Contributed talks

Single Particle Plasmon Sensors as Label-free Technique to Monitor the Dynamics of MinDE Protein Wave on Membranes
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Plasmonic gold nanorods are widely used as sensors to detect the changes in refractive index of the surrounding medium.1 The small detection volume around gold nanorods allows to study local attachment/detachment of proteins with high precision on single nanoparticle level.2,3 The measurement of these dynamics requires a combination of high time resolution and spectral precision, which we achieve with an optical dark-field spectroscopy setup, where the scattering spectrum of an individual gold nanorod is detected by a charge-coupled device (CCD) camera coupled to a transmission spectrometer. We use single particle plasmon sensors to investigate the Min system proteins attaching and detaching from lipid coated gold nanorods with an unprecedented bandwidth of 100 ms time resolution and one hour observation time. The long observation reveals small changes of the oscillation period over time. Averaging many cycles yields the precise wave profile that exhibits the four phases suggested in previous reports. Furthermore, our results show coverage oscillations on top of a static background that is absent in fluorescence-based studies and is indicative of a layer of permanently bound proteins. Hence, our single particle plasmon sensor is an attractive tool for studying dynamic processes at the molecular scale as it enables us to access the development of the protein surface coverage over time without any manipulation of the proteins for fluorescence labeling.


Nematoelastic crawlers and swimmers
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Instructions defining a process of reshaping can be determined by intrinsic geometry of object. Liquid crystal elastomers that demonstrate a strong coupling between the molecular orientation and mechanical deformations provide an opportunity to create actuators with a preorganized molecular structure. A propagating chemical wave or an external signal, e.g. a light beam, triggering a local phase transition in a nematic elastomer set it into a motion. Firstly, we consider a crawling motion of the various configurations of slender rods and thin stripes with both uniform and splayed nematic order in cross-section and detect the dependence of the gait and speed on flexural rigidity and substrate friction. Then we investigate a motion of a flexible Stokesean flagellar swimmer realised as a yarn made of two intertwined elastomer fibres, one active, that can reversibly change its length in response to a local excitation causing transition to the nematic state or swelling, and the other one, a passive isotropic elastomer with identical mechanical properties. Effectiveness, advancement and characteristic trajectories of the swimmer were examined.
Au-polystyrene Janus particles demonstrate a thermophoretic induced motion under laser illumination (λ=532 nm). The plasmons in the gold cap of the particle get excited and cause a local temperature gradient around the particle. Such out-of-equilibrium condition at the surface of the particle leads to its self-propulsion. In this study we explore the 2D self-propulsion of Janus particles between two glass substrates. The substrate is functionalized with PNIPAM brushes, as it is hypothesized that the lubricative nature of brushes will reduce the friction coefficient of the substrate which subsequently has a significant influence on the motion of particles close to the substrate. Hence, polymer brushes with varied thicknesses have been synthesized and the corresponding elastic properties have been characterized using colloidal probe AFM. Trajectories of particles are represented under different laser intensities.

Stochastic switching between multistable oscillation patterns of the Min-system

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The spatiotemporal oscillation patterns of the proteins MinD and MinE are used by the bacterium E. coli to sense its own geometry and are a prime example of a selforganizing protein system. Strikingly, both computer simulations and experiments have recently shown that for the same geometry of the reaction volume, different oscillation patterns can be stable, with stochastic switching between them. Here we use particle-based Brownian dynamics simulations to predict the relative frequency of different oscillation patterns over a large range of three-dimensional compartment geometries, in excellent agreement with experimental results. We also identify novel oscillation patterns in three-dimensional compartments with membrane-covered walls and identify a linear relation between the bound Min-protein densities and the volumeto-surface ratio. Looking at the protein densities of stable oscillation modes we additionally observe that the activator protein MinE is almost entirely depleted from the bulk volume. We analyze the geometrical determinants of these processes and assess their physiological relevance for living bacteria. In general, our work shows how geometry-sensing is limited by multistability and stochastic fluctuations.

