BP 22: Posters - Biomaterials and Biopolymers

Time: Tuesday 14:00–16:00 Location: P1A

BP 22.1 Tue 14:00 P1A

Humidity-controlled gelatin bioactuator — •Stefanie Riedel[1], Benedikt Heyart[1], Katharina Apel[1], and Stefan G. Mayr[1,2] — [1]Leibniz-Institut für Oberflächenmodifizierung e. V., Leipzig, Germany — [2]Fakultät für Physik und Geowissenschaften, Universität Leipzig, Leipzig, Germany

Natural hydrogels such as gelatin are of particular interest in biology and medicine. Due to their strong biocompatibility and biodegradability, they are highly attractive materials in regenerative medicine as extracellular matrix component. Furthermore, stimuli responsiveness of hydrogels attracts considerable interest due to the potential use in sensor and actuator applications. In regard to these applications, adaption of stimuli-responsiveness is an interesting aspect of gelatin modification. Modification of hydrogels can be achieved by crosslinking for which several methods exist. An important method is high energy irradiation by using highly energetic electrons. In contrast to several other crosslinking methods, electron irradiated gelatin is nontoxic and thus beneficial for biological applications. In the presented poster, we show a stimuli-responsive system made up from electron irradiated gelatin that becomes actuated upon exposure to humidity. Furthermore, we demonstrate how adjustment of system's and environmental properties such as gel concentration, irradiation dose, pH and salt concentration allows fine-tuning of the system's response.

BP 22.2 Tue 14:00 P1A

A Self-Assembled Active Plasmonic Waveguide with a Peptide-Based Thermomechanical Switch — Kilian Vogele[1], Jonathan List[1], Günther Pardatscher[1], Nolan B. Holland[2], Friedrich C. Simmel[1], and •Tobias Pirzer[1] — [1]Systems Biophysics and Bionanotechnology E14, Physics-Department and ZNN, TU Muenchen — [2]Department of Chemical and Biomedical Engineering, Cleveland State University

Nanoscale plasmonic waveguides composed of metallic nanoparticles are capable of guiding electromagnetic energy below the optical diffraction limit. Signal feed-in and readout typically requires the utilization of electronic effects or near-field optical techniques, whereas for their fabrication mainly lithographic methods are employed. Here we developed a switchable plasmonic waveguide assembled from gold nanoparticles (AuNPs) on a DNA origami structure that facilitates a simple spectroscopic excitation and readout. The waveguide is specifically excited at one end by a fluorescent dye and energy transfer is detected at the other end via the fluorescence of a second dye. The transfer distance is beyond the multi-color FRET range and below the Abbé limit. The transmittance of the waveguide can also be reversibly switched by changing the position of an AuNP within the waveguide, which is tethered to the origami platform by a thermo-responsive peptide. High yield fabrication of the plasmonic waveguides in bulk was achieved using silica particles as solid supports. Our findings enable bulk solution applications for plasmonic waveguides as light-focusing and light-polarizing elements below the diffraction limit.

BP 22.3 Tue 14:00 P1A

Time dependent fluoride uptake in hydroxyapatite from aqueous NaF solution - How long should we brush our teeth? — •Thomas Faidt[1], Christian Zeitz[1], Samuel Grandthyll[1], Michael Hans[2], Matthias Hannig[3], Karin Jacobs[1], and Frank Müller[1] — [1]Experimental Physics, Faculty of Natural Sciences and Technology, Saarland University, 66123 Saarbrücken, Germany — [2]Functional Materials, Faculty of Natural Sciences and Technology, Saarland University, 66123 Saarbrücken, Germany — [3]Clinic of Operative Dentistry, Periodontology and Preventive Dentistry, Faculty of Medicine - Clinical Medicine, Saarland University Hospital, 66421 Homburg, Germany

The application of fluoride containing products to protect tooth enamel from caries has been daily practice for many decades. However, to this day little is known about the time dependence of fluoride uptake in hydroxyapatite (HAP) which is the mineral component of human enamel. In our study, we use HAP pellet samples as a model system for the crystallites of tooth enamel. To investigate the time dependence of the fluoride uptake, samples were exposed to a fluoride solution (NaF, 500 ppm) for different times, resembling the tooth brushing process. XPS depth profiling revealed a saturation behavior both for the overall amount of fluoride taken up by the sample and for the thickness of the formed fluoridated layer. Our results show that the usual application times of about 2 minutes for, e. g., toothpastes are already in a range to ensure the maximum uptake of fluoride.

