, 2014, Potsdam

S. Fischer, R. Hensel and E. Arzt

Adhesion of microstructures on soft matter: How to make things stick without glue
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken
3. Preis, Poster Award

S. Fischer, E. Kroner, O. Levy, J. M. Karp and E. Arzt
Influence of microfeature characteristics on their interaction with tissue
Junior EuroMat, July 21 – 25, 2014, Lausanne <Switzerland>
2nd Poster Prize

A. Ghailane, M. Zamanzade, O. Torrents Abad and C. Motz

Micromechanical testing: Response of copper bicrystal micro beams under reverse low cycle fatigue test
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

J. S. Kaiser, K. Samet, E. Arzt, E. Kroner and N. K. Guimard

Multimodulus mushroom-shaped pillars for enhanced adhesion to soft surfaces
Doktorandenforum der Sektion D der Leibniz-Gemeinschaft, July 16 – 18, 2014, Berlin

B. Medina Clavijo, D. Britz, E. Arzt and A. S. Schneider
Steel characterization by nanoindentation
Dillinger Hütte, November 21, 2014, Dillingen

C. E. Park, S. Fischer, R. Hensel, N. K. Guimard and E. Arzt

Adhesion of micro-scale suction cups
International Poster Symposium, August 14, 2014, Saarbrücken

M. Quilitz, E. Bubel, A. Kraegeloh, C. Jung and E. Arzt
Das INM und die Leibniz-Gemeinschaft
Jahrestagung der Leibniz-Gemeinschaft, November 26, 2014, Berlin

M. Quilitz, T. Kraus, K. Moh, V. Presser and E. Arzt
Innovative Energie-Forschung am INM

1. LIESA Kongress, „Die Energiewende voranbringen: innovativ, vernetzt, saarländisch“, November 19, 2014, Saarbrücken

S. Tioual, M. Zamanzade, O. Torrents Abad and C. Motz
Interaction between dislocations and grain boundaries in nickel micro-pillars

Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

O. Torrents Abad, A. S. Schneider, C. P. Frick and E. Arzt

Size dependent kink formation of beta brass
Gordon Research Seminar and Gordon Research Conference (GRC & GRS) on Thin Film and Small Scale Mechanical Behavior, Bentley University, July 13 – 16, 2014, Waltham <MA, USA>

O. Torrents Abad, A. S. Schneider, C. P. Frick, J. M. Wheeler, J. Michler and E. Arzt

Plasticity of small-scale metal structures
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

A. Zekri, M. Zamanzade, O. Torrents Abad and C. Motz
Bending test of copper at various temperatures
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

Nanotribologie / Nanotribology

J. Blass, B. Bozna, F. Hausen, M. Albrecht, G. Wenz and R. Bennewitz

Anisotropy of dynamic friction and adhesion force on cyclodextrin assemblies mediated by ditopic guest molecules
Gordon Research Conference on Tribology, Bentley University, July 19 – 20, 2014, Waltham <MA, USA>

J. Blass, B. Bozna, F. Hausen, M. Albrecht, G. Wenz and R. Bennewitz

Single host-guest interactions on self-assembled monolayers mediated by ditopic guest molecules
International Nanotribology Forum, January 06 – 10, 2014, Kochi <Kerala, India>

B. Bozna, J. Blass, F. Hausen, M. Albrecht, J.A. Krings, G. Wenz, B.J. Ravoo and R. Bennewitz

A molecular toolkit based on cyclodextrin polymers for surface materials with switchable tribological functions
17th International Cyclodextrin Symposium (ICS17), May 29 – 31, 2014, Saarbrücken

B. Bozna, J. Blass, F. Hausen, M. Albrecht, G. Wenz and R. Bennewitz

Electrochemically controlled friction using host-guest molecules interaction
Gordon Research Conference on Tribology, Bentley University, July 19 – 20, 2014, Waltham <MA, USA>

A. Diehl, A. Caron and R. Bennewitz

Temperature determination of AFM cantilevers from thermal noise spectrum analysis
5th International Workshop on Advanced Scanning Probe Microscopy Techniques, February 24 – 25, 2014, Karlsruhe

A. Diehl, A. Caron and R. Bennewitz

Temperature determination of AFM cantilevers and imaging at high temperatures
International Poster Symposium, August 14, 2014, Saarbrücken, Posterpreis „Undergraduate“

M. Mohr, A. Caron, P. Herbeck-Engel, R. Bennewitz, P. Gluche, K. Brühne and H.-J. Fecht

Poisson's ratio of nanocrystalline diamond films
International Conference on Diamond and Carbon Materials, Melia Castilla, September 07 – 11, 2014, Madrid <Spain>

N. Özgün, R. Bennewitz, D.J. Strauss and E. Arzt

Tribo brain-identifying neural response to tribological stimuli
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

N. Özgün, D.J. Strauss and R. Bennewitz

Identifying neural response to tribological stimuli
Gordon Research Conference on Tribology, Bentley University, July 19 – 20, 2014, Waltham <MA, USA>

B. Soorali Ganeshamurty, A.S. de Wijn and R. Bennewitz

Preferential sliding directions on graphitic materials
Gordon Research Conference on Tribology, Bentley University, July 19 – 20, 2014, Waltham <MA, USA>

F. Wählich, N.J. Peter, O. Torrents Abad,

M.V.G. Oliveira, A.S. Schneider, W. Schmahl,

E. Griesshaber and R. Bennewitz

Surviving the surf: The tribo-mechanical properties of the periostracum of Mytilus sp
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

Schaltbare Oberflächen/Switchable Surfaces

C.T. Bauer, E. Kroner, D. Brodoceanu, T. Kraus, N.K. Guimard and E. Arzt

Hierarchical dry adhesives
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

C.T. Bauer, E. Kroner, N. Fleck and E. Arzt

Hierarchically patterned dry adhesives
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

A. Bellafatto, J.S. Atchison and E. Kroner

A comparative study on the effect of probe vs. sample hardness on adhesion
International Poster Symposium, August 14, 2014, Saarbrücken

A. Blickley, F. De Faria, N. Souza, J.S. Atchison, F. Soldera and F. Mücklich

Carbon nanotube synthesis by pulsed laser deposition of petroleum coke
International Poster Symposium, August 14, 2014, Saarbrücken

V. Boiko, N.K. Guimard, E. Kroner and E. Arzt

Adhesion of bioinspired micropillar system on rough surfaces
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

V. Boiko, N.K. Guimard, E. Kroner and E. Arzt

Adhesion of bioinspired micropatterned systems on rough surfaces
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D. Brodoceanu, R. Elnathan, N.H. Voelcker, E. Kroner, E. Arzt and T. Kraus

Bioinspired hierarchical structures by replica molding
2nd International School and Conference on Bio-inspired Materials, March 17 – 21, 2014, Potsdam

G.E.M. Dela Paz, J.S. Atchison and E. Kroner

Fabrication and characterization of thin-film PDMS membranes
International Poster Symposium, August 14, 2014, Saarbrücken

S. Fischer, E. Kroner, O. Levy, J.M. Karp and E. Arzt

Influence of microfeature characteristics on their interaction with tissue
Junior EuroMat, July 21 – 25, 2014, Lausanne <Switzerland>
2nd Poster Prize

M. Frensemeier, A.S. Schneider, C.P. Frick, E. Arzt and E. Kroner

Stick and switch: Bioinspired switchable adhesion in a nickel-titanium-polymer hybrid system
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

M. Frensemeier, A.S. Schneider, C.P. Frick, E. Arzt and E. Kroner

Stick and switch: Bioinspired switchable adhesion in a nickel-titanium-polymer hybrid system
7. Bionik-Kongress, October 24 – 25, 2014, Bremen

M. Frensemeier, A.S. Schneider, C.P. Frick, E. Arzt and E. Kroner

Switchable surface properties on shape memory NiTi polymer hybrid systems
MRS Spring meeting, April 21 – 25, 2014, San Francisco <CA, USA>

E. Kroner

Contact experiments on bioinspired adhesives
CAMTEC III Conference, University of Cambridge, April 07, 2014, Cambridge <UK>

A. McBride, D. Weingarth, E. Perre, J.S. Atchison and V. Presser

Investigating charge induced swelling of porous carbon electrodes in ionic liquids
National Conference on Undergraduate Research (NCUR) 2014, University of Kentucky, April 03 – 05, 2014, Lexington <KY, USA>

J. Purto and E. Kroner

Stimuli responsive polymers
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

T. Reppert, J.S. Atchison and E. Kroner

Optimization of biocompatible textiles for tissue engineering applications
International Poster Symposium, August 14, 2014, Saarbrücken

A.M. Tolosa Rodriguez, J.S. Atchison, C. Vatifahmetoglu and V. Presser

Novel processing route to obtain Si-O-C fibers by electrospinning
International Poster Symposium, August 14, 2014, Saarbrücken

J. Trusty, C. Cavelius, J.S. Atchison and E. Kroner

Preparation of SiO₂ nanoparticle arrays for biological evaluation
International Poster Symposium, August 14, 2014, Saarbrücken

M. Zeiger, D. Weingarth, M. Aslan, J.S. Atchison and V. Presser

Carbon onion/nanofiber composites for electrical energy storage
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

M. Zeiger, D. Weingarth, M. Aslan, J.S. Atchison and V. Presser

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Carbon onion/nanofiber composites for electrical energy storage
Doktorandenforum der Sektion D der Leibniz-Gemeinschaft, July 16 – 18, 2014, Berlin

Strukturbildung/Structure Formation

G.N. Ankah

Structural investigation of hybrid-organic photodiodes via focused ion beam preparation and electron microscopy
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken

G.N. Ankah, P. Büchele, S.F. Tedde, J. Adam,

O. Torrents Abad, D. Brodoceanu, K. Poulsen,

M. Koch, C. Gimmler, O. Schmidt and T. Kraus

Structural characterization of organic-inorganic polymer nanocomposites for sensing applications
MRS Spring Meeting & Exhibit, April 21 – 25, 2014, San Francisco <CA, USA>

G.N. Ankah, P. Büchele, S.F. Tedde, J. Adam,

O. Torrents Abad, M. Pfaff, K. Poulsen, M. Koch,

C. Gimmler, O. Schmidt and T. Kraus

Structural characterization of hybrid-organic nanocomposites via focused ion beam preparation and electron microscopy
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

G.N. Ankah, A.-R. Jochem, S. Elsenberg, U. Rösch,

C. Johann and T. Kraus

Membrane related losses of nanoparticles in field flow fractionation (FFF)
15th Aachener Membran Kolloquium, November 12 – 13, 2014, Aachen

C. T. Bauer, E. Kroner, D. Brodoceanu, T. Kraus, N. K. Guimard and E. Arzt

Hierarchical dry adhesives

Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

D. Brodoceanu, R. Elnathan, N. H. Voelcker, E. Kroner, E. Arzt and T. Kraus

Bioinspired hierarchical structures by replica molding
2nd International School and Conference on Bio-inspired Materials, March 17 – 21, 2014, Potsdam

D. Gerstner and T. Kraus

Modular fluidic system for agglomeration experiments
DPG Frühjahrstagung der Sektion Kondensierte Materie, March 30-April 04, 2014, Dresden

D. Gerstner and T. Kraus

Controlled agglomeration experiments in a millifluidic flow system
NaNaX 6, Nanoscience with Nanocrystals, May 18 – 23, 2014, Bad Hofgastein <Austria>

D. Gerstner and T. Kraus

Nanoparticle agglomeration in flow
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

A.-R. Jochem, G. N. Ankah, S. Elsenberg, U. Rösch, C. Johann and T. Kraus

Field-flow fractionation: Investigation of nanoparticle-membrane interactions
Doktorandenforum der Sektion D der Leibniz-Gemeinschaft, July 16 – 18, 2014, Berlin

A.-R. Jochem, G. N. Ankah, S. Elsenberg, U. Rösch, C. Johann and T. Kraus

Field-flow fractionation: Investigation of nanoparticle-membrane interactions
Doktorandentag der Chemie, Universität des Saarlandes, July 14, 2014, Saarbrücken

T. Kister and T. Kraus

Self-assembly of nanoparticles into 3D supraparticles
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

J. H. M. Maurer, L. González-García, B. Haas, I. Kanelidis and T. Kraus

Metal-polymer nanocomposites with structural control
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

S. Mörz, A. Kraegeloh and T. Kraus

Nanoparticle agglomeration and cytotoxicity
10th Zsigmondy Colloquium, April 07 – 08, 2014, Konstanz

S. Mörz, H. Peuschel, A. Kraegeloh and T. Kraus

Nanoparticle agglomeration and cytotoxicity
Physical Chemistry of Functionalised Biomedical Nanoparticles, Faraday Discussion 175, September 17 – 19, 2014, Bristol <UK>

