CPP 36: Poster: Nanoparticles and Composite Materials

Time: Wednesday 17:00–19:00 Location: P2

CPP 36.1 Wed 17:00 P2

Gold nanoparticle deposition onto doped polyaniline thin films - an in situ investigation with a combination of μGISAXS and imaging ellipsometry — •Volker Körstgens[1], Monika Rawolle[1], Adeline Buffet[2], Mottakin Abul Kashem[2], Matthias Schwartzkopf[2], Stephan V. Roth[2], and Peter Müller-Buschbaum[1] — [1]TU München, Physik Department, LS Funkt. Mat., James-Franck-Str. 1, 85748 Garching, Germany — [2]HASYLAB at DESY, 22603 Hamburg, Germany

Conducting composite materials based on polyaniline and gold have a broad range of possible applications in the fields of electronics, optics and biology. In this work the deposition of gold nanoparticles as an aqueous dispersion onto a polymer thin film is investigated. The polymer film consists of polystyrene-block-polyethylene oxide and polyaniline doped with camphorsulfonic acid. We use the unique in-situ combination of μGISAXS (grazing incidence small angle x-ray scattering with a μm-sized beam) and imaging ellipsometry [1]. It allows for a comprehensive sample characterization including the local film thickness and optical properties combined with structural information with a spatial resolution depending on the size of the x-ray beam.

This project is financially supported by BMBF grant 05KS7WO1.

[1] V. Körstgens et al., Anal. Bioanal. Chem. 396, 139-149 (2010).

CPP 36.2 Wed 17:00 P2

GISAXS Investigations of gold sputter deposition onto polystyrene colloidal crystals — •Matthias Schwartzkopf[1], Mottakin M. Abul-Kashem[1], Adeline Buffet[1], Gerd Herzog[1], Volker Körstgens[2], Jan Perlich[1], Kai Schlage[1], Peter Müller-Buschbaum[2], Ralf Röhlsberger[1], Stephan V. Roth[1], and Rainer Gehrke[1] — [1]HASYLAB at DESY, Notkestr. 85, D-22603, Hamburg, Germany — [2]TU München, Physik-Department, LS Funkt. Mat., James-Franck-Str. 1, D-85748 ,Garching, Germany

Nanocomposites are important materials for a large variety of current applications like solar cells of hybrid and colloidal multilayer [Kaune] or waveguides [Maier] in optical circuits. For their efficient production in industrial processes it is mandatory to know, how the colloidal polymer layer influences the metal film morphology and the growth kinetics during sputter deposition. Commercial available monodispersed carboxylated polystyrene spheres (cPS) were employed to deposit opal crystals as templates on silicon wafer by using temperature controlled drop casting method. The GISAXS results revealing a delayed growth of a gold skin layer by evolution of the sphere form factors and the transmission signal vanishes simultaneously. This study is showing some hints that sputtered gold atoms can diffuse into the brush-like anionic surface of the cPS spheres before growing vertical on top.

[Kaune] AMI 2009

[Maier] AM 2001

CPP 36.3 Wed 17:00 P2

Freestanding membranes with well defined nanopores — •Achim Manzke, Martin Keitsch, Fabian Enderle, Stefan Wiedemann, Alfred Plettl, and Paul Ziemann — Institute of Solid State Physics, Ulm University, D-89069 Ulm

SiO2-membranes homemade from SiO2-Si-wafers or commercial Si3N4-membranes are used as starting material. Unconventional micellar and colloidal lithography techniques are used to generate hexagonal arrays of Au and Pt nanoparticles on the membrans surface, respectively [1, 2]. Additionally, pure polystyrene particles can be etched down in size by isotropic oxygen plasma treatments [3]. Particles from all three methods are used as masks in subsequent etching steps. Combination of plasma etching, evaporation, and Ar-ion polishing techniques leads to cylindrical pores through the membrane. The micellar technique enables pore diameters from 15 to 50 nm at distances up to 130 nm. On the other hand, the colloidal method allows the fabrication of pores with diameters from 40 nm to micrometers at widely variable distances. Hence, the preparation of freestanding membranes with continuously selectable pore diameters in the nm-range will be demonstrated.