Self-Assembly of Nanotubules Formed by Short Amphiphilic Peptides in Solution

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Enhancing the general understanding of the self-assembly processes in systems containing proteins or peptides (natural or synthetic ones, designed to mimic the behavior of their natural counterparts) has been the focus of work for many scientists during the last years as the formation of fibrils and tubular nanostructures is linked to certain incurable diseases (e.g. Alzheimer's disease and type II diabetes) [1,2]. Despite all these efforts the self-assembly of peptides into nanotubes is still not fully understood. Nanotubes with a well-defined radius can be formed by self-assembly of amino acid amphiphiles (AAAs, short synthetic peptides generated from amino acids and fatty acids). The self-assembly of the AAA K:C12-B12 (N-α-lauryl-lysyl-aminolauryl-lysyl-amide) has been studied to some extent [3]. It self-assembles into stable nanotubes of great length (up to several μm) and a diameter of 70-100 nm by progressing from long thin fibers via twisted and helically coiled ribbons to nanotubes [4].
Systematic modification of the chemical structure of AAAs will improve the understanding of the molecular factors essential to nanotube formation and increase the understanding of the process kinetics.

Recent experiments have shown that such AAA nanotubes, which are naturally charged depending on pH, can be used as templates to form a polyelectrolyte layer of opposite charge around them [5]. Multi-layered nanotubes can be produced by subsequent deposition of oppositely charged materials, e.g. polyelectrolytes, on the nanotube surface, i.e. by applying the layer-by-layer (LbL) technique [6]. Accordingly we study the structural details of AAA nanotubes modified by the addition of different polyelectrolytes and for an increasing number of deposition steps in aqueous solution combining different techniques like scattering methods (SLS/DLS, SANS, SAXS), AFM and direct-imaging methods (cryo- and dry TEM, SEM). From the information provided by these methods a comprehensive understanding of structural details of the modified nanotubes can be gained where pH and surface charge are expected to be major control parameters.


**Smart hybrids: Functional gold nanoparticles incorporated into stimuli-sensitive polymer brushes**

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The modification of surfaces by coating with polymer brushes has attracted much interest in the past few years due to numerous potential applications in material and life science for the development of smart surfaces. They can be used as 3D matrices for the immobilization of nanoparticles, resulting in nanocomposite materials with interesting mechanical, optical, or catalytic properties with tailored functions [1]. Using stimuli sensitive polymers allows controlling the distribution of the particles during and after particle loading, which is of high impact for sensor applications. Knowledge about the (spatial) structure of brush/particle hybrids is rather restricted. In order to enhance the functionalities of brush/AuNP-based optical sensors, it is of crucial interest to understand the forces acting between polymer and particles. Studying the mutual influence of the brush matrix and the attached AuNPs on the structure of the resulting brush/AuNP hybrid will allow fine-tuning of the particle loading and distribution.

In this study, responsive poly-(N,N-dimethylamino)ethyl methacrylate (PDMAEMA) and poly-(N-isopropylacrylamide) (PNIPAM) brushes are used as a matrix for the attachment of gold nanoparticles (AuNPs). We find that the uptake and distribution of nanoparticles in polymer brush matrices is highly dependent on the brush thickness [2], brush grafting density [3], polymer chemistry, particle surface functionalization and particle size. The stabilizer (insulin or citrate ) of the AuNP affects the distribution within the brush.

These smart hybrids can be used as colorimetric sensors and present a model system for protein adhesion/embedding.

Self-Assembly of Unilamellar Vesicles: Towards a Generalized Understanding of Bilayer Structure and Kinetics

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Controlling the self-assembly of small unilamellar vesicles (SUVs) has been successfully done recently by the addition of amphiphilic copolymers to the model system tetradecyldimethylamine oxide (TDMAO) and lithium perfluorooctylsulfonate (LiPFOS).\textsuperscript{1}

In order to extend the results to systems of more practical interest, a generalized understanding of the self-assembly process of monodisperse SUVs on a molecular level is needed. Previous investigations of the system TDMAO and lithium perfluorooctanoate (LiPFO) have shown that intermediate structures leading to SUVs can be disk- or torus-like, depending on the overall concentration.\textsuperscript{2}

Nevertheless, the distribution of molecules within the bilayer remains unknown, but is important for understanding its properties. Due to the relatively small size of the resulting vesicles (R \sim 10 \text{ nm}), osmotic pressure and the distribution of ions inside and outside the vesicle are relevant for this system.\textsuperscript{3}

Our analysis done so far on combined stopped-flow SAXS and WAXS data (small and wide angle x-ray scattering; ID02, ESRF) has shown that in the radial direction it is sufficient to use a simple scattering length density profile consisting of three concentrical shells.