M. Quilitz, T. Kraus, K. Moh, V. Presser and E. Arzt

Innovative Energie-Forschung am INM
1. LIESA Kongress, „Die Energiewende voranbringen: innovativ, vernetzt, saarländisch“, November 19, 2014, Saarbrücken

BIOGRENZFLÄCHEN / BIO INTERFACES

Biominalisation / Biomineralization

V. Bandmann, M.-L. Lemloh, D. B. Peckys, N. de Jonge and I. M. Weiss

Membrane processes in biomineralization
Cell Physics 2014, September 23 – 26, 2014, Saarbrücken

V. Bandmann, D. B. Peckys, N. de Jonge and I. M. Weiss

Membrane processes in biomineralization
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken

M.-L. Lemloh

*Biomineralization in the Ciliate *Coleps hirtus**
33. Tagung der Deutschen Gesellschaft für Protozoologie, February 12 – 15, 2015, Essen

M.-L. Lemloh

The coleps' strategy: biomineralization process in ciliates investigated by light and electron microscopy
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken

N. J. Peter, E. Griesshaber, M. V. G. Oliveira, A. Ziegler, W. W. Schmahl, E. Arzt and A. S. Schneider

Comparison of structure-property relationships of bivalve and gastropod shells
MRS Spring Meeting, April 21 – 25, 2014, San Francisco <CA, USA>

E. Weber, C. Guth, L. Bloch, B. Pokroy and I. M. Weiss

Impact of biotechnologically produced biomineralization-fusion proteins on the crystal structure of calcium carbonate
Bio-inspired Materials - International School and Conference on Biological Materials Systems, DGM, March 18 – 21, 2014, Potsdam

E. Weber, M.-L. Lemloh, A. Schneider, A. Pohl and I. M. Weiss

Structure-property relationships of sorghum bicolor

Junior EuroMat, July 21 – 25, 2014, Lausanne <Switzerland>

I. M. Weiss

Where geology meets biology: The inorganic-organic interface
GRC conference on Biomineralization, Colby-Sawyer College, August 17 – 22, 2014, New London <NH, USA>

CVD/Biooberflächen / CVD/Biosurfaces

D. V. Pecina, K. Löw, M. Martinez Miró, D. Anschütz, A. Haidar, I. Müller, O. C. Aktas, H. Eichler and H. Abdul-Khalik

Untersuchung der Hämostabilität von neuen Beschichtungen für mechanische Herzklappen
46. Jahrestagung der Deutschen Gesellschaft für Pädiatrische Kardiologie, October 04 – 07, 2014, Weimar

Nano Zell Interaktionen / Nano Cell Interactions

J. Jung, A. K. Kierner and A. Kraegeloh

Effects of nanoparticles on lung epithelial cells under mechanical strain
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

J. Jung, A. K. Kierner and A. Kraegeloh

Effects of nanoparticles on lung epithelial cells under mechanical strain
Doktorandenforum der Sektion D der Leibniz-Gemeinschaft, July 16 – 18, 2014, Berlin

A. Kümper, N. Engel, D. Stöckmann, C. Cavelius, A. Kraegeloh and K. Unfried

Identification of cellular responses relevant to the assessment of the safety of modern nanomaterials
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

S. Mörz, A. Kraegeloh and T. Kraus

Nanoparticle agglomeration and cytotoxicity
10th Zsigmondy Colloquium, April 07 – 08, 2014, Konstanz

S. Mörz, H. Peuschel, A. Kraegeloh and T. Kraus

Nanoparticle agglomeration and cytotoxicity
Physical Chemistry of Functionalised Biomedical Nanoparticles, Faraday Discussion 175, September 17 – 19, 2014, Bristol <UK>

M. Quilitz, E. Bubel, A. Kraegeloh, C. Jung and E. Arzt

Das INM und die Leibniz-Gemeinschaft
Jahrestagung der Leibniz-Gemeinschaft, November 26, 2014, Berlin

J. Trusty, C. Cavelius, J. S. Atchison and E. Kroner
Preparation of SiO₂ nanoparticle arrays for biological evaluation

International Poster Symposium, August 14, 2014, Saarbrücken

N. Villafria, H. Peuschel, S. Kiefer, T. Ruckelshausen and A. Kraegeloh

Cytotoxicity and uptake of quantum dots in CACO-2 cells
International Poster Symposium, August 14, 2014, Saarbrücken

NANOKOMPOSIT-TECHNOLOGIE / NANOCOMPOSITE TECHNOLOGY

Nanomere / Nanomers

D. Bentz, S. Schmitz-Stöwe, M. Wild and C. Becker-Willinger

Fine textured polymer based composite materials as multifunctional low friction coatings with corrosion protection
EUROCORR 2014, September 08 – 12, 2014, Pisa <Italy>

Optische Materialien / Optical Materials

K. Abersfelder, P. W. de Oliveira and G. Kickelbick

Synthesis of silica-based Janus nanoparticles
17. GdCh Vortragstagung für Anorganische Chemie (Wöhler-Vereinigung), September 24 – 26, 2014, Saarbrücken

K. Abersfelder, P. W. de Oliveira and G. Kickelbick

Synthesis of silica-based Janus nanoparticles
ISOS XVII, The 17th International Symposium on Silicon Chemistry, August 03 – 08, 2014, Berlin

J. Adam

Size effects of BaTiO₃ particles on their ferroelectric polarisation
Materials Science Engineering (MSE 2014), September 23 – 25, 2014, Darmstadt

J. Adam, P. König and R. Drumm

Colloids of fluorescent Y₂O₃:Eu nanoparticles combining good quantum yield and dispersibility properties
17th International Conference on Luminescence and Optical Spectroscopy of Condensed Matter, July 13 – 18, 2014, Wroclaw <Poland>

G. N. Ankah, P. Büchele, S. F. Tedde, J. Adam, O. Torrents Abad, D. Brodoceanu, K. Poulsen, M. Koch, C. Gimmler, O. Schmidt and T. Kraus

Structural characterization of organic-inorganic polymer nanocomposites for sensing applications

MRS Spring Meeting & Exhibit, April 21 – 25, 2014, San Francisco <CA, USA>

G. N. Ankah, P. Büchele, S. F. Tedde, J. Adam, O. Torrents Abad, M. Pfaff, K. Poulsen, M. Koch, C. Gimmler, O. Schmidt and T. Kraus
Structural characterization of hybrid-organic nanocomposites via focused ion beam preparation and electron microscopy
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

T. Martins Amaral, P.W. de Oliveira and A. C. Hernandes
Hydrothermal synthesis of nanometric BaTi_{1-x}Zr_xO₃ for BaTiO₃/BaTi_{1-x}Zr_xO₃ films
International Poster Symposium, August 14, 2014, Saarbrücken

T. Martins Amaral, P.W. de Oliveira and A. C. Hernandes
Hydrothermal synthesis of nanometric BaTi_{1-x}Zr_xO₃ for BaTiO₃/BaTi_{1-x}Zr_xO₃ films
Doktorandenforum der Sektion D der Leibniz-Gemeinschaft, July 16 – 18, 2014, Berlin

M. Mohr, A. Caron, P. Herbeck-Engel, R. Bennewitz, P. Gluche, K. Brühne and H.-J. Fecht
Poisson's ratio of nanocrystalline diamond films
International Conference on Diamond and Carbon Materials, Melia Castilla, September 07 – 11, 2014, Madrid <Spain>

S. H. Mousavi, M. H. Jilavi and P.W. de Oliveira
Scratch resisting aluminium oxide coatings on glass substrate
13th European Vacuum Conference & 9th Iberian Vacuum Meeting & 7th European Topical Conference on Hard Coatings, September 08 – 12, 2014, Aveiro <Portugal>

QUERSCHNITTSFELD / CROSS LINKING ACTIVITIES

Innovative Elektronenmikroskopie / Innovative Electron Microscopy

G. N. Ankah, P. Büchele, S. F. Tedde, J. Adam, O. Torrents Abad, D. Brodoceanu, K. Poulsen, M. Koch, C. Gimmler, O. Schmidt and T. Kraus
Structural characterization of organic-inorganic polymer nanocomposites for sensing applications
MRS Spring Meeting & Exhibit, April 21 – 25, 2014, San Francisco <CA, USA>

G. N. Ankah, P. Büchele, S. F. Tedde, J. Adam, O. Torrents Abad, M. Pfaff, K. Poulsen, M. Koch, C. Gimmler, O. Schmidt and T. Kraus
Structural characterization of hybrid-organic nanocomposites via focused ion beam preparation

and electron microscopy
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

K. Astanina, M. Koch, C. Jüngst, A. Zumbusch and A. K. Kierner
Intercellular communication between endothelial cells via tunneling nanotubes
Cell Physics 2014, September 23 – 26, 2014, Saarbrücken

K. Astanina, M. Koch, C. Jüngst, A. Zumbusch and A. K. Kierner
Liquid droplets as a novel cargo of tunneling nanotubes
50th FEBS EMBO 2014 Conference, August 30 – September 04, 2014, Paris <France>

V. Bandmann, D. B. Peckys, N. de Jonge and I. M. Weiss
Membrane processes in biomineralization
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken

T. Dahmen, J.-P. Baudoin, A. R. Lupini, C. Kübel, P. Slusallek and N. de Jonge
Combined tilt- and focal series scanning transmission electron microscopy: TFS 3D STEM
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

N. de Jonge and D. B. Peckys
Scanning transmission electron microscopy of whole eukaryotic cells in liquid
Cell Physics 2014, September 23 – 26, 2014, Saarbrücken

D. B. Peckys, U. Korf and N. de Jonge
Detecting protein complex subunits in whole eukaryotic cells in aqueous environment
Cell Physics 2014, September 23 – 26, 2014, Saarbrücken

D. B. Peckys, U. Korf and N. de Jonge
Imaging labeled protein complex subunits in whole eukaryotic cells in their native aqueous environment
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

M. Pfaff
Gold nanoparticle movement in liquid investigated by scanning transmission electron microscopy
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken

M. Pfaff and N. de Jonge
Investigation of gold nanoparticle movement in liquid by scanning transmission electron microscopy
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

K. Song, H. K. Schmid, V. Srot, E. Gilardi, G. Gregori, K. Du, J. Maier and P. A. van Aken
Cerium reduction at the interface between ceria and yttria-stabilised zirconia and implications for interfacial oxygen non-stoichiometry
18th International Microscopy Congress, September 07 – 12, 2014, Prague <Czech Republic>

A. Verch, J. Hermannsdörfer, M. Pfaff and N. de Jonge
The effects of salt concentrations and pH on the stability of gold nanoparticles in liquid cell STEM experiments
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy, October 14 – 15, 2014, Saarbrücken

Modellierung/Simulation / Modelling/Simulation

R. Balijepalli, R. M. McMeeking, M. R. Begley and E. Arzt
Corner stress singularity in a compliant mushroom fibril
2. Doktorandentag, Universität des Saarlandes, November 12, 2014, Saarbrücken

N. Özgün, R. Bennewitz, D. J. Strauss and E. Arzt
Tribo brain-identifying neural response to tribological stimuli
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting, March 26 – 28, 2014, Saarbrücken

PROGRAMMBEREICHSUNGEBUNDEN / NOT LINKED TO A PROGRAM DIVISION

Bibliothek, Information & Dokumentation / Library & Information Services

M. Quilitz, E. Bubel, A. Kraegeloh, C. Jung and E. Arzt
Das INM und die Leibniz-Gemeinschaft
Jahrestagung der Leibniz-Gemeinschaft, November 26, 2014, Berlin

Geschäftsführung / Management Board

M. Quilitz
Neue Materialien für fortschrittliche Technologien – Das INM
Euro Space Day, October 22, 2014, Saarbrücken

M. Quilitz
Forschen auf dem Campus – Das INM
Tag der Offenen Tür der Universität des Saarlandes, July 05, 2014, Saarbrücken

M. Quilitz, E. Bubel, A. Kraegeloh, C. Jung and E. Arzt
Das INM und die Leibniz-Gemeinschaft
Jahrestagung der Leibniz-Gemeinschaft, November 26, 2014, Berlin

M. Quilitz, T. Kraus, K. Moh, V. Presser and E. Arzt
Innovative Energie-Forschung am INM
1. LIESA Kongress, „Die Energiewende voranbringen: innovativ, vernetzt, saarländisch“, November 19, 2014, Saarbrücken

INM Fellow / INM Fellow

K. Abersfelder, P.W. de Oliveira and G. Kickelbick
Synthesis of silica-based Janus nanoparticles
17. GdCh Vortragstagung für Anorganische Chemie (Wöhler-Vereinigung), September 24 – 26, 2014, Saarbrücken

K. Abersfelder, P.W. de Oliveira and G. Kickelbick
Synthesis of silica-based Janus nanoparticles
ISOS XVII, The 17th International Symposium on Silicon Chemistry, August 03 – 08, 2014, Berlin

