CPP 14: Poster: Bioinspired Functional Materials

Time: Monday 18:30–21:00 Location: P1C

CPP 14.1 Mon 18:30 P1C

Rethinking superhydrophobicity — •Schellenberger Frank, Encinas Noemí, Vollmer Doris, and Butt Hans-Jürgen — Max Planck Institute for Polymer Research, Mainz, Germany

To a certain degree, it is possible to control the macroscopic wetting properties of a surface by its nano- and microstructure. In particular, super liquid-repellant-surfaces have received interest due to their many potential applications, such as anti-fouling for for example. Super liquid-repellency can be achieved by nano- and microstructuring a low energy surface in a way, that the structure can entrap air underneath the liquid. The common criteria for super liquid-repellency are a high apparent advancing contact angle and a low contact angle hysteresis. For a better understanding of how a drop advances and recedes on such a structured surface, we imaged the motion of a water drop on a superhydrophobic array of micropillars by laser scanning confocal microscopy (LSCM). With LSCM, we imaged an advancing water front on a superhydrophobic surface at a resolution of 1 *m. The results give a qualitatively new picture of how water advances on the microscopic scale. We demonstrate that in contrast to traditional goniometer measurements, the advancing contact angle is close to 180° or even higher. In contrast, the apparent receding contact angle is determined by the strength of pinning. We propose that the apparent receding contact angle should be used for characterizing super liquid-repellent surfaces [1,2].

[1]F. Schellenberger et al., Phys. Rev. Lett. 116, 096101 (2016) [2]P. Ball, Nature Materials 15, 376 (2016)

CPP 14.2 Mon 18:30 P1C

3D depth profiles of tip–sample interaction on type I collagen fibrils in humid air — •Robert Magerle[1], Manuel R. Uhlig[1], Diana Voigt[1], Martin Dehnert[1], and Anke Bernstein[2] — [1]Fakultät für Naturwissenschaften, Technische Universität Chemnitz — [2]Orthopädie und Traumatologie, Universitätsklinikum Freiburg

The water content and intermolecular crosslinks between collagen fibrils are important factors that determine the mechanical properties of type I collagen fibrils. With atomic force microscopy (AFM) we study reconstituted type I collagen fibrils (without crosslinks) and native fibrils from sheep tendon (with crosslinks). The water content in the fibrils is controlled via the relative humidity of air in the AFM. We measure force–distance (FD) curves and amplitude–phase–distance (APD) curves and reconstruct from this data three-dimensional (3D) depth profiles of the tip–sample interaction. This reveals the contributions of the attractive capillary interaction, the adhesive interaction as well as the repulsive viscoelastic response of the hydrated collagen fibrils. Furthermore, the 3D depth profiles of the tip–sample interaction allow for accurate measurements of the fibrils' shape and the fibrils' swelling behavior with increasing water content. We compare this with the related changes in the fibrils' elastic modulus and discuss the role of water content and intermolecular crosslinks in collagen fibrils.

CPP 14.3 Mon 18:30 P1C

Study of the ion channels insertion in artificial membranes — Marcelo Cisternas[1,2], Vanessa Zepeda[1,2], Maria Jose Retamal[1,2,5], Tomas P. Corrales[3], Nicolas Moraga[1,2], Diego Diaz[1,2], Rodrigo Catalan[1,2], Sebastian Gutierrez[4], Tomas Perez-Acle[4], Patrick Huber[6], and •Ulrich G. Volkmann[1,2] — [1]Instituto de Fisica, P. Univ. Catolica de Chile (UC), Santiago, Chile — [2]CIEN-UC, P. Univ. Católica de Chile (UC), Santiago, Chile — [3]Facultad de Fisica, UTFSM, Valparaiso, Chile — [4]DLab, Fundacion Ciencia y Vida, Santiago, Chile — [5]Facultad de Quimica, P. Univ. Catolica de Chile (UC), Santiago, Chile — [6]Institute of Materials Physics and Technology, TUHH, Hamburg, Germany