Currently, we are refining our model for the detailed structure of the bilayer to better describe the fine details of the kinetics of structure formation as that is the key for controlling in a systematic way the formation of well-defined vesicles which is important in many of their applications.


Templating Monodisperse Vesicles with a Silica Precursor

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We developed a vesicle system, where the vesicle size is not governed by thermodynamics and the high polydispersity that comes with it, but by the kinetics of the growth process.[1,2] Due to this kinetic control, monodisperse vesicles can be formed with a radius ranging from 30 to 100 nm, controlled by the concentration of triblock-co-polymer.

The positive features of this vesicle system, monodispersity and adjustable, relatively small size compared to other vesicular structures, render it an ideal template for other, more rigid structures such as nanocapsules. Therefore, in this work an approach is presented to form hollow silica particles based on such vesicles.

These particles have been characterized via static and dynamic light scattering, small angle neutron scattering (SANS) and transmission electron microscopy (TEM)-imaging. Results show that silication is taking place at the surface of the vesicles, during which the vesicle size and monodispersity is retained.

Such hollow silica structures are candidates for drug encapsulation and delayed release for crop science. Accordingly as a next step for our work investigations of the release kinetics of active agents from such capsules are planned.

Modeling the assembly of protein complexes with patchy particles
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Assembly of protein complexes like virus shells, the centriole, the nuclear pore complex, or the actin cytoskeleton is strongly determined by their spatial structure. Moreover, it is becoming increasingly clear that the reversible nature of protein assembly is also an essential element for their biological function. Here we describe a computational approach for the Brownian dynamics of patchy particles with anisotropic assemblies and fully reversible reactions [1]. Different particles stochastically associate and dissociate with microscopic reaction rates depending on their relative spatial positions. The translational and rotational diffusive properties of all protein complexes are evaluated on-the-fly. Because we focus on reversible assembly, we introduce a scheme which ensures detailed balance for patchy particles. As instructive examples, we study the assembly of rings and capsids, in particular the assembly of the nine-fold ring of SAS6-proteins underlying the structure of centrioles [2], and the assembly of T1-virus capsids [3,4].


Posters

Particle-membrane interactions
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A significant number of bio-medical and industrial applications require an understanding of the toxicity and potential impact on health that synthetic nano- and micro-particles may have. One particularly interesting approach is to develop a mechanistic description of how particles of colloidal size interact with and penetrate cell membranes. This project focuses on understanding the interaction mechanism between particles and bio-membranes, and the processes that occur when a particle is at the membrane surface. Giant unilamellar vesicles [1] are used as the model membrane system; they have sizes in the micrometer range (10-100 µm) thus offering the possibility to directly visualise the interactions and to measure the bilayer mechanical properties [2]. In particular, we are exploring the effects of the geometrical and material parameters in the system. The geometrical parameters are defined by the vesicle and particle sizes and can be modulated by selecting a wide range of particle sizes (20nm-20µm). A recent theoretical study suggests that the system geometrical parameters can determine whether a particle will be engulfed by the membrane or not [3]. The interaction outcome also depends on material properties of the system, such as adhesion strength, membrane bending rigidity and spontaneous curvature. With this goal in mind, one possible approach is to vary membrane composition and particle surface chemistry in order to modulate the adhesion strength and bending rigidity. The effect of the membrane spontaneous curvature, a material membrane property, which has yet to be considered experimentally, can be varied by using membranes with asymmetrically grafted sugar-like lipids. A future development of the particle-vesicle interaction mechanism could involve using optical tweezers to bring micro-sized particles to a vesicle to achieve many-particle engulfment in membrane tubes [4]. This latter construct could be used to develop "nano-wires" upon freezing the membrane.