Werkstoffprüfung/Pulversynthese / Materials Testing/Powder Synthesis

J. Adam, P. König and R. Drumm
Colloids of fluorescent Y₂O₃:Eu nanoparticles combining good quantum yield and dispersibility properties
17th International Conference on Luminescence and Optical Spectroscopy of Condensed Matter, July 13 – 18, 2014, Wrocław <Poland>

NACHTRAG 2013 / SUPPLEMENT 2013

Im Jahresbericht 2013 fehlen die folgenden Veröffentlichungen und Poster:

In the Annual Report 2013, the following publications and posters are missing:

REFERIERTE PUBLIKATIONEN / REVIEWED PUBLICATIONS**Energie-Materialien / Energy Materials**

L. R. Parent, V. Presser, Y. Gogotsi, R. R. Unocic, R. L. Sacci, J. E. Evans, N. D. Browning, E. Perre, B. Dunn and I. Arlan

Direct observation of pseudocapacitor electrode behavior during electrochemical biasing using in-situ liquid stage electron microscopy
Microsc Microanal 2013, 19, (Supplement S2), 412-413 [01.757 (2013)]

SONSTIGE VERÖFFENTLICHUNGEN / OTHER PUBLICATIONS**Modellierung/Simulation / Modelling/Simulation**

C. Bernarding, R. Hannemann, D. P. Herrmann, D. J. Strauss and F. I. Corona-Strauss

Extraction of listening effort correlates in the oscillatory EEG activity: Investigation of different hearing aid configurations

In: 6th International IEEE EMBS Conference on Neural Engineering, NER 2013, November 06–08, 2013, San Diego <CA, USA>, IEEE, (2013), pp 1258–1261

E. Gonzalez-Trejo, D. P. Herrmann, M. Kohl, F. I. Corona-Strauss and D. J. Strauss

Paired chirp evoked cortical inhibition and its behavioral correlates in a speech intelligibility task

In: 6th International IEEE EMBS Conference on Neural Engineering, NER 2013, November 06–08, 2013, San Diego <CA, USA>, IEEE, (2013), pp 1350–1353

L. Haab, Z. Mortezapouraghdam, J. K. Schubert, J. Szczygielski, K. Schwerdtfeger and D. J. Strauss
Analysis of dominant neural activity clustering in laminar cortical processing of acoustic stimuli in rat utilizing von Mises-Fisher distribution

In: 6th International IEEE EMBS Conference on Neural Engineering, NER 2013, November 06–08, 2013, San Diego <CA, USA>, IEEE, (2013), pp 509–512

J. Ruckert, L. Haab, R. Hannemann and D. J. Strauss

Suppression of spontaneous activity in a computational tinnitus DCN model depends on notched-stimulation bandwidth

In: 6th International IEEE EMBS Conference on Neural Engineering, NER 2013, November 06–08, 2013, San Diego <CA, USA>, IEEE, (2013), pp 1406–1409

J. K. Schubert, E. Gonzalez-Trejo, W. Retz, M. Rösler, T. Teuber, G. Steidl, D. J. Strauss and F. I. Corona-Strauss

Extracting cortical inhibition correlates in ERP-images within adult ADHD

In: 6th International IEEE EMBS Conference on Neural Engineering, NER 2013, November 06–08, 2013, San Diego <CA, USA>, IEEE, (2013), pp 513–516

POSTER / POSTERS**Energie-Materialien / Energy Materials**

B. Dyatkin, V. Presser and Y. Gogotsi

Modification of surface chemistry and graphitic ordering of porous carbide-derived carbons for supercapacitor electrodes using vacuum annealing
Spring Meeting of the Materials Research Society (MRS), April 01–05, 2013, San Francisco <CA, USA>

L. Funke, J. S. Atchison and V. Presser

Electrospinning of carbide fibers for energy storage applications
STAR Scholars Summer Showcase, August 29, 2013, Philadelphia <PA, USA>

M. Langenstein, J. S. Atchison, I. Grobelsek and V. Presser

Core shell electrospinning composites for energy storage applications
STAR Scholars Summer Showcase, August 29, 2013, Philadelphia <PA, USA>

A. McBride, D. Weingarth, E. Perre, J. S. Atchison and V. Presser

Investigating charge induced expansion of porous carbon electrodes in ionic liquids
STAR Scholars Summer Showcase, August 29, 2013, Philadelphia <PA, USA>

V. M. Sadowski, J. S. Atchison, I. Grobelsek and V. Presser

Electrospun separators for application in supercapacitors
STAR Scholars Summer Showcase, August 29, 2013, Philadelphia <PA, USA>

VORTRÄGE / TALKS

Im Jahr 2014 wurden insgesamt 209 Vorträge gehalten, davon 124 eingeladene wissenschaftliche Vorträge und 85 sonstige Vorträge.

In 2014, 209 talks were given, therefrom 124 invited talks and 85 other talks.

EINGELADENE VORTRÄGE / INVITED TALKS**GRENZFLÄCHENMATERIALIEN / INTERFACE MATERIALS****Energie-Materialien / Energy Materials**

M. V. Fedorov, S. Kondrat, A. A. Kornyshev, A. A. Lee, Q. Oshanin, V. Presser, G. Pruessner, R. Qiao, C. Rochester and P. Wu

Physics of supercapacitors at the nanoscale
65th Annual Meeting of the International Society of Electrochemistry (ISE); August 31-September 05, 2014; Lausanne <Switzerland>

O. Paris, C. Prehal, H. Peterlik and V. Presser

Assessing structural hierarchy and mechanical behavior of nanostructured carbon materials
XXIII International Materials Research Congress; August 17-21, 2014; Cancun <Mexico>

S. Porada, D. Weingarth, H. V. M. Hamelers, M. Bryjak, V. Presser and P. M. Biesheuvel

Electrodes in motion for water desalination
8th Conference on Interfaces Against Pollution (IAP); May 25-28, 2014; Leeuwarden <Netherlands>

V. Presser

Capacitive deionization - an emerging energy efficient water treatment technology
Institute of Functional Interfaces, Karlsruhe Institute of Technology (KIT); January 21, 2014; Karlsruhe

V. Presser

Electrochemical energy storage
Making Energy Transition Successful - Avoiding Risks. Forum organized by the Saarland Ministry of Economics, Work, Energy, and Transport & German Labor Unions (IGM, IGBCE, ver.di); February 18, 2014; Saarbrücken

V. Presser

Electrical double layer technologies: A versatile platform for energy storage and water treatment
Seminar of the Austrian Chemical Physical Society, University Vienna; March 04, 2014; Wien

V. Presser

Electrochemical energy storage
3F-Talks, DWI - Leibniz Institute for Interactive Materials; April 11, 2014; Aachen

V. Presser

Electrochemical behavior of carbon nanofibers and related materials
International Conferences on Modern Materials & Technologies (CIMTEC), 14th International Ceramics Congress; June 08-20, 2014; Montecatini Terme <Italy>

V. Presser

Designer carbons for capacitive technologies enabling efficient energy storage, energy harvesting, and water treatment
Universität Bayreuth; October 28, 2014; Bayreuth

V. Presser

Electrical double layer technologies: A versatile platform for energy storage, harvesting, and water treatment
Nordrhein-Westfälische Akademie der Wissenschaften und der Künste; November 13, 2014; Düsseldorf

V. Presser

Challenges and potentials for capacitive energy storage systems
1. LIESA Kongress, „Die Energiewende voranbringen: innovativ, vernetzt, saarländisch“; November 19, 2014; Saarbrücken

V. Presser

Supercapacitors, pseudocapacitors, and flow capacitors
IEA Implementing Agreement on Advanced Materials for Transportation (Technical Symposium); December 01, 2014; Saarbrücken

V. Presser and D. Weingarth

The relatively unknown side of the electrical double layer: capacitive pore swelling and ion immobilization for deionization
Poznań University of Technology; February 14, 2014; Poznan <Poland>

V. Presser and D. Weingarth

Electrical double layer technologies - a versatile platform for energy storage and water treatment
Department of Chemistry, University of Cambridge; February 28, 2014; Cambridge <UK>

V. Presser and D. Weingarth

Strain in supercapacitors: Tracking ion movement and pore swelling with in situ electrochemical dilatometry
1st International Symposium on Energy Challenges & Mechanics (ECM); July 08-10, 2014; Aberdeen <UK>

D. Weingarh, A. Foelske-Schmitz, R. Kötz and V. Presser

Ionic liquids in EDLC: Challenges and useful analytical tools
NEST (Nanowires for Energy Storage) Workshop; October 14-15, 2014; Frankfurt am Main

D. Weingarh, A. Foelske-Schmitz, R. Kötz and V. Presser

Ionic liquids in electrochemistry: An overview on useful methods and analytical tools
Annual Symposium of the Koninklijke Nederlandse Chemische Vereniging Working Group on Electrochemistry; November 11, 2014; Antwerp <Belgium>

D. Weingarh, S. Porada and V. Presser

Nanoporous carbon materials for energy storage and water desalination
2. Workshop Leibniz Network Nano; July 16, 2014; Berlin

D. Weingarh and V. Presser

The effect of graphitization on the potential dependent capacitance of carbon supercapacitors
65th Annual Meeting of the International Society of Electrochemistry (ISE); August 31-September 05, 2014; Lausanne <Switzerland>

D. Weingarh and V. Presser

Advanced nanocarbons for electrochemical applications
9th Torunian Carbon Symposium; September 14-18, 2014; Torun <Poland>

M. Zeiger and V. Presser

Raman spectroscopy of carbon nanomaterials for energy applications
Renishaw's Inside Raman Seminar; September 25-26, 2014; Pliezhausen

Funktionelle Mikrostrukturen / Functional Microstructures

E. Arzt

New functional surfaces: From basics to applications
Monash University; January 31, 2014; Clayton <Australia>

E. Arzt

Size Effects in functional surfaces: from science to applications
ICONN 2014, International Conference on Nanoscience and Nanotechnology; February 03, 2014; Adelaide <Australia>

E. Arzt

Biomimetic functional surfaces
Mawson Institute; February 04, 2014; Adelaide <Australia>

E. Arzt

Biomimetic micropatterned surfaces with switchable functionality
TMS 2014, Biological Materials Symposium; February 19, 2014; San Diego <CA, USA>

E. Arzt

Biomimetic micropatterned surfaces with switchable functionality
Caltech, California Institute of Technology; February 19, 2014; Pasadena <CA, USA>

E. Arzt

Biomimetic micropatterned surfaces with switchable functionality
USCD, University of California, Department of Materials Science and Engineering; February 20, 2014; La Jolla <CA, USA>

E. Arzt

Biomimetic micropatterned surfaces with switchable functionality
USCD, University of California, Center for Magnetic Recording; February 20, 2014; La Jolla <CA, USA>

E. Arzt

From biological solutions to active functional surfaces
COMPO 2014, Weizmann Institute of Science; April 28, 2014; Rehovot <Israel>

E. Arzt

Biomimetic micropatterned surfaces for interaction with soft matter
IUTAM Symposium on Mechanics of Soft Active Materials, Technion - Israel Institute of Technology; May 13, 2014; Haifa <Israel>

E. Arzt

Bioinspired micropatterned surfaces with switchable functionality
HEMI Seminar, Johns Hopkins University; June 18, 2014; Baltimore <MD, USA>

E. Arzt

From biological solutions to active functional surfaces
Applied Mechanics Colloquium, Harvard School of Engineering and Applied Sciences; September 24, 2014; Cambridge <MA, USA>

E. Arzt

Das Leibniz-Institut für Neue Materialien (INM) Fakultätsretreat, Hofgut Imsbach; October 16, 2014; Tholey

E. Arzt

Neue funktionelle Oberflächen nach dem Vorbild Natur
8. Ranshofener Leichtmetalltage; November 06, 2014; Geinberg <Austria>

E. Arzt

Vom Vorbild Natur zu neuen Materialien – Forschung zwischen Neugier und Nutzen
Wissenschaftsforum; November 18, 2014; St. Ingbert

E. Arzt

New functional surfaces: from science to application
Mechanics Colloquia, University of Cambridge; November 21, 2014; Cambridge <UK>

E. Arzt

New functional surfaces: from science to application
materialstoday Asia 2014, City University Hong Kong; December 10, 2014; Hong Kong

S. Fischer

Lernen von der Natur: Bioinspirierte Haftstrukturen für medizinische Anwendungen
AbsolventInnenfeier der Fakultät 8, Universität des Saarlandes; November 28, 2014; Saarbrücken

R. Hensel

Mikrostrukturierte Kompositoberflächen als selbstfixierende dermale Wundauflagen
6. DFG Nachwuchsakademie: Werkstoffe in Medizin und Pharmazie; October 06-10, 2014; Essen

R. Hensel

Biomimetic surfaces – lessons from nature
RTG 1401 Workshop „Bioelectronics inside“; November 26, 2014; Radebeul

