MATERIALS SCIENCE IN MAINZ

The Graduate School of EXCELLENCE

SUMMARY > 2011 > 2012 > 2013 >

TITLE:
A doctoral student of the Graduate School MAINZ in the projection of a novel computer simulation. He discusses details of this simulation, in which hydrogen molecules interact quantum mechanically, with a colleague.

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Max-Planck-Institut für Polymerforschung
Max Planck Institute for Polymer Research

Prof. Mathias Kläui, Director of MAINZ

"WE CONTINUOUSLY **IMPROVE** OUR EDUCATION"

In June 2012, the Graduate School "Materials Science in Mainz" (MAINZ) received approval for the second time from the Excellence Initiative of the German Federal and State Governments and will be sponsored until 2017. We met the director of MAINZ, Prof. Mathias Kläui and talked about the renewed achievement, the changes associated with it and about the outlook for the graduate school beyond 2017.

Mr. Kläui, what does the success of the second phase of the Excellence Initiative mean for MAINZ?

It is a fantastic confirmation of everything that we have built up together with my predecessor, Prof. Claudia Felser, since 2007 and for our new ideas that have been evaluated very positively. "The qualification program of MAINZ could convince completely in its entirety. It is ideally tailored to the needs of every single doctoral student" - which is an original quote from the report of the DFG evaluation of our graduate school that we can be proud of.

Which kind of new ideas are these and what will change?

We are continuously improving our training portfolio; for example, by expanding our research portfolio to include more application-related topics. In order to be able to do this, we will work more intensively with companies such as BASF, IBM, and Schott. We in particular strengthen the training aspects that relate to industrially relevant skills. We also use our alumni as a network and assign them to our current graduate students as mentors or co-mentors. And we are strengthening the business acumen of our graduate students more than ever, since many of them later enter the private business sector.

How do you do that?

We offer more courses on the so-called transferable skills, such as presentation techniques, business basics or on intercultural communication. Among other things, especially our program "MAINZ goes Asia" has been very well received, within which we offered in 2013 a summer school and also a course on Chinese culture in Taiwan.

Why exactly Chinese culture?

The global cutting-edge research in materials science is rapidly evolving in East Asia. Therefore, we continue with the internationalization of MAINZ and continue the drive in this direction.

Can you provide us with other examples?

We already cooperate very closely with the Seoul National University in South Korea, Tohoku University Sendai in Japan as well as Stanford University and IBM Almaden Research Center in the United States. On the one hand, this provides us with the opportunity to send our graduate students abroad and, on the other hand, we have the ability to recruit young academics. In addition, we are perceived more strongly internationally, which also helps us to attract external funding outside of the Excellence Initiative.

Have you already been successful?

Recently we could engage Prof. Jairo Sinova, a leading international physicist from the USA, as a Humboldt Professor. He is now working as Principal Investigator for MAINZ and has already obtained an ERC Synergy Grant of almost ten million Euro, together with partners from the UK and the Czech Republic. Another example is the funding of our internationalization project "SpinNet" to promote joint PhD degrees and joint Master study programs which is funded through the DAAD with one million Euro.

The Excellence Initiative will most likely end in 2017. Hence, will the funding by further external third-party funds become more important to you?

The renewed success in the Excellence Initiative does not only mean a confirmation, but also stabilization, because the supporting institutions of the graduate school – Johannes Gutenberg University of Mainz, University of Kaiserslautern and Max Planck Institute for Polymer Research – have explicitly committed themselves for a continuation until 2017 and beyond. But, of course, we also have to raise funds through further external funding, for example through special research areas in which MAINZ is involved.

Interview: Jonas Siehoff

TABLE OF CONTENTS

The Graduate School of Excellence Materials Science in Mainz (MAINZ) is an international doctoral program currently composed of roughly 80 doctoral students. The program is conducted by excellent scientists from Johannes Gutenberg University Mainz (JGU), Max Planck Institute for Polymer Research (MPI-P) and University of Kaiserslautern (TUKL). As part of the Excellence Initiative, MAINZ has been awarded a federal grant twice (2007-2012 and 2012-2017) as one of the few doctoral programs in the interdisciplinary area of Chemistry, Physics, and Biology. Our three-year training program focuses on training through research and training for life that supply the intellectual framework necessary to become an independent scientist. Networking is one of the key aspects of the program reflected in all training offered. This aspect is embodied in our mentoring program mentMAINZ, which provides our doctoral students with early contact with international leaders in science and the industry.

FACTS & FIGURES

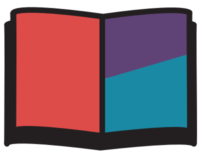
FEMALE MAINZ PhD STUDENTS

(2011-2013)

34,1 %

PUBLICATIONS

TOTAL NUMBER OF PAPERS OF MAINZ PhD STUDENTS (2011-2013)



389 All
174 First Author
215 Co-Author

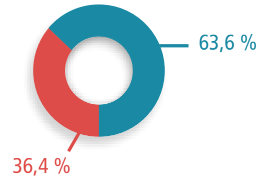
JOURNAL IMPACT FACTOR

AVERAGE JOURNAL IMPACT FACTOR OF ALL JOURNALS COMBINED WHERE PAPERS OF OUR PHD STUDENTS WERE PUBLISHED (INCLUDING FIRST AND CO-AUTHORSHIPS)

DOCTORAL DEGREES CONFERRED

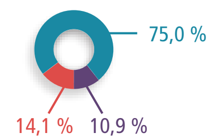
GRADING OF DOCTORAL DEGREES (2011-2013)

MAINZ

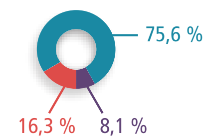


summa cum laude
magna cum laude
cum laude

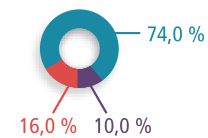
Department of Chemistry, JGU



Department of Physics, JGU



Department of Physics, TU KL



DURATION OF PHD

AVERAGE DURATION OF PHD THESES COMPLETED (2011-2013)

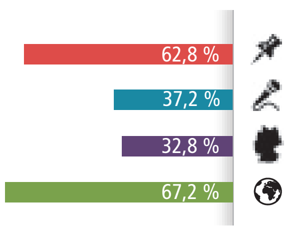
MAINZ

3,5 | Department of Chemistry, JGU
3,9 | Department of Physics, JGU
4,3 | Department of Physics, TUKL

CONFERENCE PARTICIPATION

TOTAL NUMBER OF CONFERENCES ATTENDED BY MAINZ PhD STUDENTS (2011-2013: 131)

POSTER PRESENTATIONS AND TALKS OF MAINZ PHD STUDENTS AT CONFERENCES IN GERMANY OR ABROAD

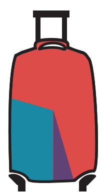


SECONDMENTS

BY CONTINENTS (2011-2013)

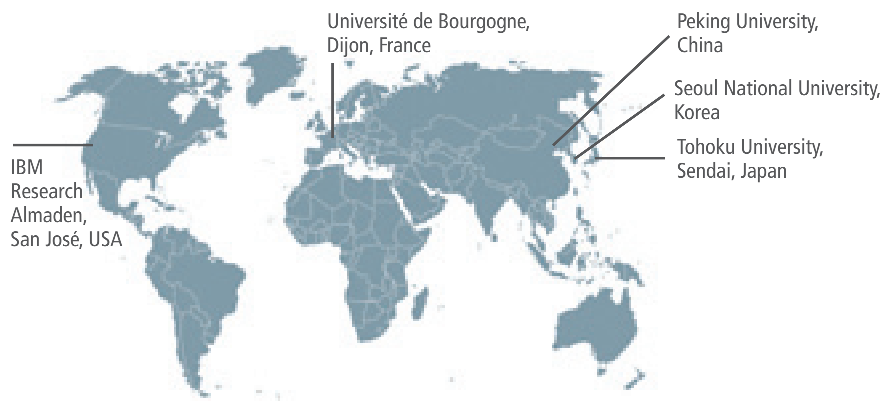
ON AVERAGE EVERY 6TH PhD STUDENT SPENDS A SECONDMENT ABROAD

THE AVERAGE DURATION OF A SECONDMENT IS 19,7 WEEKS



66,6 % North America
29,2 % Europe
4,2 % South America

COOPERATION AGREEMENTS

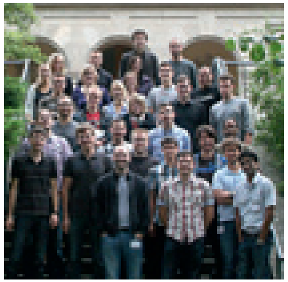


Layout: Tanja Labs

TIMELINE

2011

August 2011
MAINZ Student Seminar,
Windischeschenbach, Germany



August 2011
Summer School "Advanced Spintronic Materials", together with Tohoku University, at Villa Denis, Kaiserslautern

September 2011
Prolongation proposal handed-in for the second phase of Excellence Initiative

2012

February 2012
Summer School "Physics and Chemistry of Spintronic Materials" with Nobel laureates in cooperation with the Indian Institute of Science, Bangalore, at Orange County Resort, India

March 2012
DPG symposium organized by MAINZ students, Berlin

June 2012
Prolongation of MAINZ for the second phase of Excellence Initiative granted

July 2012
Gutenberg Lecture Award 2012:
Wolfgang Wernsdörfer

July 2012
MAINZ Award:
Christina Birkel and Christian Ohm

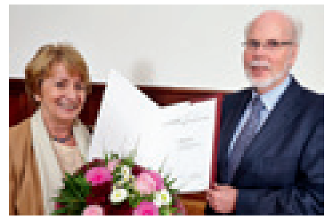
August 2012
MAINZ Student Seminar in Cambridge, England

October 2012
Summer School "Superconductivity 297K: Synthetic Highways to Room Temperature Superconductivity" in cooperation with IBM Research and Stanford University at Almaden, California

Start of lecture series "Methods in Materials Science"

August 2013
MAINZ Student Seminar in Stockholm

October 2013
First MAINZ Visiting Professorship: David Landau and Hartmut Zabel



October 2013
First MAINZ Alumni Meeting at Schloss Sörgenloch, Sörgenloch, Germany

2013

2013

April 2013
International Conference and Summer School "Newspin3" in Mainz

October 2013
MAINZ Award:
Anna Maria Hofmann and Christine Mangold

November 2013
Second MAINZ Retreat at Bad Dürkheim, Germany

Photos: Mark Bajohrs, Eric Lichtenscheidt, Markus Püttmann, Maximilian Staab, Frank Wiedemeier

MAINZ - EVENTS

Summer Schools

NAME	LOCATION	DATE
Methods in Materials Science	Istanbul, Turkey	July 2007
Theory of Electronic Structure in Materials	Königsfeld, Germany	September 2007
Thin Films	Oberwesel, Germany	November 2007
Polymer Syntheses	Kirchberg, Germany	March 2008
Solar cells and Other Semiconducting Devices (in cooperation with EPFL, Lausanne)	Lausanne, Switzerland	May 2008
Energy	Patras, Greece	June 2008
Simulation of Macromolecules on Different Scales	Hall, Austria	September 2009
Thermodynamics of Polymer-Containing Mixtures	Cadzand-Bad	September 2009
NMR-EPR-MRI	Cologne, Germany	November 2008
Nanoparticles	Titisee/Neustadt, Germany	July 2009
Novel Superconductors (in cooperation with UCSB, Materials Research Lab)	Santa Barbara, United States	August 2009
Physics of Biopolymers	Istanbul, Turkey	August - September 2009
Atomic Force Microscopy	Eisenach, Germany	October 2009
Polymers under Constraints	Titisee, Germany	January - February 2010
Photoemission	Dijon, France	February 2010
Membran Transport in Biological Systems	Sasbachwalden, Germany	June 2010
Emerging Materials for Spintronics (in cooperation with Stanford University and IBM Almaden)	Watsonville, United States	August 2010
Microscopy	Garmisch-Partenkirchen, Germany	August - September 2010
Biomimetic Materials	Segovia, Spain	October 2010
Rheology and Mechanical Properties of Polymers	Würzburg, Germany	April 2011
Quantum Properties in Anomalous Metals and Correlated Systems	Venice, Italy	May - June 2011
Electrooptics	Cambridge, United Kingdom	August 2011
Advanced Spintronics Materials and Transport Phenomena (in cooperation with Tohoku University)	Kaiserslautern, Germany	August 2011
Characterization of Polymer Interfaces/Surfaces/Thin Films (in cooperation with SPP 1369)	Wittenberg, Germany	April 2012
Physics and Chemistry of Spintronics Materials (in cooperation with Indian Institute of Science Bangalore)	Karnaka, India	February 2012
Nanoparticles	Bonn, Germany	May 2012
Superconductivity 297K: Synthetic Highways to Room Temperature Superconductivity (in cooperation with IBM Almaden and Stanford University)	Almaden, United States	October 2012
Electrosynthesis	Hirschegg, Austria	February 2013
NewSpin3	Mainz, Germany	April 2013
Nanoscience	Mainz, Germany	January 2014
New Developments in Condensed Matter Physics (in cooperation with Peking University and National Taiwan University)	Weihai, China	July - August 2014
Charge and Spin Transport in Non-Metallic Systems	Mainz, Germany	August 2014
Numerical Analytical Methods for Strongly Correlated Systems	Benasque, Spain	August 2014

Complementary Skills Courses

NAME	DATE
Oral Presentation, Scientific Wirting and Poster Preparation	June 2007
Project Management	October 2007
Career Service	October 2007
Presentations	March 2008
Oral Presentation, scientific Wirting and Poster Preparation	December 2008
Writing and Publishing	January 2009
Introduction to good scientific practice	February 2009
Job application	September 2009
Time and Self Management	September 2009
Writing and Publishing	October 2009
Intercultural Communication	November 2009
Oral Presentation	December 2009
Scientific Writing and Presentation	December 2009
Presenting in English	February 2010
Project Management: Getting a Grip on Your PhD	April 2010
Optimizing Writing Strategies for Publishing in English	April 2010
Oral Presentation	December 2010
Job Hunting an Interview Skills	January - February 2011
Leadership Skills	November 2011
Scientific Writing	December 2011
Oral Presentation	December 2011
Introduction into Patent Law	December 2011
Time Management in Doctoral Research	February 2012
Intercultural Communication	April 2012
Presence - Performance - Impact	March 2013
Publishing Research Results in English	April 2013
Project Management For Successful Researchers	August 2013
Professional X-Culture	October 2013
Poster Design & Poster Communication	October 2013
Application & Assessment	October 2013
MAINZ Application Talk	October 2013
Mit Präsenz überzeugen	March 2013
MAINZ Application Talk	April 2014
Leadership and Management Skills	May 2014
Application and Assessment	May 2014
Mit Kommunikation zum Erfolg	July 2014
Project Management For Successful Researchers	August 2014
Application & Assessment	September 2014
MAINZ Application Talk	September 2014

MAINZ Lectures Series

NAME	DATE
"Materials and Energy"	April 2009 until October 2010
"Materials and Industry"	November 2010 until September 2011
"Challenges in Materials Science"	October 2011 until February 2013
"Methods in Materials Science"	March 2013 until May 2014
"Materials and Energy"	from May 2014

MAINZ Student Seminar

NAME	LOCATION	DATE
1st MAINZ Student Seminar	Ehringerfeld, Germany	August 2010
2nd MAINZ Student Seminar	Windischeschenbach, Germany	August 2011
3rd MAINZ Student Seminar	Cambridge, United Kingdom	August 2012
4th MAINZ Student Seminar	Stockholm, Sweden	August 2013
5th MAINZ Student Seminar	Prague, Czech Republic	July 2014

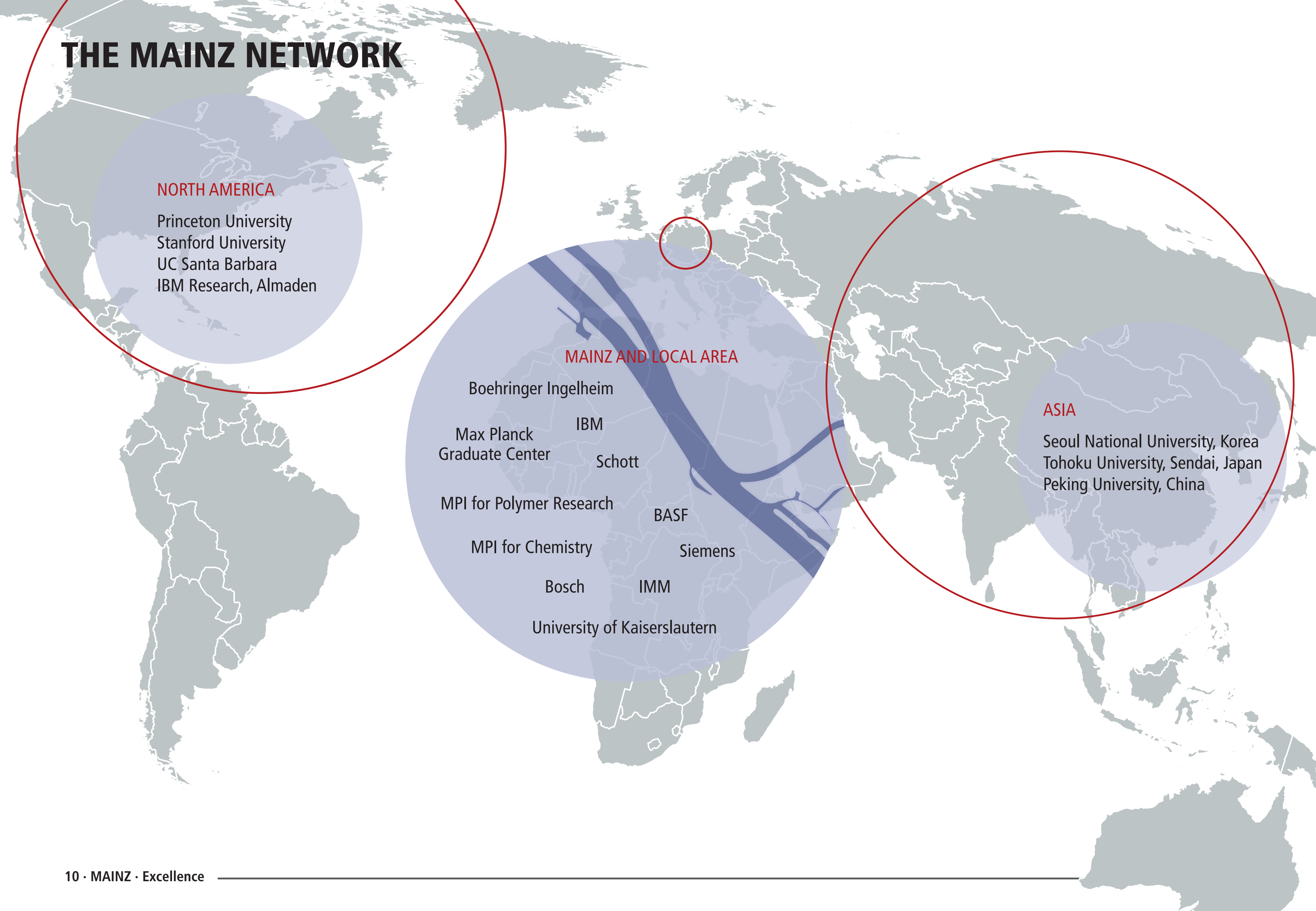
MAINZ Retreat

NAME	LOCATION	DATE
1st MAINZ Retreat 2010	Schmitten, Germany	April 2010
2nd MAINZ Retreat 2013	Bad Dürkheim, Germany	November 2013

MAINZ Award

NAME	AWARD WINNERS
MAINZ Award 2009	Dr. Frederik Wurm
MAINZ Award 2009	Dr. Daniel Kessler
MAINZ Award 2010	Dr. Mathias Junk
MAINZ Award 2010	Dr. Daniel Wilms
MAINZ Award 2011	Dr. Christina Birkel
MAINZ Award 2011	Dr. Christian Ohm
MAINZ Award 2012	Dr. Anna Maria Hofmann
MAINZ Award 2012	Dr. Christine Elisabeth Tonhauser
MAINZ Award 2013	Dr. Leonie Mück
MAINZ Award 2013	Dr. Christoph Schüll

THE MAINZ NETWORK



"THE GRADUATE SCHOOL MATERIALS SCIENCE IN MAINZ – **AN INTERNATIONAL BEST PRACTICE EXAMPLE**"

In its core research areas, the Johannes Gutenberg University Mainz (JGU) is an internationally recognized and competitive workplace for outstanding early career researchers from Germany and abroad. Among the best examples of what we have to offer is the Graduate School of Excellence "Materials Science in Mainz" (MAINZ), the showpiece of our structured and targeted strategy for the support and mentoring of young research talents.

In 2007, and again in 2012, the MAINZ Graduate School of Excellence proved successful in the Excellence Initiative of the German federal and state governments. In view of the stiff national competition, this renewed endorsement by an international expert group confirms the outstanding achievements of our materials scientists both in their research field as well as in the promotion of young researchers.

Until 2017, MAINZ will provide an environment for inspirational work by linking previously unconnected research fields, the objective being to generate creativity and innovation that will lead to pioneering discoveries in materials research.

JGU is fully committed to the successful model embodied in MAINZ, which is based on three fundamental cornerstones:

- *Promotion of high-quality research concepts for the development of materials with new functional properties*.

- *Extensive cooperation with partner universities, such as Princeton, Stanford, and Seoul National University*.

- *Close collaboration with partners from the business community for the conversion of academic theory into future technology*.

MAINZ also benefits significantly from our university's governance structures. Two examples: The appointments of Stuart Parkin (IBM Almaden and Max Planck Institute for Microstructurephysics in Halle) and Jairo Sinova as fellows of the Gutenberg Research College (GRC), who both were awarded Alexander von Humboldt Professorships in 2014, involves an intensification of our collaboration in the field of spintronics with these renowned physicists. Moreover, the GRC fellowship of Parkin also provides two doctoral candidates from the MAINZ Graduate School with the opportunity of having Professor Parkin serve as their supervisor. This includes periodic research stays abroad, principally at IBM Almaden in California, where Parkin is an IBM Fellow and manager of the Magnetoelectronics Group.

The way in which the MAINZ Graduate School combines training in an exceptional academic environment with high-quality international networking and exclusive mentoring, thus enabling students to plot the course of their future careers even at an early stage, can surely be considered as an international best practice example.

The Graduate School "Materials Science in Mainz" exemplifies a highly competitive international institution that can serve as a role model far beyond the confines of the Johannes Gutenberg University Mainz.

Prof. Georg Krausch
President of Johannes Gutenberg University Mainz

RESEARCH AREAS

In our ever-changing world, global challenges have emerged that define our lives and, as a consequence, also our research agenda. Materials science plays a leading role in tackling grand societal challenges in the fields of energy, healthcare, mobility, sustainability, and information technology. At the same time, this interdisciplinary research field provides fundamental scientific insights and exciting research opportunities. This has recently been acknowledged by the American National Academy of Sciences in a report on materials research, stating that the "thirst for fundamental understanding has been inextricably tied to the desire to manipulate nature by harnessing its properties or creating new materials to serve human needs" ("The Science of the World Around Us", Committee on Condensed-Matter and Materials Physics 2010, American National Academy of Sciences).

The Graduate School of Excellence MAINZ contributes in four research areas to help tackling these challenges. These are: **Model Systems and Correlated Matter**, **Functional Polymers**, **Hybrid Stuctures** and **Bio-Related Materials**. While core progress is made in each of these research areas, they are also strongly interlinked with projects bridging these research areas.

A member of the Graduate School MAINZ uses a high resolution electron microscope to analyze the physical properties of a newly developed nanoscale magnetic device on a chip.

RESEARCH AREAS

MODEL SYSTEMS AND CORRELATED MATTER

The research area Model Systems and Correlated Matter deals with a range of systems with varying complexity. It comprises, on the one hand, correlated materials, e.g. complex superconductors, magnetic materials, or tailored molecules; on the other hand, model systems such as ultracold quantum gases and magnon gases. Many of the peculiar properties of complex correlated matter emerge directly from the fundamental quantum-mechanical characteristics of its constituents. Model systems are particularly suited for studying these fundamental effects in correlated systems because their reduced complexity allows for more precise analysis and engineering of correlations and interaction strengths. Problems, that are encountered in real 3D materials but are difficult to understand, are tackled under idealized conditions by first studying simpler model systems of varying dimensionality. At the same time, real materials help to identify the most relevant questions for applications, which can then be investigated in model systems. To make this approach work, strong theoretical input and experimental expertise, as well as application-oriented material engineering, are brought together. The research provides an intrinsic research supply chain to enhance the understanding and the development of building blocks for the next generation of complex materials.

I am investigating how to generate and amplify so-called spin waves in magnetic materials on the micrometer scale. The study of this phenomenon should enable us to develop new electrical components, for example, processors for computers. For me, it is very helpful that the Graduate School MAINZ supports a lively exchange with scientists from other countries who are also working on similar scientific questions. For example, I have received many new technical impulses through the Summer School *Topological Insulators and Spintronics* in Taipei.

Thomas Brächer, 28 years old, doctoral student since December 2010 with Prof. Burkard Hillebrands

RESEARCH AREAS

FUNCTIONAL POLYMERS

Polymers offer an immense variety of possibilities for the tailoring of novel materials with unprecedented properties that can help to solve key challenges in many areas, including advanced healthcare materials, energy storage, and advanced optic materials. For many applications, the combination of polymers with inorganic particles on the nano- and micrometer scale currently plays a key role for eventual application. Here, one can learn from nature in a biomimetic way, either by learning to use nature´s building units or by adopting its interaction principles between soft- and hard matter. Applying this strategy, the adhesion of mussels on rocks leads to surface-adhesive polymers in general. On the other hand, microreactors permit us to obtain high definition functional polymers and polymer particles in a very rapid manner, due to the continuous processes involved, thus providing access to an immense variety of morphologies and shapes. All these facets of polymer science, ranging from topics as diverse as nanometer size colloids to novel biomedical materials and polymers for electronic applications, are being developed within the context of MAINZ.

In my thesis, I study the electron transfer process between nano crystals, a fundamental process occurring in a new type of low cost solar cells. Understanding this phenomenon can help us to make better solar cells based on these nano structures. My main benefit from MAINZ is the strong financial and organizational support. Visiting conferences funded by MAINZ has helped me to learn from the forefront of my research field. There I received constructive feedback on my own research from top scientists. Additionally, MAINZ workshops, such as time and project management, have helped me a lot to focus my research.

Wang Hai, 30 years old, doctoral student since July 2012 with Prof. Mischa Bonn

A doctoral student of the Graduate School MAINZ measures the volume of a solvent to synthesize a particular polymer on the Dean-Stark apparatus in the background.

