

CPP 17: Poster: Crystallisation, Nucleation and Self assembly

Time: Tuesday 18:15–20:15

Location: Poster A

CPP 17.1 Tue 18:15 Poster A

Stabilization of crystalline order in thin films of polyethylene close to a graphite substrate — ●ANN-KRISTIN LÖHMANN, THOMAS HENZE, and THOMAS THURN-ALBRECHT — Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Germany

The interface between a polymer melt and a crystalline surface plays an important role during crystal nucleation as well as during crystal growth. Thin polymer films on crystalline substrates can be considered as model systems. We present temperature dependent AFM measurements of thin polyethylene (LLDPE) films on graphite. Upon heating to the melting temperature the polymer film dewets leaving behind a thin ordered film of polyethylene showing the same lamellar structure as the semicrystalline film at lower temperatures. This ordered layer at the polymer-substrate interface is a few nanometres thick and stable at temperatures higher than the bulk melting point. For LLDPE-samples the ordered layer could be observed up to a temperature of 122°C, whereas the bulk melting point was 108°C. We speculate that this interfacial layer is responsible for heterogeneous nucleation on graphite and induces crystal growth of polyethylene perpendicular to the surface of the substrate.

CPP 17.2 Tue 18:15 Poster A

Microphase separation in the block copolymer PMMA-PBA synthesized by RAFT — ●STEFANIE GRÜNHEIT¹, KATHARINA TIETZ², ALEXANDER RAHN¹, PHILIPP VANA², and KONRAD SAMWER¹ — ¹Physikalisches Institut, Georg-August-Universität Göttingen — ²Institut für Physikalische Chemie, Georg-August-Universität Göttingen

Block copolymers are known to separate into microphases with a rich variety of structures as lamellae or gyroids. Hence their phase diagrams are often complex and highly interesting to study. We want to develop a phase diagram for a polymer consisting of a soft (poly(butyl acrylate), PBA) block and a hard (poly(methyl methacrylate), PMMA) block.

Therefore polymers are synthesized by reversible addition-fragmentation chain transfer (RAFT) polymerization with different blocklength ratios as well as different overall chain lengths. Thermal analysis via thermogravimetric analysis (TGA) and dynamical mechanical analysis (DMA) are performed in order to get information about stability as well as glass temperatures and elastic properties. By means of X-ray scattering and atomic force microscopy (AFM) we want to examine the structural properties with regard to microphase separation.

The presence of two glass transitions as well as the observation of patterns in AFM-pictures suggest the occurrence of microphase separated regions.

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CPP 17.3 Tue 18:15 Poster A

Effect of the crystalline α_c -process on the morphology of semi-crystalline polymers: a comparative SAXS study on poly- ϵ -caprolactone and polyethyleneoxide — ●ANNE SEIDLITZ, ALBRECHT PETZOLD, and THOMAS THURN-ALBRECHT — Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, 06120 Halle (Saale)

Semi-crystalline polymers can be classified into two different types, depending on the presence (α_c -mobile) or absence (crystal-fixed) of the α_c -Relaxation, which provides mobility to the chains in the crystals. Starting from a hypothesis made by Boyd, that all polymers with a high crystallinity are α_c -mobile while all polymers with a low crystallinity are crystal-fixed, we investigated the morphology of polyethyleneoxide (PEO) as a polymer with mobile crystalline chains and poly- ϵ -caprolactone as a polymer with fixed chains. We performed small angle x-ray scattering experiments at different molecular weights and crystallization temperatures. A simulation based on the paracrystalline model was developed to derive quantitative morphological information from the SAXS data. Clear differences between the structure of PCL and PEO were observed. For PCL the crystalline thickness d_c is well defined, while the amorphous thickness d_a displays a broad distribution. PEO shows a small, well defined d_a and a broad thickness distribution of the crystalline lamellae. Our interpretation is that the crystalline lamellae in PEO can reorganize during crystallization until

a minimal d_a is established, while the morphology of PCL corresponds to a quenched state resulting directly from the crystal growth process.