BP 22.4 Tue 14:00 P1A

Magnetic nanoparticles-filled carbon nanotubes as potential thermo-seed for Hyperthermia — •Rasha Ghunaim[1], Sebastian Schulz[2], Christian Kobrow[2], Silke Hampel[1], Ruediger Klingeler[2], and Bernd Buechner[1,3] — [1]IFW-Dresden, Germany — [2]Kirchhoff Institute for Physics,Heidelbeg,Germany — [3]TUD-Dresden,Germany

Hyperthermia can be considered as a promising tool for cancer treatment; based on the prolonged and controlled exposure of the body tissues to a temperature in the range of 40-43 °C.Magnetic nanoparticles (MNPs) are considered as promising tools for an effective therapeutic approach against cancer. These MNPs can be heated up in a (AC) magnetic field, which leads to their use as hyperthermia candidates, this magnetic-based hyperthermia is called magnetic fluid hyperthermia (MFH). However, to consider these MNPs safe and effective for the patient, they are encapsulated inside the hollow cavity of carbon nanotubes (CNTs). These nano-carries are chemically stable (protect MNPs from oxidation due to interaction with the biological system), biocompatible (can easily penetrate biological barriers) and have functionalizable surface (for better bonding with matrix elements and compounds.In this work, the current candidates for MFH are mainly binary alloys of Fe-Co, Fe-Ni, Ni-Cr, Ni-Cu and Co/Ni-ferrites.Their feasibility for magnetic hyperthermia therapies is exploited by investigating induced heating under AC magnetic field. Quantitatively, their Specific Absorption Rate (SAR) can give a hint about the amount of heat released by unit mass of material per unit time

BP 22.5 Tue 14:00 P1A

functionalized DNA origami nanostructures for molecular electronics — •Türkan Bayrak[1,2], Bezu Teschome[1,2], Tommy Schonherr[1], and Artur Erbe[1] — [1]1 Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden,Germany. — [2]Technische Universität Dresden, cfaed, 01062 Dresden, Germany.

The DNA origami method provides a programmable bottom up approach for creating nanostructures of any desired shape, which can be used as scaffolds for nanoelectronics and nanophotonics devices. (1,2,3) This technique enables the precise positioning of metallic and semiconducting nanoparticles along the DNA structures.(4) In this study, two nanostructures, i.e. DNA origami nanotube and DNA origami molds (5), are used for the fabrication of nanoelectronic devices. To this end, the DNA origami nanotubes are modified to assemble 14 gold nanoparticles (AuNPs) along them. Then electroless gold deposition is used to selectively grow the AuNPs and create eventually continues nanowires. Similarly, AuNPs are also grown within the DNA origami molds. In order to investigate the transport properties of the so-fabricated nanostructures, a method is developed by electron beam lithography. Additionally, the assembly of heterogeneous nanostructures, i.e. AuNPs and quantum dots (QDs), on a single DNA origami nanotube is demonstrated and further metallized, thus representing a first step toward the fabrication of DNA origami-templated quantum dot transistors. 1Rothemund , Nature 440.7082 (2006) 2Teschome, et al. Langmuir 32.40 (2016) 3Samanta, et al. Nanoscale 7.6 (2015) 4Teschome, et al. Langmuir 31.46 (2015) 5Helmi, et al. Nano letters 14.11 (2014)

BP 22.6 Tue 14:00 P1A

Novel Hybrid hydrogel substrates with non-linear elastic response — •Christina Jayachandran and Florian Rehfeldt — Third Institute of Physics, Georg- August Universität

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 elastic response.

Here, we present novel hybrid hydrogels that mimic the heterogeneous structure and the non-linear elastic behaviour of connective tissue by incorporating collagen fibrils into PA hydrogels. We tuned the

Young's modulus over a broad physiologically relevant range and investigated the responses of adult human mesenchymal stem cells (hMSC). On soft hybrid gels, hMSCs behave significantly different than on collagen coated gels of the same stiffness, exhibiting a typical morphology known from stiff environments. Fluorescence imaging of hybrid gels revealed that stem cells locally re-organize the underlying collagen fibrils. These findings implicate that the responses of stem cells are largely dependent on the non-linear elasticity of their environment.

