DGfB Deutsche Gesellschaft für Biophysik e.V.

Rundschreiben 2018

Grußwort der 1. Vorsitzenden

Liebe Mitglieder der Deutschen Gesellschaft für Biophysik,

nach nun insgesamt fast 4 Jahren als 1. Vorstandsvorsitzende der Deutschen Gesellschaft für Biophysik ist es mir eine große Ehre, zum letzten Mal das Grußwort an alle Mitglieder zu richten und gleichzeitig unseren neuen 1. Vorstandsvorsitzenden, Helmut Grubmüller, zum 01.01.2019 in seinem Amt begrüßen zu dürfen. Es gilt mein Dank dem gesamten Vorstand der DGfB, vor allem für die immer unkomplizierte und angenehme Zusammenarbeit.

Diese Zusammenarbeit erlaubt es uns, eine lebendige Gesellschaft aufrechtzuerhalten, geprägt durch verschiedene wissenschaftliche Treffen. Auch dieses Jahr war wieder von hervorragenden Tagungen geprägt. Nachdem die Tagung der Sektion: „Membranen, Zellen, Netzwerke“ nun nicht mehr obligatorisch in Gomadingen stattfinden kann, ist sie in den letzten Jahren nach Hünfeld, Bad Herrenalb und Drübeck im Harz gewandert. Vielleicht findet sie im Kloster Drübeck ja in Zukunft eine neue Heimat. Der Tagungsort lud auf jeden Fall dazu ein. Organisiert durch unsere Sektionssprecher Annette Meister und Maria Hoernke konnten die Teilnehmer im Kloster vom 5. - 7. März 2018 ein umfangreiches Programm zum Thema „Membrane Models for Biophysics“ genießen, unterbrochen von einem netten Beisammensein in der Klosterschänke, Musik am Abend und einer Wanderung durch den umgebenden Harz. An dieser Stelle möchte ich besonders den Organisatoren, aber auch den vielen helfenden Händen für dieses gelungene Treffen danken. Mein Dank geht auch an Claus Seidel und seinem Team, das in diesem Jahr die große Aufgabe hatte, die Jahrestagung der DGfB an der Heinrich-Heine Universität in Düsseldorf (16. - 19. September 2018) zu organisieren. Mit insgesamt 362 Teilnehmern war die Tagung ein voller Erfolg.

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Neben dem wissenschaftlichen Programm fand in Düsseldorf auch die Mitgliederversammlung statt, auf der sich die DGfB dazu entschieden hat, die drei Sektionen mit neuen Namen zu versehen. So haben wir in Zukunft die Sektionen: „Molekulare Biophysik“, „Membranbiophysik“ und „Zelluläre Biophysik“. Ich bin zuversichtlich, dass sich alle Mitglieder der DGfB auch in Zukunft in einer der drei Sektionen wiederfinden werden. Unter diesen neuen Flaggen werden im nächsten Jahr dann die Sektionstagungen traditionell weitergeführt werden. So wird unser Sektionssprecher Joachim Heberle und seine Stellvertreterin Christine Selhuber-Unkel die Tagung der Sektion: „Zelluläre Biophysik“ vom 9. - 11. August 2019 in Berlin-Wannsee ausrichten. In Zusammenarbeit mit der französischen Biophysik-Gesellschaft wird die Sektion: “Molekulare Biophysik” ihre Tagung vom 14. - 16. Februar in Hünfeld zum Thema “Structures and Dynamics of Biomolecules” durchführen. Die Vorbereitungen durch die Sektionssprecher Michael Schlierf und Indra Schröder laufen schon auf Hochtouren. Ohne das Engagement unserer Sektionssprecher würden die hochkarätigen Programme nicht entstehen, deshalb gebührt ihnen mein größter Dank an dieser Stelle. Es sind gerade diese kleinen Meetings, die einen wissenschaftlichen Austausch auf den verschiedenen Ebenen befördern und so inspirierend sind.

Weitaus größer und damit allumfassender ist der 12. EBSA und 10. ICBP-IUPAP Kongress, der vom 20. - 24. Juli 2019 in Madrid stattfinden wird. Ich bin sicher, dass sich viele unserer Mitglieder dort im Sommer einfinden werden. Auch sollten sich alle schon einmal den Termin der nächsten DGfB Jahrestagung am 20. - 23. September 2020 in Konstanz sowie die IUPAB Tagung (26. - 30. Oktober 2020) in Foz do Iguazú (Brasilien) vormerken.

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Ich möchte nicht schließen, ohne kurz inne zu halten. Am Jahresende, wo etwas Ruhe einkehrt, ist ein guter Moment auch einmal über unseren Wissenschafts-Horizont hinauszublicken und auf die Dinge zu schauen, die möglicherweise wichtiger sind. So lässt sich Gesundheit nicht in Geschenkpapier wickeln und unter den Christbaum legen und Glück kann man nicht kaufen. Dennoch sind Gesundheit, Glück und Zufriedenheit die Geschenke, für die wir dankbar sein sollten. In diesem Sinne wünsche ich allen Mitgliedern der DGfB genau das im kommenden Jahr.