Water Transport through 1-nm-Thick Functional Carbon Nanomembranes
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Water transport through two-dimensional materials is fundamentally important for understanding the interactions of water and materials. From an application point of view, membrane thickness plays an essential role in efficient separation since a minimal thickness can minimize the transport resistance and maximize permeate flux. The synthesis of 1-nm-thick functional carbon nanomembranes (CNMs) offers exciting opportunities for enriching our knowledge of water interactions as well as for developing a new class of efficient membranes [1]. CNMs are made by electron induced cross-linking of aromatic self-assembled monolayers and can be transferred to almost any surface. We found that water transport through freestanding CNMs is ultra-fast, and the permeability varies in CNMs made from different precursor molecules. The experimentally obtained permeation rate was also compared with that expected from the classical equations.

Colloidal Assembly of Spherical Polyelectrolyte Brushes on Substrates Pre-Coated with Polyelectrolytes
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Colloidal assembly with simple uniform spherical particles has drawn a widespread interest over the last several years due to its diverse research directions and emerging applications, such as fundamental physics study of fcc lattice, preparation of robust yet lightweight material, optical crystals and external stimuli sensitive structures for use in biosensing. Spherical polyelectrolyte brushes (SPBES) consist of hydrophobic polymer cores and hydrophilic polyelectrolyte shells and possess sensitivity properties to pH, ionic strength or temperature, which make them one kind of ‘smart’ particles. Here with spin- and dip-coating as the bottom-up approaches, we assemble ‘smart’ SPBES onto silica wafer pre-coated with polyelectrolytes, to form ‘smart’ 2D/3D colloidal assembly structures. AFM and ellipsometry are used to study the behaviour of the assembly in different ambient conditions.

Ring polymers under confinement
A comparison to their linear counterparts
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Ring polymers are an important class of biological macromolecules. Due to the lack of free ends they are expected to show distinct behaviour to their linear counterparts, as for example with respect to migration mechanisms. Furthermore, the knottedness of ring polymers is assumed to influence transport properties as well. This work aims to tackle the question of their static and dynamical properties under confinement. Since many biological ring polymers are in aqueous solution hydrodynamics are taken into account by a simulation method called Multi-Particle Collision Dynamics while the polymer itself is treated with Molecular Dynamics. Results will be shown regarding the diffusive behaviour of polymers in equilibrium, their mobility under flow in microfluidic channels and the influence of the macromolecular architecture.

Monitoring of Electrochemically Active Biofilms Using a Torsional Quartz Crystal Microbalance
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The mechanical and viscoelastic behavior of electrochemically active biofilms is important for their use in microbial fuel cells.[1] Therefore we investigate the use of a torsional quartz crystal microbalance as an in situ measurement tool for the mechanical and viscoelastic properties of the electrochemical active biofilm.[2]

The aim of our work is to measure the thickness of an electrochemically active biofilm, its cell density, stability and transport properties, the kinetics of its formation and its robustness against variable environmental conditions. The data shall be used to develop a physical-electrochemical biofilm model.

The viscoelastic properties shall be correlated with the current efficiency and the transport properties (protons, nutrients) of the biofilm
At last the viscoelastic properties shall be used in a control loop that optimizes the environmental conditions to increase the current efficiency and the durability of the cell.

Latex Films with In-Plane Composition Gradients Caused by Lateral Drying
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The drying process of waterborne polymer coatings always entails a mass transport. Within simple models the flow of water mostly occurs from the bottom of the film to the top. Importantly, there also is a flow of water in the plane of the drying film, related to the so-called coffee ring effect.\[^{[1,2]}\] This flow may be coupled to a flow of particles and may induce topographical features in the final film.\[^{[3,4,5]}\] This work is contained with gradients in chemical composition rather than gradients in film height. In previous works it was discovered that an indicator dye (Congo red) contained in the aqueous phase is able to visualize pH-gradients.\[^{[6]}\] These gradients now can be exploited in H\(^+\) catalyzed reactions e.g. in the keto-hydrazone crosslinking reaction leading to a gradient in crosslinking-density or rather in tack.\[^{[7]}\] Variable glass temperatures (-10 and 21 °C) and thickener contents (0, 0.3 and 0.5 wt\%) were examined.

The results of this study can be summarized as follows:
1. Lateral drying can cause pH-gradients in the final film leading to gradients in crosslinking density.
2. If the glass temperature (T\(_g\)) of the polymer is much below the drying temperature, the pH of the final film is low at the edge of the film. Protons are carried to the rim.
3. If the T\(_g\) of the polymer is close to the drying temperature or above, the pH of the final film is low at the center of the film. Protons flow inwards with the drying front.
4. A thickener is effective in decoupling the movement of the liquid from the movement of the latex spheres, which is needed to achieve gradients in composition.