CPP 17.4 Tue 18:15 Poster A

Shape-persistent linear, kinked, and cyclic oligo(phenylene-ethynylene-butadiynylene)s: self-assembled monolayers — ●STEFAN-SVEN JESTER, ALISA IDELSON, DANIELA SCHMITZ, FRIEDERIKE EBERHAGEN, and SIGURD HÖGER — Rheinische Friedrich-Wilhelms-Universität Bonn, Kekulé-Institut für Organische Chemie und Biochemie, Gerhard-Domagk-Str. 1, 53121 Bonn, Germany

Self-assembled monolayers (SAMs) of shape-persistent rigid oligomers, particularly phenylene-ethynylene-butadiynylenes at the HOPG/TCB interface were studied by scanning tunneling microscopy (STM) with submolecular resolution. Substitution of the terminating acetylene functions of the linear oligomers with polar cyanopropyl dimethylsilyl groups leads to 2D phase separation and defined rod-rod interactions, which determine the packing distances between the rigid rods. The results stimulated the connection of rigid rods via septarylene clamp units. They covalently link two rigid rod units and define the intramolecular rod-rod distance that matches the alkoxy substituent chain lengths. The systems can be described as half-ring structures of two rigid rods connected via a rotatable joint unit. These acetylene-terminated half-ring structures were also oligomerized under Cu and Pd catalysis to yield defined acyclic and cyclic oligomers. Detailed STM studies decoded the molecular origin of the surface patterning of such systems. The dodecyloxy side chains are adsorbed along the HOPG main axes and, together with the alkoxy backbone angle, determine the adsorption direction of the adlayers. [1] S.-S. Jester, A. Idelson, D. Schmitz, F. Eberhagen, S. Höger, *Langmuir* **2011**, *27*, 8205.

CPP 17.5 Tue 18:15 Poster A

Shape-persistent macrocycles: 1D and 2D aggregation — JOSCHA VOLLMMEYER, ●STEFAN-SVEN JESTER, FRIEDERIKE EBERHAGEN, and SIGURD HÖGER — Rheinische Friedrich-Wilhelms-Universität Bonn, Kekulé-Institut für Organische Chemie und Biochemie, Gerhard-Domagk-Str. 1, 53121 Bonn, Germany

The aggregation of shape-persistent macrocycles towards one-dimensional supramolecular fibers is investigated. Atomic force microscopy investigation of individual supported fibers indicates lengths of up to several micrometers and diameters as low as 3 nm. The interaction of such highly anisotropic aggregates in cyclohexane leads microscopically to the formation of networks and macroscopically to a gel phase which was also characterized by means of differential scanning calorimetry and UV-vis spectrometry. Intraannular substitution of the macrocyclic cavity with an undecyldiether strand and a tetraethylene glycol strand significantly affect the aggregation behavior as compared to a macrocycle with hollow cavity. The same molecules form two-dimensional self-assembled monolayers at the solution/solid interface (1,2,4-trichlorobenzene/HOPG). However, all three shape-persistent macrocycles - independent of the intraannular substituents - form adlayers with identical pattern structures. The results are of fundamental interest for the tailored design of sensor materials as well as functionalized adsorbate layers.

CPP 17.6 Tue 18:15 Poster A

Investigation of Flow-Induced Periodically Banded Single Crystals in Isotactic Polystyrene Thin Films — ●HUI ZHANG and GÜNTER REITER — Physikalisches Institut, Universität Freiburg, 79104 Freiburg, Germany

Observation of crystallization in thin films by microscopy techniques offers possibility to reveal nature behind crystallization. Here, isotactic polystyrene (iPS) has been studied because of the low growth rate and high glass transition temperature, which make it convenient to control the crystallization process. We found in a certain temperature range the formation hexagonal concentric banded structures in single crystals grown in thin films, which named periodically banded single crystals. Using optical microscope, we determined the distance between neighboring bands which increased both with temperature and film thickness. Detailed studies by atomic force microscopy indicated the periodically banded structure is the result of regular variation on the number of layers in lamella stacks generated via screw dislocations

which led to growth in the normal direction of the film. All lamellar layers were in registry, i.e. all chains oriented in the same direction. The mechanism responsible for the formation of this structure is discussed. To generate such periodic modulation in stack height, the depletion length ahead of the growing crystal must be significantly larger than the distance between two neighboring dislocations. Thus, crystal growth controlled by the diffusion process, which decides the number of molecule available at the growth front, can lead to the formation of regularly spaced stacks of lamellae.