R. Hensel, R. Helbig and J. Nickerl

The cuticle of springtails - A role model for robust water and oil repellent surfaces
7. Bionik-Kongress; October 24, 2014; Bremen

Nanotribologie / Nanotribology

R. Bennewitz

Observing atoms at work: High-resolution friction force microscopy
Seminar über Oberflächen- und Dünnschichtanalytik und Kolloquium des Landesforschungs-zentrums Optik und Materialwissenschaften (OPTIMAS); January 09, 2014; Kaiserslautern

R. Bennewitz

Controlling nanoscale friction by surface modification
Institutskolloquium, Philipps-Universität Marburg, Department of Physics, Molecular Solids; January 23, 2014; Marburg

R. Bennewitz

Adhesion and friction at the nanometer scale
37th Annual Meeting of the Adhesion Society; February 23-26, 2014; San Diego <CA, USA>

R. Bennewitz

Controlled plasticity - nucleating single dislocations by AFM
Nanomanipulation 2014 - 5th European Nanomanipulation Workshop; June 18-20, 2014; Mulhouse <France>

R. Bennewitz

High-resolution force microscopy of metallic surfaces
Nanotribologie Workshop, Max-Planck-Institut für Eisenforschung; June 25, 2014; Düsseldorf

R. Bennewitz

Rasterkraftmikroskopie zur Untersuchung der Mechanismen von Reibung und Verschleiß
AOFA 18 - 18. Arbeitstagung Angewandte Oberflächenanalytik; September 29-October 01, 2014; Kaiserslautern

R. Bennewitz

Molecular control of friction
Weizmann Institute of Science; November 02, 2014; Rehovot <Israel>

R. Bennewitz, J. Blass, B. Bozna, M. Albrecht and G. Wenz

Friction and adhesion of a finite number of macromolecular guest-host complexes
CECAM Workshop „Friction and Interface Dynamics at Nano- and Mesoscales“, Tel Aviv University; October 27-31, 2014; Tel Aviv <Israel>

A. Caron

Surface properties and nanomechanical behaviour of (amorphous) metals
Universität Basel; January 14, 2014; Basel

A. Caron and R. Bennewitz

Structural and nanomechanical properties of (amorphous) metals by atomic force microscopy
Euro-AFM Forum; March 17-19, 2014; Göttingen

A. Caron, J. H. M. Maurer and R. Bennewitz

Nanoplasticity of (amorphous) metals by AFM-Indentation
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting; March 26-28, 2014; Saarbrücken

A. Caron, J. H. M. Maurer and R. Bennewitz

Nanometer-scale plasticity of (amorphous) metallic surfaces
DPG Spring Meeting (Frühjahrstagung); March 30-April 04, 2014; Dresden

Schaltbare Oberflächen / Switchable Surfaces

E. Kroner

Adhesion mechanisms in micropatterned dry adhesives with hierarchical structure
SPP 1420 Winter School; March 17-18, 2014; Potsdam

E. Kroner

Switchable bioinspired adhesives
Euro Bio-inspired Materials - 2nd International School and Conference on Biological Materials Science; March 18-21, 2014; Potsdam

E. Kroner

Multi-scale characterization and mechanics on patterned surfaces
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting; March 26-28, 2014; Saarbrücken

E. Kroner

Contact experiments on bioinspired adhesives
CAMTEC III Conference, University of Cambridge; April 07, 2014; Cambridge <UK>

E. Kroner

Bioinspired switchable adhesives
ZeMA - Zentrum für Mechatronik und Automatisierungstechnik gGmbH, Kolloquium bei Prof. Seelecke; May 14, 2014; Saarbrücken

E. Kroner

Materials for future implants
3. Hornbach Research Meeting: Smart Implants, Universitätsklinikum des Saarlandes; October 11, 2014; Homburg

Strukturbiologie / Structure Formation

P. Born, V. Schön, S. Blum, D. Gerstner, P. Huber and T. Kraus

Surface-energy driven segregation of unipolar nanoparticles to an oil-vapor interface
20th Ostwald-Colloquium „Particles_@_Interfaces“; September 17-19, 2014; Mainz

T. Kraus

Directing colloidal agglomeration in material synthesis
University of Melbourne, Bio21 Molecular Science and Biotechnology Institute; February 11, 2014; Melbourne < Australia>

T. Kraus

Directing colloidal agglomeration in material synthesis
Monash University, Clayton Campus; February 12, 2014; Clayton < Australia>

T. Kraus

Directing colloidal agglomeration in material synthesis
University of Sydney, School of Chemistry; February 13, 2014; Sydney <Australia>

T. Kraus

Nassbeschichten von Nanopartikel-Filmen mit definierter Mikrostruktur
Workshop „Transparente leitfähige Materialien (TCO/TCM) - Festkörperphysikalische Grundlagen und Technologien“ der Europäischen Forschungsgesellschaft Dünne Schichten e.V.; May 13-15, 2014; Dresden

T. Kraus

Nasse Wege zu neuen Materialien
Seminarvortrag, Institut für Materialphysik im Welt- raum, DLR – Deutsches Zentrum für Luft- und Raumfahrt e.V.; June 03, 2014; Köln

T. Kraus

Pure science, not so pure science, and technology: from particles to materials
3. PhD Retreat of Section D in the Leibniz Association; July 18, 2014; Berlin

T. Kraus

Order and disorder, mobility and interaction in nanoparticle agglomeration
JAM Packed: packing and jamming of particulate systems; September 15-18, 2014; Erlangen

BIOGRENZFLÄCHEN / BIO INTERFACES

Biomineralsation / Biomineralization

I. M. Weiss

Simple prerequisites for coordinating complex biomineralization scenarios
COST Meeting 2014, University of Granada (UGR) and Andalusian Institute of Earth Sciences (IACT-CSIC); April 14-16, 2014; Granada <Spain>

I. M. Weiss

Controlled biomineralization – A simple experimental approach
Biochemisches und molekularbiologisches Kolloquium der Universität Bremen; April 25, 2014; Bremen

I. M. Weiss

Materials inspired by enzymes
1st Sino-German Bilateral Symposium on „Bioinspired Materials Science and Engineering – Biofabrication, Biomaterials and Biomacromolecules“; May 11-15, 2014; Wuhan <China>

I. M. Weiss

Pioneering applications of biomineralization-proteins for the design of bioceramics
6th Indo-German Frontiers of Engineering Symposium; May 22-25, 2014; Potsdam

I. M. Weiss

Algorithms underpinning biological architectures
Materials Science Engineering (MSE 2014); September 23-25, 2014; Darmstadt

I. M. Weiss

NamiBIND – Cooperative Materials Science for „Leibniz-In-Africa“
Leibniz-in-Afrika-Workshop, ZMT; October 16, 2014; Bremen

CVD/Biooberflächen / CVD/Biosurfaces

O. C. Aktas

Single source precursor concept for synthesis of functional surfaces
The International Workshop on Flexible Bio- and Organic Printed Electronics; May 01-03, 2014; Konya <Turkey>

O. C. Aktas

Nanostructured surfaces for biomedical applications
International Workshop on Bio-Nanotechnology on Medicine; May 28-29, 2014; Istanbul <Turkey>

O. C. Aktas

Nanostructured surfaces for biomedical applications
1st Advanced Bio-Nano Materials Joint Workshop, KIST; June 02-05, 2014; Seoul <South Korea>

O. C. Aktas

Carbon based materials for biomedical applications
German-Turkish Workshop on Graphene and Carbon Nanocomposites; June 23-25, 2014; Ankara <Turkey>

O. C. Aktas

Functional nano/bio surface
The Workshop „Cutting Edge Research and Technology Development In the field of Nanotechnology in Manufacturing“; October 15-17, 2014; Istanbul <Turkey>

O. C. Aktas

Nanostructured surface for implants
Biomaterials for Medical Application Interactions between materials and living systems; October 23, 2014; Arlon <Belgium>

O. C. Aktas

Nanostructured surfaces for implant applications

Bio/Nano Materials Joint mini workshop, KIST Europe; October 30, 2014; Saarbrücken

J. Lee

Carbon based materials for biomedical applications
German-Turkish Workshop on Graphene and Carbon Nanocomposites; June 23-25, 2014; Ankara <Turkey>

Nano Zell Interaktionen / Nano Cell Interactions

J. Jung, A. K. Kiemer and A. Kraegeloh

Effects of nanoparticles on lung epithelial cells under mechanical strain
1. Workshop of Leibniz Research Alliance (LRA) Nanosafety; July 18, 2014; Berlin

A. Kraegeloh

Focus on nanoparticle cell interactions
1st Advanced Bio-Nano Materials Joint Workshop, KIST; June 02-05, 2014; Seoul <South Korea>

A. Kraegeloh

Nanoparticle-cell interactions in focus
µFiBR 2014 - Optical Imaging in Biomedical Nanotechnology, Hasselt University; October 03, 2014; Diepenbeek <Belgium>

A. Kraegeloh, H. Peuschel, K. Böse, C. Cavalius and T. Ruckelshausen

Focus on nanoparticle cell interactions
German Chinese Symposium: Toxicology and Epidemiology of Anthropogenic Compounds; June 26-July 01, 2014; Ningbo <China>

H. Peuschel, S. Kiefer, N. Villafria and A. Kraegeloh

Nanoparticle interactions on a cellular scale
Nanoworkshop on Biomaterials/Nansafety, KIST Europe; October 30-31, 2014; Saarbrücken

M. Quilitz and A. Kraegeloh

Networking in the Leibniz Association: The Leibniz Network Nano and the Leibniz Research Alliance Nanosafety
3. PhD Retreat of Section D in the Leibniz Association; July 18, 2014; Berlin

T. Ruckelshausen

Experience super-resolution – Imaging below the diffraction limit
Bioimaging Platform: Light Microscopy & Imaging Course; April 10, 2014; Genf <Schweiz>

T. Ruckelshausen

Insights into nanoparticle cell interactions using STED microscopy
Morning Lecture „Super-resolution microscopy

and its biomedical applications“, Institut Paris-Sud d’Innovation Thérapeutique (IPSIT); May 12, 2014; Paris <France>

NANOKOMPOSIT-TECHNOLOGIE / NANOCOMPOSITE TECHNOLOGY

Nanomere / Nanomers

C. Becker-Willinger

Current nanomere science relevant to coatings
Paint Istanbul 2014; October 12, 2014; Istanbul <Turkey>

C. Becker-Willinger

Functional NANOMER® coatings for automotive applications
FMC Workshop at Evonik Oil Additives; November 28, 2014; Walluf

Optische Materialien / Optical Materials

P.W. de Oliveira

Low refractive index materials
Universität Bayreuth; February 26, 2014; Bayreuth

P.W. de Oliveira

Production of ZrO₂
Industriepartner; March 10, 2014; Bergen op Zoom <Netherlands>

P.W. de Oliveira

Nano particles for the optics
2. Workshop Leibniz Network Nano; July 16, 2014; Berlin

T.S. Müller

New materials for optics
New Industrial Challenges in Surface Treatments; September 30, 2014; Spa Francorchamps <Belgium>

QUERSCHNITTSFELD / CROSS LINKING ACTIVITIES

Innovative Elektronenmikroskopie / Innovative Electron Microscopy

N. de Jonge

Studying protein complexes on whole cells in liquid using scanning transmission electron microscopy
Opening of Microscopy Valley program, Utrecht University; June 11, 2014; Utrecht <The Netherlands>

N. de Jonge

Imaging labeled protein complex subunits in whole eukaryotic cells in their native aqueous environment
18th International Microscopy Congress; September 07-12, 2014; Prague <Czech Republic>

N. de Jonge

Studying protein complexes on whole cells in liquid using scanning transmission electron microscopy
SFB 1027 Workshop; September 22, 2014; Saarbrücken

N. de Jonge

Transmission electron microscopy of specimens in liquid
Adolphe Merkle Institute of the University of Fribourg; October 21, 2014; Fribourg <Switzerland>

N. de Jonge

Transmission electron microscopy of specimens in liquid
Max Planck Institute of Colloids and Interfaces; November 03, 2014; Potsdam

N. de Jonge and D.B. Peckys

Imaging labeled protein complex subunits in whole Eukaryotic cells in liquid with scanning transmission electron microscopy
Max-Planck-Institute of Biochemistry; February 25-26, 2014; Martinsried

N. de Jonge and D.B. Peckys

Scanning transmission electron microscopy of whole eukaryotic cells in liquid and in situ studies of nanomaterials
Debye Colloquium, Utrecht University; March 19, 2014; Utrecht <The Netherlands>

N. de Jonge and D.B. Peckys

Scanning transmission electron microscopy of micrometers-thick liquids, and applications in biology and materials science
International Workshop on Nucleation. Friedrich Alexander University; June 05-06, 2014; Erlangen-Nürnberg