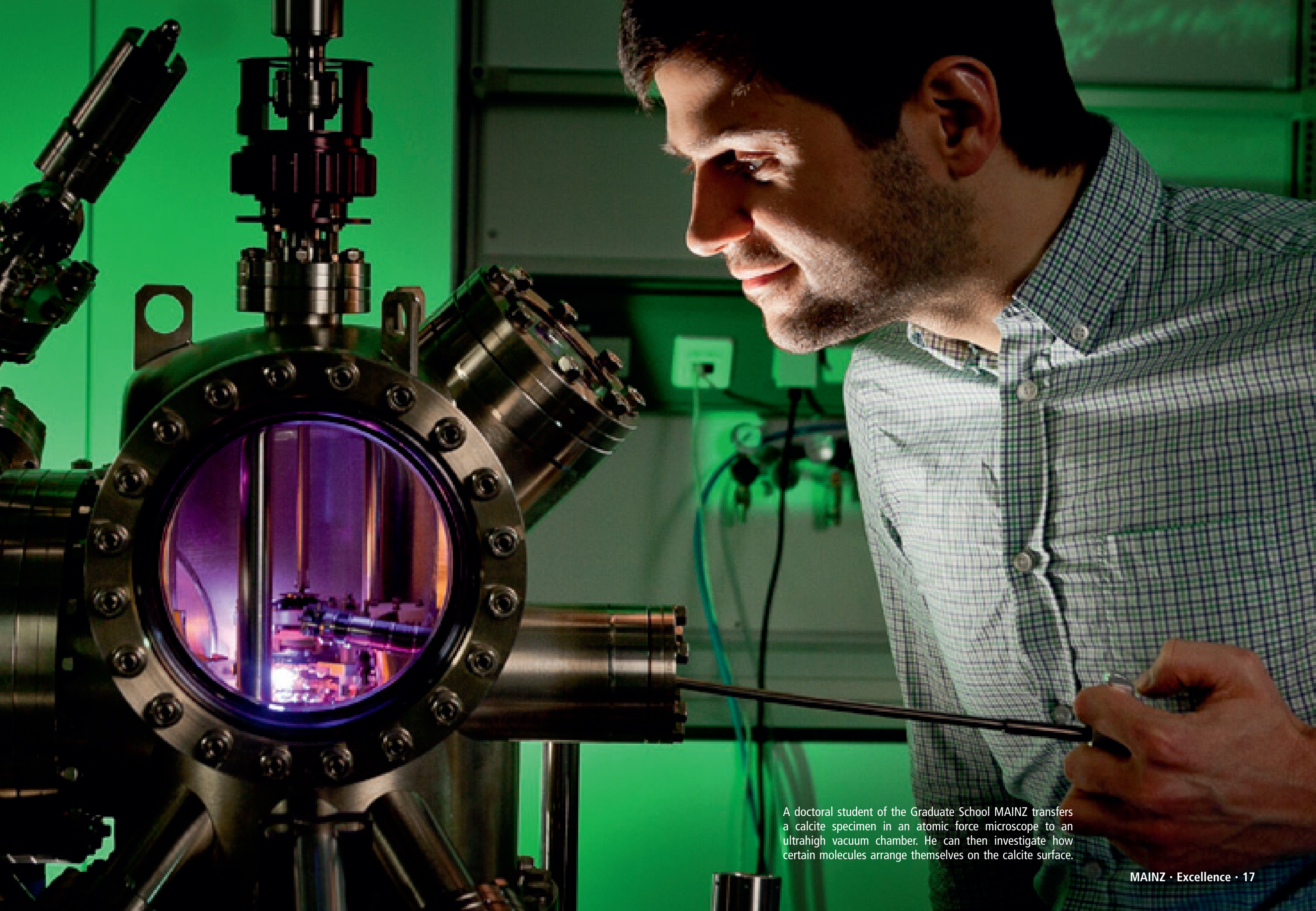
RESEARCH AREAS

HYBRID STRUCTURES

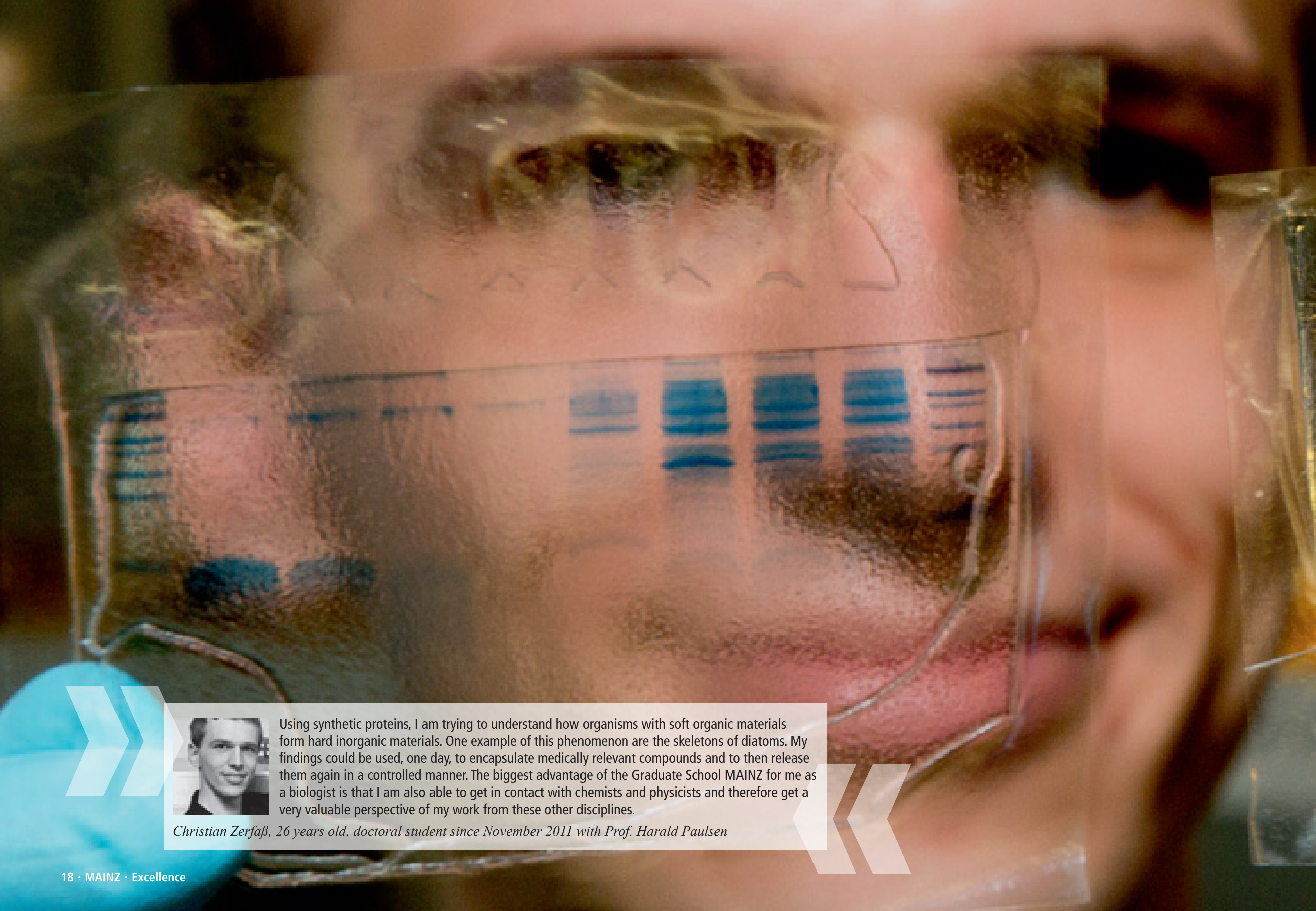
Current devices employing semiconductors face severe limitations, prompting the need for alternative approaches that combine the principal properties of different classes of materials in order to obtain novel functionalities. With recent progress in inorganic and, in particular, organic/polymeric and even biological systems, new integrated hybridized materials systems have emerged that, combined with advanced device architectures and innovative fabrication processes, provide devices with enhanced performance and unprecedented flexibility. Examples include new types of low power and low cost electronic circuits for logic, storage, and sensing devices or effi cient solid-state lighting, as well as alternative energy generation and storage. To exploit the advantages of hybrid technologies, MAINZ provides the appropriate environment for collaborative efforts between previously disparate communities, such as synthetic chemists working with condensed matter physicists, seeking to design organic spintronic devices, or systems biologists working with personnel at the Technology Platform Mainz to explore the interface between inorganic electronics and cells.

I work on the development of carbazole-based conducting polymers for so-called quantum dot hybrids. These hybrids are used as the active layer in special LEDs, to increase their efficiency. My project is very interdisciplinary – I do research at the interface of organic chemistry, physical chemistry, and chemical engineering. Thanks to the training concept of the Graduate School MAINZ I have several supervisors for my PhD thesis, and thereby the possibility to obtain feedback and support from various scientific fields. For me, the Summer and Winter Schools that MAINZ is offering are important, because my theoretical knowledge has improved significantly.

Ana Fokina, 26 years old, doctoral student since November 2012 with Prof. Rudolf Zentel



A doctoral student of the Graduate School MAINZ transfers a calcite specimen in an atomic force microscope to an ultrahigh vacuum chamber. He can then investigate how certain molecules arrange themselves on the calcite surface.



Using synthetic proteins, I am trying to understand how organisms with soft organic materials form hard inorganic materials. One example of this phenomenon are the skeletons of diatoms. My findings could be used, one day, to encapsulate medically relevant compounds and to then release them again in a controlled manner. The biggest advantage of the Graduate School MAINZ for me as a biologist is that I am also able to get in contact with chemists and physicists and therefore get a very valuable perspective of my work from these other disciplines.

Christian Zerfaß, 26 years old, doctoral student since November 2011 with Prof. Harald Paulsen

A doctoral student of the Graduate School MAINZ is checking SDS-Gels which contain Coomassie blue stained proteins which have been produced using genetically modified bacteria.

RESEARCH AREAS

BIO-RELATED MATERIALS

In recent years, MAINZ research directed at bio-related materials has increased significantly. Therefore, the interactions with medical research have been considerably strengthened within the last years. However, one major challenge for the future development of MAINZ is still to further increase the integration of biomedical research into its research portfolio. Bio-related materials research in MAINZ addresses a wide range of topics. The specific recognition capabilities of biological constituents (proteins, DNA) are utilized in order to create new bio-hybrid materials. Materials for biomedical applications comprise biocompatible and biodegradable polymers, polymer-protein/antibodies, polymer-drug conjugates, polymeric nanocapsules, and polyelectrolyte complexes for DNA transfection. Imitating biological matter may lead to the design of new materials through "learning from nature". This includes biomineralized materials for the regeneration of bones and teeth and super-amphiphobic surfaces mimicking the lotus effect or biomimetic active surfaces with smart adhesive properties.

RESEARCH HIGHLIGHTS OF MAINZ

While excellent research is the heart of our graduate school, training is the focus of MAINZ. Since it would be beyond the scope of this summary to illustrate the research programs being conducted through MAINZ in their entirety, we have instead selected a few research highlights, a digest of important publications by our young researchers, which will hopefully give you an interesting overview of research conducted at MAINZ.

Illustration: Erika Martins

Cationic nanohydrogels for the delivery of silencing (si)-RNA

Recently, we were able to establish a new concept for synthesizing polymeric cationic nanohydrogels, that offers a promising strategy for complexing and transporting siRNA into cells. For this purpose, amphiphilic reactive ester block copolymers were synthesized by RAFT polymerization of pentafluorophenyl methacrylate (PFPMA) as the reactive ester monomer together with tri(ethylene glycol) methyl ether methacrylate (MEO3MA). A self-assembly of these polymers was observed in polar aprotic solvents, which lead to the formation of nm-sized polymer aggregates. The resulting superstructures were used to convert the reactive precursor block copolymers with amine-containing cross-linker molecules into covalently stabilized hydrogel particles. This method offers a new possibility to synthesize precise nanohydrogels of various sizes, starting from a variety of block copolymers [1].
Detailed dynamic light scattering studies demonstrated the "stealth-like" properties of the nanohydrogels in human blood serum. The formation of larger aggregates, caused primarily by charge interaction with albumin, could be suppressed by loading with siRNA, thus providing a neutral zeta potential for the complex. Moreover, preliminary in vivo studies of intravital microscopy in the blood stream of mice confirmed the results inside the light scattering cuvette [2].
In terms of the biological potential of the nanogel with its siRNA payload, only the small, 40-nm particles were able to generate gene knockdown levels that lasted for approximately three days. Cell-uptake and colocalization studies with lysosomal compartments revealed that only these small nanogels were able to avoid acidic compartments of endolysosomal uptake pathways, which may contribute to their knockdown ability exclusively. In this respect, such size-dependent intracellular distribution behavior may be considered as an essential key parameter for tuning the knockdown abilities of siRNA nanogel carriers [3].

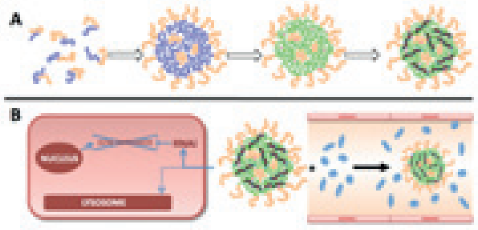


Fig.: (A) Schematic procedure for synthesizing cationic nanohydrogel particles by cross-linking of self-assembled reactive ester precusor block copoylmers with spermine – **(B)** siRNA-loaded cationic nanogel particles can cause gene knockdown by less accumulation in the lysosome (right) and avoiding aggregation with components of the blood serum (left).

REFERENCES

[1] Nuhn L, Hirsch M, Krieg B, Koynov K, Fischer K, Schmidt M, Helm M, Zentel R (2012). Cationic Nanohydrogel Particles as Potential siRNA Carriers for Cellular Delivery. *ACS Nano* 6(3): 2198-2214.
[2] Nuhn L, Gietzen S, Mohr K, Fischer K, Toh K, Miyata K, Matsumoto Y, Kataoka K, Schmidt M, Zentel R (2014). Aggregation Behavior of Cationic Nanohydrogel Particles in Human Blood Serum. *Biomacromolecules* 15(4): 1526-1533.
[3] Nuhn L, Tomcin S, Miyata K, Mailänder V, Landfester K, Kataoka K, Zentel R (2014). Size-Dependent Knockdown Potential of siRNA-Loaded Cationic Nanohydrogel Particles. Submitted.

Inspired by nature: Vanadium pentoxide nanoparticles mimic natural enzymes and inhibit surface build-up of algae and bacteria

Marine fouling is a problem that costs the shipping industry more than 200 billion dollars per year. The accumulation of organisms such as algae, mussels, and barnacles on ship hulls increases their weight, thus slowing their speed and increasing fuel consumption and CO_2 emissions. Even though it is possible to counteract this effect to some extent with antifouling paints, conventional biocides are less effective and can have adverse environmental consequences. Natural defense mechanisms provided the inspiration for a biomimetic antifouling approach. Biohalogenation in marine organisms usually occurs via the action of vanadium haloperoxidases. These enzymes mediate the oxidation of halides by hydrogen peroxide to hypohalides, which are reactive intermediates for the formation of halogenated compounds. These organic halides, in turn, inhibit bacterial sensing, thereby regulating the formation of biofilms. V2O5 nanoparticles act as functional inorganic analogues of vanadium haloperoxidases under laboratory as well as seawater conditions, with a similar mechanism and forming hypohalide (or 1O2 species in the absence of organic acceptors). This makes them a practical and cost-efficient alternative for natural haloperoxidases. The required reactants are present in seawater: halide ions are ubiquitous, while small quantities of hydrogen peroxide are formed in sunlight. The catalytic activity of V2O5 nanoparticles is preserved upon incorporation into paint formulations and prevents, under realistic marine conditions, biofouling. This inexpensive biomimetic approach can replace enzymatic preservation systems (or conventional chemical biocides) with new antibacterial, antifouling, and disinfection formulations in what could become a new, sustainable conservation concept.

◄ **Fig.: a)** Biofouling at a boat hull. **b)** knotted wrack, Ascophyllum nodosum. **c)** Mode of action of bioinspired under water paints: Like the natural enzyme vanadium bromoperoxidase vanadium pentoxide nanoparticles act as a catalyst for the formation of hypobromous acid from bromide ions (contained in sea water) and small amounts of hydrogen peroxide that are formed upon exposure to sun light. (Source: Tremel research group, JGU)

REFERENCES

[1] Natalio F, André R, Hartog AF, Stoll B, Jochum KP, Wever R, Tremel W. V_2O_5 nanoparticles mimic vanadium haloperoxidases and thwart biofilm formation. *Nature Nanotechnol.* 2012, 7, 530-535.
[2] Natalio F, André R, Pihan SA, Humanes M, Wever R, Tremel W. V_2O_5 nanowires with catalytic activity towards halogenation reactions – synthesis of self-assembled melanin-like biopolymers. *J. Mater. Chem.* 2011, 21, 11123-11129.
[3] André R, Natálio F, Humanes M, Leppin J, Heinze K, Wever R, Müller WEG, Tremel W. V_2O_5 Nanoparticles with an Intrinsic Peroxidase-Like Activity *Adv. Funct. Mater.* 2011, 21, 501-509.

Bio Serves Nano. Biological Light-Harvesting Complexes Enhance the Light Absorption of Semiconductor Nanoparticles (Quantum Dots)

Core-shell semiconductor nanoparticles, so-called Quantum Dots (QDs), outperform fluorescent dyes in several respects and, therefore, are interesting for a number of applications such as electrochemical solar cells. Type-II QDs are even able to convert light energy to reasonably stable charge separation between their core and shell structure; however, their absorption of light energy is relatively inefficient. We have shown that a light-harvesting complex (LHC), which enhances the excitation by solar light of photosynthetic reaction centers in plants, can do the same with type-II core-shell CdTe/CdSe/ZnS QDs after its coupling to the QD surface (Figure 1). A number of tags have been added to the LHC apoprotein to facilitate the attachment of this biological structure to the surface of the inorganic QDs.

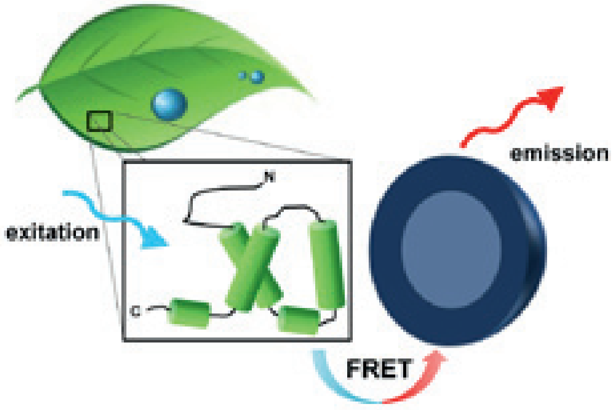


Fig.: LHC attached to the surface of a QD efficiently transfers its excitation energy to the inorganic nanocrystal.

REFERENCES

[1] Werwie M, Xu X, Haase M, Basché T, Paulsen H. Bio Serves Nano: Biological Light-harvesting Complex as Energy Donor for Semiconductor Quantum Dots. *Langmuir* 2012, 28, 5810-5818.

[2] Werwie M, Fehr N, Xu X, Basché T, Paulsen H. Comparison of Quantum Dot-binding Protein Tags: Affinity Determination by Ultracentrifugation and FRET Biochim. *Biophys. Acta General Subj.* 2014, 1840, 1651-1656.

A Path to Advanced Lithium-Ion Batteries: Introduction of a New Polymer-Based Carbon Coating Approach for Nanoparticles

Current lithium-ion batteries suffer from rather low specific capacities and a safety issue. Thus, they are not yet reasonably applicable to future application fields such as electric vehicles. One approach to improve the battery capacity or to make the battery safer is the design of new electrode materials. In particular, transition metal oxide nanoparticles are promising candidates as alternative electrodes. However, these transition metal oxide nanoparticles suffer from low electronic conductivity, side reactions on the large surface and, in some cases, structural degradation. To solve these problems, a new carbon coating approach was developed, which is based on block copolymers. These block copolymers can anchor with one short block onto the nanoparticle surface and can then be transformed into a graphitic coating by pyrolysis, because the second block consists of a suitable carbon precursor block. This approach was applied to TiO_2, a material that improves the safety of the battery when applied as an anode, and battery tests could prove that such a thin and homogeneous carbon coating is necessary for a reasonable battery performance, since the coating stabilizes the cycling behavior and prevents structural degradation of TiO_2.

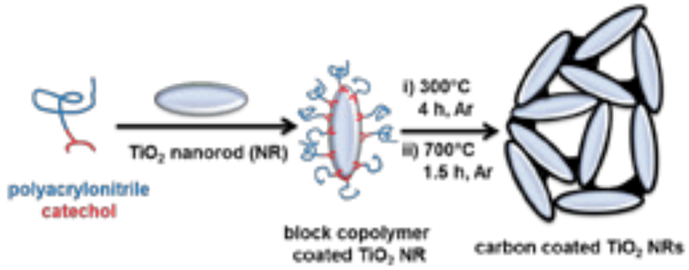


Fig.: Carbon coating approach of TiO_2 nanorods using anchoring block copolymer carbon precursor.

REFERENCES

[1] Oschmann B, Bresser D, Tahir MN, Fischer K, Tremel W, Passerini S, Zentel R. Polyacrylonitrile Block Copolymers for the Preparation of a Thin Carbon Coating Around TiO_2 Nanorods for Advanced Lithium-Ion Batteries. *Macromol. Rapid Commun.* 2013, 34, 1693.

[2] Bresser D, Oschmann B, Tahir MN, Tremel W, Zentel R, Passerini S. Stabilizing nanostructured lithium insertion materials via organic hybridization: A step forward towards high-power batteries. *Journal of Power Sources* 2014, 248, 852.

Magnetic Domain Wall Motion in Nanostructures

Physicists have developed novel approaches to achieve the propagation of magnetic domain walls through ferromagnetic nanowires. As part of the continued quest to develop ever smaller devices with improved functionalities and energy efficiencies, researchers in the field of nanomagnetism have previously proposed a variety of novel information storage, logic, and sensor applications in which data is represented by the direction of magnetization within a small region of a magnetic nanowire that is uniformly magnetized, a magnetic domain. The data can subsequently be read and processed by propagating domain walls, the interfaces between domains where the magnetization rotates through the nanowire between one orientation and the next. This method incorporates key advantages of magnetic data storage such as its non-volatility, while avoiding the need for complex physical moving components, such as the read-head of a hard disk drive.

In two publications, the domain wall displacement was analyzed and a radically new solution to moving multiple domain walls synchronously was conceived that combines the efficiency of the field driven motion with the ability to propagate multiple domain walls without data loss.

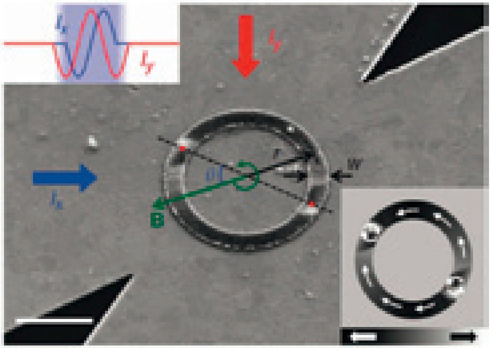


Fig.: Magnetization of a nanostructured permalloy ring.

REFERENCES

[1] Kim JS, Mawass MA, Bisig A, Krüger B, Reeve RM, Schulz T, Felix Büttner F, Yoon J, You CY, Weigand M, Stoll H, Schütz G, Swagten HJM, Koopmans B, Eisebitt S, Kläui M. Synchronous precessional motion of multiple domain walls in a ferromagnetic nanowire by perpendicular field pulses. *Nature Communications* 5, 3429 (2014).

[2] Bisig A, Stärk M, Mawass MA, Moutafis C, Rhensius J, Heidler J, Büttner F, Noske M, Weigand M, Eisebitt S, Tyliszczak T, Van Waeyenberge B, Stoll H, Schütz G, Kläui M. Correlation between spin structure oscillations and domain wall velocities. *Nature Communications* 4, 2328 (2013).

Rydberg atoms as a novel model system for many-body systems with long-range interaction

Model systems play a key role in the graduate school for the understanding of correlated materials. Establishing long-range interactions between particles allows for the study of many-body phenomena, such as multi-particle entanglement, crystallization dynamics, and strong light-matter interaction. Exciting ultracold atoms to a Rydberg state is a promising strategy in this context because the huge dipole moment of Rydberg atoms creates a long-range interaction between the atoms over a distance of more than 10 micrometers. Thereby, the interaction between the atoms can be so strong that many atoms share one single excitation and highly entangled states are created. This mechanism enables the formation of photon crystals [1] and is responsible for the appearance of a crystalline structure in a lattice system of Rydberg atoms [2]. Most recently, a theory and experimental collaboration within MAINZ has studied a so-called superatom, where 200 atoms behave as if they were a single atom [3].

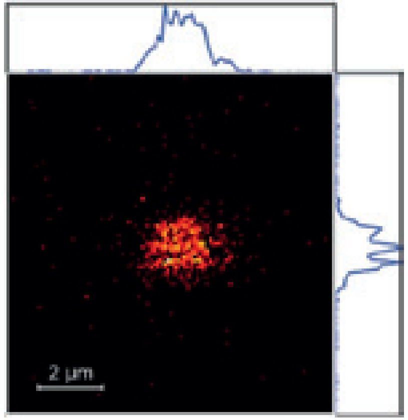


Fig.: Superatom consisting of 200 atoms

REFERENCES

[1] Otterbach J, Moos M, Muth D, Fleischhauer M. Wigner crystallization of photons in cold Rydberg ensembles. *Phys. Rev. Lett.* 111 113001 (2013).

[2] Hoening M, Muth D, Petrosyan D, Fleischhauer M. Steady-state crystallization of Rydberg excitations in an optically driven lattice gas. *Phys. Rev. A* 87, 023401 (2013).

[3] Weber TM, Hoening M, Niederpruem T, Manthey T, Thomas O, Guarrera V, Fleischhauer M, Barontini G, Ott H. Creation, excitation and ionization of a mesoscopic superatom. *arxiv* 1407.3611.