CPP 17.7 Tue 18:15 Poster A

Crystallization kinetics of PET/MWCNT nanocomposites — ●ANDREAS WURM¹, ANJA HERRMANN¹, ANDREAS KORWITZ², DORIS POSPIECH², and CHRISTOPH SCHICK¹ — ¹University of Rostock, Institute of Physics, Wismarsche Str. 43-45, 18057 Rostock — ²Leibniz-Institut für Polymerforschung Dresden e.V., Dept. of Polymer Structures, Hohe Str. 6, 01069 Dresden

Isothermal and non-isothermal crystallization behavior of polymers can be investigated with traditional calorimeters often in a limited temperature region only. This results from the fast crystallization processes on optimal conditions, which appears in most polymers in a few seconds or less. The new chip-based Mettler Flash DSC 1 allows applying heating and cooling rates of several 1000 K/s, which enables for many polymers to follow crystallization in the whole temperature range between glass transition temperature and melting temperature. We applied the new chip calorimeter for the investigation of crystallization kinetics of PET/MWCNT nanocomposites under non-isothermal and isothermal conditions. The MWCNT act as nucleating agents for PET and speed up crystallization at high temperatures, where heterogeneous nucleation dominates, for about one order of magnitude. At low temperatures, where homogeneous nucleation in the polymer itself determines the rate, only small differences are observed, which leads to the conclusion, that polymer chain dynamics is not drastically changed due to presence of MWCNT in the PET matrix.

CPP 17.8 Tue 18:15 Poster A

Nucleation and Crystallization in Glassy Polymers (PCL, iPP) — EVGENY ZHURAVLEV¹, DANIELA MILEVA², RENÉ ANDROSCH², and ●CHRISTOPH SCHICK¹ — ¹Universität Rostock, Institut für Physik, Rostock, Germany — ²Martin-Luther-Universität Halle-Wittenberg, Polymer Engineering Center of Engineering Sciences, Halle/Saale, Germany

Differential fast scanning chip calorimetry has been employed to study nucleation/ordering during annealing the glass of quenched polymers (PCL, iPP). Initially non-ordered samples were annealed below the glass transition temperature for different periods of time, and the change of structure during isothermal annealing was then analyzed by monitoring the exchange of latent heat on heating. Primary result of this work is the undoubted proof of homogeneous nucleation of ordering and mesophase formation in the glassy state. It is suggested that only local mobility of molecular segments is required to form small, ordered domains, and that the classical nucleation theory, which restricts nucleation of the crystallization/ordering process of polymers to temperatures between the equilibrium melting temperature and the glass transition temperature, needs modification.

CPP 17.9 Tue 18:15 Poster A

Heterogeneous and homogeneous crystal nucleation in colloidal hard-sphere like microgels at low metastabilities — ●MARKUS FRANKE and HANS JOACHIM SCHÖPE — Johannes Gutenberg Universität Mainz, Institut für Physik, Staudinger Weg 7, 55099 Mainz, Germany

Crystal nucleation is dominated by heterogeneous nucleation in most cases, especially at low undercoolings (metastabilities, chemical potential differences) and for that reason heterogeneous nucleation on container walls or impurities is almost unavoidable. The hard sphere model system is the simplest model system showing a fluid crystal phase transition. Sterically stabilized colloidal particles in a refractive and density matching solvent provides such a hard sphere system for experimentalists. We studied the crystallization kinetics of homogeneous bulk as well as the heterogeneous wall crystallization within the fluid crystal coexistence region. Parameters characterizing the crystallization process (induction times, growth coefficients, nucleation rate densities,...) were determined by using time resolved static light scattering and Bragg microscopy. By performing further analysis according to classical nucleation theory we can show that wall crystallization is induced by complete wetting of the cell walls with crystalline layers

leading to a vanishing nucleation barrier.