(Claudia Steinem)

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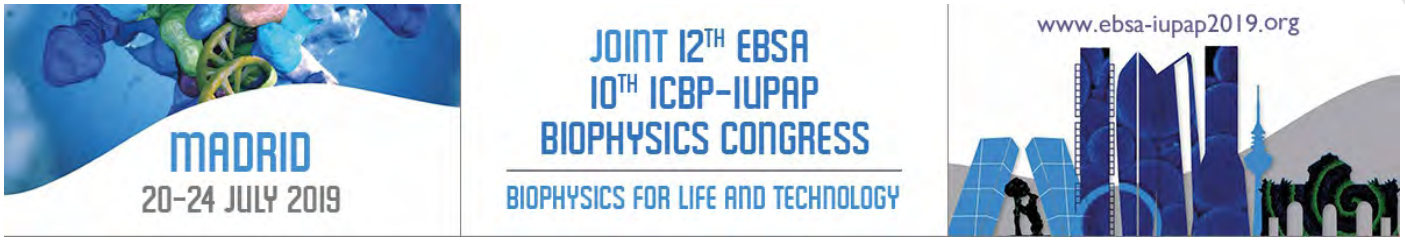
Reisestipendien für den EBSA/IUPAP congress 2019 in Madrid, Spanien

www.ebsa2019.com



Liebe Mitglieder der DGfB,

Die DGfB vergibt acht Reisestipendien über je 400 €, um Nachwuchswissenschaftlern/innen die Möglichkeit zu eröffnen am “12th EBSA and 10th ICBP-IUPAP biophysics congress” in Madrid teilzunehmen.

Bitte reichen Sie einen formlosen Antrag mit folgenden Unterlagen ein:
– Lebenslauf
– Abstract
– kurzes Empfehlungsschreiben des Betreuers/der Betreuerin
– Angabe zur Bewerbung um andere Reisestipendien

Die Mitgliedschaft in der DGfB ist nötig um eine Förderung erhalten zu können. Sie muss jedoch noch nicht bei der Antragstellung vorliegen.
Die Unterlagen schicken Sie bitte in einem PDF-Dokument an tgutsmann@fz-borstel.de. Bewerbungsschluss ist der 29. März. 2019.
Diese Stipendien sind unabhängig von den durch die EBSA vergebenen Stipendien.

Mit freundlichen Grüßen,
Thomas Gutsmann
Sekretär der DGfB

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Frühjahrstagung der Sektion „Membranen, Zellen, Netzwerke“ im März 2018 in Drübeck

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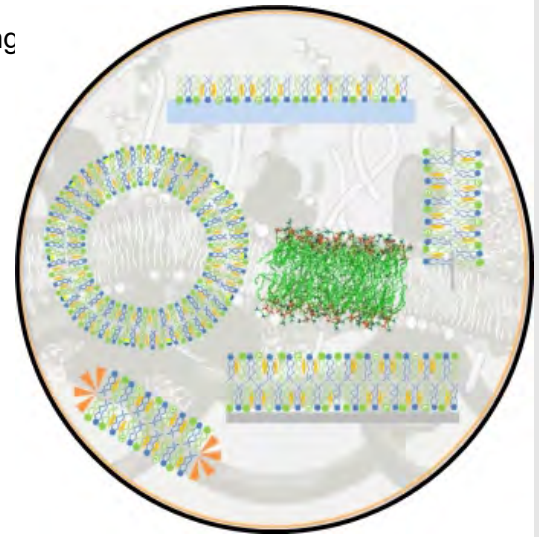
International Meeting of the DGfB Membrane Section

„Membrane Models for Biophysics“

Speaker:

1. Vesicular lipid bilayer: Alfred Blume, Kalina Hristova
2. Freestanding planar lipid bilayer: Thomas Gutsmann
3. Supported planar lipid bilayer: Claudia Steinem, Volker Kiessling
4. Lipid bilayer discs: Sandro Keller, Antoinette Killian
5. Lipid monolayers: Gerald Brezesinski
6. Computational and theoretical lipid membranes: Mark Sansom



75 participants
Organized by Annette Meister and Maria Hoernke

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Jahrestagung der DGfB

in Düsseldorf

Biennial Meeting of the German Biophysical Society, September 16–19, 2018 and the Satellite Workshop on Advanced Fluorescence Spectroscopy and Imaging, September 19–20, 2018, Düsseldorf Germany

Both events took place on the campus of the Heinrich-Heine-University Düsseldorf and attracted overall 362 attendees from 11 countries (Algeria, Belgium, China, Denmark, Germany, Finland, France, Netherlands, Switzerland, United States of America, United Kingdom). The sequential order of the meetings created significant synergies, because many visitors attended both events (333 scientists were at the DGfB Biennial Meeting and 111 at the Advanced Fluorescence Workshop).

To extend the coverage as far as possible, the DGfB Biennial Meeting was organized for the first time together with all other societies, which have research groups in biophysics: (1) Society for Biochemistry and Molecular Biology (GBM, study group Biophysical Chemistry), (2) German Bunsen Society for Physical Chemistry (DBG) and (3) German Physical Society (DPG, Fachverband Biological Physics). Moreover, the three subgroups of the DGfB, Molecular Biophysics; Membranes, Cells and Networks; Medical Biophysics reflect the aim at bringing together scientists with a wide range of interests within the broad biophysical community. In this respect, the program was organized according to seven major topics: (1) Biomolecules and their assemblies: from structure and dynamics to function, (2) Biophysics of membranes and membrane proteins, (3) Energy transduction involving light harvesting, electron transfer and proton transfer, (4) Computational biophysics, (5) Imaging molecules of life, (6) Cell biophysics meets systems and synthetic biology, and (7) Physics of disease and cancer.