PUBLICATIONS OF DOCTORAL STUDENTS OF MAINZ

Novel "Stealth" Lipids with Branched Polyether Topology

"Stealth" liposomes are pharmaceutically relevant capsules shielded by biocompatible, polar polymer chains. These liposomes play an important role in drug-delivery applications, due to their long blood circulation times and passive tumor accumulation. The synthesis and study of novel stealth-type lipids is an interdisciplinary task at the crossroads of modern polymer synthesis, pharmaceutical chemistry, and medicine. Linear-hyperbranched, amphiphilic polymers with cholesterol (Ch) as a lipid anchor have been investigated in liposome formulations and have been systematically compared with respect to their biodistribution. 20 mol% of the novel lipids were incorporated in the liposomes. The polymers were labeled with ^{18}F, and organ uptake in mice was followed by positron emission tomography (PET) for 1 h. The novel sterically stabilized liposomes showed a behavior similar to that of established, PEG shielded vesicles with respect to spleen and liver uptake and retention in blood, albeit with the advantage of multifunctionality and a considerably improved blood-to-liver and blood-to-lung. This emphasizes the promising biomedical potential of the new structures.

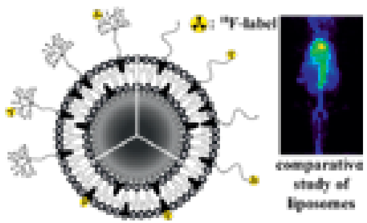


Fig.: Stealth-type liposomes with shielding polymer corona (left image) and PET image of lipid distribution (right image).

REFERENCE

Fritz T, Hirsch M, Richter FC, Müller SS, Hofmann AM, Rusitzka KAK, Markl J, Massing U, Frey H, Helm M. Click Modification of Multifunctional Liposomes Bearing Hyperbranched Polyether Chains. *Biomacromolecules* 2014, 15, 2440–2448.

Saccharide-Based Nanocapsules for Biomedical Applications

We could show that hollow nanocapsules with an aqueous core can be obtained via olefin cross metathesis. The reaction was tailored to proceed selectively at the oil-water interface of aqueous nanodroplets in an inverse miniemulsion. The cross metathesis takes place between an acrylated polysaccharide and unsaturated organophosphates under mild conditions. This general protocol allows the synthesis of biocompatible and polyfunctional nanocapsules via the bioorthogonal olefin metathesis, thus generating a highly versatile methodology for the design of future materials not only for biomedical applications but also for materials science. Drug-delivery systems consisting of dextran methacrylate cross-linked polyacrylamide nanogels were synthesized for for the treatment of hospital-acquired infections caused by antibiotic-resistant bacteria. Zinc nitrate was encapsulated in the nanogels as an alternative to common antibiotics. Subsequently, the nanogels were enclosed in a polymer shell. The obtained core-shell hybrids were able to inhibit and delay the growth of two strains of methicillin resistant S. aureus. The core-shell hybrids may be applied as coating of wound dressings. The growth of bacteria could then be inhibited locally at the infection site in an early stage of infection. Therefore the viability of a dermal model cell line was tested in presence the nanostructures. The concentrations of nanostructures used in antibacterial testing, had only a small effect on the viability of the investigated model cell line. In future, investigating the cross-linking of gel core and capsule wall could be help to estimate the drug encapsulation efficiency in advance.

Fig.: The use of cross metathesis for the formation of biodegradable nanocapsules.

REFERENCE

Malzahn K, Marsico F, Koynov K, Landfester K, Weiss CK, Wurm FR. Selective Interfacial Olefin Cross Metathesis for the Preparation of Hollow Nanocapsules, *Macro Lett.*, 2014, 3, 40.

Smart Magnetic Dispersions: from Encapsulation and Triggered Release

The entrapment and controlled release of functional compounds is of fundamental interest for biomedical applications. Upon application of a stimulus (mechanical force, temperature, pH, light, salt concentration, etc.) the protective shell is deformed or decomposed and the active compound is released and followed by a desired reaction of the active compound. In contrast to the aforementioned release triggers, a magnetic field is (almost) inert and interacts only with the deliberately integrated magnetic moiety. A release can be achieved without influencing the environment. As a consequence, the stimulus does not harm the environment (e.g. healthy tissue around a tumor) and the stimulus is not retarded (e.g. light is absorbed). Such a specific stimulus is highly desirable in many cases. For example, drugs can be released in a remote-controlled fashion at a desired time. In order to achieve a magnetic field induced release from nanocapsules, we combined the encapsulation of magnetic nanoparticles into polymer nanocapsules with the use of a thermolabile compound as shell material. The magnetic nanoparticles act as generators for heat, which is absorbed by the decomposition of the thermolabile compound. The shell degrades and active substances can be released. Magnetic nanoparticles were also used for the detection of drug delivery without nanoparticle uptake. Here, the delivery was observed by a kiss-and-run mechanism at the cell membrane. Additionally, they were also successfully used for monitoring of the fate of cells after injection appears paramount for the further development of cell therapies by using magnetic resonance imaging.

Fig.: Release of functional compounds upon application of an alternating magnetic field. **A:** Schematic illustration of the release. **B+C:** Nanocapsules loaded with magnetic nanoparticles. **D:** Release of a fluorescent compound.

REFERENCE

Bannwarth MB, Ebert S, Lauck M, Ziener U, Tomcin S, Jakob G, Münnemann K, Mailänder V, Musyanovych A, Landfester K. Tailor-Made Nanocontainers for Combined Magnetic-Field-Induced Release and MRI. *Macromol. Biosci* 2014, DOI: 10.1002/mabi.201400122.

Learning from Nature: Catechol as a Biomimetic “Adhesive” Unit Between Hard and Soft Matter for Functional Nanoparticles

Metal oxide nanoparticles possess a variety of intriguing properties that range from unusual electro-optical and magnetic properties to peculiar catalytic features. Dissolution in aqueous media is required to exploit these characteristics. For this purpose, a solubilizing polymer shell is crucial. Catechol, a di-hydroxyfunctional derivative of benzene plays an important role in the natural amino acid dopamine (Figure), which is the key unit in mussel proteins that enables them to firmly adhere to rocks in salt water. Catechol-based water-soluble polymers have been developed that are universal for the coating of metal oxide nanoparticles with a hydrophilic polymer shell. The polymer shell consists of the highly biocompatible poly(ethylene glycol) (PEG) or polyglycerol. In the case of polyglycerol, a single catechol moiety makes the difference, permitting the attachment of these polyols to a metal oxide nanoparticle coating. The resulting water-soluble nanoparticles are useful for MRT imaging, due to their solubilizing and biocompatible polymer shell.

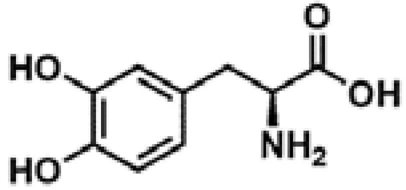


Fig.: Mussel byssus showing adhesion to a solid substrate; structure of amino acid dopamine that is responsible for adhesion at surfaces.

REFERENCE

Wilms VS, Bauer H, Tonhauser C, Schilmann AM, Müller MC, Tremel W, Frey H. Catechol-Initiated Polyethers: Multifunctional Hydrophilic Ligands for PEGylation and Functionalization of Metal Oxide Nanoparticles. *Biomacromolecules* 2013, 14, 193-199.

From Particles to Fibers: Colloid-Magnetospinning as a Novel Method for Preparing Well-Defined Nanofibers

We have demonstrated a novel method for the preparation of hybrid and inorganic fibers and nanorods in aqueous environments. Spherical magnetic building blocks of hybrid nanoparticles are assembled in an aqueous flow and an external magnetic field without any templating agent. The fast fusion speed (0.5–50 s), the facile synthetic procedure, and the aqueous fusion medium are important advantages of this novel process. The morphology of the obtained fibers, ranging from necklace-like to smooth cylindrical structures with tuneable corrugation, can be controlled by process parameters such as time of fusion and temperature, and by the morphology of the magnetic nanoparticles. The assembly of Janus nanoparticles yields zigzag structures. The complexity of the 0D initial structure is therefore used for inducing a complexity into the obtained 1D structure.
If the nanoparticles surface was decorated with bioinspired hydroxyamic acid ligands, the obtained structures could be locked by complex formation with ferric ions. After reduction of the ferric ions to ferrous ions with vitamin C, the cohesion between individual nanoparticles in the suprastructure becomes loose and singular nanoparticles are recovered. The model system shows the possibility to mimic naturally occurring bacterial assemblies.

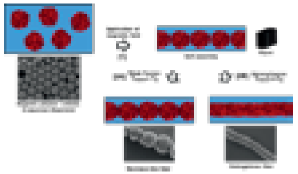


Fig.: Magnetic self assembly [1] and fusion [2] of magnetic polymer colloids in water. Increasing the temperature above the glass transition temperature (T_g) provides enough polymer chain flexibility and enables a linear sintering process.

REFERENCE

Bannwarth MB, Kazer SW, Ulrich S, Glasser G, Crespy D, Landfester K. Well-defined Nanofibers with Tunable Morphology from Spherical Colloidal Building Blocks. *Angew. Chem. Int. Ed.* 2013, 52, 10107-10111.

Dendronized Polyphenylene Borate Anions: A New Class of Rigid, Nanometer-Sized and Hydrophobic Salts

Weakly coordinating anions are of considerable importance in various fields, including catalysis, polymer chemistry, electrochemistry, ionic liquids, and battery technology. For the preparation of more weakly coordinating anions, it is a major task to increase their size and bulkiness, and thus efficiently encapsulate the ion in a nonpolor scaffold. To this end, the concept of divergent dendritic growth via thermal Diels-Alder cycloaddition was applied to tetraphenylborate anions. Thus, hydrophobic frameworks consisting of polyphenylene units were constructed around the ionic cores, leading to bulky, rigid, and molecularly defined anions with unprecedented sizes in the order of several nanometers (see figure). The structural parameters such as size, density, and surface polarity could be synthetically tuned by the choice of suitable building blocks. The impact of organic borate anions encapsulated in the dendritic frameworks on the physical properties was investigated by means of conductivity measurements, dielectric spectroscopy, dynamic light scattering, and NMR techniques. By increasing the molecular size, solubility in low permittivity solvents was increased and the coordinative interactions between ions could be effectively reduced, which was reflected by significantly larger ion dissociation values. Hence, the resulting borate salts have considerable potential for application as novel weakly coordinating anions.

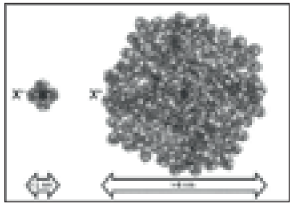


Fig.: Size comparison for modelled structures of tetraphenylborate (left) and rigidly dendronized borate (right).

REFERENCE

Türp D, Wagner M, Enkelmann V, Müllen K. Synthesis of Nanometer-Sized, Rigid, and Hydrophobic Anions. *Angew. Chem. Int. Ed.* 2011, 50, 4962-4965.

„Nano-Flowers" Made From Polymer Coated Gold Particles Trapping Small Satellites: A Way To Create Highly Sensitive Refractive Index Sensors

Highly sensitive and spectrally tunable plasmonic nanostructures are of great demand for applications such as SERS and parallel biosensing. However, there is a lack of such nanostructures for the mid-visible spectral regions as most available chemically stable nanostructures offer high sensitivity in red to far red spectrum. This work reports the assembly of highly sensitive nanoparticle structures using a hydroxylamine mediated core-satellite assembly of 20nm gold nanoparticle satellites onto 60 nm spherical gold cores. The average number of satellites allows tuning the plasmon resonance wavelength from 543 to 575 nm. The core-satellite nanostructures are stable in pH ranges from 5 to 9 and show a two-fold higher sensitivity than similar sized gold nanospheres. These hybrid inorganic-organic structures are simpler to produce than the highly sensitive gold nanorattles we had investigated before. The procedure employed to create the organic-inorganic nano flowers helped also to create a novel type of asymmetrically coated spherical nanoparticles.

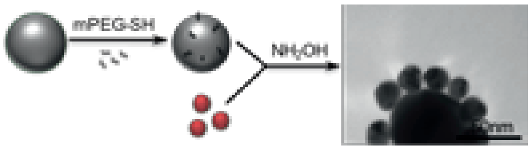


Fig.: Procedure for creating nanoflowers from PEGylated gold nanoparticles

REFERENCE

Prasad J, Zins I, Branscheid R, Becker J, Koch A, Fytas G, Kolb U, Sönnichsen C. Plasmonic Core-satellite Assemblies as Highly Sensitive Refractive Index Sensors. *ACS Nano*, submitted 2014.

DNA coated gold nanoparticles: Multiplexed Plasmon Sensor for Rapid Label-free Analyte Detection

Common approaches for parallel analyte detection in small liquid samples couple specific receptor molecules to spectrally encoded markers (e.g. SERS barcode, luminex) limiting the number of independent targets in a parallel assay to a few dozen. A (potentially) larger number of targets are possible on micro-spot arrays (e.g. DNA microarrays, multiplexed ELISA) where the type of target is encoded in the position of the corresponding spot. However, current multiplexed detection schemes are too complex, slow and/or expensive for routine use 'in the field'. We show a new approach to detect multiple analytes simultaneously in a microfluidic flow cell using randomly deposited gold nanorods. Random deposition allows an inexpensive, simple and high-throughput sensor fabrication. Each nanorod responds with a spectral shift of its plasmon resonance specifically to one target, acting effectively as a 'nano-SPR' device. Using four distinct proteins as targets, we demonstrate the feasibility of the concept, sensitivity down to nanomolar concentrations, the reactivation and reuse of the sensor over several cycles, and estimate the potential for up-scaling the concept to hundreds or thousands of targets. Our technique has the potential to simplify multiplexed detection and reduce the costs of each sensor to negligible dimensions, especially if combined with advanced nanofabrication methods like nano-stamping or optical trapping. Such inexpensive sensor platform could be used, for example, to discriminate influenza subtypes in a doctor's office.

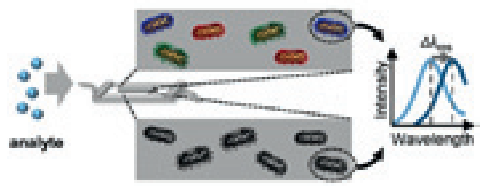


Fig.: Analyte detection with mapped (upper panel) and unmapped (lower panel) plasmonic nanoparticles

REFERENCE

Rosman C, Prasad J, Neiser A, Henkel A, Edgar J, Sönnichsen C. Multiplexed Plasmon Sensor for Rapid Label-Free Analyte Detection. *Nano Lett*. 2013, 13 (7), 3243-3247.

NanoSPR: Protein Coated Gold Nanorods For The Quantification Of Protein-Protein Binding Affinities

The dynamics in living organisms are governed by a complex network of interacting macromolecules. To fully understand, model, and potentially influence such processes, it is important to quantify binding affinities between all possible partners, preferentially without introducing fluorescent labels. Popular techniques to do so are surface plasmon resonance (SPR) biosensors, quartz crystal microbalance, fluorescence correlation spectroscopy, isothermal titration calorimetry, or analytical ultracentrifugation. However, most of the label-free techniques used to study binding affinities require the analysis of one pair of binding partners at a time, making the quantification of a complex interaction network a laborious and slow effort. We have tackled this problem in a novel way by employing individual protein coated gold nanorods as sensing elements. Each gold nanorod responds to binding events near its surface by a shift in the plasmon resonance wavelength. The nanorods are connected to proteins via specific tags, making it simple to generate a library of nanoparticles, each functionalized with a different type of protein. Particles from this library are deposited on a common substrate for simultaneous quantification of the interaction with a common target molecule. Our "NanoSPR" method provides a simple, fast, and cost-effective route to characterize binding affinities between many macromolecular partners simultaneously.

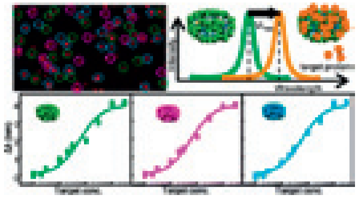


Fig.: Principle of NanoSPR: Dark field image of randomly deposited gold nanorods, binding of target proteins T injected into the flow cell to nanoparticles covered by proteins P_i produces a shift $\Delta\lambda_{res}$ in the plasmon resonance, and binding affinity of multiple protein-protein interactions.

REFERENCE

Ahijado-Guzmán R, Prasad J, Rosman C, Henkel A, Tome L, Schneider D, Rivas G, Sönnichsen C. Plasmonic Nanosensors for Simultaneous Quantification of Multiple Protein-Protein Binding Affinities. *Nano Lett.*, ASAP, DOI: 10.1021/nl501865p.

Controlling the Dynamics of an Open Many-Body Quantum System with Localized Dissipation

When quantum matter interacts with a classical environment, counter-intuitive phenomena can be observed. Removing particles from a Bose-Einstein condensate – a macroscopic quantum mechanical object consisting of ten thousand indistinguishable atoms – is an example for this: if a localized loss process is made progressively stronger, fewer atoms are progressively removed from the condensate. This is a consequence of the wave nature of the atoms and the decoherence that is induced by the loss process. Such phenomena can be used to generate new states of matter and help to understand how the classical world emerges from the microscopic realm of quantum mechanics.

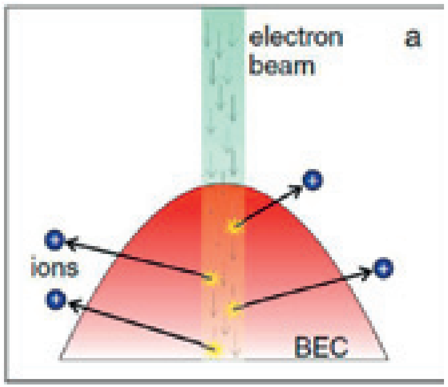


Fig.: Atoms are removed locally from a Bose-Einstein condensate.

REFERENCE

Barontini G, Labouvie R, Stubenrauch F, Vogler A, Guarrera V, Ott H. Controlling the Dynamics of an Open Many-Body Quantum System with Localized Dissipation. *Phys. Rev. Lett.* 110, 035302 (2013).

Beyond the Heisenberg Model: Anisotropic Exchange Interaction between a Cu-Tetraazaporphyrin Monolayer and Fe_3O_4 (100)

The exchange coupling of local spins is usually described by the Heisenberg model that considers the relative orientation of the two spins but not their orientation with respect to the bonding axis. In order to test this assumption, we investigated an anisotropic system of a molecular spin loosely coupled to a ferromagnet, using x-ray magnetic circular dichroism. In contrast to the Heisenberg model, we find an anisotropic exchange coupling that depends on the orientation of the molecular spin relative to the bonding axis. The exchange coupling is ferromagnetic for the magnetization direction parallel to the bonding axis and antiferromagnetic for the perpendicular direction. The anisotropy of the Heisenberg exchange coupling is attributed to an orbitally dependent exchange Hamiltonian. The interplay of the exchange interaction with the magnetization direction opens a new pathway to control the spin configuration in single molecular magnets.

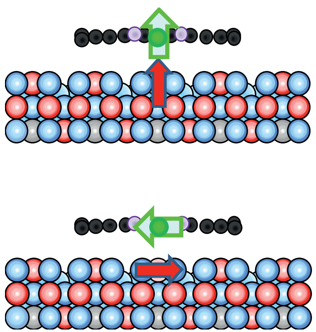


Fig.: Molecular Cu spin (green) anisotropically coupled to the ferromagnetic magnetite magnetization (red).

REFERENCE

Klanke J, Rentschler E, Medjanik K, Kutnyakhov D, Schönhense G, Krasnikov S, Shvets IV, Schuppler S, Nagel P, Merz M, Elmers HJ. Beyond the Heisenberg Model: Anisotropic Exchange Interaction between a Cu-Tetraazaporphyrin Monolayer and Fe_3O_4 (100). *Phys. Rev. Lett.* 110, 137202 (2013).

Conductance Control at the $LaAlO_3$/$SrTiO_3$-Interface by a Multiferroic $BiFeO_3$ ad-Layer

At the interface between two materials, new physical phenomena can emerge. Though both materials are insulators at the $LaAlO_3$/$SrTiO_3$ interface, a quasi 2-dimensional electron gas can form. On top of a 6 unit cell thick $LaAlO_3$ layer on $SrTiO_3$, we produced an additional layer of $BiFeO_3$, which is multiferroic and possesses antiferromagnetic and ferroelectric order. Using piezo force microscopy, we could locally polarize the multiferroic and manipulate the conductance of the electron gas. Coupling of the antiferromagnetic state of the $BiFeO_3$ to another ferromagnetic layer generates the prospect of being able to control the charge carrier density with a small external magnetic field.

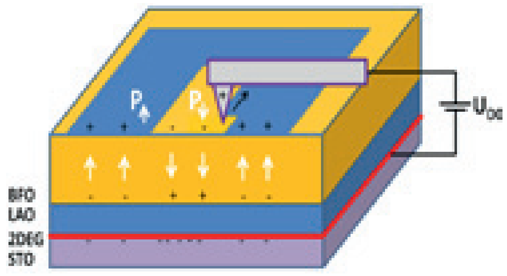


Fig.: Charge carriers are introduced locally into the electron gas at the interface by changing the ferroelectric polarization with a piezo force microscope.

REFERENCE

Mix C, Finizio S, Kläui M, Jakob G. Conductance control at the $LaAlO_3$/$SrTiO_3$-interface by a multiferroic $BiFeO_3$ ad-layer. *Appl. Phys. Lett.* 104, 262903 (2014).

TRAINING CONCEPT

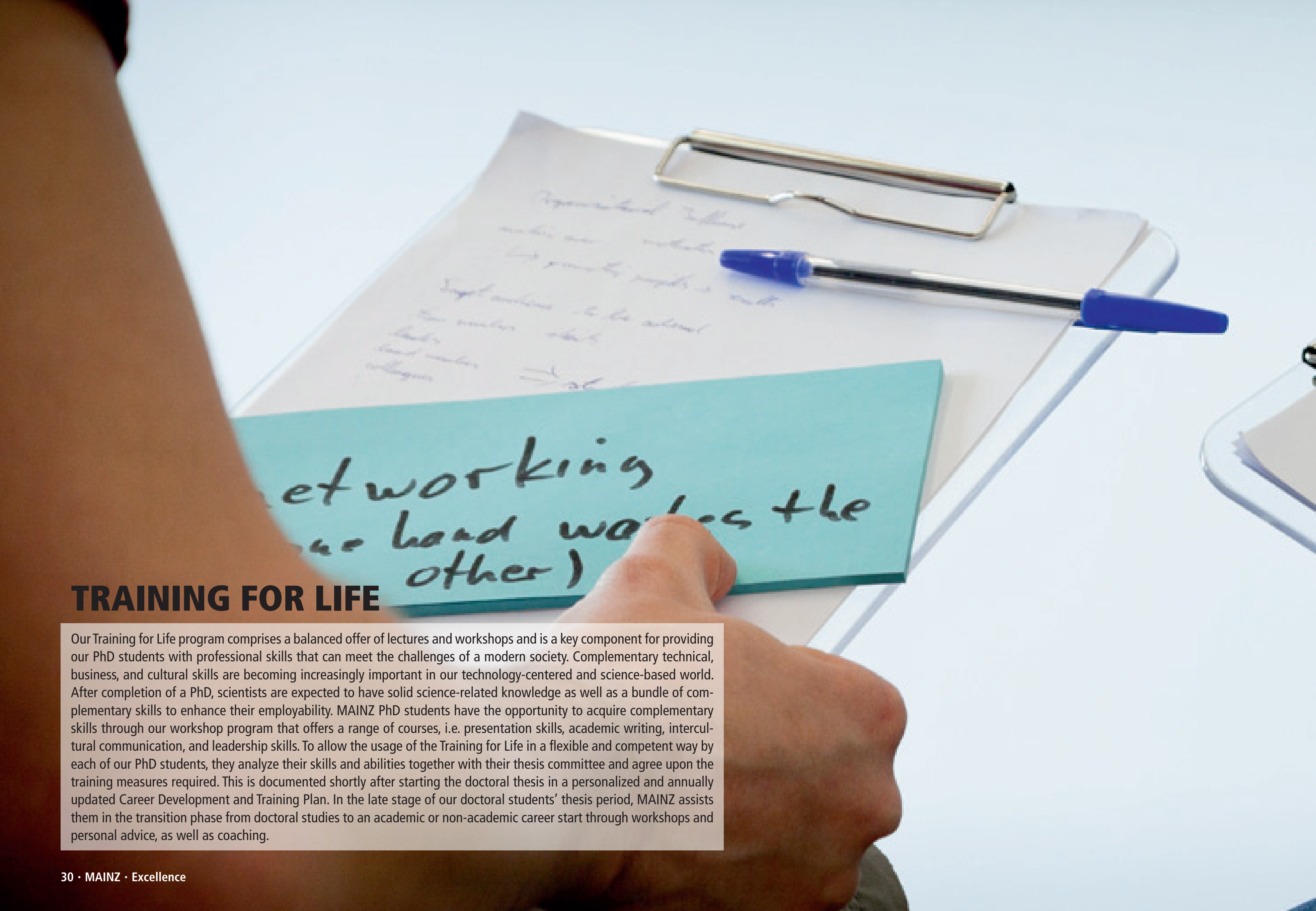
The training at MAINZ is designed to stimulate our PhD students' enthusiasm for fundamental research in materials science and to prepare them for a future career. To achieve this goal, we aim at providing a flexible and individually tailored training program, offering our PhD students a training structure that can be adapted to their individual career needs. This strategy is reflected by our training concept, which is based upon a well-balanced combination of independent high-level research, using advanced methods and techniques of materials science, and an individually tailored training program that provides our PhD students with a solid, broad, and interdisciplinary background in the field, as well as with other relevant knowledge and individually needed skills. MAINZ provides a comprehensive graduate program that combines two pillars for all the training it provides: Training through Research and Training for Life.

Using colloidal model systems, I examine the molecular dynamics during crystallization and vitrification, and also what structures are formed there. I want to deepen the understanding of the similarities and differences between these two phase transitions. From February until May 2014, I was at the RMIT University in Melbourne, where I could apply a different measurement method as from that used in Mainz. I took the opportunity for the stay, because there was a guest professor from RMIT in my work group. My stay in Melbourne was then funded by the MAINZ Graduate School. Of course, this is a huge advantage for my research.

Sebastian Golde, 28 years old, doctoral student since September 2012 with Prof. Thomas Palberg

TRAINING THROUGH RESEARCH

Our Training through Research goes far beyond the scope of a single research group. It includes interdisciplinary training and an exchange of knowledge in different fields of materials science within the graduate school. During their doctoral thesis work, MAINZ PhD students perform research in a team environment, acquire broad and general as well as interdisciplinary knowledge in different fields of materials science and build a specialized expertise in specific instrumentation. They also strengthen their intellectual capability to analyze complex situations and problems in a methodologically and scientifically sound and reliable manner. This is paralleled by the regular delivery of oral and written reports on the progress of the individual doctoral student's research project.



