shape, size and orientation. For excitation azimuthally and radially polarized doughnut modes [1] were used. The particles were immobilized on glass or embedded in media of different refractive indices. Both the scattered light from the particles and the light reflected at the glass slide were collected and contributed to the image. The resulting patterns were studied experimentally and theoretically. Particles of different shapes (spheres, rods and triangles) could be distinguished [4] and the refractive index mismatch at the sample interface could be detected. For metallic nanorods the 2-dim. orientation can be directly imaged [2] with high precision [3]. Preliminary data shows that the method also allows to determine the 3-dim. orientation of nanorods.

[1] R. Dorn, S. Quabis and G. Leuchs, Phys. Rev. Lett. 91, 233901 (2003). [2] A.V. Failla, H. Qian, H. Qian, A. Hartschuh and A.J. Meixner, Nano Lett. 6, 1374 (2006). [3] A.V. Failla, S. Jäger, T. Züchner, M. Steiner and A.J. Meixner, Opt. Expr. 15, 8532 (2007). [4] T. Züchner, A.V. Failla, A. Hartschuh and A.J. Meixner, J. Microsc., in print (2007).

CPP 13.12 Tue 18:00 C 264

Femtosecond Spectroscopy Study of the Exciton Relaxation Dynamics in Silicon Quantum Dots — •Carola Kryschi[1], Volker Kuntermann[1], Carla Cimpean[1], and Dietrich Haarer[2] — [1]Institut für Physikalische Chemie I, FAU, Egerlandstr. 3, D-91058 Erlangen — [2]BIMF, Universität Bayreuth, D-95440 Bayreuth

This contribution is targeted to the development of surface-modified silicon quantum dots (Siqdots) with tailored luminescence properties. The surface modification of Siqdots with sizes between 1 and 5 nm has been successfully achieved via two different synthesis routes, first, by controlled oxidation followed from silanization and second, by thermal hydrosilylation with chromophores. The luminescence properties of ethanolic Siqdots dispersions were characterized using stationary and time-resolved luminescence spectroscopy techniques, whereas the ultrashort exciton relaxation dynamics were examined using femtosecond transient absorption spectroscopy. Silanized Siqdots were observed to exhibit two species of photoluminescence (PL): the blue emission at 380 nm is assigned to localized surface states, whereas radiative recombination of quantum confined excitons gives rise to a broad PL band around 800 nm. Whereas the latter is ascribed to Siqdots with sizes larger than 3 nm, for Siqdots smaller than 1.5 nm exciton relaxation dynamics is understood to occur predominantly by trapping due to lower-lying surface states which may radiatively decay. Siqdots terminated with suited chromophores were observed to exhibit only one PL band in the visible that is ascribed to exciton states involving resonant couplings to the conjugated electron system of the chromophores.

CPP 13.13 Tue 18:15 C 264

Spectroscopic fingerprints of single dye - quantum dot nanoassemblies — •Danny Kowerko, Jörg Schuster, and Christian von Borczyskowsi — Center of nanostructured materials and analytics, TU-Chemnitz, 09107 Chemnitz

Self assembled nanoassemblies of semiconductor quantum dots (QDs) and organic molecules are of interest for numerous applications in science and technology. However, physics and chemistry of coupling mechanisms and possible interactions (i.e. energy transfer) are complex and thus not yet fully understood. Spectroscopic analysis of nanoassemblies in solution is difficult, since many complex dynamical process are involved [1]. We have chosen an alternative approach to study nanoassemblies by freezing all of the solution dynamics while depositing the nanoparticles in a low concentration on a silicon oxide surface. The solution which we deposit the nanoassemblies from always contains the unbound building blocks too. We may compare spectroscopic properties of the free and bound species on one and the same sample under identical conditions. By recording series of emission spectra of individual quantum dots, dyes and nanoassemblies we obtain very detailed spectroscopic information which allows us to compare the spectroscopic observable quantities for the free and the bound species. We are thus able to extract spectroscopic fingerprints of the nanoassemblies. In this talk we will present results for CdSe quantum dots and functionalized perylene bisimide dye molecules as building blocks for the aforementioned nanoassemblies.