On Sunday 16th at 18:00, the meeting started with opening remarks by Prof. em. Dr. Dr. h.c. Detlev who pointed out the importance of fundamental biophysical research for innovations that finally form the technological basis of applications in life sciences and

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medicine. Until Wednesday 19th 13:00, we had 13 plenary lectures, 56 contributed talks (42 short and 14 long) and two lectures given by the winners of the young investigator awards. Moreover, we had two long poster sessions (2 hours each) to study 202 posters that were grouped according to the seven main topics. Here you can find detailed information on the DGfB Meeting (https://www.dgfb.org/en/dgfb-meetings/dgfb-biennnial-meeting-in-duesseldorf-2018.html) and Download for the Book of Abstracts
https://www.dgfb.org/images/download/Biennial_2018/boa_dgfb_biennial_2018.pdf

During the meeting, awards in three categories were given by the DGfB:

1.) Young Investigator Award

The prize is awarded to emerging young investigators based on the career track documented in their application. The prize comprises 500 € each and was supported by the DGfB, ISS, Inc. (Champaign, IL 61822, USA) and Innovendia (Owingen, D-88696, Germany).

Josef Benesh (Goethe-University Frankfurt, Institute of Physical and Theoretical Chemistry, Frankfurt am Main, Germany): In-situ investigation of outer membrane proteins in E. coli and native membranes using dipolar EPR spectroscopy

Benedikt Sabass (Forschungszentrum Jülich, Institute of Complex Systems – Theoretical Soft Matter and Biophysics (ICS-2), Jülich, Germany): Gaining traction: towards understanding the micromechanics of bacterial life

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2.) Poster Awards

The winners of three best posters, selected by votes of all attendees, received the book "Biophysical Chemistry" (1st Edition, CRC Press 2017) written by Dagmar Klostermeier & Markus G. Rudolph. The prize is supported by the DGfB.

Annika Droste (Paracelsus Medizinische Privatuniversität (PMU), Institut für Physiologie und Pathophysiologie, Nürnberg, Germany): Detailed comparison of H2O2 production of human PMN and HL-60 derived cell lines

Rejhana Kolasinac (Forschungszentrum Jülich, Institute of Complex Systems – Biomechanics (ICS-7), Jülich, Germany): Deciphering the functional composition of fusogenic liposomes

Jeremias Sibold (Georg-August University, Institute for Organic and Biomolecular Chemistry, Göttingen, Germany): Phase separation of sphingomyelin containing lipid bilayers is controlled by lipid-substrate adhesion as well as chain length and saturation

3.) Klaus Arnold Publication Prize

The prize is awarded biannually by the Deutsche Gesellschaft für Biophysik to the first author of an outstanding publication by a young scientist working in Germany. The prize comprises 1000 €.

Marie Luise Grünbein (Max Planck Institute for Medical Research, Group of Prof. Dr. Ilme Schlichting, Heidelberg, Germany): Megahertz data collection from protein microcrystals at an X-ray free-electron laser. Nat. Commun. 9, #3487 (2018) 2018

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The program of the Satellite Workshop on Advanced Fluorescence Spectroscopy and Imaging, was based on a bottom-up approach considering the wishes of the attendees. The organizers (T. Craggs, T. Hugel, D. Lamb, J. Michaelis and C. Seidel) wanted to promote the dissemination of theory, joint procedures and tools for quantitative fluorescence measurements and planning of community-driven experimental challenges. We were overwhelm by the interest, so that we organized a program in three categories (beginners, advanced researcher and experts in fluorescence).

Let me express many thanks to all participants who presented their work and contributed to lively discussions. I also thank the scientific committee for supervising the program and in particular event lab. GmbH. Mrs. Sara Rosenblatt and Mrs. Clarissa Strietzel coordinated everything smoothly at and around the conference and kept track of all the requirements for both the annual meeting and the satellite workshop.

Additionally, I gratefully acknowledge the support of the German Research Foundation (DFG), the Fonds der chemischen Industrie (FCI), CRC-1208 (Identity and Dynamics of Membrane Systems - from Molecules to Cellular Functions) and the International Helmholtz Research School of Biophysics and Soft Matter (BioSoft) as well as all the companies sponsoring our meeting. Lastly, my sincere thanks go to HHU for their lecture hall building and administrative support as well as to all members of my working group for their great effort in providing all services during the meeting.

I am looking forward to the next exciting Biennial Meeting of the German Biophysical Society, September 20–23, 2020 in Konstanz, organized by Karin Hauser.