The study of artificial membranes is important, because these model-membranes represent the behavior of its biological analogs, with a similar structure, composed of a series of phospholipids and proteins, altering their behavior when exposed to physical and chemical stimulations. This motivates possible applications, for example in the detection and transduction of molecular signals, a very important step in the development of biosensors. In this research we measured the change in the capacitive response of a system, composed by a DPPC bilayer on a thin layer of Chitosan (CH) deposited on a silicon substrate. The system was immersed into a protein solution of gramicidin and the study of the change of the capacitive response confirms the ion channel formation in the bilayer. Acknowledgements: MJR: Fondecyt postdoc 3160803. UGV: Fondecyt 1141105 y CONICYT-PIA ACT 1409. TPC: Fondecyt Iniciación 11160664, MC: CONICYT scolarship.

CPP 14.4 Mon 18:30 P1C

AFM study of evaporated phospholipidic bilayer on thin film chitosan in liquid environment — Rodrigo Catalan[1,3], Maria Jose Retamal[1,2,3], Diego Diaz[1,3], Marcelo Cisternas[1,3], Nicolas Moraga[1,3], Tomas P. Corrales[4], Marco Soto-Arriaza[2], Patrick Huber[5], and •Ulrich G. Volkmann[1,3] — [1]Instituto de Fisica, P. Univ. Catolica de Chile (UC), Santiago, Chile — [2]Facultad de Quimica, P. Univ. Catolica de Chile (UC), Santiago, Chile — [3]CIEN-UC, P. Univ. Catolica de Chile (UC), Santiago, Chile — [4]Facultad de Fisica, UTFSM, Valparaiso, Chile — [5]Institute of Materials Physics and Technology, TUHH, Hamburg, Germany

Self-assembly of artificial biological membranes on solid substrates has gained importance due to the potential applications in the field of BioNanotechnology. Particularly important are phospholipidic membranes, e.g. DPPC, which interact with proteins that regulate the flow of ions across the membrane. In a previous work we have shown that DPPC forms a bilayer on silicon, which can serve for biosensoric applications. We have extended this concept to other phospholipids to explore their interactions with proteins. We present a thermal and morphological study of three phospholipidic thin-films: DODAB, DSPC and DMPC. These films are fabricated by Physical Vapour Deposition (PVD) on silicon and analyzed with Atomic Force Microscopy (AFM) in liquid at various temperatures. We show that these phospholipids do not decompose during PVD. Acknowledgements: MJR: Fondecyt postdoc 3160803. UGV: Fondecyt 1141105 y CONICYT-PIA ACT 1409. TPC: Fondecyt Iniciación 11160664, MC: CONICYT scolarship.

CPP 14.5 Mon 18:30 P1C

Optical characterisation of single setae of the Saharan silver ant — •Bertram Schwind[1], Helge-Otto Fabritius[2], Thorsten Wagner[1], and Xia Wu[1] — [1]Department of Chemistry, University of Paderborn, Warburger Straße 100, 33098 Paderborn, Germany — [2]Max-Planck-Institut für Eisenforschung GmbH, Max-Planck-Straße 1, 40237 Düsseldorf, Germany

The Saharan silver ant (*Cataglyphis bombycina*) is adapted to extreme hot environmental conditions of the sahara desert [1]. The body of the ant is covered with a dense array of triangular shaped setae [2]. These setae not only reflect the incoming solar radiation by internal total reflection [3], but also enhance radiative cooling [2].

To deepen our understanding on the optical properties of the setae, we measured transmission spectra of single setae by FTIR from the MIR to visible range. Both the chemical composition and the orientation of the setae may have an influence on the shape of the transmission spectra. The absorption bands in the MIR region identify the composition of the setae. The relationship between the structure of the setae (orientation, shape, size, surface morphology) and scattering is investigated by transmission experiments combined with FDTD simulations.