[1] E. I. Zenkevich, C. von Borczyskowski, J. Lum., 122, 784, 2007

CPP 13.14 Tue 18:30 C 264

Optical mesurements on periodically ordered nanoscopic metal clusters on glass substrates — •Michael Weinl, Daniel Kraus, Jörg K. N. Lindner, and Bernd Stritzker — University of Augsburg, Institute of Physics, 86135 Augsburg

Nanosphere lithography (NSL) is a versatile, fast developing tool for fabricating large areas of nanoscopic, highly ordered metallic particles on a substrate surface. NSL uses self-assembled monolayers of colloidal particles as a deposition mask with the empty space between three adjoining nanospheres acting as mask opening. In comparison to e-beam lithography, NSL produces a great amount of defects but on the other hand it is a very fast and cost-effective technique. The fixed triangle geometry of pure nanosphere lithography can be augmented by angle-resolved evaporation or by plasma and ion beam modification of the masks. In this work, polystyrene nanospheres with a diameter of 200 to 1000 nm were used to fabricate colloidal mono- and doublelayers on glas and silicon substrates. Double layers can be used as masks with smaller mask openings and larger pitch, as compared to monolayers. Regular arrays of metallic nanodots were formed by physical vapour deposition of Au and Ag through these masks. The metal particle shape and size was determined by ESEM, AFM and TEM. An apparatus for the spatially resolved mesurement of optical absorption and transmission in the spectral range of 400 to 950 nm was developed to examine the optical properties of regular metal dot arrays. The lateral resolution also allows to observe the optical properties of structures created at mask defects.

CPP 14: Membranes

Time: Tuesday 15:00–16:30 Location: C 230

CPP 14.1 Tue 15:00 C 230

Free Volume and Permeability in Boltorn-modified Gas Separation Membranes — •Klaus Rätzke[1], Jan Kruse[1], Franz Faupel[1], Dana Sterescu[2], Dimitrios Stamatialis[2], Matthias Wessling[2], and Eduardo Mendes[3] — [1]3. Technische Fakultät Universität Kiel, Germany — [2]1. University of Twente, The Netherlands — [3]2. Delft University of Technology, The Netherlands

This paper describes the the permeation properties of poly (2, 6-dimethyl-1,4-phenylene oxide) (PPO) dense polymer films containing aliphatic hyperbranched polyesters, Boltorn (H40) which are dispersed at various concentrations. Focus is on the correlation between permeation and free volume, which was determined by positron annihilation lifetime spectroscopy, using a well established correlation between orthopositrionium lifetime and average free volume size. The gas permeability of PPO with 1.0 wt % of Boltorn is 2-3 times higher than the pure polymer, while at higher concentration (9.1 wt %) of Boltorn the permeability becomes almost 50 % of the pure polymer. The gas pair selectivity, however, stays constant. The increase in permeability at low concentration of Boltorn is due to the increase of the free volume, probably due to hydrogen bonds between Boltorn and the oxygen of PPO backbone. The decreased permeability of PPO containing higher concentration of Boltorn (9.1 wt %) is due to two reasons: decrease in free volume as determined by PALS as well as phase separation. D. Sterescu, D. Stamatialis, E. Mendes, J. Kruse, K. Rätzke, F. Faupel, M. Wessling Macromolecules, 40 (2007) 5400.