[1] G. Kästle et al., Adv. Funct. Mat. 13, 853 (2003)

[2] A. Manzke et al., Adv. Mater. 19, 1337 (2007)

[3] A. Plettl et al., Adv. Funct. Mat. 19, 3279 (2009)

CPP 36.4 Wed 17:00 P2

Determination of the intrinsic permeability of nanoparticles in composites with unknown microstructure — •Béatrice Hallouet and Rolf Pelster — FR 7.2 Experimentalphysik, Universität des Saarlandes, Campus E 26, D 66123 Saarbrücken, Germany

In general the details of the microstructure in nanocomposites are unknown. Nevertheless there is a need to determine the intrinsic properties of the dispersed phase, e.g. the permeability of nanoparticles, from the measured effective properties of the system. Due to the unknown microstructure a tentative analysis using simple mixture formulas can be highly erroneous. We present a method to extract at least a partial information about the intrinsic permeability of the particles from the measured spectra. Combining dielectric and magnetic measurements we are able to convert the magnetic spectra into lower and upper bounds for the permeability of the particles. The method applies to composites in a frequency range below the interfacial polarisation peak (MWS) and has been tested for magnetic nanocomposites (nanoparticles of magnetite dispersed in a polymer), the permeability spectra of which a ferromagnetic resonance exhibit.

CPP 36.5 Wed 17:00 P2

Structure Property Relationships of Nanocomposites based on Polyethylene and Layered Double Hydroxide — •Purv Purohit, Jesus Sanchez, and Andreas Schönhals — BAM Federal Institute for Materials Research and Testing, Unter den Eichen 87, 12205 Berlin, Germany

Nanocomposites based on Polyethylene (PE) and modified ZnAl Layered Double Hydroxides (ZnAl-LDH) were prepared and investigated by a combination of differential scanning calorimetry (DSC), Small and Wide angle X-ray scattering (SAXS & WAXS) and Dielectric Relaxation Spectroscopy. Space resolved SAXS investigation show that the samples are homogeneous on a length scale of several cm and have a predominantly intercalated morphology. DSC and WAXS show that the degree of crystallinity decreases with the increasing content of LDH. The extrapolation of this dependence to zero estimates a limiting concentration of c.a. 40% LDH where the crystallization of PE is completely suppressed. The dielectric response of the nanocomposites shows several relaxation processes. The intensity of the dynamic glass transition increases with the concentration of LDH. This is attributed to the increasing concentration of the exchanged anion dodecylbenzene sulfonate (SDBS), which are adsorbed at the LDH layers. Therefore, analysis of the beta-relaxation provides information about the interfacial region between the LDH layers and the PE matrix. The glass transition temperature in this interfacial region is somewhat lower than for pure PE. This is accompanied by a change of the fragility deduced from the relaxation map.

CPP 36.6 Wed 17:00 P2

Dielectric and Thermal Investigation of adsorbed Poly(vinyl acetate) on Silica Particles — •Marieke Füllbrandt, Purv Purohit, and Andreas Schönhals — BAM Federal Institute for Materials Research and Testing, Unter den Eichen 87, 12205 Berlin, Germany

Dielectric Relaxation Spectroscopy (DRS) is applied in a broad frequency (10-1 - 106 Hz) and temperature range (178-423K) on samples with different amounts of polymer adsorbed on silica particles. DRS probe the interface at the polymer and silica. Two relaxation processes can be identified, one corresponding to the bulk polymer and other related to the interfacial molecules of polymer and silica where the dynamic glass transition is shifted to higher temperature due to reduced mobility.

Further investigations were done to obtain information about concentrations and bound carbonyl fractions of surface adsorbed Poly(vinyl acetate) using thermogravimetric analysis (TGA) and Fourier Transform Infrared Spectroscopy (FTIR) measurements.

