CPP 18 Physics of polymers II

Zeit: Dienstag 11:15–12:30 Raum: TU C130

CPP 18.1 Di 11:15 TU C130

Concentration dependent size of reversibly assembling polymers in solution: Mean field lattice theory and simulation — •Peter Lenz and Reinhard Hentschke — Fachbereich Mathematik und Naturwissenschaften, Bergische Universität, Wuppertal

The concentration dependence of the mean length of equilibrium polymers as function of solute volume fraction is studied both in a lattice description and via molecular dynamics simulation. Previous analytical models yield monotonous growth with increasing solute concentration. However, in a careful experimental study Boden and coworkers (Leeds, UK) have found that the size of self-assembled aggregates in solution may indeed decrease at high solute concentration. This unusual growth behavior can be explained via a lattice model using a more detailed description of constituent interactions in comparison to previous studies. In addition, the validity of the lattice model results is checked via molecular dynamics computer simulation of binary mixtures containing solvent and reversibly assembling monomers.

CPP 18.2 Di 11:30 TU C130

Study on the Ferroelectric Properties of Poly (vinylidene fluoride-trifluoroethylene) P(VDF/TrFE) Copolymer Nanotubes — •Yun Luo[1], Markus Geuss[2], Petra Göring[1], Klaus Rademann[2], Martin Steinhart[1], and Ulrich Gösele[1] — [1]Max-Planck-Institute of Microstructure Physics, Halle/S, Germany — [2]Institute of Chemistry, Humboldt University of Berlin, Berlin, Germany

Nanotubes and nanowires consisting of P(VDF/TrFE) copolymers with diameters from 25 nm to 400 nm have been fabricated via wetting of porous alumina templates and a subsequent annealing step under argon. By selectively removing the template, released tubes or rods with smooth walls and high aspect ratio were obtained. Large scale freestanding P(VDF/TrFE) nanotubes can also be obtained, with their open end connected to a P(VDF/TrFE) membrane and the capped end upward.

XRD measurements were performed on copolymer nanotube and nanowire arrays still embedded within the templates and revealed that the nano-objects were crystalline and exhibited a texture.

In order to demonstrate local ferroelectric behaviour, individual P(VDF/TrFE) tubes were characterized by AFM imaging and PFM performed in contact mode with a conductive cantilever (force constant 0.25 N/m). Local (remnant) piezoelectric hysteresis loops were measured by successive application of rectangular voltage pulses. Sub-micrometer domains along the tube length axis can be well resolved in the PFM image in which hysteresis loops are recorded.

CPP 18.3 Di 11:45 TU C130

Bending of magnetic filaments under a magnetic field — •Michael Winklhofer[1] and Valera Shcherbakov[2] — [1]Dept. für Geo- und Umweltwissenschaften, LMU Muenchen, Theresienstr. 41/ IV, 80333 Muenchen — [2]Institute for the Physics of the Earth, Russian Academy of Science, Borok, Yaroslaskaja oblast, Russia

Filaments consisting of magnetic particles chained by molecular linkers have been used to to probe elastic parameters on molecular scale. Other applications may comprise magnetically controlled valves or shape memory materials. We have derived analytical expressions for the equilibrium shape of magnetic fibres, considering two end-member cases, a) magnetic particles concentrated at the free end of cantilevered rods or tubes, and b) (superpara)magnetic particles distributed over the whole length of the filament. Our analysis yields also metastable equilibrium states (MES), which only exist above a critical filament length, but become more stable with increasing magnetic field. The MES for case a) are, like the ground state, circular arcs, but more strongly bent. The multiform MES in case b), which comprise hairpin, sinuous, or even closed shapes, have recently been observed in experiments, too. Because of their simple experimental realization, case a) magnetic filaments are deemed highly suitable for micro-mechanical experiments on long chains of polymer molecules.

CPP 18.4 Di 12:00 TU C130

NEUTRON SPECTROSCOPY ON POLYMERS CONFINED TO NANOPROUS GLASSES — •Andreas Schoenhals[1], Bernhard Frick[2], and Reiner Zorn[3] — [1]Bundesanstalt fuer Materialforschung und -pruefung, Unter den Eichen 87, D-12205 Berlin — [2]Institut Max von Laue - Paul Langevin (ILL) 6, rue Jules Horowitz, B.P. 156, F-38042 Grenoble Cedex 9 — [3]Forschungszentrum Juelich, Institut für Festkoerperforschung, D-52425 Juelich

The behavior polymers confined to geometries of a nanometer scale has become an interesting field. Neutron scattering (NS) is valuable tool to investigate such systems because of the high penetration depth of neutrons. Incoherent NS was carried out on poly(dimethyl siloxane) and poly(methyl phenyl siloxane) confined to Sol/Gel-glasses (7.5, 5.0, 2.5 nm). To cover a broad dynamical range of the scattering function S(Q,E) time-of-flight and backscattering are combined. For the frequency range of the Boson peak the vibrations at lowest frequencies are depressed by the confinement. Elastic scans were carried out and the mean square displacement msd was calculated. Above Tg the characteristic increase of the msd found for the bulk is strongly influenced by the confinement but for both materials in a different manner. The main influence of the confinement on S(Q,t)=FT(S(Q,E)) is an broadening of S(Q,t) with increasing confinement. These results are discussed together with dielectric measurements.

CPP 18.5 Di 12:15 TU C130

Optical absorption spectra of linear and cyclic thiophenes, selection rules manifestation — •Mariusz Bednarz and Peter Reineker — Abteilung Theoretische Physik, Universität Ulm, Albert-Einstein-Allee 11, 89069 Ulm, Germany

Recently a series of oligothiophenes with well defined chain lengths have been synthesized and chain lengths up to 96 thiophene units have been achieved by the stepwise addition of definite repeat units. Such materials are not polydisperse and a strong dependence of the electronic properties on the chain length is observed. In addition a series of fully conjugated macrocyclic structures, based on the same repeat units, have been synthesized: cyclo[n]thiophenes and cyclo(oligothiophenediacetylenes). The absorption spectra for the oligothiophenes and the cyclothiophenes show a systematic redshift with increasing number of thiophene units. Also the absorption line position of a given oligothiophene corresponds to the line position of the cyclothiophene with the doubled number of repeat units. In our theoretical approach we consider the local ground and the relevant local excited state of a repeat unit as a local two level system. The electronic excitations are described as Frenkel excitons. The conjugation between the units is taken into account by transfer integrals. From the corresponding model Hamiltonian we derive the redshift mentioned above and by taking into account selection rules the relation between the spectra of the oligothiophenes and cyclothiophenes is explained [1]. [1] M. Bednarz, P. Reineker, E. Mena-Osteritz, and P. Bäuerle, J. Lumin., in press.