CPP 14.2 Tue 15:15 C 230

Novel carbon nanomembranes as support for ultrahigh resolution structural analysis of nanoparticles — •Christoph Nottbohm[1], André Beyer[1], Alla Sologubenko[2], Inga Ennen[1], Andreas Hütten[1], Harald Rösner[3], Wolfgang Eck[4], Joachim Mayer[2], and Armin Gölzhäuser[1] — [1]Fakultät für Physik, Universität Bielefeld — [2]RWTH Aachen — [3]Forschungszentrum Karlsruhe — [4]Universität Heidelberg

The resolution in transmission electron microscopy (TEM) has reached values as low as 0.08 nm. However, these values are not accessible for very small objects in the size range of a few nanometers or lower as they have to be placed on some support, which contributes to the overall electron scattering signal, thereby blurring the contrast. Here, we report on the use of nanomembranes made from cross-linked

aromatic self-assembled monolayers as TEM sample supports. When transferred onto a copper grid, a single 1.6 nm thick nanomembrane can cover the entire grid and is free-standing within the micron-sized openings. Despite its thinness, the membrane is stable under the impact of the electron beam. Micrographs taken from nanoclusters onto these nanomembranes show highly increased contrast in comparison to images taken from amorphous carbon supports. In scanning transmission electron microscopy with nanomembrane support, a size analysis of sub-nanometer Au clusters was performed and single Au atoms were resolved.

CPP 14.3 Tue 15:30 C 230

Mechanical properties of freestanding nanomembranes from self-assembled monolayers — •Xianghui Zhang, Nils Mellech, Christoph Nottbohm, Andre Beyer, and Armin Gölzhäuser — Fakultät für Physik, Universität Bielefeld, Postfach 100131, 33501 Bielefeld, Germany

Ultrathin membranes are promising materials in science and nanotechnology. Here we report the characterization of nanomembranes with a thickness of approximately 1.5 nm, which have a remarkable high tensile strength and excellent elasticity. The nanomembranes are aromatic self-assembled monolayers (SAMs) that are laterally crosslinked by electron irradiation. The SAMs are prepared on silicon-nitride windows, supported by a silicon frame. Afterwards the silicon nitride is dissolved, providing freestanding nanomembranes that cover openings in silicon substrate with sizes from 10 μm to 50 μm. Bulge testing is used to determine Young´s modulus and residual stress of the freestanding nanomembranes. Rupture testing is performed to measure tensile strength. The nanomembranes display outstanding performance in tensile strength of up to 700 MPa, which is 4∼7 times higher than the highest currently known value for nanomembranes. The electron dose dependences of tensile strength, the Young´s modulus and the residual stress of the nanomembranes have been systematically studied. This allows to tailor its mechanical properties for the fabrication of nanoelectromechanical (NEMS) devices.

CPP 14.4 Tue 15:45 C 230

Polyelectrolyte-surfactant interactions in foam films — •Nora Kristen[1], Vasile Simulescu[1,2], and Regine v. Klitzing[1] — [1]Stranski-Laboratorium, Institut für Chemie, Technische Universität Berlin, Str. d. 17.Juni 124, 10623 Berlin — [2]West University Timisoara, 300223 Timisoara, Rumania

Interactions between polyelectrolytes and surfactants in foams are of interest for many technical applications, e.g. in cleaning processes. Foam consists of many single free-standing films; to investigate these foam films a so called Thin Film Pressure Balance (TFPB) is used. With this apparatus disjoining pressure isotherms are measured (disjoining pressure vs. film thickness).

Depending on the charge combination of the surfactant and the polyelectrolyte, two different types of films can be formed: either a Common black Film (CBF, mainly stabilized by electrostatic forces) or a Newton Black Film (NBF, mainly stabilized by steric forces).

The addition of polyelectrolytes affects the interactions within the foam due to complexation between the surfactant and the polyelectrolyte at the surfaces. With a cationic surfactant like C(n)TAB a film with positive charged surfaces is formed. After addition of negative polyelectrolyte, the charge at the surface is reversed. In both cases, a CBF is formed due to the electrostatic repulsion of the two interfaces. But what happens at isoelectric point of the surface charge: Is a NBF formed or does the film break? The addition of very low polyelectrolyte concentrations leads to a low net surface charge. Therefore the stability of films with a low polyelectrolyte concentration is investigated.