N. de Jonge, D.B. Peckys and T. Schuh

Scanning transmission electron microscopy of whole eukaryotic cells in liquid and in situ studies of nanomaterials
MRS Spring Meeting; April 21-25, 2014; San Francisco <CA, USA>

D.B. Peckys and N. de Jonge

Environmental scanning electron microscopy for quantitative studies of the fate of gold nanoparticles in intact and hydrated cells
Condensed Matter; August 24-29, 2014; Paris <France>

D.B. Peckys and N. de Jonge

Studying protein distribution and complex formation in whole, hydrated eukaryotic cells with environmental scanning electron microscopy
Workshop SFB 1027 Physical modeling of non-equilibrium processes in biological systems; December 12, 2014; Homburg

InnovationsZentrum INM / Innovation Center INM

A. K. Schlarb

Extrusion compounding, processing and morphology of polypropylene based nanocomposites
Masterbatch Asia; March 20, 2014; Bangkok <Thailand>

A. K. Schlarb

On the processing of polymer nanocomposites. From raw materials to final products
Chemical Engineering Chulalongkorn University; March 26, 2014; Bangkok <Thailand>

A. K. Schlarb

On the processing and properties of polymer nanocomposites. From raw materials to final products
Industriepartner; March 26, 2014; Rayong <Thailand>

A. K. Schlarb

Herausforderungen und Chancen für hybride Werkstoffe auf unterschiedlichen Längenskalen
Workshop +composites Saar; May 06, 2014; Saarbrücken

A. K. Schlarb

Fertigungstechnische Herausforderungen und Chancen für hybride Werkstoffe und Systeme auf unterschiedlichen Skalen
WAK-Symposium; May 21, 2014; Karlsruhe

L. Lin and A. K. Schlarb

Vibration welding of carbon nanotube reinforced polyoxymethylene: morphology and mechanical property
ECCM16 - 16TH European Conference on Composite Materials; June 22-26, 2014; Sevilla <Spain>

A. K. Schlarb

Polymerbasierte Verbundwerkstoffe
Stiftung Pfalzmetall; November 08, 2014; Speyer

A. K. Schlarb

Processing effects on the properties of thermoplastic-based nanocomposites
Chulalongkorn University; November 13, 2014; Bangkok <Thailand>

PROGRAMMBEREICHSUNGEBUNDEN / NOT LINKED TO A PROGRAM DIVISION

Geschäftsführung / Management Board

M. Quilitz and A. Kraegeloh

Networking in the Leibniz Association: The Leibniz Network Nano and the Leibniz Research Alliance Nanosafety
3. PhD Retreat of Section D in the Leibniz Association; July 18, 2014; Berlin

INM Fellow / INM Fellow

K. Jacobs

Pattern formation and control in polymeric systems: From Minkowski measures to in situ AFM
American Physical Society March Meeting; March 06, 2014; Denver <CO, USA>

K. Jacobs

Is adhesion superficial? Experiments with proteins, bacteria and geckos
Industriepartner; March 19, 2015; Remagen

K. Jacobs

Geckos, bacteria and proteins: How superficial is adhesion?
Physikalisches Kolloquium, TU Darmstadt; April 25, 2014; Darmstadt

K. Jacobs

Bakterien- und Proteinadhäsion an Zahnmaterialien: Eine Experimentalphysikalische Sicht
Industriepartner; May 09, 2014; Hamburg

K. Jacobs

Geckos, bacteria and proteins: How superficial is adhesion?
Physikalisches Kolloquium, Universität Leipzig; May 27, 2014; Leipzig

K. Jacobs

Sind wir nicht alle Softies? Hard meets soft matter physics...
Physikalisches Festkolloquium, Universität Konstanz; July 27, 2014; Konstanz

K. Jacobs

Pinsel oder Spatel: Physikalische Grundlagen der Malerei
Highlights der Physik; October 29, 2014; Saarbrücken

G. Kickelbick

The role of ATRP in self-healing nanocomposites
3rd International Symposium on Controlled/Living polymerization - From synthesis to application; May 01-04, 2014; Antalya <Turkey>

G. Kickelbick

Self-healing inorganic-organic hybrid nanocomposites
E-MRS 2014 Spring Meeting; May 26-30, 2014; Lille <France>

G. Kickelbick

Synthesis, characterization and application of metal oxide-based hybrid materials
Thermal Analysis and Calorimetry in Industry and Research 40 Years of GEFT; September 16-19, 2014; Berlin

SONSTIGE VORTRÄGE / OTHER TALKS

GRENZFLÄCHENMATERIALIEN /
INTERFACE MATERIALS

Energie-Materialien / Energy Materials

E. N. Caspi, O. Yeheskel, S. Amini, A. Zhou, V. Presser, M. W. Barsoum, B. Clausen, S. C. Vogel and D. W. Brown

Neutron diffraction evidence for incipient kink bands in highly textured Ti₂AlC

International Conferences on Modern Materials & Technologies (CIMTEC), 14th International Ceramics Congress; June 08-20, 2014; Montecatini Terme <Italy>

N. Jäckel, D. Weingarth, M. Zeiger, M. Aslan, I. Grobelsek and V. Presser

Comparison of carbon onions and carbon blacks as conductive additives for carbon supercapacitors in organic electrolytes

65th Annual Meeting of the International Society of Electrochemistry (ISE); August 31-September 05, 2014; Lausanne <Switzerland>

F. Kaasik, I. Must, E. Lust, M. Jürgens, V. Presser, A. Punning, R. Temmer, R. Kiefer and A. Aabloo

In situ measurements with CPC micro-actuators using SEM

SPIE Smart Structures/NDE 2014: Electroactive Polymer Actuators and Devices (EAPAD) XVI; March 09-13, 2014; San Diego <CA, USA>

F. Kaasik, I. Must, E. Lust, M. Jürgens, V. Presser, A. Punning, R. Temmer, R. Kiefer and A. Aabloo

In situ measurements with CPC micro-actuators using SEM

Fourth international conference on Electromechanically Active Polymer transducers & artificial muscles (EuroEAP 2014); June 10-11, 2014; Linköping <Sweden>

S. Porada, D. Weingarth, P. M. Biesheuvel and V. Presser

Effect of pore size and its dispersity of porous carbon on capacitive deionization

8th Conference on Interfaces Against Pollution (IAP); May 25-28, 2014; Leeuwarden <Netherlands>

C. Prehal, D. Weingarth, E. Perre, R. T. Lechner, H. Amenitsch, V. Presser and O. Paris

In-situ SAXS/WAXS as a novel method to study ion transport in microporous systems
Symposium on Ion Dynamics in Confined Systems; July 09, 2014; Cambridge <UK>

V. Presser and D. Weingarth

Nanomaterials for electrochemical energy applications
NanoMaterials 2014; September 10, 2014; Nancy <France>

F. Schipper, T.-P. Fellingner, G. Sans Palacios, S. Porada, D. Weingarth, V. Presser and M. Antonietti

The influence of heteroatom doping of porous carbon on the salt adsorption capacity and kinetics in capacitive deionization

8th Conference on Interfaces Against Pollution (IAP); May 25-28, 2014; Leeuwarden <Netherlands>

A. M. Tolosa Rodriguez, J. S. Atchison, V. Presser and C. Vakifahmetoglu

Novel processing route to obtain ultra-fine high purity low cost SIOC fibers by electrospinning

Materials Science Engineering (MSE 2014); September 23-25, 2014; Darmstadt

M. Zeiger, N. Jäckel, M. Aslan, D. Weingarth and V. Presser

Tuning structure and porosity of onion-like carbon synthesized via thermal annealing of nanodiamond
9th Torunian Carbon Symposium; September 14-18, 2014; Torun <Poland>

Funktionelle Mikrostrukturen /
Functional Microstructures

D. Brodoceanu, R. Elnathan, N. H. Voelcker, E. Kroner, E. Arzt and T. Kraus

Bioinspired hierarchical structures by replica molding

Euro Bio-inspired Materials - 2nd International School and Conference on Biological Materials Science; March 17-21, 2014; Potsdam

S. Fischer

Mechanisms of the interaction of microstructures with tissue

Materials Science Engineering (MSE 2014); September 23-25, 2014; Darmstadt
1. Preis, Lecture Award

S. Fischer, E. Kroner, O. Levy, J. M. Karp and E. Arzt

Influence of microfeature characteristics on their interaction with tissue

Junior EuroMat; July 21-25, 2014; Lausanne <Switzerland>

O. Torrents Abad, A. S. Schneider, C. P. Frick and E. Arzt

Size dependent deformation of beta brass

14th European Mechanics of Materials Conference, Chalmers University of Technology; August 08, 2014; Gothenburg <Sweden>

O. Torrents Abad, A. S. Schneider, C. P. Frick and E. Arzt
Size dependent kink formation of beta brass
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting; March 26-28, 2014; Saarbrücken

F. Wählich, N. J. Peter, O. Torrents Abad, M. V. G. Oliveira, A. S. Schneider, W. Schmahl, E. Griesshaber and R. Bennewitz

Surviving the surf: The tribo-mechanical role of the periostracum of Mytilus sp.

European Symposium on Friction, Wear and Wear Protection - Tagung der Deutschen Gesellschaft für Materialforschung (DGM); May 06-08, 2014; Karlsruhe

M. Zamanzade, J. R. Velayarce, A. Zekri, O. Torrents Abad, H. Vehoff, A. Barnoush and C. Motz

Bending test of micro pillars-development status and perspectives

Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting; March 26-28, 2014; Saarbrücken

Nanotribologie / Nanotribology

B. Bozna, J. Blass, M. Albrecht, G. Wenz and R. Bennewitz

High resolution force measurements of host-guest complex interaction

DPG Spring Meeting (Frühjahrstagung); March 30-April 04, 2014; Dresden

A. Caron and R. Bennewitz

Nanomechanical behaviour of (amorphous) metals
Arbeitskreistreffen „Rasterkraftmikroskopie und nanomechanische Methoden“, AK Rastersonde (DPG)/AK Nanomechanik (DGM), MPI für Eisenforschung; February 27-28, 2014; Düsseldorf

A. Caron and R. Bennewitz

Nanometer-scale mechanical behavior of (amorphous) metallic surfaces

European Symposium on Friction, Wear and Wear Protection - Tagung der Deutschen Gesellschaft für Materialforschung (DGM); May 06-08, 2014; Karlsruhe

A. Caron and R. Bennewitz

On the combination of AFM-Indentation and ncAFM-imaging at the example of metallic glasses
Nanomanipulation 2014 - 5th European Nanomanipulation Workshop; June 18-20, 2014; Mulhouse <France>

F. Hausen, R. Bennewitz and S. Perkin

Tracking the interfacial structure of ionic liquids - Impact on frictional properties

1st Gerischer-Kolb Symposium; October 15-17, 2014; Berlin

F. Hausen, J. Hoth, A. Smith, N. Cousens, S. Perkin and R. Bennewitz

Friction in ionic liquids at the molecular scale
International Nanotribology Forum; January 06-10, 2014; Kochi <Kerala, India>

M.-D. Kraß, J. Hoth, F. Hausen, N. N. Gosvami, R. W. Carpick and R. Bennewitz

Dynamic shear force microscopy of layered liquids in nanometer confinement

2014 AFM Users' Meeting, University of Duisburg-Essen; November 03-04, 2014; Essen

M. Lessel, P. Loskill, F. Hausen, N. N. Gosvami, J. Heppel, R. Bennewitz and K. Jacobs

Impact of van der Waals interactions on single asperity friction

European Symposium on Friction, Wear and Wear Protection - Tagung der Deutschen Gesellschaft für Materialforschung (DGM); May 06-08, 2014; Karlsruhe

B. Soorali Ganeshamurty, A. S. de Wijn and R. Bennewitz

Preferential sliding directions on graphitic materials
Gordon Research Seminar on Tribology, Bentley University; July 19-20, 2014; Waltham <MA, USA>

B. Soorali Ganeshamurty, A. S. de Wijn and R. Bennewitz

Preferential sliding directions on graphite

5th International Workshop on Advanced Scanning Probe Microscopy Techniques; February 24-25, 2014; Karlsruhe

P. Stoyanov, P. Romero, M. Dienwiebel, M. Moseler and R. Bennewitz

Deformation mechanism and nanomechanical properties of tungsten-carbon tribofilms: An experimental and numerical atomistic investigation

MS&T - Materials Science & Technology 2014; October 12-16, 2014; Pittsburgh <PA, USA>

F. Wählich, N. J. Peter, O. Torrents Abad, M. V. G. Oliveira, A. S. Schneider, W. Schmahl, E. Griesshaber and R. Bennewitz

Surviving the surf: The tribo-mechanical role of the periostracum of Mytilus sp.