CPP 17.10 Tue 18:15 Poster A

Polymer induced changes of the crystallization scenario in suspensions of hard sphere like microgels — RICHARD BEYER, SARA IACOPINI, THOMAS PALBERG, and ●HANS-JOACHIM SCHÖPE — Institut für Physik, Johannes Gutenberg Universität, Mainz, Germany

We investigated the crystallization scenario of hard sphere like Polystyrene microgels suspended in the good solvent 2-Ethyl-naphthalene using time resolved Bragg scattering. The slightly polydisperse samples were prepared at the melting volume fraction of the polymer free system around 0.55. For the polymer free samples we obtained polycrystalline solids via the two-step crystallization scenario known from hard sphere suspensions with little competition of wall crystal formation. Addition of non-adsorbing low molecular weight Polystyrene polymer leads to a considerably slowed crystal growth. Further we observed a delay of precursor to crystal conversion for the bulk particles while the induction times for wall nucleation are reduced. The increased polymer concentration thus shifts the balance between the two crystallization pathways and the relative amount of wall based crystals can be tuned.

CPP 17.11 Tue 18:15 Poster A

Protein crystallization in the presence of di- and trivalent metal ions — ●ANDREA SAUTER¹, GEORG ZOCHER², FAJUN ZHANG¹, THILO STEHLE^{2,3}, and FRANK SCHREIBER¹ — ¹Institut für Angewandte Physik, Universität Tübingen, Germany — ²Interfaculty Institute of Biochemistry, Universität Tübingen, Germany — ³Department of Pediatrics, Vanderbilt University, Nashville, USA

Structure determination of proteins requires high-quality single crystals. Our previous studies concerning reentrant condensation (RC) of proteins upon adding trivalent salts have opened up a way to a universal phenomenon that can be used to tune protein interactions and thus optimize protein crystallization [1,2]. RC is caused by ion binding at the protein surface and thus an effective charge inversion. We now investigated how globular proteins behave upon using divalent metal salts. A phase behaviour similar to RC is found for bovine β -lactoglobulin (BLG) with CdCl_2 or ZnCl_2 . Zeta potential measurements show a charge inversion of the protein. However, no such behaviour could be observed for other proteins by adding divalent salts, indicating the specificity of BLG. We present the growth of BLG crystals using trivalent [3] or divalent ions and their structure determined by X-ray diffraction. The positions of the metal cations that bridge acidic side chains from neighbouring protein subunits were compared for different salts. Using BLG as a model system, the role of the di- and trivalent metal ions in protein crystallization is discussed. [1] F. Zhang et al., PRL, 101, 2008, 148101; [2] F. Zhang et al., Proteins, 78, 2010, 3450-3457; [3] F. Zhang et al., J. Appl. Cryst., 44, 2011, 755-762.

CPP 17.12 Tue 18:15 Poster A

Low temperature sol-gel synthesis of polymer/titania hybrid films based on custom made poly(3-alkoxy thiophene) — ●MARTIN A. NIEDERMEIER¹, MONIKA RAWOLLE¹, PHILLIP LELLIG², VOLKER KÖRSTGENS¹, EVA M. HERZIG¹, ADELINE BUFFET³, STEPHAN V. ROTH³, JOCHEN S. GÜTMANN⁴, THOMAS FRÖSCHL⁵, NICOLA HÜSING⁵, and PETER MÜLLER-BUSCHBAUM¹ — ¹TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching, Germany — ²Max-Planck-Institut für Polymerforschung, 55128 Mainz, Germany — ³HASYLAB at DESY, 22603 Hamburg, Germany — ⁴Universität Duisburg-Essen, Institut für Physikalische Chemie, 45141 Essen, Germany — ⁵Universität, Salzburg, FB Materialforschung und Physik, 5020 Salzburg, Austria