TRAINING FOR LIFE

Our Training for Life program comprises a balanced offer of lectures and workshops and is a key component for providing our PhD students with professional skills that can meet the challenges of a modern society. Complementary technical, business, and cultural skills are becoming increasingly important in our technology-centered and science-based world. After completion of a PhD, scientists are expected to have solid science-related knowledge as well as a bundle of complementary skills to enhance their employability. MAINZ PhD students have the opportunity to acquire complementary skills through our workshop program that offers a range of courses, i.e. presentation skills, academic writing, intercultural communication, and leadership skills. To allow the usage of the Training for Life in a flexible and competent way by each of our PhD students, they analyze their skills and abilities together with their thesis committee and agree upon the training measures required. This is documented shortly after starting the doctoral thesis in a personalized and annually updated Career Development and Training Plan. In the late stage of our doctoral students' thesis period, MAINZ assists them in the transition phase from doctoral studies to an academic or non-academic career start through workshops and personal advice, as well as coaching.

During my graduate studies in inorganic chemistry, I am modeling natural electron transfer processes with ruthenium-based dye complexes, as they occur in photosynthesis. The aim is to create the possibility of artificial photosynthesis to convert solar energy into chemical energy. The funding through the MAINZ Graduate School is a great opportunity for me, because I get so many offers in addition to my professional work. Amongst others, there are seminars for self-organization, presentation techniques, or academic writing. This has contributed a lot to my personal development.

Christoph Kreitner, 26 years old, doctoral student since January 2013 with Prof. Katja Heinze

TEAM SUPERVISION

MAINZ PhD students are supervised by excellent scientists and benefit from intense attention provided by members of the graduate school throughout their PhD studies. This way, we provide our PhD students with conditions that allow them to finish their thesis within three years. A fundamental characteristic of our supervision approach is that it is carried out under the guidance of a thesis committee (two or more experienced scientists) who meet the doctoral student at set intervals to discuss the student's progress. The thesis committee is responsible for monitoring the student's research progress as well as his or her personalized development and training. Students analyze their skills and abilities together with their thesis committee shortly after starting the doctoral thesis, and agree on training to further develop individual research and complementary skills. This is documented in each student's annually updated Career Development and Training Plan to allow tracking of his or her progress throughout the doctoral thesis. In this way, we ensure that MAINZ students get the most individualized, flexible, and effective means of meeting their individual needs in preparing and writing a doctoral thesis. In conclusion, the concept of our supervision strategy is to guide our PhD students towards becoming excellent scientists.

In my work, I try to describe the influence of magnons, which are collective excitations in a magnet, in charge and spin dynamics. This challenge could play an important role in magnetization dynamics, which has not yet been thoroughly examined microscopically. Thanks to the MAINZ Graduate School, I regularly meet and discuss my work with my individual "thesis committee" which consists of two senior scientists. These discussions outside my actual working group always provide me with great new perspectives and ideas for new approaches.

Svenja Vollmar, 27 years old, doctoral student since May 2012 with Prof. Hans Christian Schneider

MENTORING PROGRAM

In our mentoring program mentMAINZ, each student can choose an external mentor from an area/company of personal career interest. The external mentor provides advice on career planning and vita shaping. The mentor also gives the mentee feedback on networking opportunities as well as on social competencies and personal development. Both career orientation and personal development of the mentee are framed in a process entourage based on group coachings. In addition to the mentoring, MAINZ offers PhD counseling and the possibility of contacting an ombudsperson.

For my doctoral thesis, I develop new methods for efficient computer simulations of liquids and dissolved molecules. Only a small but crucial part of the simulation is considered in every detail, while the rest is coarsened, but represented with less computational intensity. Such simulations can, for example, explore proteins whose experimental investigation is difficult. After my graduation, I plan to switch to the private sector. Through the mentoring program of the Graduate School MAINZ, I found my mentor at Stratley AG and can already establish valuable contacts outside the university.

Karsten Kreis, 27 years old, doctoral student since June 2012 with Prof. Kurt Kremer

INTERNATIONAL CHARACTER

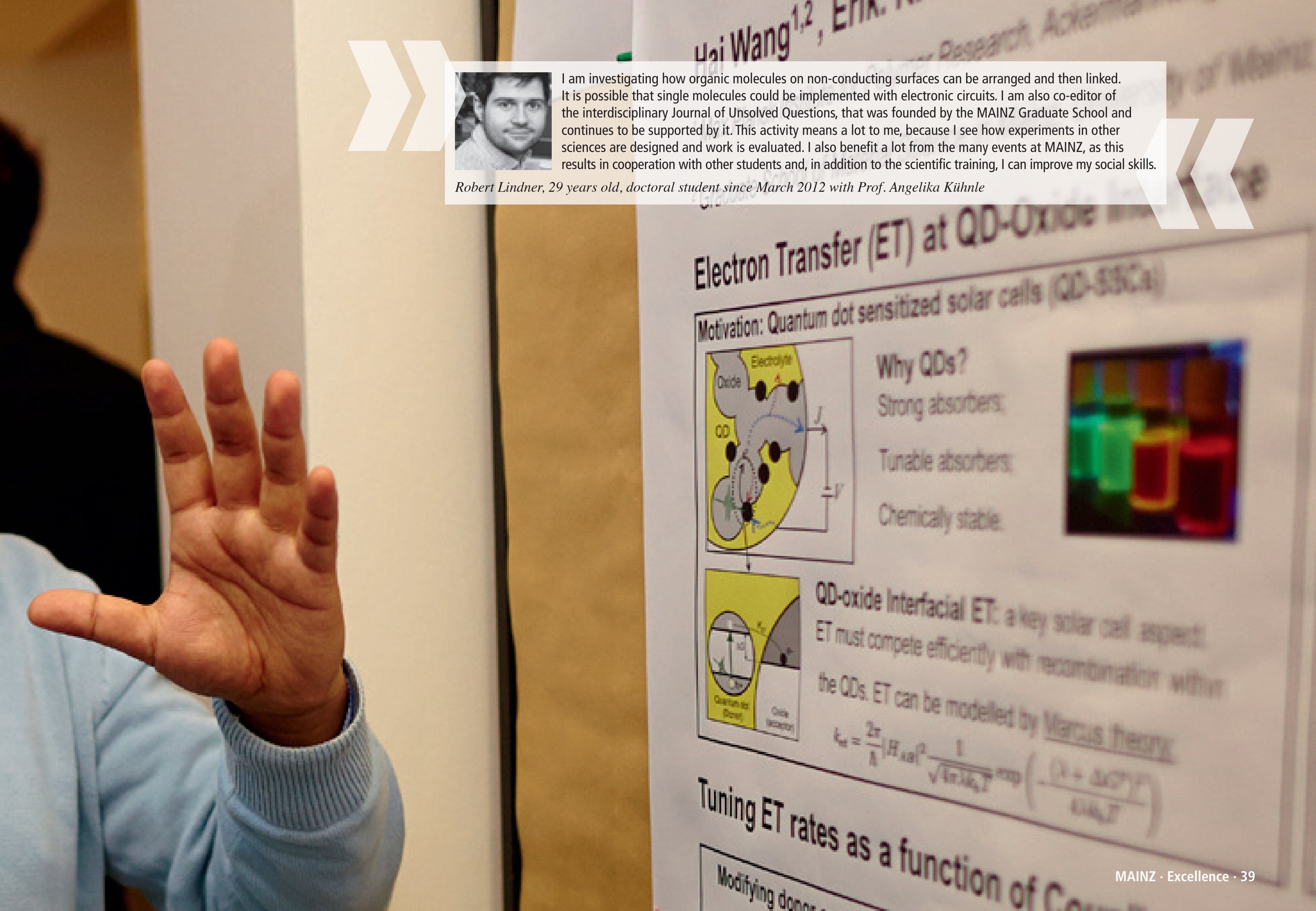
We provide our doctoral students with the outstanding opportunity to gain valuable international experience. During their thesis period, MAINZ students can spend up to 12 months at a foreign academic institution or an industrial partner and profit from already existing international contacts. MAINZ has partnered with research institutions, universities, and industrial partners from around the globe and we are still extending our network (see "Network of MAINZ", p. 8). Additionally, MAINZ students attend international summer schools – MAINZ organizes several schools each year together with international partners – and present their research work at international conferences. Furthermore, excellent foreign students who have already obtained a Bachelor's degree or started a PhD at a different institution, can apply for a research visit (internship or Guest PhD program) of up to 12 months at MAINZ. International PhD students constitute approximately 30% of all MAINZ students, hailing from over 20 different countries. Hence, English is the working language within the graduate school.

I synthesize polymeric networks containing a nonpolar and a polar component, leading to phase separation in the nanometer range. My aim is to achieve a special, gyroid morphology that is required for applications in fuel cells and bulk heterojunction solar cells. Being part of the Graduate School MAINZ gives me the opportunity to improve my knowledge in my field by visiting summer schools and presenting my results at international conferences, as well as interacting with PhD students from different fields. Another great benefit for my personal development is participation in soft skills courses.

Catarina Nardi Tironi, 27 years old, doctoral student since February 2013 with Prof. Klaus Müllen

COMMUNICATION OF SCIENCE

MAINZ students are encouraged to actively participate in national and international scientific conferences or workshops, allowing them to present the results of their research even at a very early stage of their careers. These events often serve as a forum for young scientists where they can present their own research to a wider audience, thereby obtaining greater confidence and improving their communication skills. In addition, this allows them to become known to the professional community in their respective fields. We encourage our students not only to present posters at conferences but also to deliver oral presentations about their work in sessions or symposia during those conferences. Additionally, the graduate school awards the MAINZ Visiting Professorship annually to outstanding internationally renowned scientists. In close collaboration with members of the graduate school, they, in turn, give lectures and perform research at MAINZ. In 2011 MAINZ, helped its students to establish the Journal of Unsolved Questions (www.junq.info) that has attracted international attention, due to its interesting way of communicating science – publishing negative or null results.



I am investigating how organic molecules on non-conducting surfaces can be arranged and then linked. It is possible that single molecules could be implemented with electronic circuits. I am also co-editor of the interdisciplinary Journal of Unsolved Questions, that was founded by the MAINZ Graduate School and continues to be supported by it. This activity means a lot to me, because I see how experiments in other sciences are designed and work is evaluated. I also benefit a lot from the many events at MAINZ, as this results in cooperation with other students and, in addition to the scientific training, I can improve my social skills.

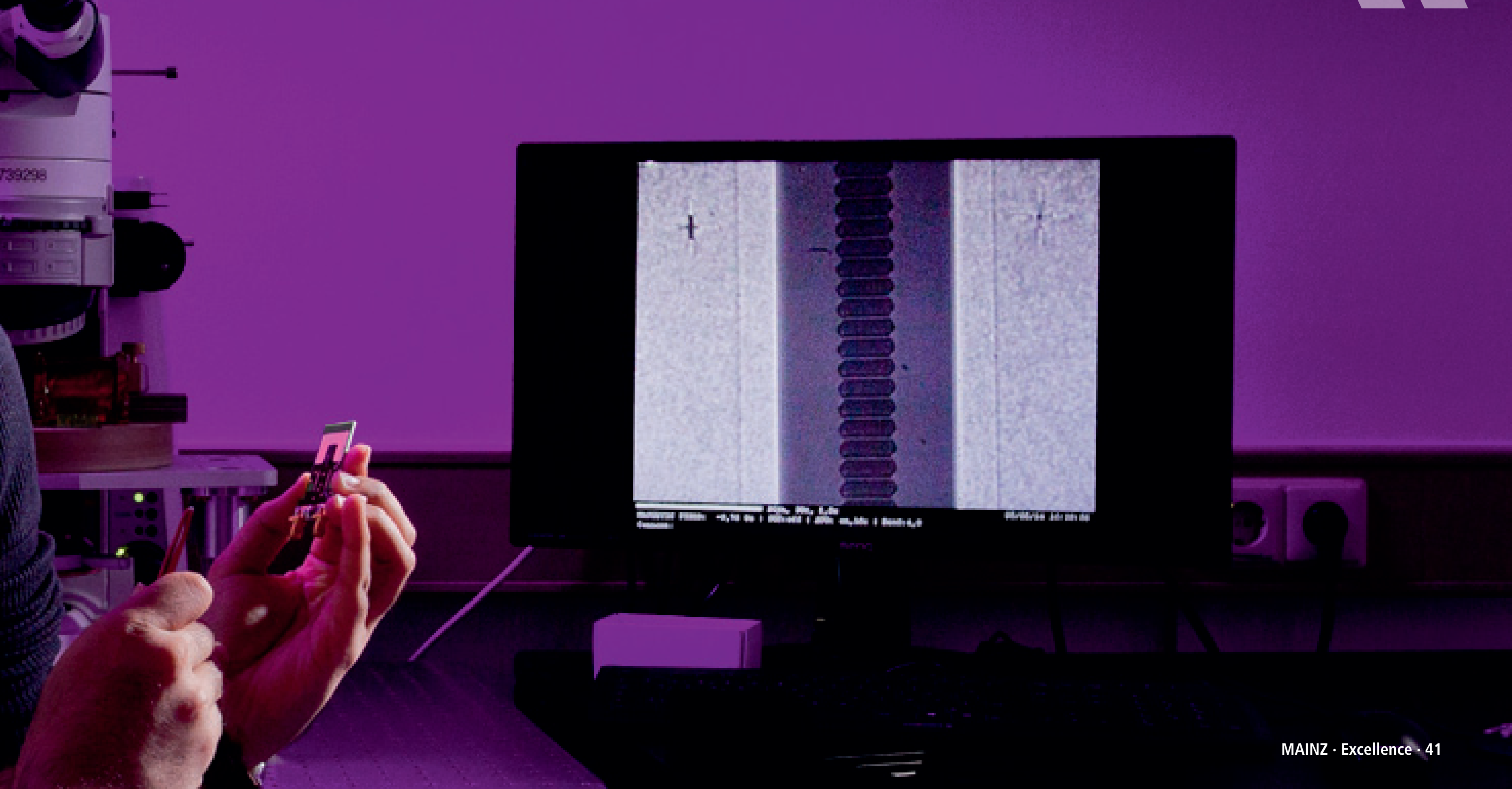
Robert Lindner, 29 years old, doctoral student since March 2012 with Prof. Angelika Kühnle

EARLY STAGE SUPPORT

Exceptional students with a Bachelor's degree who work at the host institutions of MAINZ are involved in the activities of the graduate school from an early stage. This allows them to perform high-level research while still in the process of completing their studies. After successful application to the graduate school, these students take part in a research project at MAINZ or at one of our partner universities or industrial partners worldwide for up to 12 months. During this period, students are provided with a fellowship and a travel grant. Additionally, MAINZ allows outstanding students with a Bachelor's degree to start a doctoral thesis without previously obtaining a Master's degree (fast-track doctoral thesis).

I originally came from high energy physics, but realized during my Bachelor thesis, that this field won't be able to match my interests completely. During an internship in the Kläui group, where I worked on current-induced magnetization dynamics, I became convinced that I wanted to write my Master's thesis in this field. Prof. Kläui then suggested an application for the fast track program, of which I already had heard, but which was not so relevant to a high energy physicist. Now, matching one of the fields of MAINZ, I really appreciate the opportunity for doing a faster doctorate and the further training, like a recently conducted computational tools course.

Kai Litzius, 23 years old, participant of the fast track program of MAINZ since December 2013




MATERIALS SCIENCE
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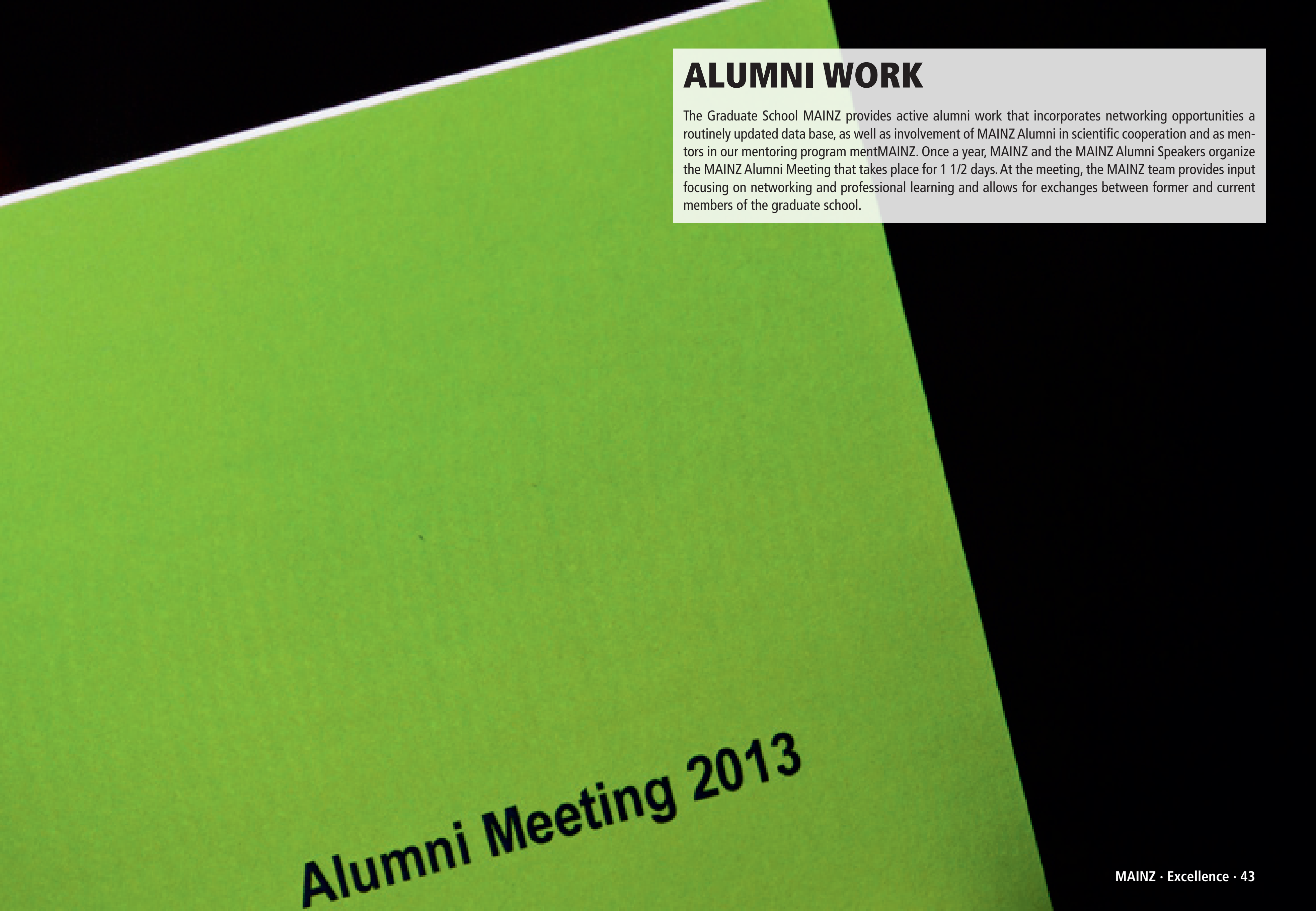
ALUMNI WORK

The Graduate School MAINZ provides active alumni work that incorporates networking opportunities a routinely updated data base, as well as involvement of MAINZ Alumni in scientific cooperation and as mentors in our mentoring program mentMAINZ. Once a year, MAINZ and the MAINZ Alumni Speakers organize the MAINZ Alumni Meeting that takes place for 1 1/2 days. At the meeting, the MAINZ team provides input focusing on networking and professional learning and allows for exchanges between former and current members of the graduate school.



CAREERS OF OUR ALUMNI

FROM MAINZ TO MIT

“My next career goal is to lead my own group,” says Sebastian Will. “I keep my eyes open for jobs in the United States and Germany.” Since 2011, he has worked as postdoc in the research group of Professor Martin Zwierlein at the Massachusetts Institute of Technology (MIT) in Cambridge. He developed entirely new experimental methods to study how molecules behave at absolute zero temperatures (minus 273 degrees). The extreme cooling of ten thousand reciprocal particles allows him to explore how their behavior is determined by quantum mechanics. “This is a completely new field of research,” says Will. “First, it is a basic research that could once lead to completely new applications.” Perhaps such “ultracold” molecules could one day be used as Qbits for a quantum computer.

During his doctoral thesis with Professor Immanuel Bloch at the Graduate School of Excellence “Materials Science in Mainz” (MAINZ), Will studied how individual ultracold atoms in so-called optical lattices arrange themselves and which quantum mechanical properties they attain. Now he can use the techniques he learned in this new context at MIT. Will is also benefiting from his experiences at the Graduate School, especially because of their interdisciplinary character: “I’m actually a nuclear physicist,” says Will. “In MAINZ, however, I also had very close contact with the solid-state physicists who work with other methods than we generally do. I have really enjoyed and benefited from the regular exchange of ideas.”

Supervised by his mentor, Professor Jürgen Gauss, who is a quantum chemist, Will was influenced by Gauss’ different background. “He has given me important tips for my career. I was very impressed by his scientific diligence and by the way he leads his group,” says Will. It is typical for MAINZ that each graduate student selects an external mentor in addition to the thesis supervisor. This mentor advises more generally than professionally about a scientific career and can provide important suggestions. For Sebastian Will, this concept has paid off: “As well as my academic supervisor, Immanuel Bloch, Jürgen Gauss also is an important role model for me as a scientist.”

Sebastian Will

- Born 1980 in Limburg a. d. Lahn
- 2001 to 2006: Study of Physics at the Johannes Gutenberg University Mainz and the Massachusetts Institute of Technology, Cambridge
- 2006 to 2011: Doctoral thesis at the Graduate School of Excellence MAINZ
- Since 2011: Postdoc at the Massachusetts Institute of Technology, Cambridge

FROM MAINZ OVER IBM TO VW

“In the medium term, the centre of my future career will be definitely VW. I would like to pursue my further development here”, says Tanja Graf. Since 2012, the chemist is working on the development of new materials for applications in vehicles. “This concerns materials for fuel cells and the reduction of wear caused by friction, especially in engines,” says Graf. That she is now working for the second largest automobile manufacturer in the world results from her doctoral work at the Graduate School of Excellence “Materials Science in Mainz” (MAINZ). During that time, her supervisor and mentor was Professor Stuart Parkin of IBM Almaden Research Center. He offered her the opportunity to do research with him in California during but also after her doctoral thesis. At her postdoc position, she met two employees from VW. “And then it ran through word of mouth recommendation,” says Graf. “The two took my resume back to Germany. Then, I received an invitation to a video interview and, finally, my current position.”

Nonetheless, she is very happy that she accepted Parkin’s offer to come to California - because she could deal with something new: “In my doctoral research with Professor Claudia Felser, I examined how the so-called Heusler materials - alloys with special magnetic properties - can be used in industrially produced magnetic sensors,” says Graf. She cooperated with the Mainz-based company Sensitec and the University of Kaiserslautern. At IBM, she explored how electrical properties of oxides can change so that it is possible to build novel transistors. “As a result, I gained some insight into another world which was a great experience. I would always recommend trying something new during one’s career,” says Graf.

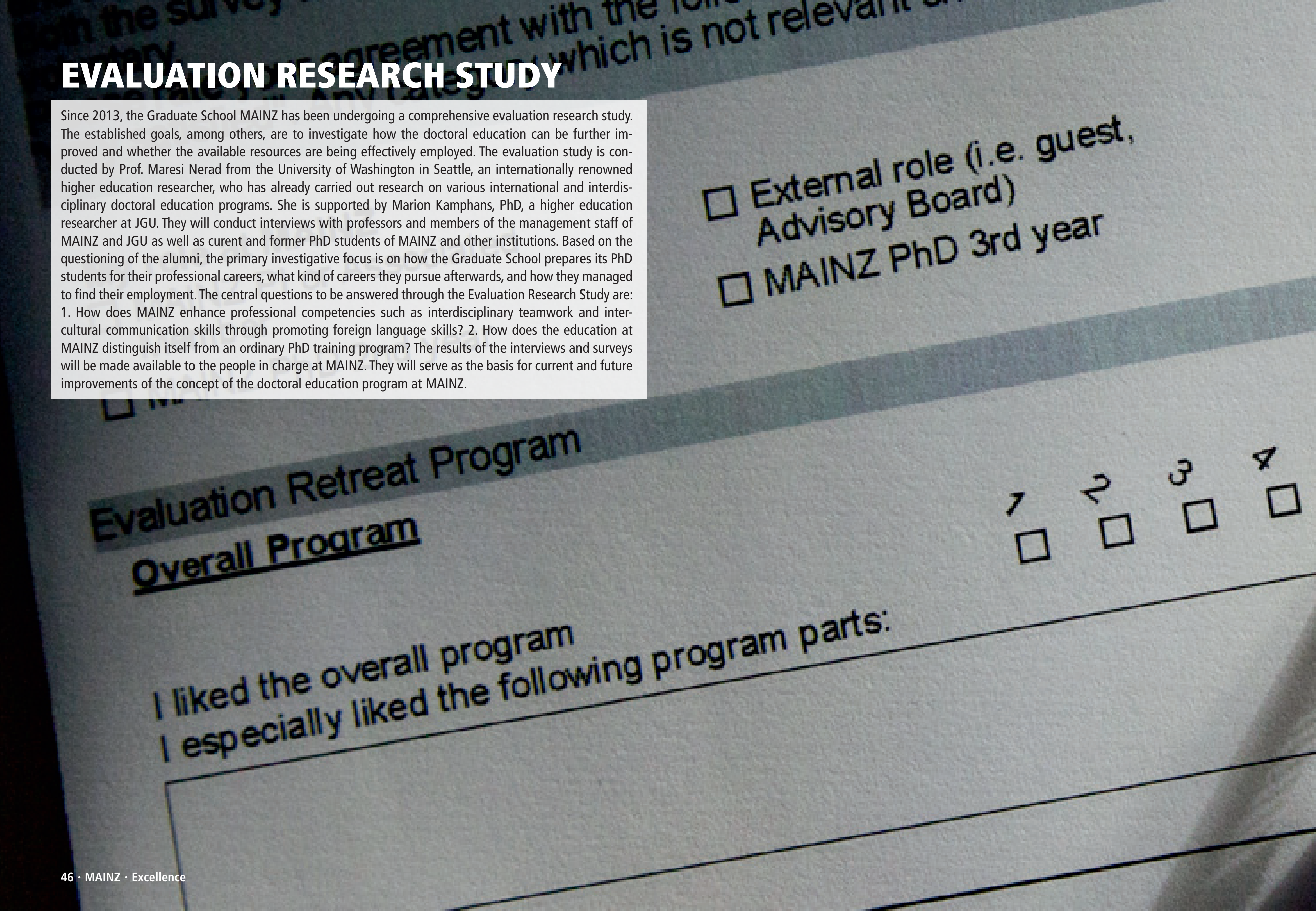
In addition to these perspectives that opened with the support of her mentor, she praises the intercultural training at MAINZ and the international experience which she could gain through the graduate school. She spent the last half year of her doctoral thesis she at the IBM Almaden Research Center. “The scientists at the Research Center come from everywhere,” says Graf. “Therefore, it was good to have attended the training in intercultural communication, because I had already learned what I was going to have to deal with.” Even today, she benefits from that training in this respect, because she is cooperating with many universities worldwide at VW.