Investigation of NIPAM Nanogel-solutions under geometrical confinement using CP-AFM
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Oscillatory structural forces (OSF) can be obtained when confining liquids and particle dispersions between two surfaces into a thin film. They originate from the ordering of molecules and nanoparticles on the solid-liquid interface and were firstly described by Isrealachvili \textit{et al.}

The wavelength \(\lambda\) of the oscillatory force perpendicular to the surface is strongly dependent on the nature of the particles and equals the inter-particle distance. For uncharged particles, \(\lambda\) only depends on the diameter of the particle (hard-sphere model) whereas charged particles tend to repel each other and their distance in the interfacial layer is equal to the distance in bulk solution and scales with \(c^{-1/3}\).

Controlling the oscillatory structural forces and therefore the behaviour at the interface leads to many possible applications, including a better control over emulsion stability, an improvement in solubilisation of otherwise low soluble substances and even a tailored affinity of particles towards each other, effecting for example chromatography products.

The use of N-Isopropylamine (NIPAM) nanospheres in aqueous solution gives thermal control over the oscillatory structural forces utilizing their volume phase transition at a specific temperature. Upon heating, the change of size and surface potential results in a better ordering of gel-particles on the silica-water interface and is visualized using Colloidal Probe Atomic Force Microscopy (CPAFM). At room temperature no OSF are observable whereas at 60°C pronounced signals of OSFs are detected. The reversibility of this effect is shown by multiple heating-cooling-cycles.
Pattern formation in reaction-diffusion systems with unilateral sources

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Alan Turing proved in 1952 in his pioneering work "The Chemical Basis of Morphogenesis" that the system of two reacting and diffusing chemicals can under some conditions become unstable. This so-called diffusion driven instability leads to a spatially inhomogeneous solution which can be interpreted as a pattern. Such patterns have a very good interpretation in biology. However, there are many problems in this concept, namely one of them is that the diffusion coefficients of the chemicals must be very different. There are many ways how to overcome this problem, for example to consider other mechanisms, which regulate the processes. More specifically, if the so called unilateral sources are included, it is possible to numerically compute patterns even for diffusion coefficients, whose ratio is close to one. Moreover, such patterns can be very irregular. In the poster, the theoretical introduction to the problem will be given, as well as results of numerical simulations for some specific models.

Neutron Reflectometry Investigation of Adsorption Behavior in a Polyelectrolyte/Surfactant mixture and its Correlation to Foam Film Stability

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The properties of foams are of interest for many industrial applications such as enhanced oil recovery and in personal care products and are therefore the subject of many studies. A way to produce stable foam films is to mix surfactants with oppositely charged polyelectrolytes, as highly surface-active complexes can be formed with the two compounds. Extensive research on such mixtures was already performed with the focus on very flexible polyelectrolytes, as PAMPS¹,². However, it is still unclear what the influence of the backbone rigidity of the polyelectrolyte on the resulting foam film properties is. In this work a mixture of a newly synthesized polyelectrolyte (sPSO₂-S220)³ with a stiffer backbone is used and mixed with the cationic surfactant C₁₄TAB.

The system has been investigated by means of neutron reflectometry experiments to get insight into the exact composition of the adsorbed sPSO₂-S220/C₁₄TAB complexes at the air/water interface. These results were correlated to foam film stabilities of the respective mixtures ⁴. Those measurements have shown a stronger adsorption and thus a higher synergistic effect for the sPSO₂-S220/C₁₄TAB mixture then for mixtures with more flexible polyelectrolytes. This is also reflected in significantly more stable foam films. Neutron reflectometry experiments showed the formation of 1:1 complexes at the surface.

Preparation and properties of vesicles (niosomes) of sorbitan monoesters for drug delivery application

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Niosomes are bilayered vesicles of non-ionic surfactants with some structural similarity to phospholipid vesicles, liposomes. These nanoparticles are formed spontaneously from the self-assembly of non-ionic amphiphiles in aqueous media due to physical agitation or heat. Therefore hollow spheres can be made, which are able to encapsulate aqueous solutes and serve as potential drug carriers.