Claus Seidel

Claus Seidel
Chair for molecular physical chemistry, HHU Düsseldorf

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Kurzprofil der AG Christine Selhuber-Unkel

https://www.tf.uni-kiel.de/matwis/bnano/en/welcome

Short profile of the Selhuber-Unkel lab, Kiel University

1. Group

Biocompatible nanomaterials

2. Head of the group

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web: https://www.tf.uni-kiel.de/matwis/bnano/en/welcome

3. Summary:

We are interested in studying the adhesion, mechanics and intracellular dynamics in living cells at different levels of complexity. As an important tool we are using functional materials to control cells by external cues, such as material-induced stimuli and material structures (Fig. 1). This also includes research on biohybrid and cell-inspired material systems. In the following, the key areas of our research are described.

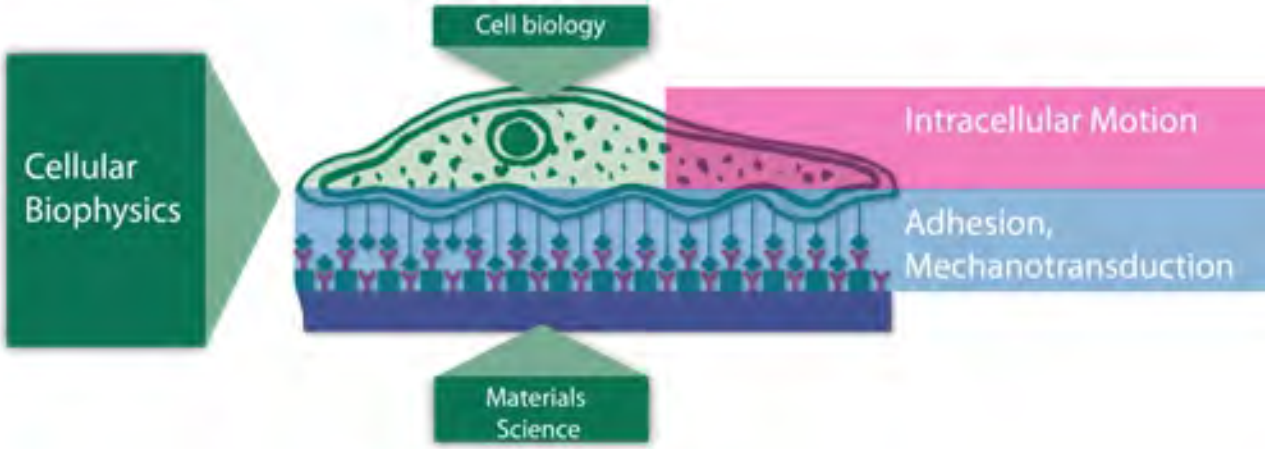

Figure 1 : Interdisciplinary research in the Selhuber-Unkel lab. We investigate biophysical questions at the interface between materials science and cell biology, with a focus on intracellular motion, cell adhesion and mechanotransduction.

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Kurzprofil der AG Christine Selhuber-Unkel

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(i) Molecular and cellular mechanotransduction

We investigate cell adhesion and mechanotransduction using single cell force spectroscopy, traction force microscopy and surface-integrated force sensors. These methods allow for studying cell adhesion and mechanotransduction from the single molecule level to the level of cells and tissues. In one of our recent studies we have shown by using RGD-functionalized push-pull substituted azobenzenes that light-induced molecular oscillations induce a reinforcement of cell adhesion (Fig. 2).

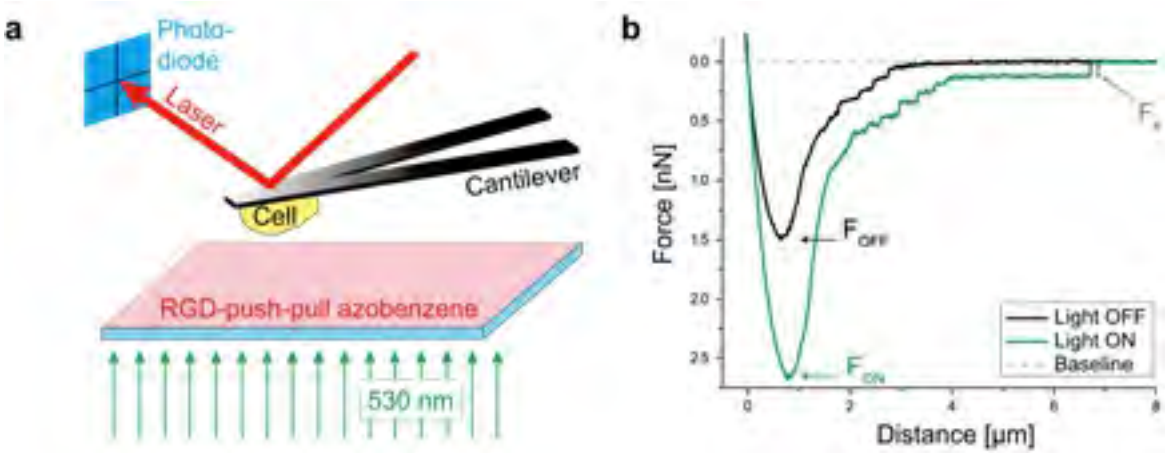

Figure 2: (a) Single-cell force spectroscopy in combination with photoresponsive azobenzene molecules, which oscillate when illuminated by light (wavelength 530 nm). (b) Force curves in a single-cell force spectroscopy experiment on surfaces functionalized with push-pull substituted azobenzenes. (Kadem et al., 2017)