CPP 36.7 Wed 17:00 P2

Segment density and coil dimensions of polymer chains anchored to solid surfaces — •Chang Jong Kim[1], Tinka Spehr[1], Bernd Stühn[1], Markus Mazurowski[2], Katrin Sondergeld[2], Roland Klein[2], and Matthias Rehahn[2] — [1]TU Darmstadt,Experimental Condensed Matter Physics — [2]TU

Darmstadt,Ernst-Berl-Institute for Technical and Macromolecular Chemistry

Polymer chains tethered onto curved substrates show different conformation compared to the bulk case. We study two model systems of spherical silica (SI) and polystyrene (PS) nanoparticles, onto which PS chains are attached by grafting from process. These grafted nanoparticles are dispersed either in good solvent (THF) or in matrix (PS). By means of small angle x-ray scatering, the structure of bare and surface modified particles in solution is determined. We also use dynamic light scattering to estimate the hydrodynamic radii of bare, surface modified and PS grafted SI/PS particles in solution. Finally by contrast matching of core and solvent, small angle neutron scattering allows to investigate the conformation of PS chains grafted on the surface of SI and PS in solution or both PS grafted SI and PS in a PS matrix. This is achieved by varying grafting density and molecular weight of PS in solution, and by varying the molecular weight of PS matrix at constant grafted PS molecular weight in the matrix case.

In the latter situation, a decrease of the thickness of the grafted layer with increasing molecular weight of the matrix is found, contrary to PS grafted SI in PS matrix where no change is observed.

CPP 36.8 Wed 17:00 P2

Synthesis and characterization of silica-encapsulated nanorods — •Nina Haselmaier, Philipp Bender, Andreas Tschöpe, and Rainer Birringer — Universität des Saarlandes, Saarbrücken, Deutschland

Ni nanorods with diameters ranging from 15-30 nm and aspect ratios > 3 are uniaxial ferromagnetic single domain particles. The unique magnetic properties translate into rheological properties in colloidal dispersions with perspective applications in microbiology. However, due to the strong dipolar interaction, both steric and electrostatic stabilization are necessary to prevent the nanoparticles from agglomeration even in dilute suspensions. In the present study Ni nanorods were synthesized by current-pulsed electro-deposition of Ni into hexagonally ordered porous alumina-templates. Afterwards they were released from the templates by dissolution of the alumina layer in sodium hydroxide (NaOH), to which PVP (polyvinyl-pyrrolidone) was added as surfactant. A thorough washing procedure resulted in stable aqueous colloidal dispersions of the Ni nanorods. SEM (scanning electron microscopy) - and TEM (transmission electron microscopy) - characterization of the nanorods reveals that their surrounding PVP-layer is about 6 nm thick. The main purpose of the PVP-layer is to avoid the formation of strong aggregates in the dispersion during sample preparation. The focus of the present study was to replace the organic PVP-layer by a mechanically rigid inorganic silica shell in order to increase the potential for surface functionalization of the nanoparticles.

CPP 36.9 Wed 17:00 P2

Effect of external magnetic field on the alignment of metal-polymer nanocomposites — •Yuan Yao[1], Ezzeldin Metwalli[1], Heokmin Choe[1], Peter Busch[2], and Peter Müller-Buschbaum[1] — [1]TU München, Physik Department, LS Funkt. Mat., James-Franck-Str. 1, 85748 Garching, Germany — [2]Jülich Centre for Neutron Science at FRM II, Forschungszentrum Jülich GmbH, Lichtenberstr. 1, 85747 Garching

Block copolymers embedded with magnetic nanoparticles have attracted strong interest as a method to fabricate hybrid nanocomposites for wide potential applications in functional devices. Furthermore, the control over the alignment of the nanoparticles within the polymer matrix is essential for producing well-aligned highly-oriented metal-polymer nanopatterns. Controlled alignment of block copolymers or metal-polymer composites was achieved via various methods. In this work, we have investigated the alignment of magnetic nanoparticles, which is maghemite, in poly(styrene-b-methylmethacrylate) diblock copolymer films. Films are prepared by solution casting. An external magnetic field is applied to the samples during the casting step. We have studied the emerged morphologies under the influence of both nanoparticle concentrations in the polymer film and the external magnetic field strength at different direction relative to the sample surface. The structures of the metal-polymer composite films have been characterized using optical microscopy, atomic force microscopy (AFM), and grazing incidence small angle neutron scattering (GISANS).