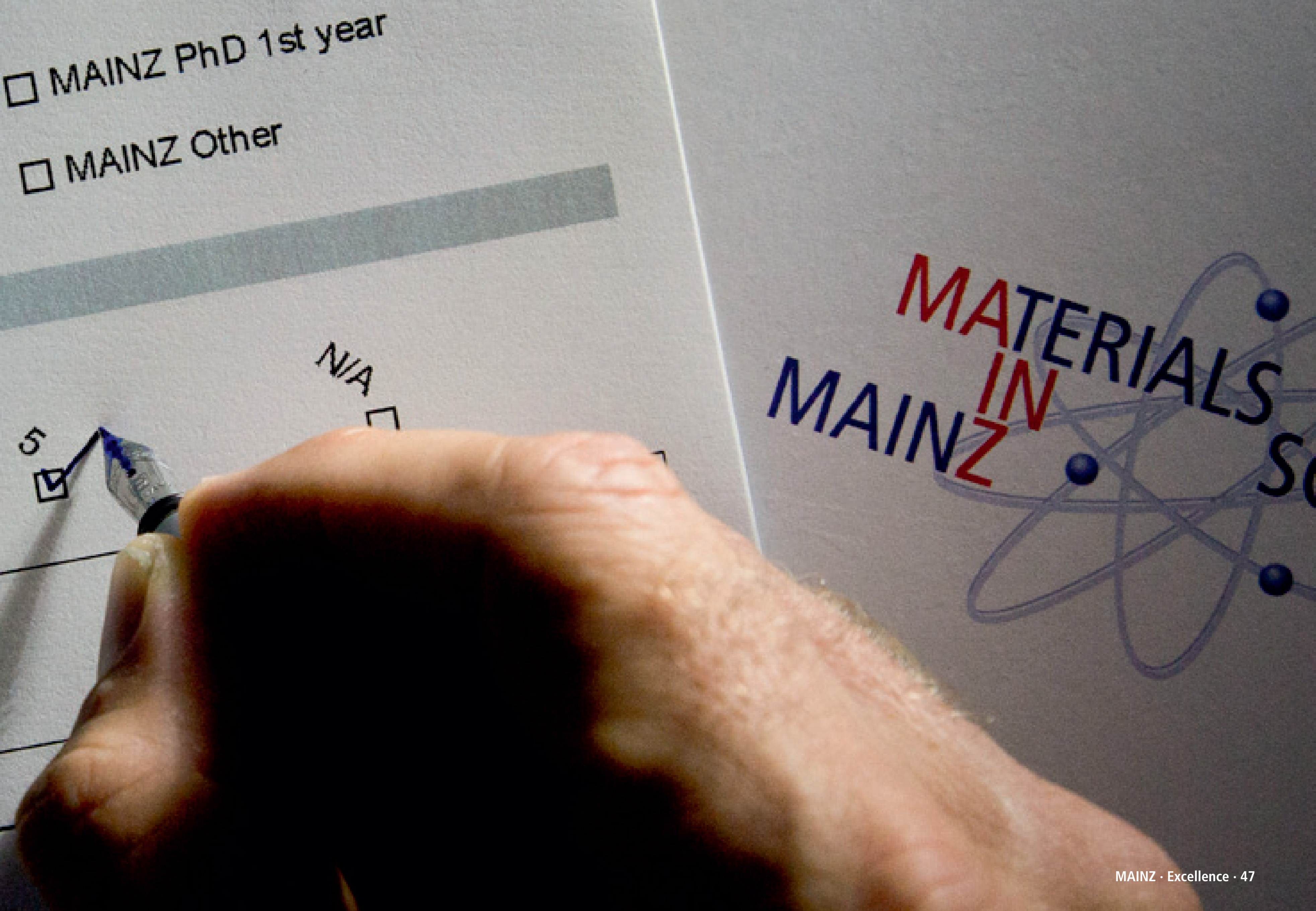
Tanja Graf

- Born 1 April 1984 in Wiesbaden
- 2003 to 2008: Study of Chemistry at the Johannes Gutenberg University Mainz
- 2008 to 2011: Doctoral thesis at the Graduate School of Excellence MAINZ
- 2011 to 2012: Postdoc at IBM Almaden Research Center, California
- Since 2012: Employee at the research and development center at Volkswagen AG, Wolfsburg

EVALUATION RESEARCH STUDY

Since 2013, the Graduate School MAINZ has been undergoing a comprehensive evaluation research study. The established goals, among others, are to investigate how the doctoral education can be further improved and whether the available resources are being effectively employed. The evaluation study is conducted by Prof. Maresi Nerad from the University of Washington in Seattle, an internationally renowned higher education researcher, who has already carried out research on various international and interdisciplinary doctoral education programs. She is supported by Marion Kamphans, PhD, a higher education researcher at JGU. They will conduct interviews with professors and members of the management staff of MAINZ and JGU as well as curent and former PhD students of MAINZ and other institutions. Based on the questioning of the alumni, the primary investigative focus is on how the Graduate School prepares its PhD students for their professional careers, what kind of careers they pursue afterwards, and how they managed to find their employment. The central questions to be answered through the Evaluation Research Study are: 1. How does MAINZ enhance professional competencies such as interdisciplinary teamwork and intercultural communication skills through promoting foreign language skills? 2. How does the education at MAINZ distinguish itself from an ordinary PhD training program? The results of the interviews and surveys will be made available to the people in charge at MAINZ. They will serve as the basis for current and future improvements of the concept of the doctoral education program at MAINZ.

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MATERIALS
IN
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Illustration: Erika Martins

MEMBERS OF THE GRADUATE SCHOOL MAINZ

PRINCIPAL INVESTIGATORS

Prof. Martin Aeschlimann

DEPARTMENT OF PHYSICS, UNIVERSITY OF KAISERLAUTERN

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

Our research program is devoted to the investigation of ultrafast phenomena in solids, thin films, and nanoparticles. This includes the combination of short pulsed laser systems with surface science technology in order to develop novel methods for measuring ultrafast relaxation processes in real time with high temporal and spatial resolution.

SELECTED PUBLICATIONS

- Koopmans B, Malinowski G, Longa FD, Steiauf D, Faehnle M, Roth T, Cinchetti M, Aeschlimann M (2010). Explaining the Paradoxical Diversity of Ultrafast Laser-Induced Demagnetization. *Nature Materials* 9(3): 259-265.
- Aeschlimann M, Bauer M, Bayer D, Brixner T, de Abajo FJ, Pfeiffer W, et al. (2007). Adaptive Subwavelength Control of Nano-Optical Fields. *Nature* 446(7133): 301-304.

Dr. Denis Andrienko

MAX PLANCK INSTITUTE FOR POLYMER RESEARCH, MAINZ

MEMBER OF GSC SINCE 05/11

AREA OF RESEARCH

The current work of the group is focused on three topics: (i) enhanced sampling of soft matter systems or systematic coarse-graining, (ii) charge and energy transport in organic semiconductors, and (iii) rational compound design. The research is material science oriented and, in a number of cases, also involves industrial partners working on the design of light-emitting diodes and solar cells. All developed methods are implemented in one package, namely the Versatile Object-oriented Toolkit for Coarse-graining and Charge Transport Applications (VOTCA). The package is written in C++ with a python/bash flow control and is available for free under the Apache license at www.votca.org.

SELECTED PUBLICATIONS

- Ruehle V, Lukyanov A, May F, Schrader M, Vehoff T, Kirkpatrick J, Baumeier B, Andrienko D (2011). Microscopic simulations of charge transport in disordered organic semiconductors. *J. Chem. Theory Comput.*,7, 3335.
- Feng X, Marcon V, Pisula W, Hansen MR, Kirkpatrick J, Grozema F, Andrienko D, Kremer K, Müllen K (2009). Towards high charge-carrier mobilities by rational design of the shape and periphery of discotics. *Nature Materials*, 8, 421.
- Ruehle V, Junghans C, Lukyanov A, Kremer K, Andrienko D (2009). Versatile Object-oriented Toolkit for Coarse-graining Applications. *J. Chem. Theory Comput.*, 5, 3211.

Prof. Thomas Basché

**INSTITUTE OF PHYSICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ**

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

Fluorescence microscopy and scanning force microscopy are employed to study single molecules and nanoparticles. We are interested in the photophysics and photochemistry of the individual particles as well as energy and charge transport in their assemblies. The simultaneous use of both microscopies allows us to correlate structure and photophysics of individual molecules or to study the impact of localized stress on their optical properties. In another line of research, semiconductor and gold nanocrystals are assembled into supramolecular aggregates to achieve novel optical properties.

SELECTED PUBLICATIONS

- Stottinger S, Hinze G, Diezemann G, Oesterling I, Mullen K, Basche T (2014). Impact of Local Compressive Stress on the Optical Transitions of Single Organic Dye Molecules. *Nature Nanotechnology* 9 182.
- Xu X, Stottinger S, Battagliarin G, Hinze G, Mugnaioli E, Mullen K, Basche T (2011). Assembly and Separation of Semiconductor Quantum Dot Dimers and Trimers. *J. Am. Chem. Soc.* 133 18062.
- Fuckel B, Hinze G, Nolde F, Mullen K, Basche T (2009). Control of the Electronic Energy Transfer Pathway between Two Single Fluorophores by Dual Pulse Excitation. *Phys. Rev. Lett.* 103 103003.

Prof. Paul Blom

**MAX PLANCK INSTITUTE FOR POLYMER
RESEARCH, MAINZ**

MEMBER OF GSC SINCE 11/12

AREA OF RESEARCH

The research focuses on the mechanism of charge transport and recombination in organic semiconductors. Important aspects are the effects of molecular structure, charge carrier density, and impurities in organic devices. Recently, by incorporating the role of impurities in the recombination, the operation of organic light-emitting diodes and organic photovoltaic devices has been described consistently. In 2005, the first organic memory device based on polymeric ferroelectrics was developed, followed in 2008 by a new type of two-terminal memory device and electronic switch. By using self-assembly, molecular diodes were constructed whose active part consists of only one monolayer of functional molecules. We recently realized transistors and complete integrated circuits using a self-assembled monolayer of molecules as the active layer. This result is now considered as the first true demonstration of 'bottom-up electronics'. Future research will focus on directed self-assembly of organic components.

SELECTED PUBLICATIONS

- Kuik M, Wetzelaer GAH, Nicolai HT, Craciun NI, de Leeuw DM, Blom PWM (2014). 25th Anniversary Article: Charge Transport and Recombination in Polymer Light-Emitting Diodes. *Adv. Mater.* 26: 512–531.
- de Bruyn P, van Rest AHP, Wetzelaer GAH, de Leeuw DM, Blom PWM (2013). Diffusion-Limited Current in Organic Metal-Insulator-Metal Diodes. *Phys. Rev. Lett.* 111: 186801.
- Nicolai HT, Kuik M, Wetzelaer GAH, de Boer B, Campbell C, Risko C, Bredas JL, Blom PWM (2012). Unification of Trap-limited Electron Transport in Semiconducting Polymers. *Nat. Mater.* 11: 882-887.

Prof. Mischa Bonn

MAX PLANCK INSTITUTE FOR POLYMER RESEARCH, MAINZ

MEMBER OF GSC SINCE 11/12

AREA OF RESEARCH

We exploit the intrinsic motion of molecules, in particular their vibrations, to learn about the natural world. To that end, we use a combination of cutting edge spectroscopies and microscopies to probe questions regarding physico-chemical coupling in systems relevant to biology and materials science. The main topics of research are:

- Surface spectroscopy of interfacial molecular dynamics: We use surface-specific vibrational spectroscopy with ultra-high time resolution to elucidate the mechanism and timescales of molecular motion and energy transfer at surface and interfaces, in particular of water.
- Label-free vibrational spectroscopy and microscopy of soft matter and biomolecular systems and water in such systems, including model systems for biological membranes. Using Coherent Anti-Stokes Raman Scattering (CARS) spectro-microscopy, we can quantify local molecular concentrations in complex samples, including live cells and microfluidic devices.
- In a third effort, we study carrier dynamics in organic semiconducting systems, including graphene (nanostructures), nanocrystalline semiconductors, and other photovoltaic building blocks and systems, using Terahertz time-domain spectroscopy.

SELECTED PUBLICATIONS

- Lis D, Backus EHG, Hunger J, Parekh SH, Bonn M (2014). Liquid flow along a solid surface reversibly alters interfacial chemistry. *Science* 344(6188):1138-42.
- Narita A, Feng XL, Hernandez Y, Jensen SA, Bonn M, Yang HF, et al. (2014). Synthesis of structurally well-defined and liquid-phase-processable graphene nanoribbons. *Nature Chemistry. 2014*;6(2):126-32.
- Piatkowski L, Zhang Z, Backus EHG, Bakker HJ, Bonn M (2014). Extreme surface propensity of halide ions in water, *Nature Communications* 5, 4083-87.

Prof. Hans-Jürgen Butt

MAX PLANCK INSTITUTE FOR POLYMER RESEARCH, MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

We study the structure and the properties of interfaces and the interaction between them. Our aim is to better understand the relationship between structural changes, dynamics, and the driving forces. Major topics are interfacial forces, super liquid-repellent surfaces, and the dynamics of wetting. The methods we use include scanning probe techniques, confocal microscopy, focused ion beam, microrheology, light and X-ray scattering. To expand the range of accessible length and time scales, new methods are continuously being developed. Our goal is to solve fundamental questions, with the perspective for future applications.

SELECTED PUBLICATIONS

- Butt HJ, Semprebon C, Papadopoulos P, Vollmer V, Brinkmann M, Ciccotti M. (2013). Design principles for superamphiphobic surfaces. *Soft Matter* 9: 418-428.
- Deng X, Mammen L, Butt HJ, Vollmer D (2012). Candle soot as a template for a transparent robust superamphiphobic coating. *Science* 335: 67-70.
- Sokuler M, Auernhammer GK, Roth M, Liu CJ, Bonaccurso E, Butt HJ (2010). The Softer the Better: Fast Condensation on Soft Surfaces. *Langmuir* 26(3): 1544-1547.

Prof. Hans-Joachim Elmers

**INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ**

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

Our research focuses on ferromagnetic epitaxial films and nanostructures, as well as new materials with high spin polarization and dynamic magnetic properties. Using spin-polarized low-temperature scanning tunneling spectroscopy, magnetization structures and their interaction with electronic states are investigated with atomic resolution. The width of magnetic domain walls in two-dimensional ferromagnets consisting of a single atomic layer shrinks below one nanometer, thus pushing the physical limits of magnetic storage density to the atomic scale. Recent activities include spatially resolved spin transport through molecules deposited on ferromagnetic surfaces. As a recent highlight, we determined the spin-resolved density-of-states function in Heusler alloys from polarization-dependent X-ray absorption. Experimental progress has been achieved with a method allowing an X-ray absorption measurement on epitaxial films in transmission. A newly detected circular dichroism effect in threshold two-photon photoemission using femtosecond laser pulses enables future investigations of magnetization dynamics on a femtosecond time scale.

SELECTED PUBLICATIONS

- Bayer D, Diehl S, Baumgarten M, Muellen K, Methfessel T, Elmers HJ (2014). Tuning the hole injection barrier in the intermolecular charge-transfer compound DTBDT-F(4)TCNQ at metal interfaces. *Phys. Rev.* B 89 075435.
- Jourdan M, Minar J, Braun J, Kronenberg A, Chadov S, Balke B, Gloskovskii A, Kolbe M, Elmers HJ, Schönhense G, Ebert H, Felser C, Kläui M (2014). Direct observation of half-metallicity in the Heusler compound Co_2MnSi. *Nature Communications* 5 3974.
- Klanke J, Rentschler E, Medjanik K, Kutnyakhov D, Schönhense G, Krasnikov S, Shvets IV, Schuppler S, Nagel P, Merz M, Elmers HJ (2013). Beyond the Heisenberg Model: Anisotropic Exchange Interaction between a Cu-Tetraazaporphyrin Monolayer and Fe_3O_4(100). *Phys. Rev. Lett.* 110 137202.

Prof. Michael Fleischhauer

**DEPARTMENT OF PHYSICS,
UNIVERSITY OF KAISERSLAUTERN**

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The main research field is theoretical quantum optics and physics of ultra-cold quantum gases with applications to many-body physics and quantum information. In particular, we study the interaction of quantized light with coherently prepared media, quantum information processing with photons and atomic ensembles, as well as coherence and interference effects in optical meta-materials. We also focus on ground-state and non-equilibrium properties of strongly interacting ultra-cold quantum gases in reduced dimensions and topological systems.

SELECTED PUBLICATIONS

- Grusdt F, Hoening M, Fleischhauer M (2013). Topological edge states in the one-dimensional superlattice Bose-Hubbard model. *Phys. Rev. Lett.* 110, 260405.
- Otterbach J, Moos M, Muth D, Fleischhauer M (2013). Wigner crystallization of photons in cold Rydberg ensembles. *Phys. Rev. Lett.* 111 113001.
- Petrosyan D, Otterbach J, Fleischhauer M (2011). Electromagnetically induced transparency with Rydberg atoms. *Phys. Rev. Lett.* 107, 213601.

Prof. Holger Frey

DEPARTMENT OF CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

Synthetic Polymer Chemistry; design and synthesis of novel functional polymer materials; branched and dendritic polymers; block copolymers and nanostructures; novel surfactants and biomedical applications. Central research areas: polyether chemistry (PEG, PPO), polyesters, polycarbonates from CO_2, Si-based polymer structures (polycarbosilanes, silicones). Central objectives are the design of novel macromolecular architectures, investigation of their structure-property relationships, and their potential application in areas such as nanotechnology, surface modification, medicine and sensor technology; novel Li-ion conductors and hybrid structures with high ion mobility.

SELECTED PUBLICATIONS

- Thomas A, Müller SS, Frey H (2014). Beyond Poly(ethylene glycol): Linear Polyglycerol as a Multifunctional Polyether for Biomedical and Pharmaceutical Applications. *Biomacromolecules*, 15, 1935-1954.
- Geschwind J, Frey H (2013). Poly(1,2-glycerol carbonate): A Fundamental Polymer Structure Synthesized from CO_2 and Glycidyl ethers. *Macromolecules*, 46, 3280–3287.
- Tonhauser C, Golriz AA, Moers C, Klein R, Butt HJ, Frey H (2012). Stimuli-Responsive Y-Shaped Polymer Brushes Based on Junction-Point Reactive Block Copolymers. *Adv. Mater*, 24, 5559-5563.

Prof. Jürgen Gauss

INSTITUTE OF PHYSICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The research comprises the development and application of quantum-chemical methods for the investigation of the electronic structure of atoms and molecules. The emphasis is on high-accuracy calculations with the inclusion of electron-correlation effects (via many-body methods such as perturbation or coupled-cluster theory), on the treatment of relativistic effects in quantum-chemical calculations, as well as on the efficient calculation of molecular properties (molecular geometries, NMR parameters, excitation energies, etc.) using analytic-derivative and response-theory techniques. The application of quantum-chemical methods to chemical problems involves issues from all areas of chemistry, ranging from the highly accurate prediction of rotational spectra through to the determination of the structure of supramolecular systems via NMR chemical-shift calculations.

SELECTED PUBLICATIONS

- Köhn A, Hanauer M, Mück LA, Jagau TC, Gauss J (2013). State-specific multireference coupled-cluster theory. *WIREs Comput. Mol. Sci.* 3: 273-367.
- Mück LA, Lattanzi V, Thorwirth S, McCarthy MC, Gauss J (2012). Cyclic SiS_2 – a new perspective on the Walsh rule. *Angew. Chem. Int. Ed.* 51: 3695-3968.
- Janke M, Rudzevich Y, Molokanova O, Metzroth T, Mey I, Diezemann G, Marszalek PE, Gauss J, Böhmer V, Janshoff A (2009). Mechanically interlocked calix[4]arene dimers display reversible bond breakage under force. *Nat. Nanotechnol.* 4: 225-229.

Prof. Katja Heinze

INSTITUTE OF INORGANIC CHEMISTRY
AND ANALYTICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 05/11

AREA OF RESEARCH

All our key research areas rely on a "design – synthesis – evaluation" concept with the aim of establishing structure (geometric/electronic) – properties/activities relationships on an atomic scale.
Specifically, our group is heavily engaged in six key research areas:

- biomimetic chemistry with a specific focus on functional mimics of enzymes containing molybdenum,
- photosynthesis research, especially experimental modeling of light harvesting and charge separation processes,
- fundamentals of electron transfer reactions, namely, photoinduced electron transfer, electron transfer coupled to proton transfer, and electron transfer coupled to atom transfer reactions,
- homogeneous catalysis with transition metal complexes with emphasis on multi redox reactions and atom transfer reactions,
- transition metal complex chromophores for dye-sensitized solar cells (DSSCs) and light-emitting electrochemical cells (LECs), and
- transition metal complexes in sensor applications (optical sensing).

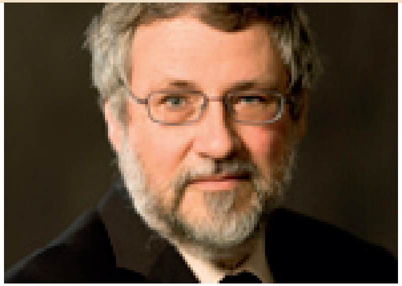
SELECTED PUBLICATIONS

- Breivogel A, Kreitner C, Heinze K (2014). Redox and Photochemistry of Bis(terpyridine)ruthenium(II) Amino Acids and their Amide Conjugates – from Understanding to Applications. *Eur. J. Inorg. Chem*. accepted (DOI: 10.1002/ejic.201402466). [invited review article]
- Hüttinger K, Förster C, Heinze K (2014). Intramolecular electron transfer between molybdenum and iron mimicking bacterial sulphite dehydrogenase. *Chem. Commun.* 50, 4285-4288. [highlighted as cover]
- Siebler D, Linseis M, Gasi T, Carrella LM, Winter RF, Förster C, Heinze K (2011). Oligonuclear Ferrocene Amides: Mixed-valent Peptides and Potential Redox-switchable Foldamers. *Chem. Eur. J.* 17, 4540-4551.

Prof. Burkard Hillebrands

DEPARTMENT OF PHYSICS,
UNIVERSITY OF KAISERSLAUTERN

MEMBER OF GSC SINCE 11/07



AREA OF RESEARCH

The "Magnetism" research group of Prof. Burkard Hillebrands is active in the field of spin dynamics and spintronics, focusing on high frequency phenomena such as spin waves and their quanta, the magnons, and ultrafast magnetic switching processes. The main experimental techniques used are Brillouin light scattering (BLS) spectroscopy and microscopy, as well as magneto-optic Kerr effect (MOKE) techniques. The research field currently comprises magnon-based spintronic phenomena, magnon gases, magnonic spin-caloric transport phenomena, and novel spintronic materials.

SELECTED PUBLICATIONS

- Serga AA, Tiberkevich VS, Sandweg CW, Vasyuchka VI, Bozhko DA, Chumak AV, Neumann T, Obry B, Melkov GA, Slavin AN, Hillebrands B (2014). Bose–Einstein condensation in an ultra-hot gas of pumped magnons. *Nat. Commun.* 5, 3452.
- Agrawal M, Vasyuchka VI, Serga AA, Karenowska AD, Melkov GA, Hillebrands B (2013). Direct measurement of magnon temperature: New insight into magnon-phonon coupling in magnetic insulators. *Phys. Rev. Lett.* 111, 107204.
- An T, Vasyuchka VI, Uchida K, Chumak AV, Yamaguchi K, Harii K, Ohe J, Jungfleisch MB, Kajiwara Y, Adachi H, Hillebrands B, Maekawa S, Saitoh E (2013). Unidirectional spin-wave heat conveyer. *Nature Materials* 12, 549.

Prof. Gerhard Jakob

INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The overarching theme of my research is transport properties of thin films and heterostructures of new functional materials. The physical phenomena investigated are magnetotransport effects, thermal transport, superconductivity, and transport in 2d-electron systems. We prepare new complex materials and heterostructures as thin film multilayers. In such systems, the interface between two diverse materials enables properties and functionalities not necessarily present in either of the starting materials. Our aim is to understand the underlying mechanisms and the application of the effects. State-of-the-art sputter deposition or laser ablation is used for deposition of the metallic and oxidic systems, respectively. Current research topics are: the improvement of the thermoelectric figure of merit, using nanostructured Half-Heusler materials; spintronic applications of fully spin polarized Heusler compounds; conductivity of the 2-dimensional electron gas at the interface of the two insulating materials $LaAlO_3$ and $SrTiO_3$; controlling magnetic properties with an electric field using multiferroic materials in thin film heterostructures.

SELECTED PUBLICATIONS

- Mix Ch, Finizio S, Kläui M, Jakob G (2014). Conductance Control at the LaAlO3/SrTiO3-Interface by a Multiferroic BiFeO3 Ad-layer. *Appl. Phys. Lett.* 104(26): 262903(4).
- Jakob G, Eichhorn T, Kallmayer M, Elmers HJ (2007). Correlation of Magnetism and Martensitic Transition in Epitaxial Ni2MnGa Films. *Phys. Rev.* 76(17): 174407(6).
- Gacic M, Jakob G, Herbort Ch, Adrian H, Tietze T, Brück S, Goering E (2007). Magnetism of Co-doped ZnO Thin Films. *Phys. Rev.* 75(20): 205206(8).

Prof. Mathias Kläui

INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 05/11

AREA OF RESEARCH

The Kläui group focuses on the static and dynamic properties of geometrically confined spin structures, magnetoresistance effects and spin transfer torque as well as spin current-induced magnetization dynamics. In addition to metallic materials, advanced oxidic multiferroics and novel materials, such as graphene are investigated. The electronic and magnetic properties change radically when going from bulk materials to nanostructures with reduced dimensions. Rather than being dominated only by materials features, the shape starts to play a key role and allows one to geometrically engineer the properties. Fundamentally, novel physical effects emerge as lateral structure dimensions become comparable to or smaller than characteristic length scales. On the temporal scale, we investigate spin dynamics excited by magnetic fields, spin - polarized currents and photons. In particular the latter allows us to go beyond the classical magnetization dynamics and study the interplay between the energy and angular momentum transfer between the electron and the spin system as well as the lattice on a femtosecond timescale. We have a wide range of equipment at our disposal including advanced deposition tool, a full nanofabrication suite and magnetic characterization tools ranging from conventional magnetometry to one of the few Scanning Electron Microscopes with Polarization Analysis (SEMPA).