European Symposium on Friction, Wear and Wear Protection - Tagung der Deutschen Gesellschaft für Materialforschung (DGM); May 06-08, 2014; Karlsruhe

Schaltbare Oberflächen / Switchable Surfaces

D. Brodoceanu, R. Elnathan, B. Prieto-Simón, B. Delalat, T.M. Guinan, E. Kroner, N.H. Voelcker and T. Kraus

Dense arrays of vertical nanopores in silicon
MRS Fall Meeting; November 30-December 05, 2014; Boston <MA, USA>

D. Brodoceanu, R. Elnathan, N.H. Voelcker, E. Kroner, E. Arzt and T. Kraus

Bioinspired hierarchical structures by replica molding
Euro Bio-inspired Materials - 2nd International School and Conference on Biological Materials Science; March 17-21, 2014; Potsdam

S. Fischer, E. Kroner, O. Levy, J.M. Karp and E. Arzt
Influence of microfeature characteristics on their interaction with tissue

Junior EuroMat; July 21-25, 2014; Lausanne <Switzerland>

E. Kroner

Bioinspired switchable surfaces
Department of Zoology, University of Cambridge; April 09, 2014; Cambridge <UK>

E. Kroner

Bioinspired switchable surfaces
Department of Engineering / Bioengineering, University of Cambridge; April 10, 2014; Cambridge <UK>

Strukturbiologie / Structure Formation

D. Brodoceanu, R. Elnathan, B. Prieto-Simón, B. Delalat, T.M. Guinan, E. Kroner, N.H. Voelcker and T. Kraus

Dense arrays of vertical nanopores in silicon
MRS Fall Meeting; November 30-December 05, 2014; Boston <MA, USA>

D. Brodoceanu, R. Elnathan, N.H. Voelcker and T. Kraus

Dense hole arrays in silicon via colloidal lithography and metal-assisted chemical etching
Materials Science Engineering (MSE 2014); September 23-25, 2014; Darmstadt

D. Brodoceanu, R. Elnathan, N.H. Voelcker, E. Kroner, E. Arzt and T. Kraus

Bioinspired hierarchical structures by replica molding
Euro Bio-inspired Materials - 2nd International School and Conference on Biological Materials Science; March 17-21, 2014; Potsdam

C. Johann, S. Elsenberg, S. McSheehy Ducos, D. Kutscher, A.-R. Jochem and T. Kraus
Characterization of modified nanoparticles using asymmetrical flow field-flow fractionation (AF4)

coupled to ICP-MS

24. ICPMS Anwendertreffen 2014, Helmholtz-Zentrum; September 15-19, 2014; Geesthacht

T. Kraus

Self-assembly of nanoparticles into regular clusters inside emulsion droplets
MRS Spring Meeting; April 21-25, 2014; San Francisco <CA, USA>

T. Kraus, P. Born and D. Brodoceanu

Directed agglomeration for functional nanocomposites
23rd Australian Conference on Microscopy and Microanalysis (ACMM23) and the International Conference on Nanoscience and Nanotechnology (ICONN 2014); February 02-06, 2014; Adelaide <Australia>

T. Kraus and N. Fleck

Film and defect formation in wet coating
Industriepartner; May 09, 2014; Southampton <UK>

BIOGRENZFLÄCHEN / BIO INTERFACES

Biomineralisation / Biomineralization

M.-L. Lemloh and I.M. Weiss

Small-scale properties of biominerals
Euro Bio-inspired Materials - 2nd International School and Conference on Biological Materials Science; March 18-21, 2014; Potsdam

N.J. Peter, E. Griesshaber, C. Reisecker, M.V.G. Oliveira, W. Schmahl, E. Arzt and A.S. Schneider

The comparison of structure-property relationships of bivalve and gastropod shells
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting; March 26-28, 2014; Saarbrücken

E. Weber, C. Guth, L. Bloch, B. Pokroy and I.M. Weiss
Impact of biotechnologically produced biomineralization-fusion proteins on the crystal structure of calcium carbonate

Euro Bio-inspired Materials - 2nd International School and Conference on Biological Materials Science; March 18-21, 2014; Potsdam

CVD/Biooberflächen / CVD/Biosurfaces

S. Brück and O.C. Aktas

Les Nanocomposites
Journée Technique: Transformation des matériaux composites : assemblages, performances et nouveaux matériaux; March 19, 2014; Sallaumines <France>

S. Brück and O.C. Aktas

Nanocomposites
Conférence technique: Entrez au coeur de l'innova-

tion avec les matériaux composites; March 19, 2014; Stavelot <Belgium>

S. Brück and O.C. Aktas

Nanokomposite - Überblick und Anwendungen
Workshop +Composites SAAR; May 06, 2014; Saarbrücken

S. Brück and O.C. Aktas

Lightweight metal matrix composites – stretching the boundaries of metals like magnesium, aluminium and titanium
Conférence technique: Les composites a matrice métallique/ceramiques sont-ils les matériaux d'avenir?; May 20, 2014; Liège <Belgium>

S. Brück and O.C. Aktas

Nanocomposites
+Composites Webinar; October 21, 2014; Saarbrücken

M. Lambert, C.K. Akkan, A. May, N. Agarwal and O.C. Aktas

Controlling size and distribution of noble metal nanoparticles embedded in Al₂O₃
E-MRS Spring Meeting 2014; May 26, 2014; Lille <France>

J. Lee

Synthesis of biphasic nanostructures and laser surface patterning for selective cell guidance
1st Advanced Bio-Nano Materials Joint Workshop, KIST; June 02-05, 2014; Seoul <South Korea>

J. Lee

Controlled cell migration on nano/micro structures for regenerative tissue engineering
Bio/Nano Materials Joint mini workshop, KIST Europe; October 30, 2014; Saarbrücken

J. Lee, S. Brück and O.C. Aktas

Composite materials for biomedical applications
Workshop +Composites SAAR; May 06, 2014; Saarbrücken

J. Lee, S. Brück and O.C. Aktas

Application of nano-composites as biomaterial
Plus Composites Workshop on Nano-composites and their applications; June 19, 2014; Luxembourg <Luxembourg>

J. Lee, W. Metzger, M. Martinez Miró, C.K. Akkan, A. May, M. Veith and O.C. Aktas

Study of controlled cell migration on laser patterned biphasic nanowires
Scandinavian Society for Biomaterials - 7th annual meeting (Biointerfaces in Biomaterials); March 26-28, 2014; Aarhus <Denmark>

K. Löw, J. Lee, A. Haidar, M. Martinez Miró, C.K. Akkan, M. Veith, O.C. Aktas and H. Abdul-Khalik

Guided orientation of human cardiomyocytes on laser patterned biphasic core/shell nanowires
46. Jahrestagung der Deutschen Gesellschaft für Pädiatrische Kardiologie; October 04-07, 2014; Weimar

A. May, N. Agarwal, M. Lambert, C.K. Akkan, F.P. Nothdurft and O.C. Aktas

Laser assisted nitriding and surface characterization of titanium alloy Ti₆Al₄V for dental applications
E-MRS Spring Meeting 2014; May 27, 2014; Lille <France>

A. May and O.C. Aktas

Functional biomedical coatings
International Workshop on Bio-Nanotechnology in Medicine; May 28-30, 2014; Istanbul <Turkey>

Nano Zell Interaktionen / Nano Cell Interactions

J. Jung

Die Auswirkung von Nanopartikeln auf Lungenzellen unter mechanischer Beanspruchung I
Seminar AG Kiemer, Institut für Pharmazeutische Biologie, Universität des Saarlandes; January 16, 2014; Saarbrücken

J. Jung and A. Kraegeloh

Die Auswirkung von Nanopartikeln auf Lungenzellen unter mechanischer Beanspruchung II
Seminar AG Kiemer, Institut für Pharmazeutische Biologie, Universität des Saarlandes; November 06, 2014; Saarbrücken

A. Kraegeloh

Nano Zell Interaktionen
ZIM Kickoff-Meeting „Nano-Pharm“; November 03-04, 2014; Niedersteinbach <France>

A. Kraegeloh

Nanoparticle cell interactions in focus
Universität des Saarlandes; November 21, 2014; Saarbrücken

K. Unfried, D. Stöckmann, U. Sydlik, C. Bieschke, A. Autengruber, N.A. Agha, M. Gotic, S. Grether Beck, A. Kümper, A. Kraegeloh and J. Haendeler

Molecular mechanisms of nanoparticle-cell interaction: tools to study cell stress reactions triggered by poorly soluble nanomaterials
7th International Congress on Nanotoxicology; April 23-26, 2014; Antalya <Turkey>

NANOKOMPOSIT-TECHNOLOGIE / NANOCOMPOSITE TECHNOLOGY

Nanomere / Nanomers

C. Becker-Willinger

Funktionelle Nanomer-Beschichtungen
Industriepartner; January 21, 2014; Stuttgart

C. Becker-Willinger

New INM-materials approaches
Industriepartner; February 06, 2014; Saarbrücken

C. Becker-Willinger

Nanomers - Highly structured integrated functional coatings for practical solutions in industrial applications
Hannover Messe; April 08, 2014; Hannover

C. Becker-Willinger

NANOMERE
Industriepartner; May 07, 2014; Wuppertal

C. Becker-Willinger

NANOMERE – Korrosionsschutz-Beschichtungen
Industriepartner; May 20, 2014; Ingolstadt

C. Becker-Willinger

NANOMERE
Industriepartner; June 03, 2014; Saarbrücken

C. Becker-Willinger

INM – Short overview of activities
Industriepartner; June 11, 2014; Saarbrücken

C. Becker-Willinger

INM – Short overview – activities of NANOMERS
Industriepartner; June 26, 2014; Saarbrücken

C. Becker-Willinger

NANOMERE
Industriepartner; July 07, 2014; Saarbrücken

C. Becker-Willinger

NANOMERS - Short overview of activities
Industriepartner; August 01, 2014; Saarbrücken

C. Becker-Willinger

NANOMER – Korrosionsschutz-Beschichtungen
Industriepartner; August 19, 2014; Saarbrücken

C. Becker-Willinger

NANOMER – Composite coatings
Industriepartner; August 28, 2014; Saarbrücken

C. Becker-Willinger, S. Schmitz-Stöwe, M. Opsoelder, M. Jochum, S. Albayrak and E. Perre

Structure property relationships in highly structured composite layers as corrosion protection coatings on mild steel
EUROCORR 2014; September 12, 2014; Pisa <Italy>

C. Becker-Willinger

NANOMER – Korrosionsschutz-Beschichtungen
Industriepartner; October 28, 2014; Wolfsburg

Optische Materialien / Optical Materials

J. Adam

Expertise and activities of INM's Optical Materials group related to the field of Advanced Thin, Organic and Large Area Electronics (TOLAE) Technologies
Info Day and Networking Event: Organic Electronics in Horizon 2020, European Commission, DG Connect / Photonics; February 14, 2014; Brussels <Belgium>

J. Adam

Size effects of BaTiO₃ particles on their ferroelectric polarisation (Short presentation of Poster A10-154)
Materials Science Engineering (MSE 2014); September 23-25, 2014; Darmstadt

S. Heusing, P. Rogin, M. Lacroix, F. Hardinghaus, P. Garcia-Juan and P.W. de Oliveira

Flexibility of gravure printed ITO coatings on foil
10th International Conference on Coatings on Glass and Plastics (ICCG 10); June 22-26, 2014; Dresden

S. Heusing, P. Rogin, M. Lacroix, F. Hardinghaus, P. Garcia-Juan and P.W. de Oliveira

Study of the flexibility of gravure printed ITO coatings on foil
5th International Symposium on Transparent Conductive Materials (TCM 2014); October 12-17, 2014; Platania <Crete, Greece>

QUERSCHNITTSFELD / CROSS LINKING ACTIVITIES

Innovative Elektronenmikroskopie / Innovative Electron Microscopy

N. de Jonge

Scanning transmission electron microscopy of liquid specimens
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy; October 14-15, 2014; Saarbrücken

D. B. Peckys

Environmental scanning electron microscopy for studying proteins and organelles in whole, hydrated eukaryotic cells with nanometer resolution
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy; October 14-15, 2014; Saarbrücken

M. Pfaff

Gold nanoparticle movement in liquid investigated by scanning transmission electron microscopy
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy; October 14-15, 2014; Saarbrücken

A. Verch

Crystallisation of calcium carbonate studied by liquid cell scanning transmission electron microscopy
CISCEM 2014 - 2nd Conference on In-Situ and Correlative Electron Microscopy; October 14-15, 2014; Saarbrücken

Modellierung/Simulation / Modelling/Simulation

R. Balijepalli, M. R. Begley, R. M. McMeeking and E. Arzt

Modeling the delamination of fibrils using Dugdale cohesive zones
Nanobrücken 2014 - Nanomechanical Testing Workshop & Hysitron User Meeting; March 26-28, 2014; Saarbrücken

PROGRAMMBEREICHSUNGEBUNDEN / NOT LINKED TO A PROGRAM DIVISION

Geschäftsführung / Management Board

M. Quilitz

Nanotechnology in the Leibniz Network Nano
Hannover Messe. TechTransfer Forum; April 07, 2014; Hannover