CPP 36.10 Wed 17:00 P2

Combinatorial synthesis and characterisation of binary plasmonic metal nanoparticles in micro fluid segment sequences — •Andrea Knauer[1], Steffen Schneider[1], Andrea Csáki[2], Wolfgang Fritzsche[2], and J. Michael Köhler[1,2] — [1]Techn. University of Ilmenau, Germany — [2]Inst. for Photonic Technologies, Jena, Germany

This work reports on the screening of optical properties of Au/Ag core/shell and multishell nanoparticles by automated stepwise variation of reactant ratios in two and three dimensional parameter spaces during the micro continuous-flow synthesis under segmented-flow conditions. The optical properties of binary metal nanoparticles shift with the layer ratio of the metallic components as well as with their shape, size, surface charge and ligand-shell. Therefore, the optimization of the optical properties is a multi parameter problem demanding for new experimental strategies. The complete space of the combinations of the reactant concentrations was covered by combined slowly shifting flow rates for two reactants and a periodically fast shifting flow rate of a third solution. The total flow rate was kept constant. For these synthesis screenings, the concentrations of metal salts, reducing agent, and added ligands were varied. The three-dimensional addressing of parameter spaces can be used for finding the optimal conditions for a narrow size distribution of the obtained nanoparticles and for a tuning of their optical properties.

CPP 36.11 Wed 17:00 P2

Silver nanowires grown within tubular J-aggregates — Dörthe M. Eisele[1], Holm Kirmse[1], •Egon Steeg[1], Keith J. Stevenson[2], David A. Vanden Bout[2], Stefan Kirstein[1], and Jürgen P. Rabe[1] — [1]Humboldt-Universität zu Berlin, Germany — [2]University of Texas at Austin, USA

It was shown previously that silver nanowires with diameters below 10 nm and length exceeding microns can be grown within tubular J-aggregates by reduction of silver salt [1]. The J-aggregates self assemble from amphiphilic cyanine dyes in aqueous solutions. The silver ions are reduced by oxidizing the dyes.

We report here on the formation of sliver nanowires within the aggregates under various experimental conditions. Since the nucleation is supposed to be photo-assisted the growth is influenced by the choice of illumination time and wavelength of light. Additionally, the growth kinetics plays an important role. We discuss the correlation between these parameters and the structural properties of the wires, such as diameter, length, and crystallinity. These experiments give insight into the nucleation and growth mechanism of metal nanowires within an amphiphilic template in an aqueous environment.

[1] D.M. Eisele, H. v. Berlepsch, C. Böttcher, K.J. Stevenson, D.A. Vanden Bout, S. Kirstein, and J.P. Rabe, JACS 132 (2010) 2104.

CPP 36.12 Wed 17:00 P2

TiO_2-Ag nanocomposites for antimicrobial and photocatalytic application — •Tomislav Hrkac[1], Venkata Sai Krian Chakravadhanula[1], Natalie Wohner[1], Bodo Henkel[1], Thomas Strunskus[1], Vladimir Zaporojtchenko[1], Rainer Podschun[2], Claudia Röhl[3], Dieter Garbe-Schönberg[4], and Franz Faupel[1] — [1]Institute for Materials Science - Multicomponent Materials, Christian-Albrechts-University Kiel (CAU) — [2]Institute for Infection Medicine, CAU Kiel and University Medical Center Schleswig-Holstein Campus Kiel (UKSH) — [3]Institute of Toxicology and Pharmacology for Natural Scientists, UKSH Kiel — [4]Institute of Geosciences, CAU Kiel

Nanocomposites offer the possibility to combine the antimicrobial property of Ag with the photocatalytic activity of TiO_2 in one material. Here TiO_2-Ag 3D nanocomposites with different filling factor and different morphologies were prepared by physical vapor deposition techniques. The antimicrobial and toxicological properties were studied and correlated to the silver release measured by ICP-MS. The optical and structural properties of the composite were characterized by UV-Vis, XRD, HRTEM and XPS, and the photocatalytic activity was determined by UV illuminated dye photodegradation. Considering the different morphologies the correlation of antimicrobial efficiency and silver release will be discussed.