SELECTED PUBLICATIONS

- Geilhufe J, Kläui M et al. (2014). Monolithic focused reference beam X-ray holography. *Nature Comm.* 5, 3008.
- Kim J-S, Kläui M et al. (2014). Synchronous precessional motion of multiple domain walls in a ferromagnetic nanowire by perpendicular field pulses. *Nature Comm.* 5, 3429.
- Bisig A, Kläui M et al. (2013). Correlation between spin structure oscillations and domain wall velocities. *Nature Comm*. 4, 2328.

Prof. Kurt Kremer

MAX PLANCK INSTITUTE
FOR POLYMER RESEARCH, MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The work of Kurt Kremer focuses on numerical investigations of polymer systems and soft matter in general, based on strong method development efforts. These include multiscale simulation techniques as well as novel adaptive resolution procedures. Systems covered range from highly idealized polymer models, which are used to investigate basic conformational and rheological properties, to highly specialized models for macromolecular organic electronics or biological problems.

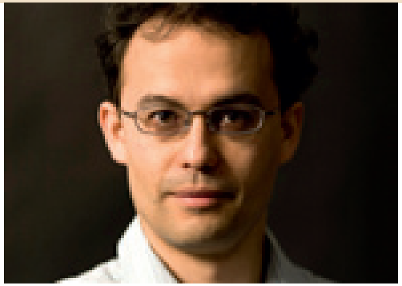
SELECTED PUBLICATIONS

- Mukherji D, Kremer K (2013). Coil-Globule-Coil Transition of PNIPAm in Aqueous Methanol: Coupling All-Atom Simulations to Semi-Grand Canonical Coarse-Grained Reservoir. *Macrom*. 46(22): 9158-9163.
- Mukherje B, Peter C, Kremer K (2013). Dual translocation pathways in smectic liquid crystals facilitated by molecular flexibility. *Phys. Rev. E* 88(1): 010502.
- Potestio R, Espanol P, Delgado-Buscalioni R, Everaers R, Kremer K, Donadio D (2013): Monte Carlo Adaptive Resolution Simulation of Multicomponent Molecular Liquids. *Phys. Rev. Lett.* 111(6): 060601.

Prof. Thomas D. Kühne

INSITUTE OF PHYSICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/10



AREA OF RESEARCH

Due to the fact that many interesting chemical and physical processes are intrinsically associated with large length and time scales, a statistical mechanical treatment, together with quantum mechanical methods, is required. Hence, our research is focused on developing and applying novel Molecular Dynamics methods, together with numerical electronic structure calculations that can be solved by modern high-performance computers. In terms of application, our scope is on the structure and dynamics of complex systems in condensed phases. Specific examples are hydrogen bond networks in aqueous solutions, biophysical reactions on water surfaces and in confined geometries, but also solid/liquid interfaces and amorphous glasses.

SELECTED PUBLICATIONS

- Kühne TD, Khaliullin RZ (2013). Electrostatic signature oft the instantaneous asymmetry in the first coordination shell in liquid water. *Nature Commun*. 9:1450.
- Los J, Kühne TD (2013). Inverse simulated annealing for the determination of amorphous structures. *Phys. Rev. B* 87:214202.
- Khaliullin RZ, Eshet H, Kühne TD, Behler J, Parrinello M (2011). Nucleation mechanism for direct graphite-to-diamond phase transition. *Nature Mater*. 10:693.

Prof. Angelika Kühnle

**INSTITUTE OF PHYSICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ**

MEMBER OF GSC SINCE 10/09

AREA OF RESEARCH

Molecular self-assembly represents a very promising strategy for the fabrication of tailor-made functional structures, e.g., for future molecular electronic devices. Consequently, molecular self-assembly has been studied extensively on metallic surfaces, yielding deep insights into the mechanisms governing molecular self-assembly. For many applications, however, these studies need to be extended to insulating substrates, e.g., in order to reduce electronic coupling to the substrate surface. Other areas of interest include biomineralization, incrustation inhibition, and on-surface synthesis.
Our research is dedicated to understanding molecular binding and structure formation on dielectric surfaces, both under the precise control of ultra-high vacuum as well as in biologically relevant environments such as aqueous solutions.
We cooperate with organic chemists to explore the structural variety of tailor-made organic molecules providing dedicated functionalities. For detailed data interpretation, we work in close cooperation with theoreticians, revealing insights into molecule-surface interactions and contrast formation in atomic force microscopy. Besides projects dedicated to a fundamental understanding of molecular structure formation, we also work on application-oriented projects in cooperation with industrial partners.

SELECTED PUBLICATIONS

- Lindner R, Rahe P, Kittelmann M, Gourdon A, Bechstein R, Kühnle A (2014). Substrate Templating Guides the Photo-Induced Reaction of C60 on Calcite, *Angew. Chem. Int. Ed.* 53 doi: 10.1002/anie.201309128.
- Rahe P, Kittelmann M, Neff J, Nimmrich M, Maass P, Reichling M, Kühnle A (2013). Tuning molecular self-assembly on bulk insulator surfaces by anchoring of the organic building blocks, *Adv. Mat.* 25 3948.
- Hauke CM, Bechstein R, Kittelmann M, Storz C, Kilbinger AFM, Rahe P, Kühnle A (2013). Controlling Molecular Self-Assembly on an Insulating Surface by Rationally Designing an Efficient Anchor Functionality that Maintains Structural Flexibility, *ACS Nano* 5491.

Prof. Katharina Landfester

**MAX PLANCK INSTITUTE
FOR POLYMER RESEARCH, MAINZ**

MEMBER OF GSC SINCE 05/09

AREA OF RESEARCH

Polymeric nanoparticles offer the versatility to cover a wide range of mesoscopic properties for sophisticated applications. However, making smart nanoparticles is inevitably linked to a deep understanding of the overall physico-chemical principles of their formation. By means of the miniemulsion process, we can design custom-made nanoparticles and nanocapsules for almost any purpose. This is facilitated by the enormous versatility of the miniemulsion process. Moreover, the accumulation of knowledge about the formation process has led to successful and precise control of important nanoparticle parameters such as size, shape, morphology, degradation, release kinetics, and surface functionalization. This degree of control is unique and allows us to tune specific properties tailored to particular applications; the successful up-scaling of process is of technical relevance. Furthermore, the encapsulation and release of a great variety of payloads, ranging from hydrophobic to hydrophilic substances, has been successfully achieved in a highly controlled manner and with an unmatched high encapsulation efficiency. The continuous progress in understanding the detailed properties of nanosized objects and their interactions with living tissue or with electromagnetic radiation opens new opportunities.

SELECTED PUBLICATIONS

- Bannwarth MB, Kazer SW, Ulrich S, Glasser G, Crespy D, Landfester K (2013). Well-defined Nanofibers with Tunable Morphology from Spherical Colloidal Building Blocks. *Angew. Chem. Int. Ed.* 52: 10107-10111.
- Jaskiewicz K, Larsen A, Lieberwirth I, Koynov K, Meier W, Fytas G, Kröger A, Landfester K (2012). Probing Bioinspired Transport of Nanoparticles into Polymersomes. *Angew. Chem. Int. Ed.* 51: 4613-4617.
- Staff RH, Gallei M, Mazurowski M, Rehahn M, Berger R, Landfester K, Crespy D (2012). Patchy Nanocapsules of Poly(vinylferrocene)-Based Block Copolymers for Redox-Responsive Release. *ACS Nano* 6: 9042-9049.

Prof. Klaus Müllen

MAX PLANCK INSTITUTE
FOR POLYMER RESEARCH, MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The Müllen group focuses on the development of synthetic concepts for low molecular compounds and polymers applicable in electronics, biomedical transport, modern energy technologies, and in material sciences. In particular, a polymer synthesis driven approach toward graphenes using twisted dendritic polyphenylenes as precursors has been developed to obtain monodisperse nanographenes that can be used as perfect materials for modern polymer electronics e.g. in field effect transitors, for energy storage in batteries, or as electrode materials.

SELECTED PUBLICATIONS

- Wu ZS, Parvez K, Feng XL, Müllen K (2013). Graphene-based in-plane micro-supercapacitors with high power and energy densities. *Nature Communications* doi:10.1038/ncomms3487.
- Henson ZB, Müllen K, Bazan GC (2012). Design strategies for organic semiconductors beyond the molecular formula. *Nature Chemistry* 4(9): 699-704.
- Cai JM, Ruffieux P, Jaafar R, Bieri M, Braun T, Blankenburg S, Muoth M, Seitsonen AP, Saleh M, Feng XL, Müllen K, Fasel R (2010). Atomically precise bottom-up fabrication of graphene nanoribbons. *Nature* 466(7305): 470-473.

Prof. Herwig Ott

DEPARTMENT OF PHYSICS,
UNIVERSITY OF KAISERSLAUTERN

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

Ultracold quantum gases are an ideal instrument to study many-body physics under controlled and clean experimental conditions. The research group of Herwig Ott is specialized on high resolution imaging and manipulation of ultracold quantum gases with help of scanning electron microscopy. With this technique, the local static and dynamic properties of ultracold quantum gases can be investigated. The research topics that are studied within the group include low-dimensional quantum gases, static and dynamic correlation functions, tunnelling dynamics in optical lattices, non-equilibrium dynamics, open quantum systems, the implementation of long-range interactions via Rydberg states, the simulation of quantum spin systems, dissipative processes in ultracold quantum gases, as well as technical applications such as high brightness ultracold ion sources.

SELECTED PUBLICATIONS

- Barontini G, Labouvie R, Stubenrauch F, Vogler A, Guarrera V, Ott H (2013). Controlling the Dynamics of an Open Many-Body Quantum System with Localized Dissipation. *Phys. Rev. Lett.* 110:035302.
- Guarrera V, Würtz P, Ewerbeck A, Vogler A, Barontini G, Ott H (2011). Observation of local temporal correlations in trapped quantum gases. *Phys. Rev. Lett.* 107:160403.
- Gericke T, Würtz P, Reitz D, Langen T, Ott H (2008). High-resolution scanning electron microscopy of an ultracold quantum gas. *Nat. Phys.* 4(12): 949-953.

Prof. Thomas Palberg

INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The group focuses on experimental soft matter physics, in particular, strongly interacting colloidal systems investigated by optical microscopy and light scattering. Non-equilibrium properties of colloidal fluids, crystal glasses and clusters (phase behavior, elasticity, diffusion, conductivity), as well as phase transition kinetics have been studied extensively, in close collaboration with theory and simulation. Recent studies focused on behavior in confinement, under shear or other external fields. Exciting new topics are active suspensions, micro-swimmers, and liquid-solid interfaces under stress.

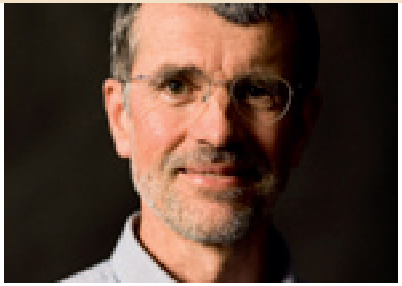
SELECTED PUBLICATIONS

- Reinmüller T, Schöpe HJ, Palberg T (2013). Self-Organized Cooperative Swimming at Low Reynolds Numbers. *Langmuir* 29, 1738-1742.
- Palberg T, Köller T, Sieber B, Schweinfurth H, Reiber H, Nägele G (2012). Electro-kinetics of Charged-Sphere Suspensions Explored by Integral Low-Angle Super-Heterodyne Laser Doppler Velocimetry. *J. Phys.: Condens. Matter* 24, 464109 (19pp).
- Kozina A, Diaz-Leyva P, Bartsch E, Palberg T (2012). Polymer-Enforced Crystallization of a Eutectic Binary Hard Sphere Mixture. *Soft Matter* 8, 627-630.

Prof. Harald Paulsen

INSTITUTE OF GENERAL BOTANY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07



AREA OF RESEARCH

We use recombinant plant proteins for tailor-made biological-chemical hybrid constructs with potentially useful functions. Our main object is the major light-harvesting chlorophyll protein of the photo-synthetic apparatus, a spontaneously folding and assembling pigment-protein complex. The mechanism of its self-organization is unraveled by spectroscopic means, and the complex is decorated with organic dyes and/or bound to semiconductor nanocrystals or other solid surfaces for potential photovoltaic or biosensor functions. Another approach uses recombinant derivatives of silica-biomineralizing protein from diatoms, aiming to use these to control low-pressure, low-temperature silica formation on various surfaces. Finally, we work with a water-soluble chlorophyll-binding protein, another spontaneously assembling pigment-protein complex that is attractive because of its unusual thermal and biochemical stability. Our expertise includes the generation, mutagenesis, and modification of recombinant proteins, including membrane proteins in artificial liposomes. Structures are analyzed by biochemical and spectroscopic techniques as well as EM, EPR, NMR, AFM, and MS.

SELECTED PUBLICATIONS

- Werwie M, Fehr N, Xu X, Basché T, Paulsen H (2014). Comparison of quantum dot-binding protein tags: affinity determination by ultracentrifugation and FRET. *Biochim. Biophys. Acta - Gen. Subjects* 1840, 1651-1656.
- Schüler T, Renkel J, Hobe S, Susewind M, Jacob DE, Panthöfer M, Hoffmann-Röder A, Paulsen H, Tremel W (2014). Designed peptides for biomineral polymorph recognition: a case study for calcium carbonate. *J. Mater. Chem. B* 2, 3511-3518.
- Dockter C, Müller AH, Dietz C, Volkov A, Polyhach Y, Jeschke G, Paulsen H (2012). Rigid core and flexible terminus: structure of solubilized light-harvesting chlorophyll a/b complex (LHCII) measured by EPR. *J. Biol. Chem.* 287(4), 2915-2925.

Prof. Eva Rentschler

INSTITUTE OF INORGANIC AND
ANALYTICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

Molecular magnetism is one of the most challenging research areas in the development of new technologies in electronics. We synthesize molecular clusters and extended low dimensional systems of exchange-coupled transition metal ions. In particular, clusters with isolated spin ground states and molecular size big enough to make addressing possible are essential objectives. The characteristic arrangement of spin carriers in metallacrowns provides a rational approach towards new Single Molecule Magnets (SMMs) with a high spin ground state and a large effective anisotropy barrier to magnetization reversal. Low nuclearity, as well the as the expected isolated ground state, distinguishes these heterometallic metallacrowns for the investigation of the quantum mechanical principles of Single-Molecule Magnetism and hold the prospect of achieving addressing via a purposeful linking. The understanding of the interaction of the molecular magnetic moments with a ferromagnetic surface is crucial for aiming at spintronic devices comprising molecular components. Thus, in addition to high level magnetic susceptibility measurements, XPS and XMCD investigations are performed. STM investigations of our physisorbed or covalently linked high spin molecules on surfaces provide necessary information on the distribution and orientation of deposited SMMs.

SELECTED PUBLICATIONS

- Klanke J, Rentschler E, Medjanik K, Kutnyakhov D, Schoenhense G, Krasnikov S, Shvets IV, Schuppler S, Nagel P, Merz M, Elmers HJ (2013). Beyond the Heisenberg Model: Anisotropic Exchange Interaction between a Cu-Tetraazaporphyrin Monolayer and Fe3O4(100), *Phys. Rev. Lett.* 110(13): 137202.
- Funes A, Carrella L, Alborés P, Rentschler E (2013). $\{Co^{III}_2Dy^{III}_2\}$ single molecule magnet with two resolved thermal activated magnetization relaxation pathways at zero field, *Dalton Trans.*, 43(6): 2361-2364.
- Alborés P, Plenk C, Rentschler E (2012).Tailoring the exchange interaction in covalently linked basic carboxylate clusters through bridging ligand selection, *Inorg. Chem.*, 51 (15): 8373–8384.

Prof. Friederike Schmid

INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 02/10

AREA OF RESEARCH

The research of the Condensed Matter Theory group is devoted to the statistical thermodynamics of solids and liquids, with a special focus on soft condensed matter and complex fluids (membranes, polymers, colloids), and on biologically motivated problems. Since our research relies heavily on computer simulations, much effort is also spent on the development of new efficient simulation techniques. Among other things, we are currently interested in transport and electrohydrodynamic phenomena in electrolyte solutions (electrophoresis and dielectrophoresis), in self-organizing macromolecular systems, and in membrane phase transitions. We perform our simulations on local clusters (including GPUs) and on parallel supercomputers.

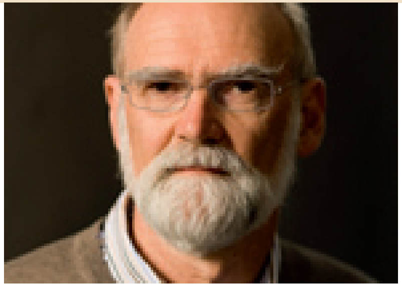
SELECTED PUBLICATIONS

- Meinhardt S, Vink RLC, Schmid F (2013). Monolayer curvature stabilizes nanoscale raft domains in mixed lipid bilayers. *PNAS* 110, 4476.
- Schmid F (2013). Self-consistent field approach for crosslinked copolymer materials. *Phys. Rev. Lett.* 111, 028303.
- He XH, Schmid F (2008). Spontaneous formation of complex micelles from a homogeneous solution. *Phys. Rev. Lett.* 100 137802.

Prof. Manfred Schmidt

INSTITUTE OF PHYSICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07



AREA OF RESEARCH

Synthesis of perfectly defined polymers with chemical recognition sites for directed self-assembly, biological synthetic hybride polymers for biomedical applications, polyelectrolytes and polyelectrolyte complexes, including DNA and RNA, and polymer characterization, in particular, light scattering techniques including stopped flow light scattering for monitorization of aggregation processes.

SELECTED PUBLICATIONS

- Sahl M, Muth S, Branscheid R, Fischer K, Schmidt M (2012). Helix–Coil Transition in Cylindrical Brush Polymers with Poly-l-lysine Side Chains. *Macromolecules*, 45(12), 5167–5175.
- Cong Y, Gunari N, Zhang B, Janshoff A, Schmidt M (2009). Hierarchical Structure Formation of Cylindrical Brush Polymer-Surfactant Complexes. *Langmuir* 25(11), 6392-6397.
- Kuehn F, Fischer K, Schmidt M (2009). Kinetics of Complex Formation between DNA and Cationically Charged Cylindrical Brush Polymers Observed by Stopped Flow Light Scattering. *Macromol. Rapid Commun.* 30(17), 1470-1476.

Prof. Gerhard Schönhense

INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

We work in the research areas of electron-spectroscopy (UPS, XPS) and -microscopy (PEEM). Special aspects are Synchrotron-radiation based techniques (XMCD-PEEM, NEXAFS, HAXPES), non-magnetic and magnetic dichroism effects in photoemission, and detection of electron spin-polarisation. Current research is focused on novel charge-transfer complexes, stardust samples, ferromagnetic films, and adsorbates. Imaging techniques with ultrahigh time resolution and plasmon-mediated optical near fields are studied using fs-laser PEEM. One recent issue is the transfer of angular momentum by circularly polarised near fields. Various technological developments concern the combination of microscopy and spectroscopy. The group developed extensions of the photoemission electron microscope (PEEM), in particular, time-of-flight techniques, time-resolved image detection, and momentum microscopy. Several types of spin-polarisation detectors (including a novel multichannel version) have been developed. We also study donor-acceptor combinations based on novel functionalised polycyclic aromatic hydrocarbons and charge-transfer salts using UPS, NEXAFS and HAXPES. Projects of current interest are the application of spin-resolved detection in HAXPES and spin-filtered momentum microscopy.

SELECTED PUBLICATIONS

- Schertz F, Schmelzeisen M, Mohammadi R, Kreiter M, Elmers HJ, Schönhense G (2012). Near Field of Strongly Coupled Plasmons: Uncovering Dark Modes. *Nano Lett.* 12, 1885.
- Medjanik K, Chercka D, Nagel P, Merz M, Schuppler S, Baumgarten M, Müllen K, Nepijko SA, Elmers HJ, Schönhense G, Jeschke HO, Valenti R (2012). Orbital-Resolved Partial Charge Transfer from the Methoxy Groups of Substituted Pyrenes in Complexes with Tetracyanoquonodimethane – a NEXAFS Study. *J. Am. Chem. Soc.* 134, 4694.
- Kolbe M, Lushchyk P, Petereit B, Elmers HJ, Schönhense G, Oelsner A, Tusche C, Kirschner J (2011). Highly Efficient Multichannel Spin-Polarization Detection. *Phys. Rev. Lett.* 107, 207601.

Prof. Jairo Sinova

INSTITUTE OF PHYSICS,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 01/14

AREA OF RESEARCH

As a condensed matter theory group, we are interested in physical phenomena of many body systems in which the behavior of the collective system is unique and quite different from the behavior of its individual components. Condensed matter physics is a vast field of physics that provides endless opportunities. Our group has focused over the past few years on the subfield of spintronics and mesoscopic electronic transport. These fields study the effects that the coupling of the spin and charge degrees of freedom of the electron has on bulk properties of materials, as well as transport and optical phenomena. Some of our main contributions to this field are related to spin Hall effects, diluted magnetic semiconductor physics, and current-induced magnetization dynamics. New avenues are always opening up with novel and unforeseen connections to other points of views and topics.

SELECTED PUBLICATIONS

- Kurebayashi H, Sinova J, Fang D, A. C. Irvine AC, Wunderlich J, Novak V, Campion RP, Gallagher BL, Vehstedt EK, Zarbo LP, Vyborny K, Ferguson AJ, Jungwirth T (2013). Observation of a Berry phase anti-damping spin-orbit torque. *Nature Nanotechnology* 9, 2.
- Tikhonov KS, Sinova J, Finkelstein AM (2013). Spectral non-uniform temperature, non-local heat transfer, and the spin Seebeck effect. *Nature Communications* 4, 2945.
- Sinova J, Culcer D, Niu Q, Sinitsyn NA, Jungwirth T, MacDonald AH (2004). Universal Intrinsic Spin-Hall Effect. *Phys. Rev. Lett.* 92, 126603.

Prof. Carsten Sönnichsen

INSTITUTE OF PHYSICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The Nanobiotechnology Group (AG Sönnichsen) at the Institute of Physical Chemistry at the University of Mainz studies the physical chemistry of nanoparticles, and their application in nanosciences, biochemistry, and medicine. Our focus is on the utilization of metal nanoparticles for the sensing of single biomolecules, the measurement of dynamic processes of medically relevant molecular targets in tissues and cells, and the development of nanoparticles for photocatalytic applications. While an important part of our work focusses on the application of nanoparticles, e.g. their appropriate functionalization for biosensing purposes, we are also very interested in the physical and chemical mechanisms of wet-chemical nanoparticle formation itself and the basic physical and chemical properties of the resulting particles. Besides optical microscopy, our workhorse characterization techniques are electron and dark-field microscopy. Beyond the synthetic level, our group has a complete array of methods and expertise at their hand to develop nanoparticles for biomedical applications, spanning from tissue culture experimentation to pre-clinical in-vivo testing.

SELECTED PUBLICATIONS

- Ament I, Prasad J, Henkel A, Schmachtel S, Sönnichsen C (2012). Single unlabeled protein detection on individual plasmonic nanoparticles. *Nano Lett.* Feb 8;12(2):1092-5.
- Jakab A, Rosman C, Khalavka Y, Becker J, Trügler A, Hohenester U, Sönnichsen C (2011). Highly sensitive plasmonic silver nanorods. *ACS Nano.* Sep 27;5(9):6880-5.

Prof. Wolfgang Tremel

INSTITUTE OF INORGANIC AND
ANALYTICAL CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ
MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The inorganic materials chemistry group is interested in the synthesis and in-depth structural and physical characterization and the design and potential applications of new materials with a variety of chemical, physical, or electronic properties. Areas of interest include electronic and magnetic materials, tribology and surface properties. A second and larger field of activity is the chemistry of organized matter and hybrid materials. Our interdisciplinary research combines elements of chemistry, physics, engineering, and biology for an understanding of self-assembly and self-organization in both equilibrium and non-equilibrium ensembles at various length-scales. We apply these ideas in practical applications ranging from micro- and nanotechnology through biology and biomedicine. In particular, we are interested in bio-inspired chemically-derived routes to complex inorganic materials. We are attempting in a bottom-up approach to integrate concepts and knowledge of how organisms fabricate bio-minerals such as bones, shells and teeth within a biomimetic approach to the synthesis of organized materials with structural hierarchy and morphological complexity across a range of length scales top-down and bottom up approaches converge in our biology-oriented work on the self-assembly of cell components responsible for metastasis.

SELECTED PUBLICATIONS

- Zeier WG, Pei Y, Ksenofontov V, Heinrich CP, Snyder GJ, Tremel W (2013). Phonon scattering through a high structural atomic disorder in the thermoelectric solid solution $Cu_2Zn_{1-x}Fe_xGeSe_4$. *J. Am. Chem. Soc.* 135 (2): 726-732.
- Natalio FN, Coralles T, Panthöfer M, Lieberwirth I, Schollmeyer D, Müller WEG, Kappl M, Butt HJ, Tremel W (2013). Flexible Minerals: Self-Assembled Calcite Spicules with Extreme Bending Strength. *Science* 339 (no. 6125): 1298-1302.
- Natalio FN, André R, Hartog AF, Stoll B, Jochum KP, Wever R, Tremel W (2012). V2O5 nanoparticles mimic vanadium haloperoxidases and thwart biofilm formation. *Nature Nanotechnol.* 7(8): 530-535.

Prof. Siegfried Waldvogel

INSTITUTE OF ORGANIC CHEMISTRY
JOHANNES GUTENBERG UNIVERSITY MAINZ
MEMBER OF GSC SINCE 11/12

AREA OF RESEARCH

Main areas of research are the development of novel electroorganic transformations (both anodic and cathodic), the development of new methodologies in the field of MoCl5-mediated oxidative coupling reactions and their application in natural product synthesis, the synthesis of novel and rigid C3-symmetric receptors and reaction templates, the supramolecular recognition of neutral molecules and their detection by colour formation, exploiting these binding events for tracing of explosives including the device and prototype development based on HFF-QMB technology, and the synthesis of materials for energy storage devices (including sulphur-based cathodes and ultra-stable electrolytes).