M. Quilitz

Nanotechnology at the INM – The Leibniz Institute for New Materials
Hannover Messe. TechTransfer Forum; April 07, 2014; Hannover

INM Fellow / INM Fellow

K. Jacobs

Impact of van der Waals interactions on single asperity friction
European Symposium on Friction, Wear and Wear Protection - Tagung der Deutschen Gesellschaft für Materialforschung (DGM); May 07, 2014; Karlsruhe

K. Jacobs

Adhesion & adsorption of proteins & bacteria: not a superficial thing
Thesinge Meeting; September 08, 2014; Thesinge <Netherlands>

NACHTRAG 2013 / SUPPLEMENT 2013

Im Jahresbericht 2013 fehlen die folgenden Vorträge:

In the Annual Report 2013, the following talks are missing:

EINGELADENE VORTRÄGE / INVITED TALKS

Energie-Materialien / Energy Materials

V. Presser

Supercaps, pseudocaps, flow caps: dynamical energy storage
Bayer Early Excellence in Science Award Seminar; May 17, 2013; Saarbrücken

V. Presser

Carbon and carbide nanomaterials for energy & gas storage and water purification
Materials Science and Engineering Colloquium, Saarland University; July 16, 2013; Saarbrücken

V. Presser

Endo- & exohedral carbon electrodes and electrochemical dilatometry
Latest Developments in Electrochemical Capacitors; December 16, 2013; Tartu <Estonia>

SONSTIGE VORTRÄGE / OTHER TALKS

Energie-Materialien / Energy Materials

A. C. Forse, J. M. Griffin, H. Wang, N. M. Trease,

V. Presser, Y. Gogotsi, P. Simon and C. P. Grey
Nuclear magnetic resonance study of ion adsorption on titanium carbide-derived carbons
224th Meeting of the Electrochemical Society; October 27-November 01, 2013; San Francisco <CA, USA>

M. Naguib, J. Come, Y. Dall'Agnese, O. Mashtalir, V. Presser, P.-L. Taberna, P. Simon, M. W. Barsoum and Y. Gogotsi

MXENES: A new family of 2D transition metal carbides for Li-ion battery anodes
NAATBatt 2013 Annual Members Meeting and Conference; January 17-18, 2013; Austin <TX, USA>

► PATENTE / PATENTS

Im Jahr 2014 wurden sechs neue Patentanmeldungen hinterlegt, die noch nicht offengelegt worden sind. Es wurden fünf Patente erteilt, davon zwei innerhalb von Europa und drei auf internationaler Ebene. Das INM – Leibniz-Institut für Neue Materialien unterhält somit 89 aktive Patentfamilien.

In 2014, INM has filed six new patent applications which are not yet published. Five patents have been granted. Two of these patents have been granted in Europe and three internationally. Thus the INM – Leibniz Institute for New Materials has 89 active patent families.

ERTEILTE EUROPÄISCHE PATENTE / PATENTS GRANTED IN EUROPE

Europäisches Patent Nr. 1899407 B1

Titel: „Konsolidierungsmittel und dessen Verwendung zur Herstellung von hydrolysestabilen Formkörpern und Beschichtungen“

Erfinder: Klaus Endres, Bernd Reinhard, Helmut Schmidt

Europäisches Patent Nr. 1463963 B1

Titel: „Verfahren zur Herstellung optischer Elemente mit Gradientenstruktur“

Erfinder: Peter de Oliveira, Ulrike Dellwo, Martin Mennig, Helmut Schmidt, Heike Schneider

ERTEILTE INTERNATIONALE PATENTE / PATENTS GRANTED INTERNATIONALLY

Taiwanesisches Patent Nr. I434140

Titel: „Verbundzusammensetzung für mikrostrukturierte Schichten“

Erfinder: Carsten Becker-Willinger, Etsuko Hino, Pamela Kalmes, Mitsutoshi Noguchi, Norio Ohkuma, Yoshikazu Saito, Michael Veith

US Patent Nr. 8796018

Titel: „Verwendung von nanostrukturierten Oberflächen und Verfahren zum Anreichern oder Isolieren von zellulären Subpopulationen.“

Erfinder: Frank Narz, Michael Veith

Japanisches Patent Nr. 5619180

Titel: „Synthese von Nanopartikeln mittels ionischer Flüssigkeiten“

Erfinder: Martin Amlung, Peter de Oliveira, Michael Groß, Peter Rogin, Michael Veith

► LEHRVERANSTALTUNGEN / TEACHING

WINTERSEMESTER 2013 / 2014

Aktas, Cenk

Chemical Nanotechnology

FH Kaiserslautern, Vorlesung, 2 SWS

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 (mit Boller, Christian, IZFP)

Non Destructive Testing: Polymer Materials Part 1

DIU – Dresden International University,

Blockvorlesung, 1 SWS

Weiss, Ingrid M.

Protein-/Enzymreinigung

Universität Regensburg, Kurs/Seminar, 4 SWS

SOMMERSEMESTER 2014

Aktas, Cenk

Biomedical Coatings

FH Kaiserslautern, Vorlesung, 2 SWS

Arzt, Eduard

INM-Kolloquium

Universität des Saarlandes, Kolloquium, 2 SWS

Arzt, Eduard und Mitarbeiter/innen

NanoBioMaterialien-2

Universität des Saarlandes, Vorlesung/Übung, 2 SWS

Bennewitz, Roland

Gute Wissenschaftliche Praxis

Universität des Saarlandes, Blockseminar, 3 SWS

Presser, Volker

Grundlagen der Thermodynamik

Universität des Saarlandes, Vorlesung/Übung, 4 SWS

Presser, Volker (mit Wenz, Gerhard, Universität des Saarlandes)

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

Presser, Volker (mit Kollegen, Universität des Saarlandes)

Praktikum I-1: Verwendung von Origin

Universität des Saarlandes, Praktikum, 0,5 SWS

WINTERSEMESTER 2014/2015

Aktas, Cenk

Nanomaterials: Synthesis, Properties and Applications

FH Kaiserslautern, Vorlesung, 2 SWS

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, Kroner, Elmar

Einführung in die Materialwissenschaft für (Studierende der) Mikrotechnologie und Nanostrukturen

Universität des Saarlandes, Vorlesung/Übung, 5 SWS

Bennewitz, Roland

Gute Wissenschaftliche Praxis

Universität des Saarlandes, Blockseminar, 2 SWS

Jonge, Niels de

Elektronenmikroskopie

Universität des Saarlandes, Vorlesung/Übung, 5 SWS

Kraegeloh, Annette (mit Bernhardt, Rita, Wittmann, Christoph, Universität des Saarlandes)

Biochemie I

Universität des Saarlandes, Vorlesung, 4 SWS

Kraus, Tobias

Functional Coatings

Universität des Saarlandes, Vorlesung, 2 SWS

Weiss, Ingrid M.

Protein-/Enzymreinigung

Universität Regensburg, Kurs/Seminar, 4 SWS



▶ VORTRÄGE IM INM-KOLLOQUIUM / INM COLLOQUIUM TALKS

Prof. Steve Weiner, Weizmann Institute of Science, Rehovot, Israel
Biom mineralization pathways
09.01.2014, Host: PD Dr. Ingrid Weiss

Prof. Jan Hengstler, Leibniz-Institut für Arbeitsforschung an der TU Dortmund, Dortmund
Strategies of toxicity testing and their relevance for nanosafety
22.01.2014, Host: Dr. Annette Kraegeloh

Dr. Enrico Burello, TNO, Zeist, The Netherlands
In silico strategies for hazard assessment of nanomaterials
12.02.2014, Host: Prof. Eduard Arzt

Dr. Rafal Klajn, Weizmann Institute of Science, Rehovot, Israel
New out-of-equilibrium materials constructed from molecular switches and superparamagnetic nanoparticles
05.03.2014, Host: Dr. Tobias Kraus

Dr. Benjamin Schulz, Max Planck Institute for Dynamics and Self-Organization, Göttingen
Thin film effects of smectic liquid crystals: on surface dynamics and nanomanipulation
19.03.2014, Host: Dr. Nathalie Guimard

Asst. Prof. Giusy Scalia, Seoul National University, Korea
Liquid crystal nanocomposites
10.04.2014, Host: Prof. Eduard Arzt

Dr. Lars Pastewka, Fraunhofer-Institut für Werkstoffmechanik IWM, Freiburg
Modeling mechanics and mechanochemistry at interfaces – Rough adhesive contacts and wear of diamond
24.04.2014, Host: Prof. Eduard Arzt

Dr. Anne Thielbeer, R&D Inkjet Inks, TIGER Coatings, Wels, Austria
Polymer microarrays for biological applications
07.05.2014, Hosts: Prof. Eduard Arzt/Dr. Nathalie Guimard

Prof. Dieter Vollath, NanoConsulting, Stutensee
Estimation of thermodynamic data of metallic nanoparticles based on bulk values
21.05.2014, Host: Prof. Eduard Arzt

Prof. Peer Fischer, Max-Planck-Institut für Intelligente Systeme, Stuttgart
Three-dimensional hybrid nanostructures, chemical nanomotors, and active matter
03.06.2014, Host: Prof. Eduard Arzt

Prof. Jürgen Groll, University of Würzburg
Bioactivation and Morphology of Biomaterials as Complementary Triggers for Regenerative Medicine
10.06.2014, Host: Prof. Eduard Arzt

Prof. Alexander Böker, DWI – Leibniz-Institut für Interaktive Materialien, Aachen
Building with colloids: Directing the self-assembly of hybrid (bio)nanoparticles
24.06.2014, Host: Prof. Eduard Arzt

Prof. Peter Fratzl, Max-Planck-Institut für Kolloid- und Grenzflächenforschung, Potsdam
Water as a fuel – the materials basis for passive plant movements
02.07.2014, Host: Prof. Eduard Arzt/PD Dr. Ingrid Weiss

Prof. Sandra Korte-Kerzel, RWTH Aachen
Plasticity of hard and brittle materials – insights from nanomechanical testing
09.07.2014, Host: Prof. Eduard Arzt

Dr. Aránzazu del Campo, Max Planck Institute for Polymer Research, Mainz
Light triggers to mimic dynamic processes in the cellular microenvironment
15.07.2014, Hosts: Prof. Eduard Arzt/Dr. Nathalie Guimard

Prof. Nicola Spaldin, ETH Zurich, Switzerland
Coupled and competing instabilities in oxide thin films: Insights from electronic-structure calculations
23.07.2014, Host: Prof. Eduard Arzt

Prof. Dirk J. Broer, Eindhoven University of Technology, Eindhoven, The Netherlands
Morphing dynamics in liquid crystal polymer films and coating surfaces
05.08.2014, Host: Dr. Elmar Kroner

Prof. Dr. Stéphanie P. Lacour, EPFL, Lausanne, Switzerland
Engineering Silicone Elastomers for Soft Bioelectronic Applications
01.10.2014, Host: Prof. Dr. Eduard Arzt

Dr. Kristina Tschulik, University of Oxford, UK
Single Nanoparticle Electrochemistry – Sizing, Counting and Characterizing Individual Nanoparticles
22.10.2014, Host: Dr. Tobias Kraus

Dr. Marthe Rousseau, CNRS – Université de Lorraine, Nancy, France
Ultrastructure and Formation Process of Nacre as a Source of Inspiration for New Materials
29.10.2014, Host: PD Dr. habil. Ingrid Weiß

Pattarachai Srimuk, Kasetsart University, Bangkok, Thailand
Cobalt(II)hydroxide-CuBTC composite for use in supercapacitors
30.10.2014, Host: Jun.-Prof. Dr. Volker Presser

Prof. Dr. Julie Cairney, University of Sydney, Australia
Atomic Scale Information to Solve Materials Problems: New Techniques in Atom Probe Microscopy
12.11.2014, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Ralph Spolenak, ETH Zurich, Switzerland
Colors in Thin Film Materials: from Interference in Insulators to Interstitials in Intermetallics
12.11.2014, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Martin Müser, Forschungszentrum Jülich
Friction Mechanisms at Small and Large Scales: New Insights From Computer Simulations
19.11.2014, Hosts: Prof. Dr. Roland Bennewitz, Prof. Dr. Eduard Arzt

Dr. Pavel Levkin, Karlsruhe Institute of Technology
Synthesis and Application of Biofunctional Polymer Surfaces with Special Wettability
19.11.2014, Host: Prof. Dr. Eduard Arzt

Dr. Mihaela Delcea, University of Greifswald
Advanced Functional Materials and Micro/Nano-engineered Surfaces for Biomedical Applications
24.11.2014, Host: Prof. Dr. Eduard Arzt

PD Dr. Ljiljana Fruk, Karlsruhe Institute of Technology
Biofunctionalized Nanotools for Sensing and Optoelectronic Devices
25.11.2014, Host: Prof. Dr. Eduard Arzt

