BP 46: Posters - Biomaterials and Biopolymers

Time: Wednesday 17:00–19:00 Location: Poster C

BP 46.1 Wed 17:00 Poster C

Neutron Reflectometry Yields Structural Insight into Protein Adsorption from Blood Serum onto Polymer Brushes — Ignacio Rodriguez Loureiro[1], •Victoria Latza[1], Avraham Halperin[2], Giovanna Fragneto[3], and Emanuel Schneck[1] — [1]Max Planck Institute of Colloids and Interfaces, Potsdam, Germany — [2]Université Joseph Fourier, Grenoble, France — [3]Institut Laue-Langevin, Grenoble, France

The density profiles of proteins adsorbed from human blood serum onto poly(ethylene glycol) (PEG) brushes grafted to phospholipid surfaces are characterized by neutron reflectometry (NR). PEG brushes are commonly used to suppress undesired protein adsorption to biotechnological surfaces but brush failure is often reported. In contrast to conventional methods, NR with contrast variation allows directly distinguishing among primary protein adsorption at the grafting surface, secondary adsorption at the brush outer edge, and ternary adsorption to the polymer chains. We find significant primary protein adsorption into the lipid headgroup region. At the same time our results exclude pronounced ternary adsorption. Interestingly, the total amount of protein adsorbed to the brush-decorated surfaces is comparable to that adsorbed to the bare lipid surfaces.

BP 46.2 Wed 17:00 Poster C

Novel hybrid hydrogel substrates elicit differential responses from human mesenchymal stem cells — •Christina Jayachandran[1] and Florian Rehfeldt[2] — [1]Drittes Physikalisches Institut, Georg- August -Universität, Göttingen, Germany — [2]Drittes Physikalisches Institut, Georg- August -Universität, Göttingen, Germany

It has been shown in the recent past that the responses of cells depend upon their environment's physical and chemical properties. Cultured on conventional collagen coated polyacrylamide (PA) gels, cells only 'feel' the linear elastic behaviour, in contrast to native extracellular matrix's non-linear elasticity.

In this study, we prepared hybrid hydrogels by incorporating collagen fibrils into the linearly elastic (PA) hydrogel. We tuned these gels in their physical stiffness from the soft to the stiff regime and investigated the responses of adult human mesenchymal stem cells (hMSC). On soft hybrid gels, hMSCs behave significantly different than on collagen coated gels, as they show classical morphologies resembling a stiff environment. Fluorescence imaging of hybrid gels revealed that stem cells locally re-organize the underlying collagen fibrils. These findings imply that stem cells behaviour is dependent on the non-linear elasticity of collagen and can show 3D network like behaviour even on a 2D hydrogel.

BP 46.3 Wed 17:00 Poster C

Stochastic binding of Staphylococcus aureus — •Nicolas Thewes[1], Alexander Thewes[2], Friederike Nolle[1], Ludger Santen[2], and Karin Jacobs[1] — [1]Saarland University, Dept. of Experimental Physics, 66041 Saarbrücken — [2]Saarland University, Dept. of Theoretical Physics, 66041 Saarbrücken

Bacteria exhibit an outstanding ability to adhere to various kinds of surfaces. The Hydrophobic interaction plays a crucial role for the adhesion of bacteria [1]. Hence, we studied the contact formation process of Staphylococcus aureus to hydrophobic surfaces by combining AFM single cell force spectroscopy and computer simulations of a simple model for bacterial adhesion [2]. We found that the contact formation of S. aureus relies on thermally fluctuation cell wall proteins that tether to a surface and subsequently pull the bacterium to the surface. That way, S. aureus is able to attach to surfaces over distances far beyond the range of classic surface forces.

In our model the bacterial surface biopolymers are represented by elastic springs that interact with a surface via a square potential. The model is analyzed using Monte-Carlo Simulations and the results suggest that the bacterial adhesion process in general, can be described by solely taking into account the tethered biopolymers between a bacterium and a surface.