The formation of multilamellar vesicles (niosomes) of a series of Sorbitan monoesters (Span 40, 60 and 80) has been studied using a thin film hydration technique and then sonication. Studies showed that addition of Cholesterol increases Niosome’s hydrodynamic diameter and stability. Experiments have shown that the best ratio for Span:Cholesterol is 1:1 molar ratio for span series. Z-average sizes of the niosomes were between 100 nm and 5 µm. High surface charges showed that niosomes can be suspended in water well and this is beneficial for their storage and administration. The niosome preparation method was found to be repeatable in terms of size distribution, zeta potential and stability.

Ellipsoid-Shaped Magnetic Nanoclusters through Emulsion Electrospinning

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One-dimensional (1D) organic/inorganic nanomagnets with high saturation magnetization and superparamagnetic properties are difficult to obtain.[1] Nonetheless, they are highly desirable 1D-materials since the properties differ strongly for their spherical counterparts. Common approaches to generate such 1D-structures include i) template assistance,[2] ii) self-assembly of the single building blocks,[3-5] or iii) electrospinning. We now developed a process that allows to generate magnetic nanellipsoids by implementing magnetic droplets into electrospinning to obtain stretched iron oxide clusters.[6] In this novel process the aspect ratio of the ellipsoids strongly correlates with the diameter of the spun fibers. The aspect ratio of the ellipsoids strongly increases with a decreasing fiber diameter. After spinning, the polymer fibers can easily dissolved in water to obtain an aqueous dispersion of the ellipsoid clusters, which makes them accessible for various biomedical applications.


Thinning Process during Deposition of Block Copolymer Films: Experiments vs Theory

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Spin coating is a commonly used technique to deposit non-volatile substances from solution onto planar supports. Coating thicknesses from thin to ultrathin can be achieved reproducibly [1]. An excess amount of liquid deposited on a spinning, planar, wettable substrate forms a thinning film of uniform thickness ht as the liquid flows outward (and is spun off) until a transition height (htr) [2]. The evaporation of volatile film components adds to the film thinning. The non-volatile components get
continuously enriched, eventually exceeding saturation. The final deposit evolves from aggregation during film thinning in the presence of the solvent.

Although spin casting is a well established experimental technique [3]; the coverage, surface morphology, structure, and other film properties are the result of a dynamic process which still under active investigation [4]. Understanding quantitatively the spin cast process; let us identify the hydrodynamic and evaporation contributions during the film thinning [2]; combined with AFM we investigate the resulting morphology of PS-PMMA films. Experiments at different concentrations show how the process deviates respect to the theory in the context of the evaporation rates measured online [5]. In this sense the resulting topology not only could be explain as function of the final thickness but link to the deposition process parameters [6].


**Self-assembly in dendritic-linear co-polymers: Formation of multi-core uni-molecular micelles in a single dendrimer**

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Single dendritic-linear co-polymers are able to form uni-molecular micelles in selective solvent conditions. The conformations and the thermodynamics of these systems are investigated theoretically in terms of a mean-field surface tension argument and a Flory-type mean-field theory. The results suggest the splitting of the intuitively expected single-core structure into a multi-core uni-molecular structure under specific solvent conditions with increasing dendrimer’s generation. As proof of evidence coarse-grained Monte Carlo simulations were performed using the Bond Fluctuation model. The investigated tri-functional dendritic co-polymers with linear chains attached to the terminal monomers indicate the formation of multi-core structures for high generations and low spacer lengths. Despite the simplicity of the applied models a reasonable agreement between theory and simulations is shown. The findings are aimed to improve the understanding of the spontaneous self-assembly in well-defined macro-conformations under changing environments in dendritic co-polymers for potential applications as drug-delivery systems.

**A coarse-grained elastic model for cell deformation**

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A broad range of in silico models (e.g., liquid or viscoelastic drop models) has been introduced to reproduce the complex mechanical properties of various cell types [1]. These models are used to understand and quantify experimental measurements. In this work, we employ a coarse-grained cell model which incorporates the membrane properties similar to the RBC-model [2] and an elastic inner mesh to include the cytoskeletal properties. The model is formulated in the framework of the dissipative particle dynamics simulation method and can include multiple cell compartments with different mechanical properties. We perform various mechanical tests that are similar to experiments [1] to determine the mechanical properties of a single cell. We also investigate the deformation of this cell in fluid flow. We expect that this model will help us better understand the contributions of different cell compartments to overall cell deformation.