- L. F. Kadem, K. G. Suana, M. Holz, W. Wang, H. Westerhaus, R. Herges, C. Selhuber-Unkel (2017): High Frequency Mechanostimulation of Cell Adhesion. Angewandte Chemie International Edition, 56: 225-229.
- S. Huth, J. F. Reverey, M. Leippe, C. Selhuber-Unkel (2017): Adhesion Forces and Mechanics in Mannose-Mediated Acanthamoeba Interactions, PLOS ONE, 12(5):e0176207.
- L. F. Kadem, M. Holz, K. G. Suana, Q. Li, C. Lamprecht, R. Herges, C. Selhuber-Unkel (2016): Rapid Reversible Photoswitching of Integrin-mediated Adhesion at the Single-Cell Level. Advanced Materials, 28:1799-1802.
- Q. Li, S. Huth, D. Adam and C. Selhuber-Unkel (2016): Reinforcement of integrin-mediated T-Lymphocyte adhesion by TNF-induced Inside-out Signaling. Scientific Reports, 6:30452.

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(ii) Intracellular and cellular dynamics

Intracellular motion of endogenous particles is an essential mechanism for the biological function of cells. It is not only important for ensuring the transport of stored molecules, e.g., lipids and enzymes, but can also be a decisive factor for the development of diseases. Crowded systems are of particular interest. A very specific biological system, in which intracellular motion is related to pathogenicity, is the human pathogenic amoeba *Acanthamoeba castellanii*. This amoeba can, upon contact with the human eye, cause a severe keratitis after entering the eye through small lesions of the outermost epithelial cell layer. After having reached the cornea, the amoebae start to destroy target-cells by an extracellular killing mechanism that is based on the intracellular transport of granules towards the target-cell. The granules release pore-forming molecules, which destroy the membrane of the target-cell. With our investigations we aim at understanding the biophysical principles underlying such a "killing kiss" between amoeba and target-cell.

- J. F. Reverey, J.-H. Jeon, H. Bao, M. Leippe, R. Metzler and C. Selhuber-Unkel (2015): Superdiffusion dominates intracellular particle motion in the supercrowded cytoplasm of pathogenic Acanthamoeba castellanii. Scientific Reports, 5: 11690.
- S. B. Gutekunst, C. Grabosch, A. Kovalev, S. N. Gorb and C. Selhuber-Unkel (2014): Influence of PDMS substrate stiffness on the adhesion of Acanthamoeba castellanii. Beilstein Journal of Nanotechnology, 5: 1393-1398.

(iii) Structured and cell-inspired materials

Structured materials can be used to mimic the natural 3D environment of cells. On the other hand, they can also be used to resemble the complex mechanical properties of cells themselves. For example, aerographite is a novel carbon-based material that exists as a self-supportive 3D network of interconnected hollow microtubes. It can be synthesized in a variety of architectures and its structure mimics that of collagen fibers (Fig. 3). We can also work on the inverse structures of such fibrous materials, i.e. hydrogels containing microchannels. Both materials are very promising for tissue engineering. Furthermore, we are employing structured synthetic materials to mimic mechanical properties of cells, in biohybrid systems, and in studies on collective migration.

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Figure 3: Scanning electron microscopy image of fibroblast cells (green) adhering to aerographite microfibers (Lamprecht et al., 2016).

- M. Taale, F. Schütt, K. Zheng, Y. Mishra, A. Boccaccini, R. Adelung, C. Selhuber-Unkel (2018): Bioactive Carbon Based Hybrid 3D Scaffolds for Osteoblast Growth. ACS Applied Materials & Interfaces, DOI: 10.1021/acsami.8b13631.
- C. Lamprecht, M. Taale, I. Paulowicz, H. Westerhaus, C. Grabosch, A. Schuchardt, M. Mecklenburg, M. Böttner, R. Lucius, K. Schulte, R. Adelung, C. Selhuber-Unkel (2016): A tunable scaffold of microtubular graphite for 3D cell growth. ACS Applied Materials & Interfaces, 8:14980-14985.

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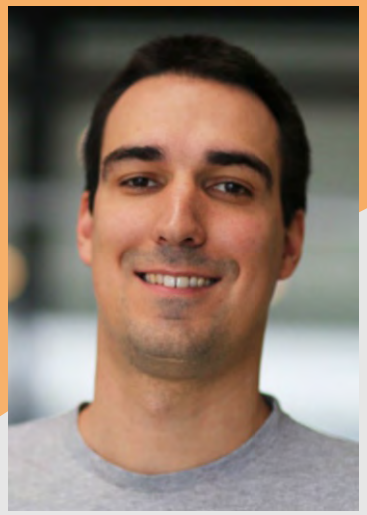
Kurzprofil der AG Emanuel Schneck

http://www.mpikg.mpg.de/5446645/Physics_of_Biomolecular_Interfaces



Short profile of the Schneck lab, Max Planck Institute of Colloids and Interfaces, Potsdam

1. Group

Physics of Biomolecular Interfaces

2. Head of the group

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web: http://www.mpikg.mpg.de/5446645/Physics_of_Biomolecular_Interfaces

3. Summary:

Cells and the biological organisms they form are constituted to a large fraction by functional biomolecular layers. The most prominent example are the biological membranes – only few nanometers in thickness – which have diverse functions in context with cell compartmentation and metabolism. It is the chemical characteristics of their surfaces that determines how the membranes interact with one another and with their surroundings, for example whether they spontaneously form multilamellar assemblies or whether they can be targeted by other molecules. In order to study biomolecular layers of biological and technological relevance, we immobilize layers with well-defined molecular compositions at the surfaces of solids or liquids and investigate their physical properties and response to external stimuli. To this end, we focus on the layers' structure, because structural insights allow for robust conclusions about molecular functions. For the structural characterization on the nanometer and sub-nanometer scale we employ modern methods of x-ray and neutron scattering [1-3], which we also further develop ourselves [4]. Additional mechanistic insight is obtained with the help of computer simulations with atomic detail [5].