CPP 36.13 Wed 17:00 P2

Photothermal Correlation Spectroscopy on Gold Nanoparticles and Nanorods — •Jonas Buchmann[1], Markus Selmke[1], Daniel Rings[2], Klaus Kroy[2], and Frank Cichos[1] — [1]Institut für Experimentelle Physik I, Universität Leipzig, Deutschland — [2]Institut für Theoretische Physik, Universität Leipzig, Deutschland

Photothermal Correlations Spectroscopy (PhoCS) is a detection technique that is based on the release of heat from absorbing nano-objects.

The released heat changes the local temperature and the local refractive index to provide an efficient scattering of a probe laser. Thus, absorbing particles diffusing through a the focal volume create signal burst which allow the characterization of the Brownian motion of heated particles - so called hot Brownian motion.

Here we explore the hot Brownian motion of gold nano particles and gold nano rods of various sizes. Among other effects we find an anomalous size dependence of the diffusion coefficient at constant incident heating power, which is explained within the theoretical framework of hot Brownian motion.

CPP 36.14 Wed 17:00 P2

Fine-Tuning of the Plasmon-Resonance of Gold Nanoparticles in Layered Geometry — •Madlen Klötzer[1], Steffen Mitzscherling[1], Mareike Kiel[1], and Matias Bargheer[1,2] — [1]Institut für Physik und Astronomie, Universität Potsdam — [2]Helmholtz Zentrum Berlin, Berlin

Multilayer systems containing gold nanoparticles and polyelectrolytes with a high degree of structural perfection are prepared by spin assisted layer-by-layer deposition. X-ray reflectivity and TEM measurements show well stratified layers of polyelectrolytes and gold nanoparticles.(1) The particle's packing density in-plane is verified by AFM measurement. The in-plane particle distance is varied by the adsorption time of the gold suspension and the distance between the gold layers is defined by the number of polyelectrolyte double layers. Optical spectroscopy (reflection and transmission) with polarized light reveals a tuning of the particles plasmon resonance determined by the interaction of particles.

(1) M. Kiel, S. Mitzscherling, W. Leitenberger, S. Santer, B. Tiersch, T. K. Sievers, H. Möhwald, and M. Bargheer, Langmuir 2010, 26 (23), 18499

CPP 36.15 Wed 17:00 P2

Detection of a surface charge on fluorescent CdSe/ZnS Quantum Dots in Toluene — •Nicole Amecke and Frank Cichos — Molecular Nanophotonics, University of Leipzig, Leipzig, Germany

Semiconductor nanocrystals, that fluoresce in the visible range like CdSe/ZnS QDs, have been a widely studied material over the last decades due to applications in bio-labeling, laser diodes, solar cells and many others. Their size-tunable fluorescence shows high quantum yields, however most synthesized single crystals still show fluctuating and interrupted emission. Those effects have been mostly assumed to be due to charges in the crystal core or at the surface leading to nonradiative decay channels and spectral shifts. However, those charges remain difficult to investigate during fluorescence detection. We took another step to change this, using a confocal microscope and investigating the fluorescence intensity of QDs in a homogeneous electric field close to one electrode. We find motion to the negative electrode and the formation of a screening layer. Despite the positive charge on these particles we measure a fluorescence lifetime comparable to that of immobilized single particles. Thus, a charge in the core can be excluded. As we are measuring in toluene, an intrinsic surface charge is suggested. We estimate the amount of this charge and the percentage of charged particles by comparing velocities and concentrations with simple electrophoretic dynamics. The possibility for this charge as origin of the measured intensity fluctuations of immobilized particles is discussed.

CPP 36.16 Wed 17:00 P2

The accurate estimation of power law exponents in terms of binned data — •André Heber, Nicole Amecke, and Frank Cichos — Molecular Nanophotonics, University of Leipzig, Leipzig, Germany

Since the first observations of single quantum dots, is has been known that they show random intensity switches between a photon-emitting state, called on-state, and an off-state, where no photons are emitted. The durations of the states are described as cut-off power laws or pure power laws, respectively. It is estimated that the power laws stretch from the fluorescence lifetime of a quantum dot to hours. However, due to experimental limitation, in intensity time traces only on- and off- states longer than 1 ms can be measured. In this poster we argue that it is difficult to conclude from the measurement of binned data to the microscopic mechanisms of the blinking behavior. We compare different analysis methods including least square fits and maximum likelihood estimators of simulated blinking traces. As a result we show that linear least square fits to log-log histograms are better suited to determine the power law from binned data than maximum likelihood estimators.

