BP 9: Posters: Biotechnology and bioengineering

Time: Monday 17:30–19:30 Location: P3

BP 9.1 Mon 17:30 P3

Quantum-mechanical study of crystalline and amorphous calcite — Gernot Pfanner[1], •Martin Friák[1,2], Li-Fang Zhu[1], Svetoslav Nikolov[3], Anna Maria Janus[1], Helge Otto Fabritius[1], Pavlína Hemzalová[1], Duancheng Ma[1], Dierk Raabe[1], Julia Huber[4], Andreas Ziegler[4], and Jörg Neugebauer[1] — [1]Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf, Germany — [2]Institute of Physics of Materials AS CR, v.v.i. Brno, Czech Republic — [3]Institute of Mechanics, Bulgarian Academy of Sciences, Sofia, Bulgaria — [4]Central Facility for Electron Microscopy, University of Ulm, Ulm, Germany

Arthropoda, that represent nearly 80 % of all known animal species, are protected by an exoskeleton formed by their cuticle. The cuticle represents a hierarchically structured multifunctional bio-composite based on chitin and proteins. Some groups like Crustacea reinforce the load-bearing parts of their cuticle with calcite. We present a theoretical parameter-free quantum-mechanical study of the phase stability and structural and elastic properties of both crystalline and amorphous (ACC) calcite employing a supercell approach. Computational supercells employed as structural models for crystalline and amorphous calcite contain six and twenty $CaCO_3$ formula units, respectively. Our comparative study shows that the density of amorphous calcite is lower than that of its crystalline form and that also the studied single-crystalline elastic constants are lower in case of ACC. Both findings are in qualitative agreement with available experimental data.

BP 9.2 Mon 17:30 P3

Hardware implementation of artificial memristors for neural networks — •Bernhard Kaltschmidt, Marius Schirmer, Savio Fabretti, and Andy Thomas — Bielefeld University, Bielefeld, Germany

Recently, we developed a circuit board, which is able to simulate a memristor like behavior. This circuit board was combined with *Lego Mindstorms NXT*. With this strategy, it was possible to emulate associative memory in an autonomous robot. Currently, we are working on our next step. Here, we want to replace the *Lego Mindstorms NXT* with a combination of a *Raspberry Pi* mini computer and a circuit board (*Brick Pi*), which offers the ports to connect original *Lego*-elements. The intention of this project is to upgrade the weak processing unit of the *Lego Mindstorms NXT* with a device, which has all the abilities of a complete computer system. This is supported by the simulation of the Pavlov model network in *Brian*.

BP 9.3 Mon 17:30 P3

Bioactive Surfaces by Polymer Pen Lithography — •Ravi Kapoor[1], Falko Brinkmann[1,2], Sylwia Sekula-Neuner[1], Michael Hirtz[1], and Harald Fuchs[1,2] — [1]Institut für Nanotechnologie (INT) & Karlsruhe Nano Micro Facility (KNMF), Karlsruher Institut für Technologie (KIT), 76021 Karlsruhe, Germany — [2]Physikalisches Institut & Center for Nanotechnology (CeNTech), Universität Münster, 48149 Münster, Germany

Polymer pen lithography (PPL) is a promising soft lithography technique which has the capability of patterning large areas with precision without denaturing or damaging delicate organic and biologically active compounds. PPL is actually combination of microcontact printing and dip-pen nanolithography, and it takes the advantage of microcontact printing for patterning large areas and dip-pen nanolithography for precisely delivering the ink molecules on the surface. The ink transfer mode is alike microcontact printing or pen spotting approaches, depending on the ink / substrate combination. Multiplexing, i.e. patterning more than one ink compound in close proximity onto the surface is highly demanded in biological applications and can be provided by PPL. Here we present the application of PPL for patterning with different bio-active ink / substrate combinations, e.g. a DNP azide ink on an alkyne-terminated surface with copper catalyzed azide-alkyne cycloaddition (CuAAC). The retained functionality of the DNP allergen head group is confirmed by detection of allergen specific Immunoglobin E (IgE) antibodies. This will offer important improvements for substrates used in the study of mast cell activation in the future.