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Kurzprofil der AG Emanuel Schneck

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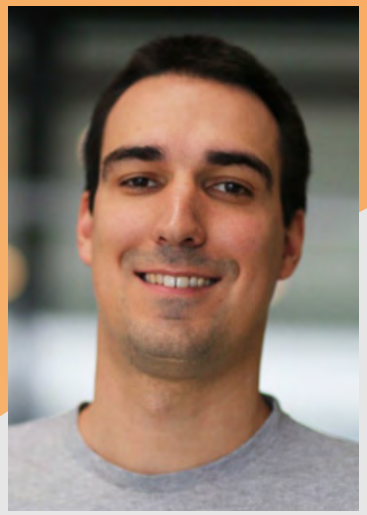

3.1. Polymer functionalization against protein adsorption

The adsorption of proteins onto the surfaces of implants and drug delivery systems is commonly believed to be the initial step of harmful foreign body response in patients. In order to suppress undesired protein adsorption, artificial materials in biomedical applications are often functionalized with end-grafted hydrophilic polymer chains, so-called “polymer brushes”. This approach, however, does not always lead to the results hoped for. With the help of neutron reflectometry, we obtain detailed insights into the adsorption characteristics of proteins out of human blood serum onto polymer-functionalized solid surfaces [1, 2]. It turns out that the brushes do not completely suppress protein adsorption (Fig. 1). By contrast, certain blood proteins, whose identity is still unknown, do even accumulate within the brushes in the form of a so-called “ternary adsorption”. These results challenge the common picture of the working principle of polymer brushes and suggest that it may have to do with the suppression of protein-protein recognition as secondary effect [2].

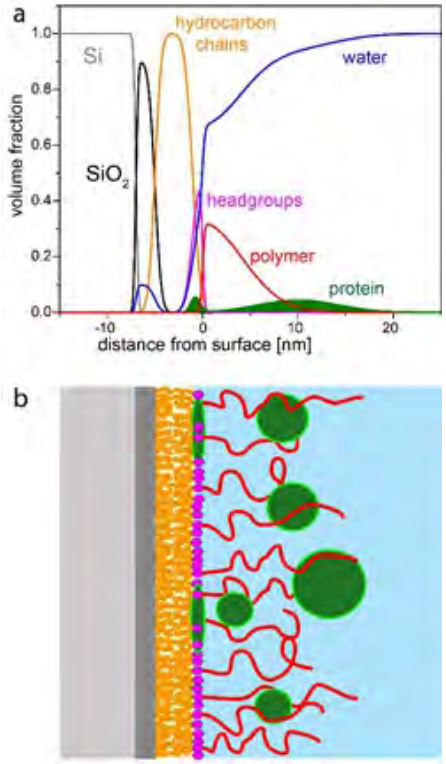

Figure 1: Structural characterization of biomolecular layers. (a) Neutron reflectometry elucidates the spatial distribution of various chemical components after the adsorption of proteins onto a polymer-functionalized silicon surface. (b) Schematic illustration of the protein distribution in the polymer brush.

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Kurzprofil der AG Emanuel Schneck

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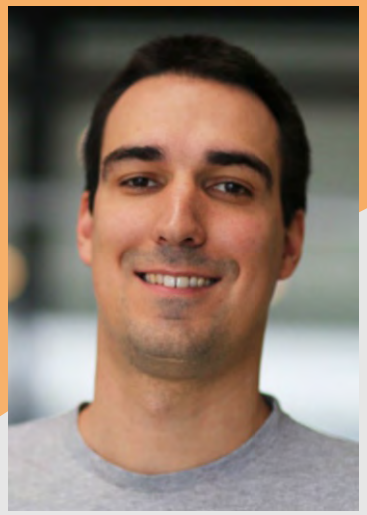