CPP 36.17 Wed 17:00 P2

Competition between diffusion and aggregate formation on a single molecule level — •Frank Gerlach, Daniel Täuber, and Christian von Borczyskowski — Chemnitz University of Technology, Optical Spectroscopy and Molecular Physics, Chemnitz, Germany

Nanoparticles and dye molecules are widely used as fluorescence labels in biophysical and medical applications. For this reason the mutual interaction among these two types of reporter molecules is of special interest. In this communication we use fluorescence and single molecule methods to explore the competition between diffusion of single dye molecules in thin liquid films and aggregate formation between surface attached colloidal semiconductor quantum dots (QD) and perylene bisimide dye molecules. This is a combined study on aggregate formation [1] and diffusion experiments [2]. We observe the diffusion with respect to the competition of the dynamics in thin liquid films with aggregate formation. The formation of assemblies is a sequence of attachments and detachments, which is controlled by the ligands present on the QD surface.

[1] D. Kowerko, J. Schuster, N. Amecke, M. Abdel-Mottaleb, R. Dobrawa, F. Würthner, C. von Borczyskowski, PCCP, 12, 4112, 2010.

[2] D. Täuber, C. von Borczyskowski et al: Diff. Fund. 11, 107, 2009.

CPP 36.18 Wed 17:00 P2

Comparative studies of the electrical behavior of catalytically grown scrolled graphene and multi-walled carbon nanotubes — •Andreas Schaper[1], Mingsheng Wang[2], Houqing Hou[3], Yoshio Bando[2], and Dmitri Golberg2[2] — [1]Center for Materials Science, Philipps University, 35032 Marburg, Germany — [2]National Institute for Materials Science, Tsukuba, Ibaraki 3050044, Japan — [3]Chemistry College of Jiangxi University, Nanchang, JX 330027, P.R. China

Besides the well known single-walled and nested-tube multi-walled carbon nanotubes (SWCNTs, MWCNTs), and the successful isolated flat graphene, scrolled graphene (carbon nanoscrolls, CNSs) has been receiving increasing interest in recent time. Here, we report in situ electron microscope measurements of the electrical behavior of CNSs and CNTs prepared using catalyst-assisted chemical vapour deposition. In the low-bias region, strictly linear IV characteristics were observed with resistance values in the range 0.8 - 15.0 kΩ for CNSs and 20 - 30 kΩ for MWCNTs. With increasing applied voltage, a superlinear behavior was detected with maximum current-carrying capacities of 8.5 x 10^8 A/cm^2 (CNSs) and 10^7 A/cm^2 (MWCNTs). As revealed by the IV data and by time-resolved image sequences, the electric breakdown of the scrolls always occurred in an abrupt manner, while the nanotubes showed a sequential destruction of the concentric-shell geometry. Due to their superb properties, CNSs are promising as electronic device elements with no limitations as to electric contacting.

CPP 36.19 Wed 17:00 P2

Photoinduced Charge Transfer in Blends of PbSe Nanocrystals and Poly(3-hexylthiophene) — •Elena Selishcheva, Florian Witt, Niklas Trautwein, Holger Borchert, Jürgen Parisi, and Joanna Kolny-Olesiak — University of Oldenburg, Department of Physics, Energy and Semiconductor Research Laboratory (EHF), 26111 Oldenburg, Germany

Colloidal, infrared-absorbing lead selenide nanocrystals (PbSe NC) are one of the promising candidates for application as a photoactive component in hybrid solar cells due to their ability to absorb light over a large energy range of the solar spectrum. The nanoparticles blended with a conjugated polymer, such as poly(3-hexylthiophene) (P3HT), are a donor/acceptor system, which can promote efficient charge transfer. The charge separation between donor and acceptor can be studied by electron paramagnetic resonance (EPR), which detects the unpaired spin of polarons, and by photoinduced absorption spectroscopy (PIA), which monitors the change in the transmission of a nanoparticles/polymer blend due to polaronic transitions.