A low temperature route to directly obtain polymer/titania hybrid films is presented. For this, a poly(3-alkoxy thiophene) is synthesized and used in a sol-gel process together with an ethylene glycol modified titanate (EGMT), as the titania precursor. Atomic force microscopy and scanning electron microscopy reveals that the poly(3-alkoxy thiophene) acts as the structure directing agent for the titania matrix and still maintains a high degree of crystallinity, as shown with grazing incidence wide angle X-ray scattering. UV/Vis measurements show a similar absorption behavior to P3HT with an absorption maximum around 500 nm and the typical UV absorption behavior of rutile titania.

CPP 17.13 Tue 18:15 Poster A

Manipulating crystallization by seed induced heterogeneous

nucleation — ●ANDREAS ENGELBRECHT and HANS JOACHIM SCHÖPE — Johannes Gutenberg-Universität, Mainz, Germany

Most solids consist of crystals and their material properties are highly controlled by the crystallization kinetics. Controlling crystal nucleation and growth is of great interest in condensed matter physics and material science. Container walls and impurities are almost omnipresent making heterogeneous nucleation the dominant process in many cases biasing the material microstructure. We here present a crystallization kinetics study in a colloidal model system of charged spheres adding nucleation seeds analog to inoculation in metallic systems.

We performed video microscopy of the crystallization process observing nucleation and growth of both homogeneously nucleated and seed induced crystals. While single crystals form by homogeneous nucleation, multi domain crystals nucleate on seeds appearing like bloomy flowers. We are able to extract time resolved nucleation rate densities, crystal size distributions and induction times for different seed concentrations. We see homogeneously nucleated crystals compete with those induced by the seeds. Hence crystallization kinetics and therefore also the arising microstructure can be tuned with the amount of added seeds.

CPP 17.14 Tue 18:15 Poster A

Strain-induced nucleation for establishing highly oriented iPP — ●KONRAD SCHNEIDER — Leibniz-Institut für Polymerforschung Dresden, Germany

The mechanical properties of semi-crystalline materials are mainly determined by the morphology of the material, especially the crystalline phase. This can be controlled in a wide range by nucleating agents. By stretching of partially crystallized material the crystallite orientation of the subsequent crystallized phase can be influenced in a wide range. By simultaneous WAXS (wide angle x-ray scattering) during drawing and crystallization the built-up of the final structures can be followed. It will be shown, how which structural variability is possible by this procedure.

CPP 17.15 Tue 18:15 Poster A

Opal-like Crystals: Structural Analysis by Small Angle Neutron Scattering — ●PARVIN SHARIFI RAJABI, MULDA MULDARISNUR, and FRANK MARLOW — Max-Planck-Institut für Kohlenforschung, Mülheim (Ruhr), Germany

Spherical building blocks ordered in a close-packed fcc arrangement form opal-like structures. They are interesting photonic crystals. Self-assembly is a direct and cheap approach for the opal fabrication but mostly, it results in structures with many defects. The photonic properties of these structures are highly sensitive to the structural imperfection. Characterization by different diffraction approaches can resolve the details of the structure.

Opals and inverse opals were fabricated by capillary deposition method [1]. They were characterized optically, by SEM and mostly by SANS. The SANS data were analyzed in respect to structural imperfections and lattice deformations. The preliminary interpretation was significantly extended [2].

[1] H. L. Li, W. Dong, H. J. Bongard, F. Marlow, J. Phys. Chem. B 2005, 109, 9939.

[2] F. Marlow, M. Muldarisnur, P. Sharifi, H. Zabel, Phys. Rev. B 2011, 84, 073401.