[1] N. Thewes et al, Beilstein J. Nanotechnol. 2014, 5, 1501 - 1512
[2] N. Thewes et al, Soft Matter 2015, 11, 8913 - 8919

BP 46.4 Wed 17:00 Poster C

DNA-based molecular force sensors in reconstituted actin networks — •Christina Jayachandran[1], Florian Rehfeldt[2], and Christoph Schmidt[3] — [1]Drittes Physikalisches Institut, Georg-August -Universität, Göttingen, Germany — [2]Drittes Physikalisches Institut, Georg- August -Universität, Göttingen, Germany — [3]Drittes Physikalisches Institut, Georg- August -Universität, Göttingen, Germany

Actin is the main structural component of the cytoskeleton among the other bio-polymers responsible for cellular shape and mechanical stability. The actin cytoskeleton which self-assembles into networks of crosslinked filaments and bundles is responsible for a myriad of cellular processes, ranging from migration, division, intracellular transport to cell morphogenesis. Stresses and stress propagation in these networks are crucial for function.

We utilize dsDNA constructs as stress sensors in order to understand network mechanics. We studied the macro- and micro-rheological properties of in vitro actin networks to test the sensors and to analyze network failure mechanisms beyond the non-linear response.

BP 46.5 Wed 17:00 Poster C

Programming mechanics in semiflexible DNA tube networks — •Carsten Schuldt[1,2], Tina Händler[1,2], Martin Glaser[1,2], Tom Golde[1,2], Jessica Lorenz[2], Jörg Schnauss[1,2], Josef A. Käs[1,2], and David M. Smith[2] — [1]Soft Matter Physics Division, Institute for Experimental Physics I, University of Leipzig, Germany — [2]Fraunhofer Institute for Cell Therapy and Immunology, Leipzig, Germany

Biologically evolved materials are often used as inspiration in the both the development of new materials as well as examinations into the underlying physical principles governing their general behavior. One prominent example is the semiflexible polymer actin and its set of modulatory proteins and motors. Here, a major goal is to understand the emergent viscoelastic properties of networks assembled from individual filaments. Impossible with actin, we assess the impact of the filamentous rigidity (persistence length l_p) on network mechanics in *in vitro* experiments. We employ programmable DNA tubes comparable to actin but tunable in their circumference and therefore their l_p.

According to the well established tube model, network elasticity G_0 should drop with increasing l_p. Here, we show that networks made of DNA tubes resemble many of the characteristics of actin. However, we find that network elasticity increases linearly with filaments stiffness $G_0 \sim l_p$. Since our observations are in strong contrast to the theoretical predictions, we conclude that the current tube model describes the bulk elasticity inadequately and demands theoretical revision.

BP 46.6 Wed 17:00 Poster C

Mesh size of semiflexible polymer networks — •Tina Händler[1,2], Martin Glaser[1,2], Tom Golde[1], Carsten Schuldt[1,2], Jörg Schnauss[1,2], Josef Käs[1], and David Smith[2] — [1]University of Leipzig, Soft Matter Physics Division, Leipzig — [2]Fraunhofer Institute for Cell Therapy and Immunology, Leipzig

Studying the mechanics and dynamics of biopolymers has inspired many ideas and theories in polymer physics. One prominent example is actin, being the best-studied semiflexible polymer. Unfortunately, naturally occurring protein-based biopolymers are limited in their properties such as length, stiffness and interaction strengths. This highlights the advantage of having "programmable" model polymers at hand, which give the opportunity to experimentally test parameters otherwise unavailable in natural systems. Nanotubes formed from synthetic DNA strands are an ideal match to this need: they are semiflexible over their typical length scale and can be hybridized to have characteristics such as persistence length which are similar to actin filaments or can be varied in a controllable way. We use this model system to measure the mesh size of entangled networks by observing the reptation of single filaments. The results show a concentration scaling similar to the theoretically predicted scaling for flexible polymers, as opposed to the stiff rod approximation. These findings point towards a more complex description of semiflexible polymer reptation and demonstrate the applicability of this method.