Prof. Dr. Andrij Pich, DWI – Leibniz-Institut für Interaktive Materialien, Aachen/RWTH Aachen
Aqueous Nanogels: from Chemical Design to Multifunctional Materials
26.11.2014, Host: Dr. Tobias Kraus

Prof. Dr. Rudolf Zentel, University of Mainz
Actuating Microparticles by Processing LCEs in a Microfluidic Device
02.12.2014, Host: Dr. Elmar Kroner

Prof. Dr. Claudia Fleck, TU Berlin
Natural Damage Tolerance: Crossing the Material-Architecture Border
02.12.2014, Host: Prof. Dr. Eduard Arzt



▶ VERANSTALTUNGEN / EVENTS

First European NanoReg II Workshop

Organisation, Beteiligung
Eduard Arzt, Annette Kraegelo and Mario Quilitz
Amsterdam, The Netherlands, January 23, 2014

Nano Tech 2014

Stand, Exponate
Joachim Blau, Karsten Moh, Thomas Müller and Rainer Hanselmann
Tokyo, Japan, Januar 29-31, 2014

Behandlung von materialspezifischen Aspekten im EU-Programm HORIZONT 2020

Organisation, Ausrichtung
Marcus Geerkens
Saarbrücken, January 30, 2014

Delegation der Institute KEIT und KIMM, Korea

Organisation, Präsentationen, Führungen
Annette Kraegelo and Mario Quilitz
Saarbrücken, February 2, 2014

Horizon 2020 für Naturwissenschaftlerinnen

Organisation, Ausrichtung
Christina Sauer-Hormann and Silke Zeiter-Semmet (mit Universität des Saarlandes)
Saarbrücken, February 6, 2014

Second European NanoReg II Workshop

Organisation, Beiträge
Eduard Arzt, Annette Kraegelo and Mario Quilitz
Luxemburg, Luxemburg, February 24, 2014

Delegation von Institutionen aus dem Blount County, USA

Organisation, Präsentationen, Führung
Martina Bonnard and Mario Quilitz
Saarbrücken, February 26, 2014

Horizon 2020 - dynastor

Organisation, Ausrichtung
Michael Busse, Rainer Hanselmann, Volker Presser and Daniel Weingarh
Saarbrücken, March 19, 2014

Mit dem Mikroskop die Welt erkunden – Girls' Day am INM

Organisation, Ausrichtung
Nathalie Guimard, Marcus Koch, Christina Sauer-Hormann, Susanne Selzer, Silke Siegrist, Paula Yagüe Isla and Silke Zeiter-Semmet
Saarbrücken, March 20, 2014

Horizon 2020: Multi-scaled Scaffolds for Enhanced Vascularization in Engineered Tissues

Organisation
Jennifer Atchison, Martina Bonnard, Rainer Hanselmann and Elmar Kroner (mit Fraunhofer ICT-IMM)
Mainz, March 20-21, 2014

Nanomechanical Testing Workshop – Nanobrücken 2014

Organisation, Ausrichtung
Eduard Arzt, Roland Bennewitz, Arnaud Caron, Christine Hartmann, Elmar Kroner and Oscar Torrents-Abad
Saarbrücken, March 26-28, 2014

Hannover Messe 2014,

Stand, Exponate
Dirk Bentz, Rainer Hanselmann, Thomas Müller, Michael Opsölder, Mario Quilitz, Sabine Schmitz-Stöwe and Wolfram Seitz
Hannover, April 7-11, 2014

Workshop +composites Saar

Organisation, Ausrichtung
Cenk Aktas and Stefan Brück
Saarbrücken, May 6, 2014

6. Internationale Fachmesse für gedruckte Elektronik, LOPEC

Stand, Exponate
Martin Amlung, Michael Opsölder and Wolfram Seitz
München, May 27-28, 2014

International Workshop on Bio-Nanotechnology in Medicine

Organisation
Cenk Aktas (mit Hakki Dalcik)
Istanbul, Turkey, May 28-30, 2014

Infoveranstaltung für Organisatoren der Messe „Abi - und was dann“ 2014

Vorträge, Führungen
Mario Quilitz (mit Universität des Saarlandes)
Saarbrücken, June 11, 2014

TechConnect World

Stand, Exponate
Eduard Arzt, Carsten Becker-Willinger, Joachim Blau, Karsten Moh, Thomas Müller and Günter Weber
Washington D.C., USA, June 16-17, 2014

International Workshop on Graphene-Based Nanocomposite Materials

Organisation
Cenk Aktas (mit Ibrahim Uslu)
Ankara, Turkey, June 23-25, 2014

+Composites Webinar on Nanocomposites

Organisation, Ausrichtung
Cenk Aktas and Stefan Brück
Saarbrücken, July 1, 2014

Tag der offenen Tür an der Universität des Saarlandes

Vorträge, Führungen
Christine Hartmann, Marcus Koch, Volker Presser, Mario Quilitz and Tobias Kraus
Saarbrücken, July 5, 2014

11. Alliantreffen der Sprecher bibliothekarischer Gremien (Helmholtz-Gemeinschaft, Max-Planck-Gesellschaft, Fraunhofer-Gesellschaft, Leibniz-Gemeinschaft)

Organisation, Ausrichtung
Elke Bubel
Saarbrücken, July 10, 2014

Workshop Horizon 2020: Biomimetic meso-fiber-based artificial extracellular matrix for differentiation to and expansion of, type II pneumocytes for COPD Therapies

Organisation
Jennifer Atchison, Martina Bonnard, Rainer Hanselmann, Annette Kraegelo, Elmar Kroner and Henrike Peuschel (mit Institut d'Investigació Sanitària de Palma)
Palma de Mallorca, Spain, July 10-11, 2014

Open Access und Urheberrecht in der Wissenschaft

Organisation, Ausrichtung
Elke Bubel
Saarbrücken, July 11, 2014

Zweiter Workshop Leibniz-Netzwerk Nano

Organisation, Vorträge
Eduard Arzt, Christine Hartmann, Peter William de Oliveira, Volker Presser and Mario Quilitz
Berlin, July, 16-17, 2014

Erster Workshop des Leibniz-Forschungsverbundes Nanosicherheit

Organisation
Eduard Arzt, Christine Hartmann and Annette Kraegelo
Berlin, July 17, 2014

3. Doktorandenforum der Sektion D der Leibniz-Gemeinschaft

Organisation, Vorträge
Tobias Kraus and Mario Quilitz (mit B. Voit, IPF, Leibniz-Gemeinschaft)
Berlin, July 17 - 18, 2014

Infoveranstaltung für MentoMINT

Vorträge, Führungen
Johanna Blass, Christine Hartmann and Daniel Weingarh
Saarbrücken, July 27, 2014

International Poster Symposium

Organisation, Ausrichtung
Tobias Kraus, Volker Presser, Mario Quilitz and Daniel Weingarh
Saarbrücken, August 14, 2014

Jahrestagung des Arbeitskreises der Bibliotheken und Informationseinrichtungen der Leibniz-Gemeinschaft

Organisation
Elke Bubel (mit Sprecherrat AK Bibliotheken der Leibniz-Gemeinschaft)
Bonn, September 10-12, 2014

Quantenwelten – Highlights der Physik

Stand, Exponate
Roland Bennewitz and Niels de Jonge
Saarbrücken, September 27 – October 1, 2014

Conference on In-Situ and Correlative Electron Microscopy – CISCEM 2014

Organisation, Ausrichtung
Christine Hartmann and Niels de Jonge
Saarbrücken, October 14-15, 2014

Euro-Space-Day

Stand, Exponate
Mario Quilitz
Saarbrücken, October 22, 2014

ITN-Workshop: „Nano In Life – Imaging Modelling, in vivo, in vitro“

Organisation
Annette Kraegelo (mit Kiemer, Alexandra, Diesel, Britta, Trojahn, Ulrike, Fröhlich, Eleonore)
Graz, Austria, October 30-31, 2014

Eröffnung der Leibniz-Jahrestagung

Stand, Exponate
Eduard Arzt, Carola Jung, Mario Quilitz and Günter Weber (mit Leibniz-Gemeinschaft, Schloss Dagstuhl - Leibniz-Zentrum für Informatik)
Berlin, November 26, 2014

Besuch einer Delegation aus Bosnien und Herzegowina

Präsentation, Führung
Roland Bennewitz (mit Universität des Saarlandes)
Saarbrücken, December 11, 2014

▶ KOOPERATIONEN / COOPERATIONS

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

Christian-Albrechts Universität / Kiel

Deutsches Forschungszentrum für Künstliche Intelligenz / Saarbrücken

Deutsches Krebsforschungszentrum / Heidelberg

Deutsches Museum / München

Fachhochschule Kaiserslautern / Kaiserslautern

Fachhochschule Zweibrücken / Zweibrücken

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

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

Forschungszentrum Jülich / Jülich

Fraunhofer ICT-IMM / Mainz

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

Friedrich-Alexander-Universität / Erlangen-Nürnberg

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

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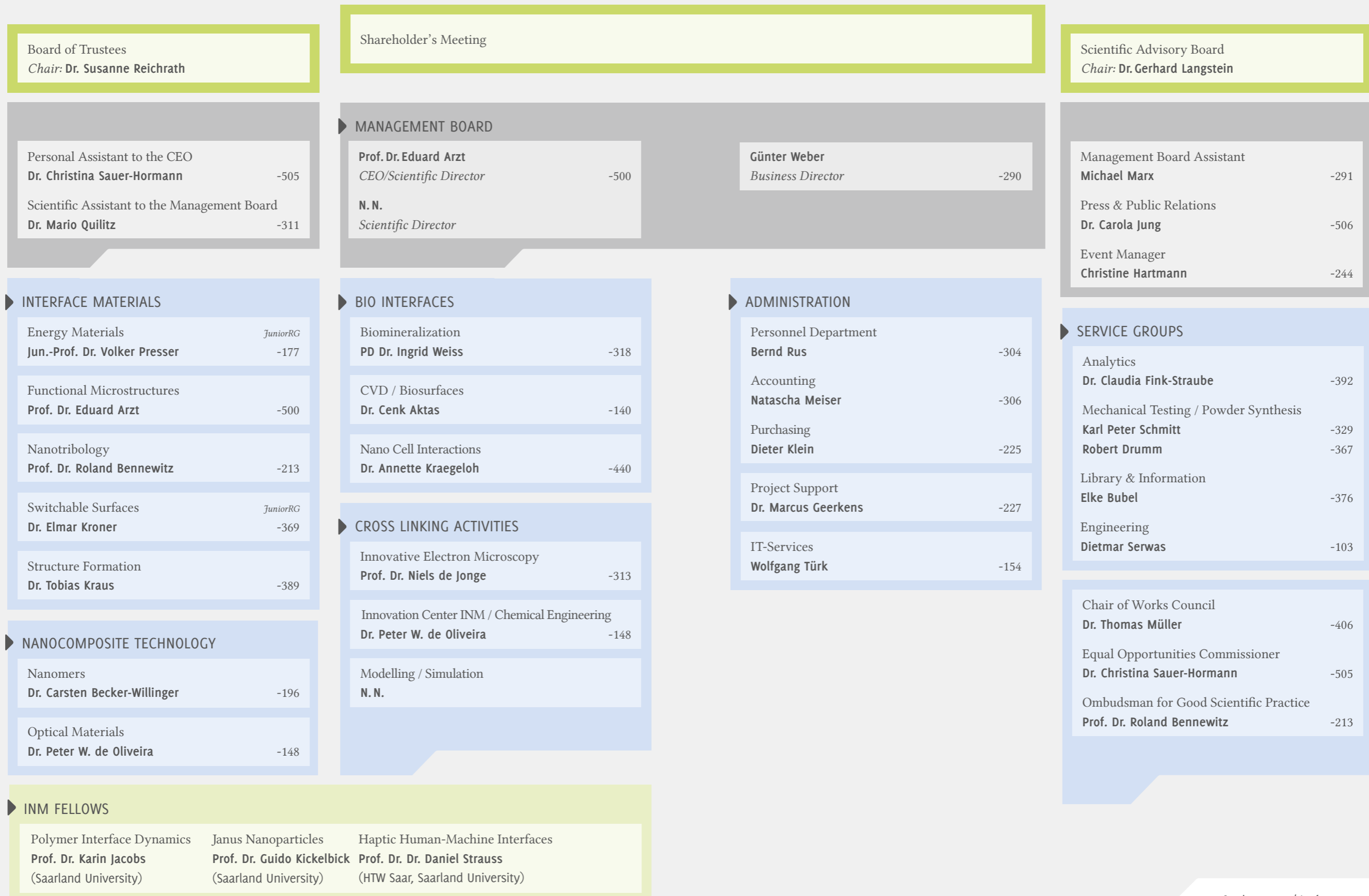
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