3.2. Molecular conformations in single and interacting bacteria surfaces

The outer surfaces of Gram-negative bacteria are composed of lipopolysaccharide (LPS) molecules exposing oligo- and polysaccharides to the aqueous environment. This unique, structurally complex biological interface is of great scientific interest as it mediates the interaction of bacteria with antimicrobial agents as well as with neighboring bacteria in colonies and biofilms. Structural studies on LPS surfaces, however, have so far dealt almost exclusively with rough mutant LPS of reduced molecular complexity. With the help of neutron reflectometry, we investigate planar monolayers of wild-type LPS featuring strain-specific linear polysaccharides (so-called O-side chains) in the presence and absence of divalent cations and under controlled interaction conditions (Fig. 2). The saccharide profiles are found to be bimodal, with dense internal oligosaccharides and more dilute, extended O-side chains [3]. The structure is significantly affected by a depletion of calcium: the lateral packing is reduced, and water appears to overlap with the hydrocarbon chain region. At the same time the internal oligosaccharides become more extended in the perpendicular direction. Both effects can be attributed to enhanced electrostatic repulsion in the absence of divalent cations and yield insight into the enhanced vulnerability of bacteria under these conditions. For interacting LPS monolayers we have established the pressure-distance curve and determined the distance-dependent saccharide conformation. The pressure-distance data are well described by the Alexander-de-Gennes model of interacting polymer brushes. The O-side chain conformation is nearly un-perturbed at the largest separation, with only a weak overlap at the midplane (Fig. 2). The corresponding central water fraction is above 90 %, suggesting the preservation of hydrodynamic pathways for small molecules.

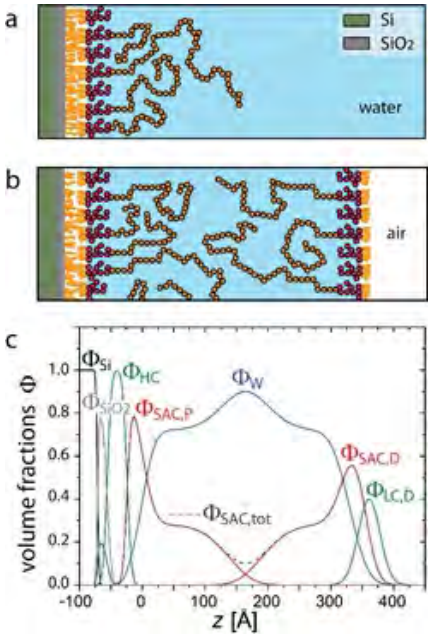

Figure 2: (a and b) Schematic illustrations of one single and two interacting solid-supported LPS surfaces mimicking the outer surfaces of bacteria. (c) Volume fraction profiles of all chemical components as obtained by neutron reflectometry with contrast variation.

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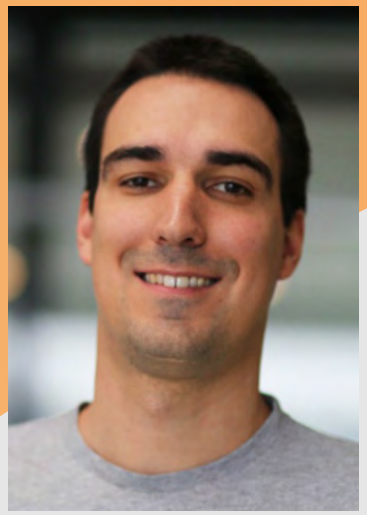

3.3. Stability of membrane stacks – a matter of the dipoles

Naturally occurring membrane stacks, such as the photosynthetically active thylakoids, exhibit high glycolipid contents. In contrast to the commonly studied phospholipids, glycolipids in their headgroups display many small electric dipoles in the form of OH groups instead of a single large dipole (Fig. 3). This difference is determining for the spontaneous stack formation of glycolipid membranes, as we have recently found out [5]. We have used atomistic molecular dynamics simulations (Fig. 3) to first reproduce experimentally obtained pressure-distance curves between phospho- and glycolipid membranes and to then analyze them. The analysis revealed that the physical mechanisms responsible for the strong short-range repulsion between phospholipid membranes are inoperative for the glycolipids, due to the architecture of their headgroups. The key aspect are the interactions between the lipid molecules and the water molecules. As a result, stack formation of glycolipid membranes is promoted [5].

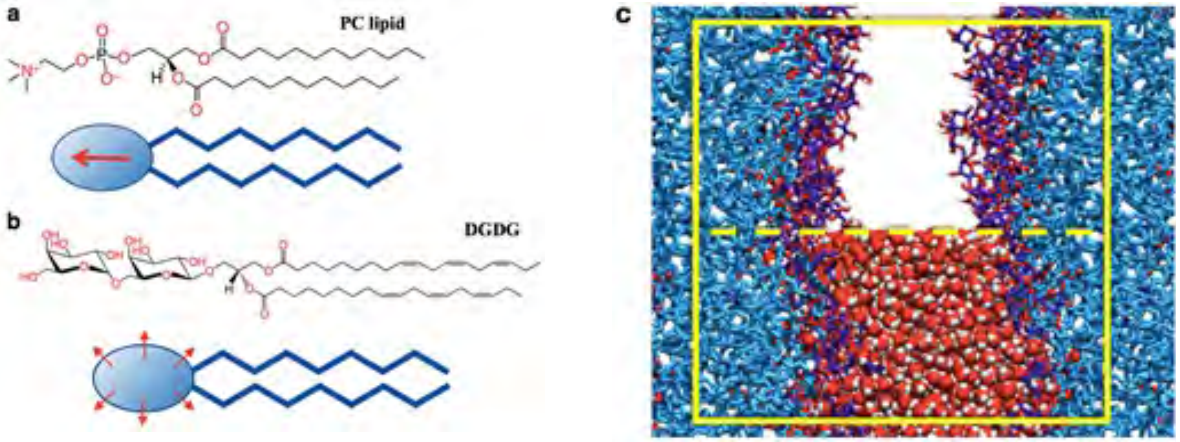

Figure 3: Chemical structures of (a) a PC lipid with one large electric dipole and of (b) a glycolipid (here: DGDG) comprising multiple small electric dipoles in the form of OH groups. Both are schematically illustrated below the chemical structures. (c) Simulation snapshot of interacting DGDG membranes. The simulation box with periodic boundary conditions is indicated with a bright rectangle. For illustration, water molecules are only shown in the lower half of the box.