CPP 17.16 Tue 18:15 Poster A

From atoms to layer: growth kinetics during sputter deposition observed via in-situ GISAXS — ●MATTHIAS SCHWARTZKOPF¹, MOTTAKIN M. ABUL KASHEM¹, GUNTARD BENECKE², ADELIN BUFFET¹, DENISE ERB¹, BERIT HEIDMANN¹, GERD HERZOG¹, VOLKER KÖRSTGENS³, EZZELDIN METWALLI³, JAN PERLICH¹, ANDRÉ ROTHKIRCH¹, KAI SCHLAGE¹, PETER MÜLLER-BUSCHBAUM³, RALF RÖHLSBERGER¹, RAINER GEHRKE¹, and STEPHAN V. ROTH¹ — ¹DESY, Notkestr. 85, D-22607 Hamburg — ²MPIKG, Dep. Biomat., Am Mühlenberg 1, D-14424 Potsdam-Golm — ³TU München, Physik Department E13, James-Frank-Str. 1, D-85748 Garching

For an efficient and controllable production of active nanostructured surfaces, sputter deposition plays a very important role in industrial processing [1]. In order to tune the unique size-dependent optoelectronic and catalytic properties of gold clusters, it is mandatory to know, how the growth kinetics influences the metal film morphology during sputter deposition. We therefore investigate in-situ growth ki-

netics of gold during sputter deposition by grazing incidence small-angle-X-ray scattering (GISAXS). The high time resolution allows determining the growth kinetics of the initial nucleation and the subsequent 2D self-assembly of clusters at industrial deposition rates. The temporal evolution of the structural parameters reveals four general stages of gold cluster growth. We show that each stage is characterized by a predominant surface process and its intrinsic kinetics.

[1] Faupel et al., Adv. Eng. Mat. 12, 1177 (2010)

CPP 17.17 Tue 18:15 Poster A

Monodisperse polystyrene@vinyl-SiO₂ core-shell particles and hollow SiO₂ spheres for photonic crystals fabrication — ●TIAN-SONG DENG and FRANK MARLOW — Max-Planck-Institut für Kohlenforschung, Kaiser-Wilhelm-Platz 1, 45470 Mülheim an der Ruhr, Germany

SiO₂-coated particles have been attracted much attention in recent years, since these core-shell particles have potential applications as chemical micro containers and colloidal crystals, and especially photonic crystals. In this paper a method of preparing highly monodisperse core-shell particles and hollow spheres is described. Both kinds of particles are very useful building-blocks for colloidal crystals. The key of the method is the use of vinyltrimethoxysilane as a precursor for the shells which are obtained by direct growth of vinyl-SiO₂ on negatively charged PS template particles. This method delivers a tunable shell thickness (between 10 nm and 170 nm) combined with a very low polydispersity (smaller than 3%) and no aggregation of the obtained particles. Furthermore, the core-shell particles could be converted into hollow SiO₂ spheres by removing the PS cores in a calcination process. Both, the PS@vinyl-SiO₂ particles and the hollow SiO₂ spheres can be self-assembled into colloidal crystals using their suspensions which are highly monodisperse and aggregation-free. The synthesis method might be extended for coating uniform organo-SiO₂ shells on different kinds of core materials. In addition, the use of other organo-oxide precursors could lead to new hollow oxide particles useful for colloidal crystal formation.

CPP 17.18 Tue 18:15 Poster A

Universality in block copolymers: a corresponding states hypothesis — ●JENS GLASER, JIAN QIN, PAVANI MEDAPURAM, and DAVID MORSE — Dept. of Chemical Engineering and Materials Science, University of Minnesota, 421 Washington Ave SE, Minneapolis, MN 55455, USA

Phase behavior and fluctuations of very long block copolymers are well described by self-consistent field theory, and by the random-phase (RPA) approximation for concentration fluctuations. The SCF / RPA predicts behavior that depends on only a few dimensionless parameters. More sophisticated coarse-grained theories instead suggest an extended form of this principle of corresponding states, in which the behavior is predicted to depend on one additional parameter, the independent degree of polymerization $\bar{N}$. We are testing this prediction by comparing extensive computer simulations of several different coarse-grained simulation models of AB diblock copolymer melts. We utilize a novel simulation methodology based on graphical processing unit (GPU) accelerated hybrid molecular dynamics / Monte Carlo replica exchange simulations on a cluster of many GPUs. We present data for off-lattice models with soft- and hard-core non-bonded interactions, and a lattice model, comparing simulations of different models that are designed to have matched values of $\bar{N}$. The results provide extremely strong evidence for the corresponding states hypothesis, which is found to remain accurate even for chains that are much too short to be accurately described by SCFT or the RPA.