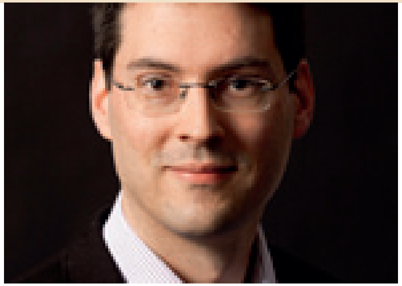
SELECTED PUBLICATIONS

- Brutschy M, Schneider MW, Mastalerz M, Waldvogel SR (2012). Porous Organic Cage Compounds as Highly Potent Affinity Materials for Sensing by Quartz Crystal Microbalances. *Adv. Mater.* 24: 6049-6052.
- Kulisch J, Nieger M, Stecker F, Fischer A, Waldvogel SR (2011). Efficient and Stereodiverse Electrochemical Synthesis of Optically Pure Menthylamines. *Angew. Chem. Int. Ed.* 50: 5564-5567.
- Barjau J, Schnakenburg G, Waldvogel SR (2011). Diversity-Oriented Synthesis of Polycyclic Scaffolds by Post-Modification of an Anodic Product Derived from 2,4-Dimethylphenol. *Angew. Chem. Int. Ed.* 50: 1415-1419.

Prof. Artur Widera

DEPARTMENT OF PHYSICS,
UNIVERSITY OF KAISERSLAUTERN

MEMBER OF GSC SINCE 11/10



AREA OF RESEARCH

The research focuses on single particle control in ultracold quantum gases, which are established model systems for various quantum many-body phenomena. In particular, we immerse single or few neutral atoms, as well-controlled impurities, into a Bose-Einstein condensate. The high level of control over all relevant degrees of freedom, including the interaction strength between impurity and quantum gas, allows us to experimentally tackle, e.g., solid state simulations of quasi-particles relevant for unconventional electron pairing in solids; dynamics of quantum information carriers coupled to a bath; or investigations of fundamental properties of correlated quantum many-body systems.

SELECTED PUBLICATIONS

- Spethmann N, Kindermann, John S, Weber C, Meschede D, Widera A (2012). Dynamics of Single Neutral Impurity Atoms Immersed in an Ultracold Gas. *Phys. Rev. Lett.* 109: 235301.
- Brakhane S, Alt W, Kampschulte T, Martinez-Dorantes M, Reimann R, Yoon S, Widera A, Meschede D (2012). Bayesian Feedback Control of a Two-Atom Spin-State in an Atom-Cavity System. *Phys. Rev. Lett.* 109: 173601.
- Steffen A, Alberti A, Alt W, Belmechri N, Hild S, Karski M, Widera A, Meschede D (2012). Digital atom interferometer with single particle control on a discretized space-time geometry. *Proceedings of the National Academy of Science*, 109(25): 9770-9774.

Prof. Rudolf Zentel

INSTITUTE OF ORGANIC CHEMISTRY,
JOHANNES GUTENBERG UNIVERSITY MAINZ

MEMBER OF GSC SINCE 11/07

AREA OF RESEARCH

The expertise of the group is synthetic polymer chemistry aiming at the design of new polymeric materials, which behave as actuators (LC-elastomers, which are semiconducting organic/ inorganic hybrid systems (application e.g. in OLEDs), or nanocarriers for biomedical applications). The molecular structure is thereby chosen as the basis for the material's properties. The research interests are located around 3 themes: 1. Liquid crystalline materials and mesophases in general; 2. Synthesis of self-organizing semiconducting polymeric materials; 3. Functionalized blockcopolymer structures that self assemble into micellar structures.

SELECTED PUBLICATIONS

- Nuhn L, Hirsch M, Krieg B, Koynov K, Fischer K, Schmidt M, Helm M, Zentel R (2013). Cationic Nanohydrogel Particles as Potential siRNA Carriers for Cellular Delivery. *ACS Nano* 6: 2198–2214.
- Fleischmann E-K, Liang H-L, Kapernaum N, Giesselmann F, Jan Lagerwall J, Zentel R (2012). One-piece micropumps from liquid crystalline core-shell particles. *Nature Communications* 3:1178, DOI: 10.1038/ncomms2193.
- Zorn M, Bae WK, Kwak J, Lee H, Lee C, Zentel R, et al. (2009). Quantum Dot - Block Copolymer Hybrids with Improved Properties and Their Application to Quantum Dot Light-Emitting Devices. *ACS Nano* 3(5): 1063-1068.

FORMER PRINCIPAL INVESTIGATORS

No.	Title, Last Name, First Name	Current Institution	Member of GSC until
1.	Prof., Bach, Volker	Institute for Analysis and Algebra, Braunschweig	09/10
2.	Prof., Banhart, Florian	IPCMS, University of Strasbourg	12/07
3.	Prof., Bloch, Immanuel	Max-Planck Institute for Quantum Optics, Munich	03/09
4.	Prof., Felser, Claudia	Max-Planck Institute for Chemical Physics of Solids, Dresden	04/14
5.	Prof., Janshoff, Andreas	Institute of Physical Chemistry, Göttingen	12/08
6.	Prof., Knoll, Wolfgang	Austrian Institute of Technology, Wien	07/08
7.	Dr., Sirker, Jesko	Department of Physics, Kaiserslautern; Department of Astronomy, University of Manitoba, Winnipeg	02/14

ASSOCIATED MEMBERS

No.	Title, Last Name, First Name	Institution	Member of GSC since
1.	Prof., Anglin, James R.	Department of Physics, Kaiserslautern	11/07
2.	Dr., Balke, Benjamin	Institute of Inorganic and Analytical Chemistry, JGU Mainz	10/11
3.	Dr., del Campo, Aránzazu	Max Planck Institute of Polymer Research, Mainz	10/09
4.	Prof., Eggert, Sebastian	Department of Physics, Kaiserslautern	11/07
5.	Dr., Jourdan, Martin	Institute of Physics, JGU Mainz	11/07
6.	Jun.-Prof., Mathias, Stefan	Department of Physics, Kaiserslautern	11/12
7.	Jun.-Prof., Orús, Román	Institute of Physics, JGU Mainz	05/13
8.	Jun.-Prof., Rizzi, Matteo	Institute of Physics, JGU Mainz	05/13
9.	Jun.-Prof., Schneider, Hans Christian	Department of Physics, Kaiserslautern	11/07
10.	Prof., Speck, Thomas	Institute of Physics, JGU Mainz	11/13
11.	Jun.-Prof., Sulpizi, Marialore	Institute of Physics, JGU Mainz	11/10
12.	Dr., Virnau, Peter	Institute of Physics, JGU Mainz	11/12
13.	Prof., Windpassinger, Patrick	Institute of Physics, JGU Mainz	02/14
14.	Prof., Wolf, Eva	Institute of General Botanics, JGU Mainz	06/14
15.	Dr., Wurm, Frederik R.	Max Planck Institute of Polymer Research, Mainz	11/12

FORMER ASSOCIATED MEMBERS

No.	Title, Last Name, First Name	Current Institution	Member of GSC until
1.	Dr., Baumgarten, Martin	Max Planck Institute of Polymer Research, Mainz	10/12
2.	Prof., Blaum, Klaus	Max Planck Institute for Nuclear Physics, Heidelberg	07/08
3.	Jun.-Prof., Blümer, Nils	Institute of Physics, JGU Mainz	10/12
4.	Prof., Decker, Heinz	Institute of Molecular Biophysics, JGU Mainz	06/14
5.	Prof., Deserno, Markus	Department of Physics, Kaiserslautern, Carnegie Mellon University	12/07
6.	Dr., Fecher, Gerhard	Max Planck Institute for Chemical Physics of Solids, Dresden	10/12
7.	Jun.-Prof., Hoffmann-Röder, Anja	Novel Glycoconjugates and functionalized Bio-molecules, Ludwig-Maximilians-University, Munich	05/09
8.	Prof., Hübner, Wolfgang	Department of Physics, TU Kaiserslautern	10/12
9.	Prof., Köhn, Andreas	Institute of Theoretical Chemistry, Stuttgart	03/14
10.	Prof., Kuhr, Stefan	Department of Physics, Kaiserslautern; University of Strathclyde, Glasgow	08/09
11.	Prof., Markl, Jürgen	Institute of Zoology, JGU Mainz	10/12
12.	Dr., Maskos, Michael	Fraunhofer ICT-IMM, Mainz	05/09
13.	Dr., Oettel, Martin	Institute of Physics, Tübingen	10/12
14.	Prof., Paul, Wolfgang	Institute of Physics, JGU Mainz; Martin Luther University, Halle-Wittenberg	06/09
15.	Prof., Rauschenbeutel, Arno	Institute of Atomic and Subatomic Physics, Vienna University of Technology	06/10
16.	Prof., Renz, Franz	Institute of Anorganic Chemistry, Hannover	12/07
17.	Dr., Schärtl, Wolfgang	Institute of Physical Chemistry, JGU Mainz	10/12
18.	Prof., Schilling, Rolf	Institute of Physics, JGU Mainz	10/12
19.	Prof., Schilling, Tanja	Theory of Soft Condensed Matter, University of Luxembourg, Limpertsberg	12/09
20.	Dr., Weigel, Martin	Institute of Physics, JGU Mainz	11/10
21.	Prof., van Dongen, Peter G.J.	Institute of Physics, JGU Mainz	10/12

EXTERNAL MEMBERS

No.	Title, Last Name, First Name	Institution	Member of GSC since
1.	Dr., Drese, Klaus S.	Fraunhofer ICT-IMM, Mainz	05/11
2.	Dr., Letz, Martin	Schott AG, Mainz	02/14
3.	Dr., Mannstadt, Wolfgang	Schott AG, Mainz	10/11
4.	Prof., Parkin, Stuart	Max Planck Institute of Microstructure Physics, Halle and IBM Research Almaden, San José	01/11

SENIOR PRINCIPAL INVESTIGATORS

No.	Title, Last Name, First Name	Current Institution	Member of GSC since
1.	Prof., Binder, Kurt	Institute of Physics, JGU Mainz	11/07
2.	Prof., Wegner, Gerhard	Max Planck Institute of Polymer Research, Mainz	11/07
3.	Prof., Spiess, Hans Wolfgang	Max Planck Institute of Polymer Research, Mainz	11/07

DOCTORAL STUDENTS
CURRENT DOCTORAL STUDENTS

No.	Name	Thesis (title)	Main supervisor (names)	Member of GSC from - to (date)
1.	Andraschko, Felix	Dynamics in one-dimensional quantum gases	Jun. - Prof. Sirker	12/12 - now
2.	Bach,Sven	Early stages of the precipitation of zinc phosphate	Prof. Tremel	05/13 - now
3.	Becker, Greta	Sticky polyphosphoesters with catechol and DNA-motifs	Dr. Wurm	07/14 - now
4.	Bozhko, Dmytro	Magnon gases and condensates	Prof. Hillebrands	03/14 - now
5.	Braun, Hubertus	Dielectric glass-ceramics for wireless applications	Prof. Elmers	04/12 - now
6.	Carabelos, Noelia	Heme-oxygenase -1 implications in morphology, adhesive behavior and epithelial-mesenchymal transition of prostate cancer cells	Dr. del Campo	05/14 - now
7.	Chernenkaya, Alisa	Spectroscopy on highly correlated organic conductors	Prof. Schönhense	09/13 - now
8.	Christ, Eva-Maria	Cationic polymerization of oxetanes	Prof. Frey	09/13 - now
9.	Cui, Jizhai	Dynamic photoemission electron microscopy observation of magnetization change for strain-mediated ferromagnetic nanostructures controlled by patterned electrodes on piezoelectrics	Prof. Jourdan	06/14 - now
10.	De Lucia, Andrea	A multi-scale approach to high-resolution magnetization dynamics simulations	Prof. Jakob	09/13 - now
11.	Diehl, Marcel	Electronic properties of transition metal complexes bearing non-innocent ligands	Prof. Rentschler	06/12 - now
12.	Donavan, Michael	Side chain dynamics of surface bound proteins	Prof. Bonn	09/13 - now
13.	Fantini, Andrea	Metal to insulator fast switching in complex oxides	Prof. Kläui	01/12 - now
14.	Ferrante, Yari	Magnetic tunnel junctions with heusler alloy electrodes	Prof. Aeschlimann	05/13 - now
15.	Finizio, Simone	Charge spin dynamics in advanced oxidic materials	Prof. Kläui	01/12 - now
16.	Fischer, Tobias	Scanning force- and fluorescence microscopy of single molecules and nanoparticles	Prof. Basché	07/16 - now
17.	Fokina, Ana	Semiconductor nanocrystal-block copolymer hybrids for optoelectronic applications	Prof. Zentel	05/13 - now
18.	Golde, Sebastian	Optical experiments to investigate the non-equilibrium dynamics in colloidal suspensions	Prof. Palberg	09/12 - now
19.	Golling, Florian Ernst	Olefin polymerizations in fluorous emulsions	Prof. Müllen	08/11 - now
20.	Grusdt, Fabian	Topological quantum states in open systems	Prof. Fleischhauer	09/12 - now
21.	Heller, Phillip Sebastian	Polymeric cerriers for DANN vaccines - synthesis, characterization, evaluation	Prof. Zentel	06/14 - now
22.	Herold, Sebastian	Studies on the electroorganic synthesis of 1,5-diaminonaphthalene and related compounds	Prof. Waldvogel	01/14 - now
23.	Herzberger, Jana	Polymer supported catalysis: Polyethers with tunable properties from tailored amino functional epoxides	Prof. Frey	12/13 - now
24.	Heuser, Johannes	Lattice-Boltzmann methods for complex fluids	Prof. Schmid	02/13 - now
25.	Holuj, Paulina	Nanostructured half-heusler superlattices as a model system for thermoelectric materials	Prof. Jakob	01/14 - now

No.	Name	Thesis (title)	Main supervisor (names)	Member of GSC from - to (date)
26.	Ivanov, Ivan	Terahertz spectroscopy on graphene and graphene nanostructures	Prof. Bonn	07/13 - now
27.	Jakobs, Sebastian	Investigation of quantum-well systems with a giant spin-orbit-coupling by means of spin-, time- and angle-resolved two-photon-photoemission (STAR-2PPE)	Prof. Aeschlimann	12/10 - now
28.	Jünemann, Johannes	Frustration, topology and other exotic many-body effects	Jun. - Prof. Rizzi	03/14 - now
29.	Kamimoto, Natsuyo	Efficient synthesis of nitrogen-bridged terthiophenes by powerful oxidizers	Prof. Waldvogel	04/14 - now
30.	Kehlberger, Andreas	Spin caloric transport	Prof. Kläui	01/12 - now
31.	Klein, Rebecca	Novel perfluoropolyether based surfactants	Prof. Frey	12/12 - now
32.	Köhler, Stephan	Adsorption behavior of Fibrinogen on silicate surfaces	Prof. Schmid	01/12 - now
33.	Köhring, Hannah	Degradable poly(ethylene glycol)(OEG)-nanocarriers for encapsulation of therapeutic proteins, directed	Prof. Frey	02/13 - now
34.	Krautscheid, Pascal	High resolution imaging of spin current-driven magnetization manipulation in nanoscale structures using SEMPA	Prof. Kläui	09/13 - now
35.	Kreis, Karsten	The adaptive resolution molecular dynamics method applied to biomolecules	Prof. Kremer	02/13 - now
36.	Kreitner, Christoph	Synthesis and characterization of new Ruthenium complexes: Functional chromophores and electron transfer relays	Prof. Heinze	05/13 - now
37.	Leibig, Daniel	Synthesis and characterization of functionalized and reactive polymers with controlled structure for appliance in microelectronic deviced as well as in the human body	Prof. Frey	06/14 - now
38.	Lenz, Thomas	Smart soft lithography for molecular electronics	Prof. Blom	07/14 - now
39.	Lindner, Robert	Covalent coupling of organic molecules on insulating surfaces	Prof. Kühnle	12/12 - now
40.	Litzius, Kai	Magnetism and spintransport in metallic nanostructures	Prof. Kläui	12/13 - now
41.	Lo Conte, Roberto	Magnetic nanostructures with structural inversion asymmetry	Prof. Kläui	08/12 - now
42.	Mann, Laura	Molecular dynamics investigated by plasmon rulers	Prof. Sönnichsen	07/14 - now
43.	Melnyk, Anton	Understanding polymer bulk heterojunction solar cells using computer simultations	Prof. Kremer	07/13 - now
44.	Najafi, Saeed	Simulations of macromolecules	Prof. Kremer	01/14 - now
45.	Nardi Tironi, Catarina	Amphipolar networks	Prof. Müllen	02/13 - now
46.	Oschmann, Bernd	Preparation of graphitic coated inorganic nanoparticles for the application in lithium-ion batteries	Prof. Zentel	02/13 - now
47.	Passarello, Donata	New phases of matter by electrolyte gating of oxide thin films	Prof. Hillebrands	09/12 - now
48.	Rein, Markus	Fabrication and analysis of carbon allotropes	Prof. Kläui	12/13 - now
49.	Rieger, Florian	SCFT Studies of soft matter systems	Prof. Schmid	09/12 - now
50.	Rost, Daniel	Exact Quantum-Monte-Carlo methods für correlated electron systems	Prof. Binder	01/13 - now
51.	Roy, Soham	Dynamics of room temperature ionic liquids (RTILs)	Prof. Bonn	06/14 - now
52.	Schaefer, Erik	Multichannel-Spin-Polarimetry for the analysis of spin-transport in metall-prganic interfaces	Prof. Elmers	12/13 - now
53.	Scherer, Christoph	Structural information of multicomponent glass systems	Prof. Schmid	09/11 - now

No.	Name	Thesis (title)	Main supervisor (names)	Member of GSC from - to (date)
54.	Schick, Isabel	Synthesis, characterization and application of inorganic Janus-Particles	Prof. Tremel	01/12 - now
55.	Schmidt, Felix	Simulation of solid-state polarons with ultracold quantum gases	Prof. Widera	06/14 - now
56.	Seiwert, Dennis	Unfolding of major light Harvesting Complex (LHC2) via atomic force microscopy: Measuring the LHC2-stability in artifical membranes	Prof. Paulsen	01/14 - now
57.	Shuai, Jiang	Polyurethane and its composite materials	Prof. Landfester	12/13 - now
58.	Singh, Inderjeet	Hybrid nanocomposites for devices	Prof. Landfester	06/14 - now
59.	Staab, Maximilian	Time resolved measurements of magnetisation dynamicsof CoPt layers with perpendicular anisotropy.	Prof. Schönhense	06/12 - now
60.	Statt, Antonia	Monte Carlo simulations of nucleation of colloidal	Prof. Virnau	12/13 - now
61.	Steinbach, Tobias	Poylphosphates revisited: From degradable polymer therapeutics to synthetic DANN	Prof. Frey	01/12 - now
62.	Thielen, Philip	Ultrafast material science on the nanoscale probed with HHG PEEM	Prof. Aeschlimann	01/12 - now
63.	Trefz, Benjamin	Computer Simulations of the statistical behaviour of active particles	Prof. Virnau	07/12 - now
64.	Uribe Ordonez, Lalita	Mechanical properties of foldamers	Prof. Gauß	10/13 - now
65.	Velkov, Hristo	spin dynamics in novel magnetic materials	Prof. Sinova	07/14 - now
66.	Vollmar, Svenja	Electronic dynamics in ferromagnets with microscopic electron-magnon interaction	Prof. Schneider	05/13 - now
67.	Wang, Hai	Carrier dynamics in photovoltaic nanostructures	Prof. Bonn	06/12 - now
68.	Wang, Zi Jun	Conjugated porous polymers for energy application	Prof. Landfester	07/13 - now
69.	Weldert, Kai	Synthesis and characterization of novel thermoelectric materials	Prof. Tremel	05/13 - now
70.	Zerfass, Christian	Controlled silicic acid polymerization by using synthetic and recombinant peptides in biomimetically inspired precipitat	Prof. Paulsen	12/11 - now
71.	Zheng, Yiran	Epitaxial crystallization of poly(3-hexylthiophene)on oriented substrate	Prof. Landfester	03/14 - now
72.	Zhou, Zhengliu	Effect of BFO layer thickness and growth conditions on the exchange bias field and maximum coupling temperature	Prof. Jakob	06/14 - now

DOCTORAL STUDENTS
ALUMNI

No.	Last Name, First Name	Title of Thesis	Host Supervisor	Member of GSC from - until
1.	Afshar, Yaser	Polymer induced pores in lipid-membranes	Prof. Schmid	04/11 - 03/12
2.	Agrawal, Milan	Spin dynamics in non-magnetic metals	Prof. Hillebrands	11/10 - 01/14
3.	Andres, Markus	Correlations in Low Dimensional Spin and Fermion Lattice Models	Prof. Eggert	05/07 - 04/08
4.	Anyfantakis, Manos	Writing of Mesoscopic Structures in Polymer Solutions Using Laser Beams	Prof. Butt	02/09 - 01/10
5.	Bannwarth, Markus	Magnetic switchable nanocapsuls	Prof. Landfester	02/11 - 11/13
6.	Bantz, Christoph	Polymeric Nanoparticles and Nanocontainers: From Materials Science to Biotechnology	Prof. Schmidt	01/08 - 12/09
7.	Barz, Matthias	Functional Polymer Based Nanoparticles: Development of Defined Complex Structures as Basis for In vitro and In vivo Applications	Prof. Zentel	04/07 - 12/08
8.	Battagliarin, Glaucho	Synthesis of Zwitterionic Acridinic Derivatives with High Torsional Angle Along the Conjugation Axys Direction	Prof. Müllen	02/09 - 01/10
9.	Beckmann, Dirk	Benzo-bis-benzothiophene Based Organic Field-Effect Transistors	Prof. Müllen	01/08 - 07/09
10.	Beyer, Patrick	Photocrosslinkable Liquid Crystalline Polymers with Different Chain Topologies	Prof. Zentel	01/07 - 07/07
11.	Birkel, Alexander	Tin (IV) Oxide Nanostructures: Controlled Synthesis, Properties and Applications in Dye-Sensitized Solar Cells	Prof. Tremel	06/08 - 11/10
12.	Birkel, Christina	Wet Chemistry Synthesis Towards Nanostructures of Thermoelectric Antimonides	Prof. Tremel	08/08 - 10/10
13.	Böhm, Paul	Functional silicones and silicone-containing block copolymers	Prof. Frey	11/09 - 07/12
14.	Brächer, Thomas	High resolution x-ray holography of spin dynamics in high magnetic anisotropy structures	Prof. Hillebrands	11/11 - 02/14
15.	Bohle, Anne	NMR on Supramolecular Assemblies	Prof. Spiess	02/08 - 01/10
16.	Bühler, Jasmin	Poly(2-oxazoline) Brushes as Nanocarriers for Biomedical Applications	Porf. Schmidt	08/11 - 06/13
17.	Büttner, Felix	Topological mass of magnetic Skyrmions probed by ultrafast dynamic imaging	Prof. Kläui	11/11 - 08/13
18.	Busko, Dmitry	Conversion of the Multimode Conical LaserBbeams by Simulated Raman Scattering	Prof. Landfester	05/09 - 04/10
19.	Calcavecchia, Francesco	The Quantum Fluid of Metallic Hydrogen	Prof. Kühne	11/10 - 11/13
20.	Cho, Don Mark	Synthesis and Characterization of Polymers for Use in Organic Electronic Devices	Prof. Müllen	08/08 - 06/10
21.	Choi, Hyeok-Cheol	Magnetic anisotropy of the exchange-biased NiFe/FeMn/CoFe trilayer system	Prof. Kläui	12/12 - 05/13
22.	Coustet, Marcos	Photoactive Macromolecular Materials	Dr. del Campo	08/10 - 11/10
23.	Dallos, Timea	Study of the Synthesis and Intramolecular Interactions in the Case of Phenothiazine Derivates and Other Heterocyclic Rings	Prof. Müllen	04/08 - 03/09
24.	Diehl, Anna-Maria	Phosphonate Ligands in Extended Inorganic Hybrids and as Radical Units in Complexes	Prof. Rentschler	09/07 - 11/10
25.	Diehl, Sandra	Investigation of electronic correlation effects in organic charge-transfer salts using scanning tunneling	Prof. Elmers	04/11 - 07/14
26.	Dietzsch, Michael	Precipitation of calcium carbonate during the early stages in the presence of polyionic additives	Prof. Tremel	01/11 - 01/14