CPP 14.5 Tue 16:00 C 230

Dynamics of Phospholipids in the Stabilizer Layer of Dispersed Lipid Nanoparticles Investigated by Quasielastic Neutron Spectroscopy — •Tobias Unruh, Sebastian Busch, and Christoph Smuda — Technische Universität München, Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II) and Physik Department E13, Garching, Germany

Dispersions of colloidal lipid particles such as triglyceride nanoparticles are used as delivery systems for intravenous administration of drugs. The stabilizing properties of the surfactant layer in the interface between the nanoparticles and the aqueous dispersion medium are determined i.a. by the dynamics of the stabilizer molecules, which holds in particular if the dispersed particles undergo rapid shape or size changes as e.g. during their production in a homogenizer or their crystallization after preparation [1].

Investigations on the dynamics of phospholipid molecules in dispersions of alkanes and triglycerides performed by quasielastic neutron spectroscopy (QENS) will be presented. The measurements were carried out at the high resolution time–of–flight spectrometer TOFTOF of the FRM II in Garching. Due to the high neutron flux of the instrument the investigation of samples with only 20 mg of phospholipid in the beam was possible. The dynamics of the phospholipids is compared to their dynamics in the bilayers of small unilamellar vesicles (SUVs) and the effect of the addition of a co–surfactant on the phospholipid dynamics will be discussed.

[1] K. Westesen, B. Siekmann, Int. J. Pharm., 151 (1997) 35

CPP 14.6 Tue 16:15 C 230

Nanoporous Templates from Supramolecular Assembly of Block Copolymers — •Bhanu Nandan, Marcus Böhme, Radim Krenek, and Manfred Stamm — Leibniz Institute of Polymer Research Dresden, Hohe Strasse 6, 01069 Dresden

Highly ordered arrays of nanostructures derived from block copolymer self-assembly have attracted lot of attention for nanotechnological applications, such as in nanostructured networks and membranes, nanoparticles templates and nanoreactors, photonic crystals, and high density information storage media. In the present work, we investigated nanotemplates based on supramolecular assembly (SMA) of polystyrene-*block*-poly(4-vinylpyridine) (PS-*b*-P4VP) and a low molar mass additive 2-(4'-hydroxyphenylazo)benzoic acid (HABA). The strong repulsion between PS and P4VP in this system allowed fabrication of templates with characteristic length-scale which was not accessible in the past with other block copolymers. Moreover, the morphology of these nanotemplates could be tailored by (1) choosing block copolymer of appropriate block length ratio, (2) varying concentration of HABA, or (3) by blending the SMA with respective homopolymers. Long range order was improved by solvent annealing under controlled conditions and using substrates of low roughness. It is further shown that the SMA fabricated in this work can be used to template various functional inorganic nanostructures by electrodeposition, physical vapour deposition or by soaking in nanoparticle solutions.

CPP 15: Single Molecules

Time: Tuesday 17:00–19:00 Location: C 230

CPP 15.1 Tue 17:00 C 230

Single molecule probes in soft materials — •Jörg Schuster and Christian von Borczyskowski — TU Chemnitz, Institut für Physik, 09107 Chemnitz

Within the past years, single molecule spectroscopy has become a routine tool which is extensively used to study soft, mostly biological, materials. The success of single molecule spectroscopy is due to the fact, that single molecule probes are sensitive to the structure and dynamics of their local nanoscale environment. Fluctuations of single molecule observables such as dipole orientation, spectral positions, excited state lifetime which would be averaged out in ensemble experiments are exploited in order to detect static and dynamic heterogeneities in combination with a nano scale resolution.

The present talk will be focussed on the application of single molecule probes in the field of nonbiological, soft materials, including simple and complex liquids as well as polymers. A number of very different single molecule based techniques is used, including single molecule tracking in a wide field microscope as well as spectroscopy in a confocal instrument. The application of special dye probes will be demonstrated by some recent experiments from our group. In addition, we report on a very recent finding, namely to use the so called power law intermittency (blinking), as a probe of local dielectric relaxations and charge trapping in nonconducting polymer materials.

CPP 15.2 Tue 17:15 C 230