BP 22.7 Tue 14:00 P1A

Liquid crystalline ordering of amyloid-iron(II,III) oxide hybrid fibrils under magnetic field — •Jianguo Zhao[1], Sreenath Bolisetty[1], Stephane Isabettini[2], Joachim Kohlbrecher[3], Jozef Adamcik[1], Peter Fishcer[2], and Raffaele Mezzenga[1] — [1]Laboratory of Food and Soft Materials, D-HEST, ETH Zurich — [2]Laboratory of Food Process Engineering, D-HEST, ETH Zurich — [3]Laboratory of Neutron Scattering and Imaging, PSI

Magnetic field is a promising approach to induce spatial ordering in the originally disordered suspension of magneto-responsive rod-like particles. By loading iron(II,III) oxide nanoparticles with amyloid fibrils, we fabricated hybrid fibrils having high magneto-responsiveness, high aspect ratio (length-to-diameter, L/D) and flexibility. An apparently increased orientation was obtained upon increasing magnetic field strength and fibrils volume fraction (phi). At constant dimensionless concentration (phi*L/D), stiff hybrid fibrils with varied aspect ratios and volume fractions displayed identical degree of ordering at constant magnetic field; while the semiflexible fibrils with contour length close to persistence length exhibited a lower degree of alignment. To the best of our knowledge, this is first direct experimental proof of Khokhlov-Semenov theory, which predicts that the ordered phase for anisotropic colloidal particles is highly restricted by the semiflexible nature of the particles under external fields. We believe these findings are detrimental for the fundamental understanding and applications of liquid crystalline phases in numerous external fields. *current address: Drittes Physikalisches Institut, Georg-August-Universität Göttingen.

BP 22.8 Tue 14:00 P1A

Zno nanowires application in controlling the wettability for biomedical uses — •Amitender Singh and Saravjeet Singh — Deenbandhu Chhotu Ram University of Science and Technology Murthal, Sonipat-131039, India

Hydrophobic materials are widely used for different biological applications and nanostructures are mainly used for preparation of hydrophobic surfaces. Mainly used materials and polymers for these studies are silicone, polydimethylsiloxane (PDMS) and poly (methyl methacrylate) (PMMA) etc. To achieve this hydrophobicity, various attempts have been made recently to improve the surface properties by various chemical and physical methods. The host-material interactions take place through the surface of the material. So, the material*s biocompatibility is mainly related to its surface properties more as compared to its bulk properties. Further, Wang et al. showed that ZnO nanowires are completely bio-safe and biocompatibility when used in various concentrations below 100μg/ml. This study is aimed to develop facile method to prepare hydrophobic coating on various substrates for different biomedical applications. Here, we report the variations in contact angle on various substrates like; glass, quartz, Si and PDMS where CA measurements were done before and after ZnO nanowires coating. A drastic change in CA was found after ZnO nanowires coating on various substrates. It was found that the surface wetting properties can be tuned further for various biomedical applications like wound dressing, surgical tools and bio implants.

BP 22.9 Tue 14:00 P1A

Tuning synthetic semiflexible networks by bending stiffness — •Carsten Schuldt[1,2], Jörg Schnauss[1,2], Tina Händler[1,2], Martin Glaser[1,2], Jessica Lorenz[2], Tom Golde[1], Josef A. Käs[1], and David M. Smith[2] — [1]Institute for Experimental Physics I, Leipzig University, Germany — [2]Fraunhofer IZI, Leipzig, Germany

The mechanics of complex soft matter such as cells or tightly-entangled biopolymer networks cannot be understood in the classical physical frame of flexible polymers or rigid rods. Instead, the underlying filaments are semiflexible, with their finite bending stiffness leading to non-trivial bulk mechanical responses. A natural model for such polymers is the protein actin. Experimental studies of actin networks, however, are limited since the persistence length cannot be readily tuned.

Here, we experimentally investigated this parameter for the first time through bulk rheological and single-filament measurements of entangled networks formed by structurally tunable DNA nanotubes. This de novo model system enabled the validation of numerous characteristic properties inherent to semiflexible polymers and networks thereof, i.e. persistence length, inextensibility, reptation, and mesh size scaling. The scaling of the elastic plateau modulus with concentration is consistent with previous measurements and established theories. In contrast, we showed that the elastic plateau modulus scales linear with the persistence length, which drastically opposes the predominant theoretical predictions [1].

[1] Schuldt et al.: Tuning synthetic semiflexible networks by bending stiffness, Phys. Rev. Lett. 117, 197801 (2016)