References:

[1] Wehner, R. et al., Nature 357, pp. 586 - 587, 1992; doi: 10.1038/357586a0

[2] Norman, N. S. et al., Science 17 Jul 2015: Vol. 349, Issue 6245, pp. 298-301, doi: 10.1126/science.aab3564

[3] Willot, Q. et al., PLoS ONE 11(4): e0152325. doi:10.1371/journal.pone.0152325

CPP 14.6 Mon 18:30 P1C

Simulation of the Cuticular Photonic Crystals Evolved by the Neotropic Weevil Entimus Imperialis — •Fernando Luis Rodríguez Gallegos[1], Xia Wu[2], and Jens Förstner[1] — [1]Theoretical Electrical Engineering Group, Paderborn University, Germany — [2]Department of Chemistry, Paderborn University, Germany

We analyze the reflectance within the visible spectrum of the photonic crystals found in the scales of the neotropic weevil Entimus Imperialis. Our simulations show that the reflected signal at certain frequencies is cross polarized with respect to the excitation source. We present details of our simulation procedure, explain the underlying mechanism using a reduced equivalent structure and finally show the agreement to our experimental results.

CPP 14.7 Mon 18:30 P1C

Actin stress fiber dynamics under lateral constraint — •Andreas Müller and Tilo Pompe — Universität Leipzig, Institute of Biochemistry, Johannisallee 21-23, 04103 Leipzig

Cells at interfaces experience inhomogeneous mechanical environments, including spatial constraints, even down to 1D confinement, e.g., on single fibers in reconstituted in vitro fibrous scaffolds and also in various tissues in vivo. Previously, we found a bimodal distribution of actin stress fibers in cells under varying lateral constraint, indicated by the distinct formation of exterior and interior stress fibers and their respective spacing. We now investigated the dynamics of stress fiber formation and the correlated cell traction forces.

We use micro-patterned hard substrates and polyacrylamide hydrogels with fibronectin for subsequent culture of cells on stripe-like patterns. Cells are analyzed for several hours using SiR-Actin probes, focusing on actin cytoskeleton pattern, overall cell characteristics, and cell traction forces. We show that the magnitude of traction forces does correlate weakly with lateral constraint while actin cytoskeleton morphology and directionality of traction forces are strongly correlated and governed by the degree of confinement. Furthermore, time resolved actin stress fiber patterns are investigated in relation to cell dynamics.

With our setup, we are able to determine the mechanical and morphological response of cells in spatially constraining environments in a time-resolved manner.

CPP 14.8 Mon 18:30 P1C

Dissipative bio-inspired supramolecular materials — •Marta Tena-Solsona, Benedikt Reiss, and Job Boekhoven — Technische Universität München

Synthetic self-assembled supramolecular materials have enormously developed during last decades. Applications of them are found in healthcare opto-electronics, and a wide range of fields. Although the behavior of these man-made materials is well-known, they are far from competing with biological counterparts. Especially, concerning spatio-temporal control, responsiveness, or adaptivity against external stimuli. The main differences between both type of systems lie in the energy balance. While most artificial assembled materials operate close to the thermodynamic equilibrium, many of the more advanced biological machineries are kinetically governed by self-assembly processes. These processes require a constant input of energy in order to be sustained, and to continuously dissipate energy. This dissipative mode of self-assembly requires specific design rules which are not fully understood in chemically driven man-made materials. Therefore, the design of these dissipative self-assembled systems remains challenging and the number of man-made examples is still limited. Our work focuses on translating the interesting properties biology offers, to the fully synthetic dissipative assemblies. We have designed a chemical reaction network based on small molecules that forms transient, far from-equilibrium materials, by consuming a chemical fuel. The dissipative nature of our system allows us to spatio-temporary control these assemblies which are of colloidal nature or hydrogels.