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27.	Dockter, Christoph	The Analysis of Structure and Assembly of Light-Harvesting Complex II by Electron Paramagnetic Resonance (EPR)	Prof. Paulsen	12/07 - 08/09
28.	Duro Castano, Aroa	Define Polyglutamates as Drug Carriers	Prof. Zentel	04/11 - 07/11
29.	Ebert, Marlon	De-mixing and test particle dynamics in complex fluids	Prof. Binder	11/09 - 12/12
30.	Eichhorn, Tobias	Microstructure of Epitaxial Ni2MnGa Films	Prof. Jakob	10/08 - 12/11
31.	Fassbender, Birgit	Synthesis of Polyphosphacenephosphonicacid as Electrolyte Membrane in Fuel Cells	Prof. Spiess	01/08 - 12/09
32.	Feist, Florian	Investigations on the Photophysics of Single Conjugated Polymer Chains at Low Temperatures	Prof. Basché	06/06 - 09/10
33.	Filevich, Oscar	Biocompatible Caged-Compounds to Control Gene Expression by Light	Dr. del Campo	09/09 - 02/10
34.	Fine, Tamir	Mechanical Properties of Pore Spanning MDCK II Apical and Basolateralplasma Membranes Probed by AFM	Prof. Janshoff	01/08 - 01/09
35.	Fischer, Anna Magdalena	Synthetic strategies towards different polyester architectures	Prof. Frey	09/10 - 08/11
36.	Fischer, Janina	Near-Field Mediated Enhancement of Two-Photon-Induced Fluorescence on Plasmonic Nanostructure	Dr. Kreiter	06/09 - 05/10
37.	Fleischhaker, Friederike	Designed Functional Defects in Colloidal Photonic Crystals: Switching, Biomonitoring and Modified Photoluminescence	Prof. Zentel	08/06 - 05/07
38.	Fritz, Dominik	Coarse Graining Methods and Polymer Dynamics	Prof. Kremer	11/06 - 05/10
39.	Gan, Yanjie	Point Defects in Carbon Nanostructures Studied by In situ Electron Microscopy	Prof. Schmidt	05/08 - 10/08
40.	Geidel, Christian	Hydrophobic Modified Anorganic Nanoparticles for Nano-Composite Materials	Prof. Müllen	01/09 - 07/10
41.	Gilz, Lukas	Non-equilibrium Quantum Thermodynamics	Prof. Anglin	04/10 - 04/13
42.	Gojzewski, Hubert	Visco-Elastic Properties of Thin Nylon Films Using Multi-Cycling Nanoindentation	Prof. Butt	10/08 - 07/09
43.	Graf, Tanja	Design of smart materials and novel thin film devices for thermoelectric and spintronic applications	Prof. Felser	11/08 - 05/11
44.	Gundlach, Kristina	Hybrid Complexes From Biological and Synthetic Materials for Light Harvesting and Charge Separation Applications	Prof. Paulsen	03/08 - 06/10
45.	Gupta, Jyotsana	Nonlinear Optical Studies of Nano-Hybrids and Polymers	Prof. Bubeck	05/09 - 08/10
46.	Haberkorn, Niko	Template-Assisted Patterning of Functional Polymers	Prof. Zentel	06/08 - 08/10
47.	Hadji, Rashid	X-ray and Neutron Reflectometry to Determine Thin Film Structures	Prof. Butt	01/08 - 02/08
48.	Happ, Peter	Heterometallacrowns as High-Spin Molecules	Prof. Rentschler	02/11 - 04/14
49.	Haschick, Robert	Synthesis of Polymer Nanoparticles in Non-Aqueous Emulsions	Prof. Müllen	02/08 - 07/09
50.	Hauke, Christopher	Investigation codeposition and molecular self-assembly of thermical stable molecules on insulating surfaces using noncontact atomic force microscopy	Prof. Kühnle	03/11 - 05/13
51.	Heinrich, Christophe	Structure-Property Relationships in Pnictide and Chalcogenide Thermoelectric Materials	Prof. Tremel	04/11 - 05/14
52.	Herbort, Christian	Tunnel Junctions with Heusler Electrodes: Spin Polarization of Co2CrO, 6FeO, 4Al and the Influence of the Barrier	Prof. Adrian	10/07 - 07/10
53.	Herrera, Isaac	Sequential Functionalization of Copolymers Containing Different Active-Esters	Prof. Zentel	09/08 - 02/09
54.	Hild, Kerstin	Femtosecond Laser-based Investigations of Magnetic Circular Dichroism in Near-Threshold Photoemission	Prof. Elmers	01/09 - 04/11
55.	Hilf, Jeannette	New materials through the combination of carbon dioxide with tailored epoxide building blocks	Prof. Frey	10/11 - 01/14

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56.	Hilf, Stefan	New Methods for the Functionalization of Metathesis Polymers	Prof. Frey	07/07 - 05/09
57.	Hofmann, Anna Maria	Amphiphilic polyethers via oxyanionic polymerization: From liposomes to liquid chrystals	Prof. Frey	11/08 - 10/11
58.	Hoshyargar, Faegheh	Formation Mechanisms of Chalcogenic Nanoparticles	Prof. Tremel	05/09 - 05/10
59.	Jagau, Thomas-Christian	Treatment of Exited State in Multireference Couple-Cluster Theory	Prof. Gauß	02/11 - 12/12
60.	Jakap, Arpad	Plasmoscope: Automated Spectroscopy of Single Nanoparticles	Prof. Schmidt	03/09 - 06/12
61.	Jakobi, Eberhard	Numerical and Analytical Investigations of Strongly Correlated Termionic Multiband Systems	Prof. Blümer	11/07 - 05/10
62.	Jaskiewicz, Karmena	Crystallization of Polymers	Prof. Butt	05/09 - 12/09
63.	Jenkins, Catherine	Intermetallics for Spintronics and Shape Memory	Prof. Felser	05/09 - 10/09
64.	Jimenez-Garcia, Lucia	Phosphonic Acid-Containing Molecules as Proton Conductors and Linkers for Hybrid Materials	Prof. Müllen	01/08 - 04/11
65.	Jung, Martin	Magnetic Interaction of Spin Exchange-Coupled Systems with Nitroxide and Nitronyl-Nitroxide Radicals	Prof. Rentschler	06/07 - 01/09
66.	Jung, Verena	An Investigation into Complex Inorganic Materials with Mössbauer Spectroscopy	Prof. Felser	01/07 - 02/09
67.	Junk, Matthias	Assessing the Functional Structure of Molecular Transporters by EPR Spectroscopy	Prof. Spiess	10/07 - 05/10
68.	Kamm, Valentin	Electronic and Optical Properties of Organic Semiconductors	Dr. Laquai	08/09 - 07/10
69.	Kessler, Daniel	Inorganic-Organic Hybrid Polymers: Solution-Processible Coating Materials for Defined Surface Functionalization	Prof. Zentel	03/09 - 08/09
70.	Khalavka, Yuriy	Metal-Semiconductor Hybrid Particles	Prof. Sönnichsen	09/07 - 08/10
71.	Kieslich, Gregor	Thermoelectric properties of nanostructured and nanoparticular compounds	Prof. Tremel	10/10 - 06/13
72.	Kins, Christoph	Synthesis and Investigation of functional polymer Materials	Prof. Spiess	12/10 - 05/12
73.	Klanke, Julia	Metallo (II)-Phthalocyanines on Surfaces	Prof. Rentschler	09/11 - 06/13
74.	Klinger, Daniel	Switchable Core-Shell-Particles with an Hydrogelic Core	Prof. Landfester	01/10 - 12/10
75.	Klos, Johannes	Synthesis and Characterization of Oligo(thiophene Carboxamide)s	Prof. Zentel	11/08 - 10/10
76.	Kocun, Marta	Force Spectroscopy of Biomolecules	Prof. Janshoff	01/08 - 01/09
77.	Köller, Tetyana	Transport Behavior of Aqueous Colloidal Polymer Dispersions	Prof. Palberg	05/07 - 05/10
78.	Kömmelt, Sabine	Oligodeoxynucleotide-Polypeptide-Polypeptide Block Copolymers	Prof. Schmidt	01/07 - 01/10
79.	Koll, Dominik	Three Approaches Towards one Aim: Nanostructured Photovoltaic Devices	Prof. Tremel	11/08 - 05/11
80.	Koll, Kerstin	Functionalization and Characterization of Magnetic Nanoparticles for Biomedical Applications	Prof. Tremel	01/09 - 05/11
81.	Kozina, Xeniya	Hard X-Ray photoemission of bulk and thin films of Heusler´s compound	Prof. Felser	11/08 - 03/12
82.	Krez, Julia	Thermoelectric properties in phase-separated half-Heusler materials	Prof. Felser	08/11 - 06/14
83.	Krohne, Korinna	Topologically Controlled Interpolyelectrolyte Complexes	Dr. Maskos	10/09 - 09/10
84.	Kühn, Frauke	Polycation-DNA-Complexes: Characterization and Application in Gene Transfection	Prof. Schmidt	01/08 - 11/10

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85.	Kulaga, Emilia	Structure of Nanocomposites	Prof. Butt	05/09 - 11/09
86.	Kutnyakhov, Dmytro	Spin Analysis of Photoelectrons from Tunneling Devices	Prof. Elmers	09/07 - 09/10
87.	Labouvie, Ralf	Ultracold bosons in optical lattices	Prof. Ott	12/10 - 12/13
88.	Lange, Birger	Chemistry on Functional Polymer Opals	Prof. Zentel	01/07 - 06/07
89.	Lazarra, Thomas	Optical Waveguide Spectroscopy and Laser-by-Laser Dendrimer Self Assembly in Porous Aluminia Templates	Prof. Knoll	01/08 - 12/08
90.	Lechmann, Maria	Nanostructured Hybrid Materials	Prof. Butt	08/07 - 07/09
91.	Li, Yi	Electrostatically Self-Assembled Nanoparticles Based on Biomolecules	Prof. Schmidt	09/07 - 02/10
92.	Liaqat, Faroha	Photonic and Phononic Crystals: Creating and Exploring Barriers	Prof. Tremel	06/10 - 06/11
93.	Loges, Niklas	Controllling the Morphology and Polymorphy of Calcium Carbonate by Monomeric and Polymeric Ionic Additives	Prof. Tremel	05/07 - 06/09
94.	Lotz, Alex	Multi cantilever arrays for antibacterial coating	Dr. Förch	10/09 - 09/10
95.	Ludwig, Christian	Optimizing Thin-Film Solar Cells by Computer Simulations	Dr. Gruhn	07/08 - 04/11
96.	Luis, Duque	Development and Analysis of Polymer Based Multifunctional Bactericidal Materials	Dr. Förch	10/09 - 09/10
97.	Luty-Blocho, Magdalena	Syntheses of Polymer-Stabilized AU and Pt(C) Nanoparticles Using Micro-Mixers	Prof. Schmidt	01/10 - 03/10
98.	Luz, Gisela	Biomimetic Composites Obtained by Layer-by-Layer Assembly of Bioglass and Natural Polyelectrolytes	Dr. del Campo	09/10 - 12/10
99.	Makowski, Marcin	Adhesion of Biopolymers Particularly Highly Adhesive Proteins Like the Catecholic Amino Acid 3 4-Dihydroxyphenylalanine (DOPA)	Prof. Butt	10/09 - 10/10
100.	Malzahn, Kerstin	Drug Release Systems Based on Plasma Polymerization Modified Surfaces	Prof. Landfester	07/11 - 06/14
101.	Marsico, Filippo	Polyphosphoesters via olefin metathesis	Dr. Wurm	12/12 - 05/14
102.	Mauer, Ralf	Hydrogen Barrier Properties of Reactive Sputtered Alumiumoxide	Dr. Laquai	01/09 - 07/10
103.	Medina, Angel	Formation of DANN complexes in aqueous and organic solvents	Prof. Schmidt	10/08 - 07/12
104.	Medina Hernando, Stefan	A Mesoscopic Simulation Method for Electrolyte Solutions	Prof. Schmid	07/10 - 07/13
105.	Medyanyk, Kateryna	Electron Spectroscopy of Novel Charge Transfer Systems Based on Polycyclic Aromatic Hydrocarbons	Prof. Schönhense	10/08 - 01/11
106.	Meister, Michael	Quasi steady-state photoinduced absorption on ID176	Dr. Laquai	03/09 - 07/10
107.	Meshcheriakova, Olga	FMR Investigations of Heusler and Related Compounds	Prof. Felser	11/10 - 11/13
108.	Meuer, Stefan	Liquid Crystalline Phases of Anisotropic, Polymer Functionalized Nanoparticles	Prof. Zentel	05/06 - 11/08
109.	Minoia, Andrea	Force Field-Based Modelling on Self-Assembly of Tetrathiafulvalene (TTF) Derivatives	Prof. Kremer	12/07 - 11/08
110.	Mix, Christian	Laserablation of interface dominated oxide heterostructures	Prof. Jakob	02/11 - 12/13
111.	Moderegger, Dorothea	Radiolabeling of defined polymer architectures with fluorine-18 and iodine-131 für ex vivo and un vivo evaluation: Visualization of structure-property relationship	Prof. Zentel	01/10 - 08/12
112.	Moers, Christian	Amphiphilic linear-hyperbranched polymers	Prof. Frey	11/10 - 01/14
113.	Mück, Leonie	Multireference Coupled-Cluster Methods for Open-Shell Systems	Prof. Gauß	01/10 - 12/12

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114.	Müller, Sophie	Polyether based lipids for biomedical applications	Prof. Frey	08/11 - 07/14
115.	Müller, Waltraut	Hydrophobic and Hydrophilic Loading of Polymeric Vesicles	Dr. Maskos	01/07 - 11/09
116.	Muth, Dominik	Dynamics of ultra cold quantum gases in low dimensions	Prof. Fleischhauer	09/09 - 04/12
117.	Naghavi, Shahab	Theoretical Study of correlated systems using hybrid functionals	Prof. Felser	11/07 - 12/10
118.	Natalello, Adrian	Adjusting the Reactivity in Living Carbanionic Polymerization	Prof. Frey	01/12 - 05/14
119.	Neumann, Timo	Dynamic Control of Spin Waves through Localized, Magnetic Inhomogeneities	Prof. Hillebrands	04/06 - 12/09
120.	Nguyen, Thi Huong	Rupture Force of Aptamer Binding Small Molecules	Prof. Butt	10/09 - 09/10
121.	Nicolescu, Alina	Solid State NMR Spectroscopy	Prof. Spiess	02/11 - 04/11
122.	Niun Tun, Thet	Systematic Wetting Studies of Au Nanowires on Different Surfaces	Dr. Köper	08/08 - 11/09
123.	Noskov, Sergey	Determination of Hamaker Constants of Polymeric Nanoparticles in Organic Solvents and Aqueous Electrolyte Solutions by Asymmetrical Flow Field-Flow Fractionation	Dr. Maskos	02/07 - 08/10
124.	Obermeier, Boris	Linear-Hyper Branched Block Copolymers as Soluble High-Loading Supports for Catalysts	Prof. Frey	12/07 - 12/10
125.	Ohm, Christian	Preparation of Defined Micro- and Nanometer-Sized Structures from Liquid Crystalline Elastomers	Prof. Zentel	05/08 - 12/10
126.	Opper, Kathleen	Acid Containing Precise Polyolefins	Prof. Müllen	11/08 - 03/09
127.	Pang, Shuping	Nanostructured Functional Carbon Materials for Energy Storage	Prof. Müllen	01/08 - 12/08
128.	Paroor, Harsha Mohan	Network Formation in Mixtures of Colloids	Prof. Butt	11/08 - 11/09
129.	Plenk, Christian	Using Click Chemistry for a Controlled Linkage of Single-Molecule Magnets	Prof. Rentschler	06/11 - 05/14
130.	Poma, Adolfo	Theoretical Foundation of the Coarse-Grained Approaches in Multiscale Simulations	Dr. DelleSite	12/07 - 11/08
131.	Prasad, Janak	Plasmonic Nanoparticle as Multiplexed Sensors	Prof. Sönnichsen	10/10 - 07/11
132.	Preis, Jasmin	Sulfur-Cotaining Polymers for Surface Attachment	Prof. Frey	05/09 - 07/12
133.	Pütz, Anna-Maria	Investigation of Higher Dimensional Structures like 2D Sheets or 3D Net-Work Composed of Transition Metal Carboxylate Complexes	Prof. Rentschler	09/07 - 09/10
134.	Raccis, Riccardo	Interaction of Molecular Diffusants and Hydrogel Components:PNIPAAm-Rhodamine Interaction in Solution	Prof. Butt	10/08 - 12/09
135.	Rahe, Philipp	The Calcite(1014) Surface: A Versatile Substrate for Molecular Self-Assembly	Prof. Kühnle	08/10 - 07/11
136.	Reichert, Peter	Molecular Structure of Liquid Interfaces Studied by X-Ray Reflectivity	Prof. Butt	01/11 - 05/14
137.	Reuter, Frank	Dinuclear 3d-Transition Metal Complexes with Derivatives of the Para-Phenylenediamine as Redoxavtive Bridging Ligands	Prof. Rentschler	08/08 - 10/10
138.	Rix, Stephan	Point Defects in Calciumfluoride and their Effect on Material Properties under 193nm Laser Irridation	Prof. Felser	10/08 - 01/11
139.	Roth, Marcel	Dynamics of Colloidal Suspensions: Growth, Aggregation, Reorganisation and Drying	Prof. Butt	05/08 - 12/11
140.	Roth, Meike	Synthesis and Hydrogenation of Unsaturated Substrates with Parahydrogen, PHIP	Prof. Spiess	08/08 - 07/10
141.	Roth, Peter	α,ω End Group Functionalization of RAFT Polymers Based on Pentafluorophenyl Esters and Methane Thiosulfonates	Prof. Zentel	11/08 - 08/09
142.	Rühle, Victor	Morphologies and Charge Transport in Conjugated Polymers	Prof. Kremer	10/08 - 09/10

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143.	Ruthard, Christian	Structure and Properties of Nanostructures from Polyelectrolytes and Porphyrins: Self-Assembly in Aqueous Solution	Dr. Gröhn	01/08 - 12/10
144.	Saha, Sanjib	Polyelectrolytes in Poor Solvents	Prof. Schmidt	09/08 - 08/09
145.	Sahl, Mike	Synthesis and Characterisation of Polypeptide Brushes	Prof. Schmidt	04/08 - 01/11
146.	Schattling, Philipp	Utilization of Organic and Inorganic Membranes for Templating Organic Semiconductors to be used in Organic Photovoltaic Applications	Prof. Zentel	05/11 - 05/13
147.	Scheibe, Patrick	Polymer Stabilized Lipid Membranes	Prof. Zentel	08/08 - 12/09
148.	Scherer, Christian	AF-FFF for the fractionation of polymerics nanoparticles	Dr. Maskos	10/09 - 09/10
149.	Schladt, Thomas	Design of Multifunctional Magnetic Nanomaterials for Biomedical Applications	Prof. Tremel	07/08 - 11/10
150.	Schneider, Imke	Spin and Electronic Densities in Low-Dimensional Strongly Correlated Systems	Prof. Eggert	04/06 - 08/10
151.	Schömer, Martina	Synthesis and Application of Non-Crystalline, Multifunctional Polyethers Based on Polyethylene Glycol (PEG)	Prof. Frey	10/09 - 11/12
152.	Schoop, Leslie Mareike	Investigation of Superconducting Properties in AlB2 Structure Type and Related Compounds	Prof. Felser	04/11 - 03/14
153.	Schüll, Christoph	Multifunctional Macromolecular Architectures Based on Hyperbranched Polyglycerol	Prof. Frey	07/10 - 04/13
154.	Schultheiss, Helmut	Coherence and Damping of Spin Waves in Magnetic Micro Structures	Prof. Hillebrands	07/07 - 06/10
155.	Schultheiss, Katrin	Spin-wave transport in two-dimensional microstructures	Prof. Hillebrands	06/10 - 08/13
156.	Schwab, Matthias	From Large Polycyclic Aromatic Hydrocarbons to Extended Aromate-Rich Networks	Prof. Müllen	01/09 - 04/11
157.	Schwall, Michael	Heusler Compounds for Thermoelectric Applications	Prof. Felser	08/11 - 11/12
158.	Schwartz, Veronique	Synthesis and Characterization of Polymeric Nanocapsules	Dr. Förch	10/09 - 09/10
159.	Sebastian, Thomas	Linear and nonlinear spin dynamics in Co2Mn0.6Fe0.4Si Heusler microstructures	Prof. Hillebrands	03/10 - 10/13
160.	Sengupta, Esha	The Analysis of Surface Potentials of Organic Electronic Devices with Scanning Probe Microscopy	Dr. Berger/Prof. Butt	10/09 - 09/10
161.	Serrano, Cristina	Nanostructured Polymer Fibers with Enhanced Adhesion to Tissue	Dr. del Campo	01/11 - 04/11
162.	Seyler, Helga	Synthesis of Hetero Sequences of Monodisperse Oligo(p-Bezamides) as Stiff-Chain Polyelectrolite Oligomers	Prof. Frey	03/07 - 12/09
163.	Shen, Yi	Modification of Hyperbranched Polyglycerol and Application	Prof. Frey	01/08 - 12/09
164.	Simon, Sascha	Versatility of Carbazole in Pi-Conjugated Materials -Macrocycles, Double-Strand-Structures and Donor-Acceptor-Copolymers	Prof. Müllen	11/08 - 11/10
165.	Slaughter, Liane	In vitro development of a lipid sensing system for small volumes	Prof. Sönnichsen	08/11 - 03/12
166.	Söffing, Stefan	Spin- and charge correlations of interacting fermions in inhomogeneous confined lattice systems	Prof. Eggert	06/09 - 02/12
167.	Spirin, Leonid	Molecular Dynamics Simulations of Sheared Brush-like systems	Prof. Binder	09/07 - 10/10
168.	Steidl, Lorenz	Colloids and Colloidal Superstructures as Building Blocks for the Construction of Functional Materials	Prof. Zentel	11/08 - 12/11
169.	Strauch, Thomas	Multiscale Simulations of Polybutadiene-Solutions	Prof. Paul	02/06 - 07/09
170.	Su, Qi	Polycyclic Aromatic Hydrocarbons: From Synthesis to Materials	Prof. Müllen	01/08 - 12/08
171.	Tarantola, Marco	Dynamics of Ephithelial Monolayers Assessed by Acoustic Impedimetric Whole Cell Biosensors	Prof. Janshoff	09/07 - 01/10

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172.	Thielen, Jörg	Ion-Conducting Membranes for Lithium Accumulators	Prof. Landfester	12/08 - 12/10
173.	Tonhauser, Christine	Functional Poly(ethylene oxide) -based Copolymers	Prof. Frey	12/09 - 06/12
174.	Tonhauser, Christoph	Sythesis of functional polymers in a microstructured reactor	Prof. Frey	09/09 - 05/12
175.	Trotzky, Stefan	Detection and Control of Second Order Tunneling Processes with Ultracold Atoms in Optical Lattices	Prof. Bloch	05/07 - 05/10
176.	Türp, David	Rigidly Dendronized Anions	Prof. Müllen	10/08 - 10/11
177.	Utech, Stefanie	Magnetic Nanoparticles for Micro TAS chips	Dr. Maskos	10/09 - 09/10
178.	Vehoff, Thorsten	Simulations of Charge Transport in Organic Compounds	Prof. Kremer	06/08 - 05/10
179.	Vianna, Sulivan	Fluorescence Correlative Spectroscopy	Prof. Butt	02/09 - 04/10
180.	Vice, Bradley	Plasma Polymers and Bacterial Attachment	Dr. Förch	09/08 - 04/09
181.	Vogel, Nicolas	Surface patterning with colloidal monolayers	Prof. Landfester	09/08 - 06/11
182.	Wang, Long	Application of Metal/Carbon Composites	Prof. Landfester	05/09 - 04/10
183.	Weber, Stefan	Electrical Scanning Probe Microscopy on Organic Optoelectronic Structures	Prof. Butt	11/08 - 11/10
184.	Wei, Yuing	Dynamics and Microstructure Studies of Precision Olefins by Solid State NMR	Prof. Spiess	08/08 - 10/08
185.	Weller, Désirée	Synthesis and Characterization of thermorespnsive polymer brushes with peptic side chains	Prof. Schmidt	04/11 - 11/13
186.	Wenzlik, Daniel	Liquid Crystalline Cellulose Derivates for Mirrorless Lasing	Prof. Zentel	04/10 - 03/13
187.	Werre, Mathias	New Synthetic Strategies to Mictoarmstarpolymers and AnBAn-Triblockcopolymers	Prof. Frey	08/10 - 08/13
188.	Will, Sebastian	Interacting bosons and fermions in three-dimensional optical lattice potentials - From atom optics to quantum simulation	Prof. Bloch	10/06 - 11/11
189.	Willerich, Immanuel	Supramolecular Dendrimer-Dye-Nanoparticles by Electrostatic Self-Assembly	Prof. Schmidt	07/08 - 07/11
190.	Wilms, Daniel	From Anionic Polymer Synthesis in Continuous Flow to Novel Branched Macromolecules	Prof. Frey	04/07 - 03/10
191.	Wilms, Dorothea	Computer simulations of two-dimensional colloidal crystals under confinement and shear	Prof. Binder	10/10 - 01/13
192.	Wilms, Valerie	Rmultifunctional Polyether Architectures: Versatile Materials for Surface Attachment and Functionalization	Prof. Frey	10/09 - 10/12
193.	Wiss, Kerstin	Synthetic Routes toward Functional Block Copolymers and Bioconjugates via RAFT Polymerization	Prof. Zentel	07/07- 07/10
194.	Wolf, Cornel	Structured Antibody Surfaces for Bio-Recognition and a Label-free Detection of Bacteria	Prof. Landfester	04/09 - 12/10
195.	Wolf, Florian	Branched Polyesters: Synthesis, Characteristics and Pharmacology	Prof. Frey	03/07 - 12/09
196.	Wolf, Stephan	Nonclassical Crystallization of Bi-valent Metal Carbonates	Prof. Tremel	04/07 - 07/09
197.	Wu, Si	Photoresponsive Properties of Azobenzene	Prof. Bubeck	11/09 - 03/10
198.	Wurm, Frederik	Linear-Hyperbranched Block Copolymers: Synthesis, Properties and Bioconjugation	Prof. Frey	04/07 - 05/09
199.	Yella, Aswani	Synthesis and Functionalization of Fulleren Nano Particles	Prof. Tremel	04/06 - 09/09
200.	Yordanov, Stoyan	TIR-FCS: Total Internal Reflection Fluorescence Correlation FCS: Total Internal Reflection Fluorescence Correlation	Prof. Butt	10/08 - 12/09

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201.	Yu, Yaming	Supramolecular Architectures from Nanoscopic Building Blocks	Prof. Frey	03/09 - 08/09
202.	Zakerin, Marjan	Thermofused Film Formation Bay Laser	Prof. Gutmann	10/09 - 10/10
203.	Zeier, Wolfgang	High temperature thermoelectric transport in quaternary copper selenides and ternary Zintl- antimonides	Prof. Tremel	10/10 - 05/13
204.	Zhu, Yao-Hui	Theory of Signal Propagation in Time-Dependent Spin Transport	Prof. Schneider	04/06 - 07/09
205.	Zins, Inga	Plasmonic Nanorods and Nanoparticle-Assemblies. Synthesis, Characterization, and Usage as Sensors	Prof. Sönnichsen	10/07 - 03/11
206.	Zorn, Matthias	Polymer-Nanoparticle Composites: From Orientation Phenomena to Optoelectronic Applications	Prof. Zentel	07/08 - 03/10
207.	zur Borg, Lisa	Semiconducting block copolymers for optoelectronic devices	Prof. Zentel	06/11 - 01/13

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MEMBER OF MAINZ SINCE 03/14

COOPERATION WITH INDUSTRY AND TECHNOLOGY TRANSFER

MAINZ offers its students contact with the world's leading industrial partners in the field of Materials Science. Personnel from our industrial partners are involved in many graduate school activities, such as lectures, summer schools, as mentors, and in joint research projects. In cooperative research projects, students have the opportunity to complete all or part of their thesis at one of our industrial partners. These projects are performed in close collaboration with, and under supervision of, an experienced academic scientist of the graduate school, which serves to facilitate technology transfer.

I am working on novel materials for electronic applications. For example, vanadium dioxide undergoes a transition from an insulating to a metallic phase. My goal is to study this transition on an ultrafast timescale of a few pico seconds to gain insights into the physics, which are still unclear. In the future, this material might be used in energy efficient and high speed electronic devices. The collaboration between MAINZ and IBM gives me the great opportunity to conduct research in a corporate environment with supervision from university and industrial scientists. I believe this has been crucial in giving me a unique insight into corporate research, and on how scientific discoveries can be transferred into technologies.

Andrea Fantini, 27 years old, doctoral student since January 2013 with Prof. Mathias Kläui

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