CPP 17.19 Tue 18:15 Poster A

IR spectroscopic studies on SiO condensation — ●STEFFEN WETZEL and ANNEMARIE PUCCI — Kirchhoff-Institut für Physik, INF 227, 69121 Heidelberg

Silicon oxides used to be relevant as gate oxides in microelectronics and are of great importance in astronomy as building blocks of silicates, the most abundant minerals in space. The IR spectral feature of the Si-O stretching vibration strongly depends on the chemical composition and on the formation conditions. We studied the growth of thermally evaporated SiO on clean Si(111)7x7 at room temperature and found a strong shift of the resonance frequency for the first stage of film growth indicating the formation of an SiO_x (0 ≤ x ≤ 1) interlayer. Condensation experiments at substrate temperatures between 40 K and 470 K reveal as well a clear shift of the resonance frequency, indicating gradual disproportionation of SiO into Si and SiO₂ for the

higher temperatures. Both effects will be discussed in detail and be presented along with details on the experimental setup.

CPP 17.20 Tue 18:15 Poster A

Nucleation and growth of large scale ordered structures in highly swollen thin-films of Poly- γ -benzyl-L-glutamate (PBLG) — •KAIWAN JAHANSHAH¹, IOAN BOTIZ^{1,2}, and GÜNTER REITER^{1,2} — ¹Institute of Physics, University of Freiburg — ²Freiburg Research Institute of Advanced Studies (FRIAS)

In the α -helical confirmation, the PBLG molecule exhibits chirality and a huge electrical dipole moment making it capable to form liquid crystal, fibrils and even large scales of ordered structures. The mechanisms governing these structure formations are still poorly understood which motivated our experimental study about PBLG assemblies obtained by solvent annealing of spin coated thin films. By controlling the physical parameters like polymer concentration with respect to the solubility limit (below which no ordered structures can nucleate), and also adding a non-solvent to the system, we can precisely control the nucleation density and the growth rate of large scale ordered structures as well as their shape and size in three dimensions. Consequently we could study the kinetics of growth process of Poly(γ -benzyl-L-glutamate) molecules in such systems and define time dependence of the size of the ordered structures as well as the effect of solvent/non-solvent ratio on the nucleation density of such structures.

CPP 17.21 Tue 18:15 Poster A

The Effect of Surface Affinity on the Morphology of Double Crystalline Co-Oligomer Thin Films — •ROBERT SCHULZE, THOMAS F. KELLER, and KLAUS D. JANDT — Institute of Materials Science and Technology, Friedrich-Schiller-University Jena, Germany

The lamellar morphology of double crystalline co-oligomers in the bulk was recently attributed to a stacking of extended or folded chains.

Thus, the aim of the present study was to show that the lamellar morphology of extended chains of a double crystalline co-oligomer can be used to create amphiphilic nanopatterns on surfaces.

Therefore we analyzed polyethylene-block-poly(ethylene oxide) co-oligomer thin films onto chemically different substrates by atomic force microscopy.

After drop-casting from dilute solution we observed quantized values of the film thickness that correspond to multiple integers of the theoretically extended chain length. On neutral surfaces, annealing leads to perpendicular lamellae, where the lamellar thickness resembles the theoretical extended chain length, whereas on hydrophilic and hydrophobic surfaces residual thin films possess no defined lamellar surface structure.

These observations can be explained by assuming that the formation of thin film morphology is dominated by the crystallization of extended chains under the influence of the surface affinity. On neutral surfaces, annealing facilitates a chain rotation from perpendicular to parallel, therefore enabling the formation of a lateral lamellar surface morphology with potential applications, as e.g. in the biomedical field.