Coarse-grained modelling of DNA origami behaviour under tension
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DNA origami has been well-established as a versatile platform for engineering structures with wide-ranging applications in nanosensing [1], nanomedicine [2], and nanoelectronics [3]. Harnessing the full potential of DNA origami to realize complex nanoscale architectures requires a comprehensive understanding not only of origami folding and unfolding dynamics, but of its mechanical properties. Knowledge of the mechanical behavior of origami has applications in the assembly of tensegrity structures (in which portions of the molecule must self-assemble under tension [4,5]); the exploitation of DNA origami for nanomechanical processes [6]; the use of DNA origami under tension in biosensing applications [7]; and the employment of origami structures as mediators of force in the capacity of ‘handles’ in single molecule force spectroscopy experiments [8]. More fundamentally, the tension-induced unfolding behavior of DNA origami can provide valuable insight into the selfassembly process by enabling a detailed study of unfolding pathways.

While efforts to characterize the properties of DNA origami through microscopy abound [9], a dearth of force spectroscopy studies [10] – uniquely capable of investigating mechanical behaviour – exist for origami nanostructures. Using oxDNA [11, 12], a nucleotide-level coarse-grained DNA model, we have performed single-molecule force spectroscopy simulations to study DNA origami systems under tension via the application of harmonic force traps. Our studied systems include the Rothemund tile [13]; a nanotube first introduced to showcase mechanical self-assembly as an alternative to thermal annealing [14]; and a 7-tile origami structure designed for use in biosensing [7]. Our simulations allow examination of the unfolding process in unrivalled detail; we correlate characteristic features in force-extension curves with structural changes underlying individual unfolding barriers and propose a rough form for the energy landscapes. Our results are in excellent agreement with experimental data and herald the rich potential of tension-driven unfolding simulations to inform efforts to control forceresponse behavior through origami design.


Electrostatic discharge (ESD) for The Field Programmable Gate Arrays (FPGA)
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Peripheral electronic integrated circuits (IC) are likely to be damaged by static electricity or electrostatic discharge (ESD). While some devices can withstand thousands of volts of ESD damage before, others may have a threshold of only a few volts to be damaged. There are three models in the industry today used to describe the transfer of charge during an ESD event on the human body model, the machine model and the Model induced field.

This work explains how to configure various output voltage tracking for The Field Programmable Gate Arrays (FPGA) which allow the correct start and stop sensitive multi-rail systems. We will also
check a setting that prevents electrostatic discharge internal FPGA (ESD) bias diodes or be overstated for increase or decrease output. These configurations will improve system reliability, which is critical to the productivity and availability of microelectronic circuits and industrial equipment.

**Pickering emulsions: Alternative reaction medium for catalytic reactions**

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A system can be classified into green chemistry, if it produces a minimum of by-products, uses reactants and solvents which are environmentally friendly and uses catalysts which are very substrate-selective [1]. Pickering-emulsions (PEs) are particle-stabilized emulsions. In combination with silica (fumed silica) or halloysites (clay nanotubes) as stabilizing nanoparticles, PEs fulfills the qualifications of green chemistry and open up new industrial applications.

Halloysites and silica are inorganic nanotubes/nanoparticles with negative charges at the outer surface. The two particle types differ in shape and size. Halloysites are hollow nanotubes (800x50 nm) and silica are compact nanoparticles (150x50 nm). In this study, the hydroformylation of long chain olefins (1-Dodecene) in PEs was used as a model system, to prove the catalytic power of Halloysites [2] and silica. The water phase contains the homogeneous catalyst ([HRh(CO)(TPPTS)₃]) and the oil phase (1-dodecene) is the reactant. After the hydroformylation the expensive rhodium-catalyst can be easily separated from the product (tridecanal) and can be reused. The effect of these particles was analyzed. In order to understand and to control the catalytic efficiency the essential interfacial interactions between water, oil and nanoparticles and the self-assembly of the particles at the oil/water interface are studied.