BP 9.4 Mon 17:30 P3

Single molecule detection of insulin autoantibodies in type 1 diabetes — •Juliane Beyer[1], Ralf Paul[2], Ezio Bonifacio[2], and Stefan Diez[1,3] — [1]B CUBE - Center for Molecular Bioengineering, Technische Universität Dresden, Germany — [2]CRTD - Center for Regenerative Therapies Dresden, Germany — [3]Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany

Type 1 diabetes (T1D) is characterized as a chronic autoimmune disease caused by a selective inflammatory destruction of the insulin producing beta cells in the pancreatic islets of Langerhans. Closely associated to T1D are insulin autoantibodies (IAAs), representing early markers of the disease. Therefore the reliable detection is needed to i) predict the onset of T1D, ii) implement successful regenerative therapies and iii) to prevent loss of the beta cell mass.

For this purpose, we developed a novel optical assay for the detection of insulin autoantibodies using single molecule detection. This quantitative approach specifically detects IAAs in the low pM range using quantum dots and total internal reflection microscopy (TIRF).

So far, for clinically diagnostics, IAAs are detected using an antigen radiolabelling approach which is time consuming, hazardous and expensive. With our novel assay we are able to specifically detect high affinity antibodies without using radiolabelled antigens.

In the future our assay could be used as a point of care measurement for T1D, readily usable in the health care sector combining the prognostic and diagnostic measurements of autoantibodies in T1 D.

BP 9.5 Mon 17:30 P3

Programmable patterning of protein bioactivity on surfaces using visible light — •Cordula Reuther[1,2], Robert Tucker[2,4], Leonid Ionov[2,3], and Stefan Diez[1,2] — [1]B CUBE, TU Dresden, Dresden, Germany — [2]Max-Planck-Institute of Molecular Cell Biology and Genetics, Dresden, Germany — [3]Leibnitz Institute for Polymer Research, Dresden, Germany — [4]Hansen Medical, Mountain View, California, USA

Patterning functional proteins on engineered surfaces is of interest for the development of nanotechnology, tissue engineering, biosensors and cell biology. Here, we report on the programmable patterning of proteins as well as the local activation of enzymes using patterned wide-field illumination by visible light. Specifically, the light locally heats the carbon-coated surface and switches the conformation of a thermo-responsive poly(N-isopropylacrylamide) (PNIPAM) polymer layer in aqueous solution between the swollen state at $T < 30°C$ (protein-repelling conformation) to the collapsed state at $T > 33°C$ (protein-binding conformation). Thereby, functional protein patterns with different geometries and sizes could be successfully generated in situ. Moreover, we demonstrated the specific patterning of multiple kinds of proteins side-by-side by sequential processing without the need for specific linker molecules or elaborate surface preparation. Additionally, while performing microtubule-based gliding motility assays, the accessibility of kinesin-1 motor proteins could be switched reversibly in a localized manner.

BP 9.6 Mon 17:30 P3

DNA origami nanopores for controlling DNA translocation — Silvia Hernandez Ainsa, Nicholas Bell, Vivek Thacker, Kerstin Göpfrich, Karolis Misiunas, and •Ulrich F Keyser — Cavendish Laboratory, University of Cambridge, JJ Thomson Ave, CB3 0HE, Cambridge, UK

DNA origami nanopores are emerging as sensors for biological molecules [1]. Here, we combine DNA origami structures with glass nanocapillaries to reversibly form hybrid DNA origami nanopores. Trapping of the DNA origami onto the nanocapillary is proven by imaging fluorescently labeled DNA origami structures and simultaneous ionic current measurements of the trapping events [2]. We show three applications highlighting the versatility of these DNA origami nanopores. First, by tuning the pore size we can control the folding of dsDNA molecules. Second, we show that the specific introduction of binding sites in the DNA origami nanopore allows selective detection of ssDNA as a function of the DNA sequence [2]. Third, we are able to use voltage to change the state of our DNA origami nanopores to lower the frequency of DNA translocation and explain this with a mechanical model [3].

[1] N. A. W. Bell et al. DNA origami nanopores. Nano Letters

12(1):512-517, 2012.

[2] S. Hernandez Ainsa et al.DNA origami nanopores for controlling DNA translocation. ACS nano, 7(7):6024-6030 2013.

[3] S. Hernandez Ainsa, et al. Voltage responsive DNA origami nanopores. submitted. 2013.