In this work we present a novel synthesis of oleic acid capped PbSe NC. Prior to mixing with the polymer these particles were treated with hexylamine, because its shorter hydrocarbon chain (compared to oleic acid) is supposed to improve the charge transfer in blends PbSe NC/P3HT. The charge separation was studied by EPR and PIA. These measurements suggest that charges are produced by photoinduced charge transfer. The blends PbSe NC/P3HT were used to prepare first laboratory solar cells.

CPP 36.20 Wed 17:00 P2

Structural investigation of poly(organosiloxane) nanocapsules with iron oxide cores by (A)SAXS and XRD — •Johannes Möller[1], Martin A. Schroer[1], Michael Paulus[1], Patrick Degen[2], D.C. Florian Wieland[1], Christoph J. Sahle[1], Alexander Nyrow[1], Melek Cebi[2], Sabine Leick[2], Heinz Rehage[2], and Metin Tolan[1] — [1]Fakultät Physik/DELTA, TU Dortmund, Maria-Goeppert-Mayer-Str. 2, D-44227 Dortmund — [2]Physikalische Chemie II, TU Dortmund, Otto-Hahn-Str. 6, D-44227 Dortmund

We report the results of (anomalous) small angle X-ray scattering ((A)SAXS) and diffraction (XRD) measurements to study the internal structure and the formation process of poly(organosiloxane) nanocapsules filled with iron oxide cores of different sizes. The synthesis of the nanocapsules has two essential features. First iron oxide nanoparticles are synthesized by a chemical precipitation process. The second step consists of the preparation of a thin poly(organosiloxane) shell around the iron oxide core. The possibility of removing partially or completely the magnetic core of the capsules by chemical etching processes offers the opportunity of assembling hollow nanocapsules, which can be used to produce new types of microreactors or for therapeutic delivery of drugs, genes or radionuclides. The radius distribution functions of the iron oxide cores are determinded by SAXS measurements, showing the dissolution of the cores inside the capsules. Information about the structure of the iron oxide cores and the poly(organosiloxane) network at the surface are revealed by X-ray diffraction.

CPP 36.21 Wed 17:00 P2

Gold Nanoparticles Decorated with oligo(ethylene glycol) Thiols: Surface Charges and their Influence on Protein Resistance — •Moritz Schollbach[1], Maximilian W. A. Skoda[2], Robert M. J. Jacobs[3], Fajun Zhang[1], and Frank Schreiber[1] — [1]IAP Universität Tübingen — [2]ISIS Rutherford Appleton Laboratory UK — [3]CRL University of Oxford UK

Protein resistant behavior of oligo(ethylene glycol) thiol self assembled monolayers (OEG SAM) on gold surfaces [1] makes them interesting for various applications. In previous studies we investigated the resistance to adsorption of bovine serum albumin (BSA) on a model system of OEG SAM coated gold nanoparticles (AuNP) [2]. Gold colloids allow easy observation because protein repulsion leads to aggregation via a depletion-attraction effect [3]. By extending this study to other proteins, we found that surface charges play a crucial role. Zeta potential (ζ) measurements of AuNP show negative values, corresponding to a low net negative surface charge. Added negatively charged protein (BSA) does not change ζ. The size distribution, obtained by dynamic light scattering (DLS), shows separate peaks for colloid and BSA. In contrast, adding the positive charged Lysozyme (LYZ) raises ζ, resulting in a charge inversion for higher LYZ concentrations. For samples with $\zeta \approx 0$ the size distribution shows aggregates of AuNP. These results indicate that LYZ can adsorb on the AuNP, neutralizing the surface charge and destabilizing the system. [1] F. Schreiber, J. Phys.: M. 16, 2004, R881. [2] F. Zhang et al. J. Phys. Chem. A, 111, 2007, 12229 [3] F. Zhang et al. Eur. Biophys. J., 37, 2008, 551

CPP 36.22 Wed 17:00 P2

Aggregationsprozesse mono- und multivalent stabilisierter Goldnanopartikel und Quantenpunkte — •Benjamin Stein und Christina Graf — Insitut für Chemie und Biochemie FU Berlin Takustr. 3 14195 Berlin