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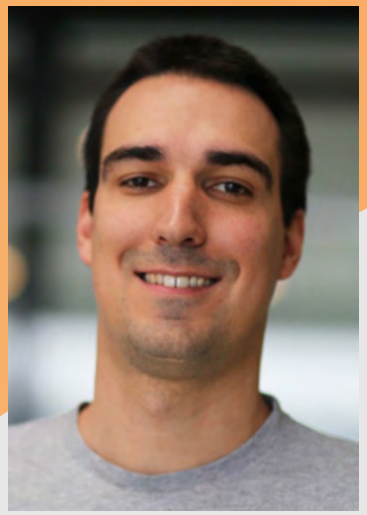

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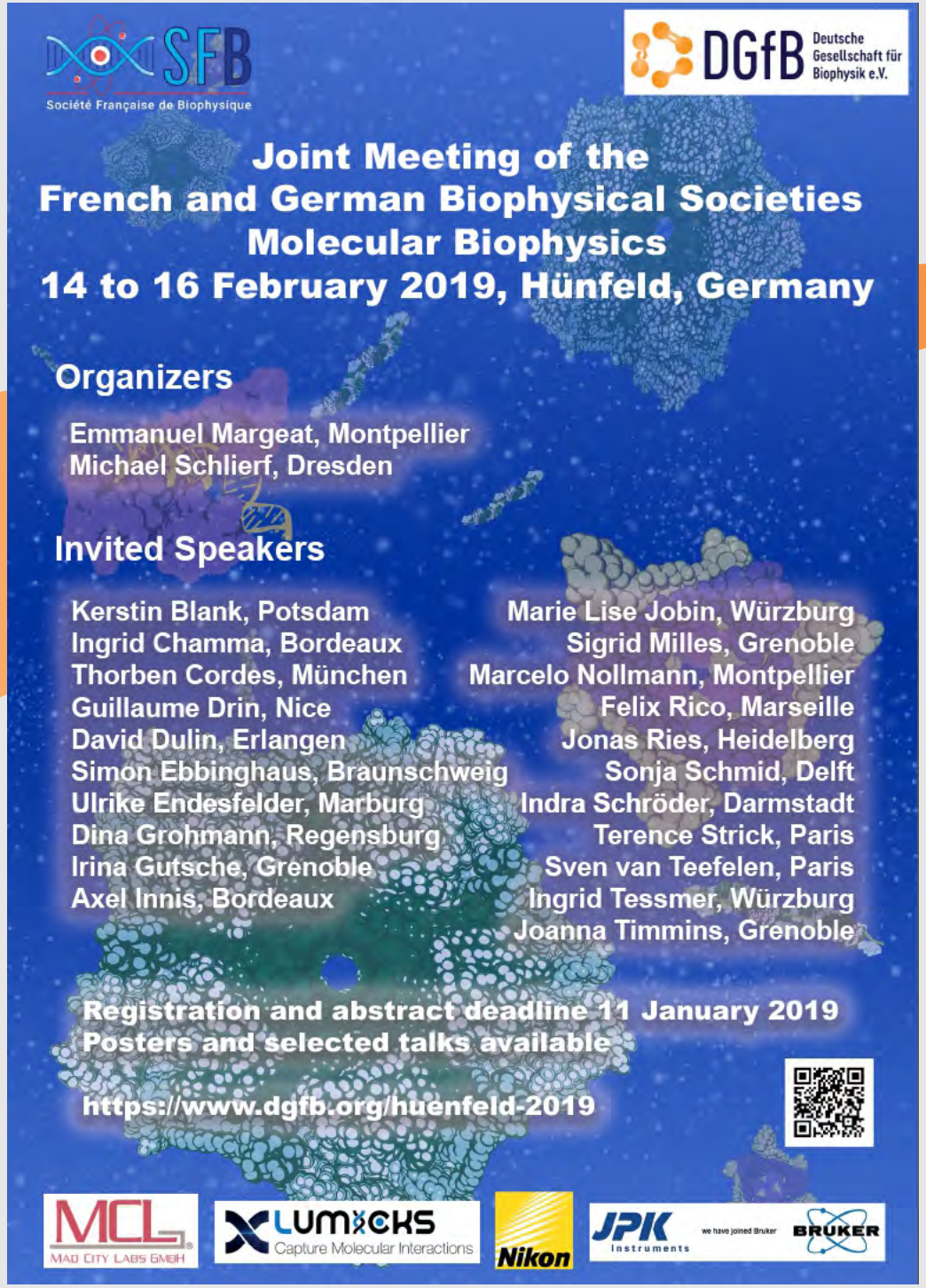
Frühjahrstagung der Sektion „Molekulare Biophysik“ im Februar 2019 in Hünfeld



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