Die unterschiedlichen Aggregationsgeschwindigkeiten von Nanopartikeln, die mit mono- oder multivalent bindenden Liganden stabilisiert sind, wurden bei verschiedenen pH-Werten und Temperaturen untersucht. Die Liganden bestehen aus Thiol-terminierten Verbindungen und sind zudem durch eine Polyethylenglykoleinheit hydrophil und dadurch im pharmazeutischen Bereich vielfach anwendbar. Zunächst wurden die Austauschreaktionen an einfach zu synthetisierenden und stabilen, Citrat stabilisierten Goldnanopartikeln durchgeführt (d=17nm). Anschließend wurden die Experimente auf CdSe/ZnS-Kern-Schale-Quantenpunkte (d=4 nm) erweitert. Das Ausmaß der Aggregation der Goldpartikel wurde anhand der Lage und Breite des Plasmonenresonanzbanden im UV-Vis-Spektrum bestimmt. Zeitabhängige Messungen bei niedrigen und hohen pH-Werten zeigen, dass divalente Liganden den Aggregationsprozess gegenüber monovalenten Liganden verlangsamen. Zudem weisen die divalent geschützten Goldnanopartikel eine größere Stabilität bei erhöhten Temperaturen auf. Auch die Aggregation der Quantenpunkte bei unterschiedlichen pH-Medien, die mittels Fluoreszenz und UV-Spektren detektiert wurde, zeigt denselben Trend, dass divalente Liganden stabilisierender als monovalente wirken.

CPP 36.23 Wed 17:00 P2

Ion transport mechanisms in ternary mixtures of polymer electrolytes and ionic liquids - a molecular dynamics simulation study — •Diddo Diddens[1,2] and Andreas Heuer[1,2] — [1]Institut für physikalische Chemie, Universität Münster, Corrensstraße 30, 48149 Münster, Germany — [2]NRW Graduate School of Chemistry, Corrensstraße 36, 48149 Münster, Germany

Electrolytes based on mixtures of lithium salts and poly(ethylene oxide) (PEO) are important candidates for modern lithium ion batteries used in electronic devices. Unfortunately, in case of the common binary electrolytes like PEO/lithium-bis(trifluoromethane sulfonimide) (LiTFSI), the ionic conductivity is too low for technological use. Among several other attempts that have been made to overcome this deficiency, the incorporation of room temperature ionic liquids (RTILs) into these materials promise a significant improvement, as the ionic conductivity is increased about an order of magnitude at room temperature, thus making them an ideal compromise between solid and liquid electrolytes. Based on these experimental findings, we study the underlying microscopic transport mechanisms by means of MD simulations. The transport mechanisms are discussed in context with our insights from a previous study of the binary PEO/LiTFSI electrolyte, thus pointing out the microscopic processes relevant for macroscopic ion transport.

CPP 36.24 Wed 17:00 P2

Lithium-containing diblock copolymer thin films for solid-state micro-batteries — •William Hefter[1], Ezzeldin Metwalli[1], Man Nie[1], Volker Körstgens[1], Jan Perlich[2], Stephan V. Roth[2], and Peter Müller-Buschbaum[1] — [1]TU München, Physik Department, LS Funkt. Mat., James-Franck-Str. 1, 85748 Garching, Germany — [2]HASYLAB at DESY, Notkestr. 85, 22603 Hamburg, Germany

The ion-conducting polymer electrolyte in thin film format is important in the fabrication of lightweight and shape-flexible solid-state micro-batteries. Thin hybrid films based on polystyrene-block-polyethylene oxide and the alkali salt of lithium (bis) trifluoromethanesulfonimide are investigated using optical microscopy, atomic force microscopy and grazing incidence small angle x-ray scattering. The structure of the hybrid films are examined as a function of Li/PEO ratio. Below a critical concentration cLi/PEO the crystallization of PEO is prohibited and nanostructured block copolymer films with Li incorporated in the PEO domain are obtained. In a concentration regime above cLi/PEO aggregation of Li salt to the polymer film surface occurs due to limited capability of the PEO to accommodate the Li ions in the thin film geometry. A solvent vapor annealing of such films further enriches Li salt at the surface due to the interaction with the interfaces.