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Fachverband Mikrosonden (MI)

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Overview of Invited Talks and Sessions

(Lecture room: EMH 225; Posters: B)

Invited Talks of the Joint Symposium "Domain Wall Functionality and Engineering in Complex Oxides" (SYDW)

See SYDW for the full program of the symposium.

SYDW 1.1	Mon	9:30–10:00	H 0105	**Domain walls: from conductive paths to technology roadmaps** — •Gustau Catalan
SYDW 1.2	Mon	10:00–10:30	H 0105	**Domain walls and oxygen vacancies - towards reversible control of domain wall conductance** — •Patrycja Paruch
SYDW 1.3	Mon	10:30–11:00	H 0105	**Novel mechanisms of domain-wall formation** — •Andres Cano
SYDW 1.4	Mon	11:30–12:00	H 0105	**Novel materials at domain walls** — •Beatriz Noheda
SYDW 1.5	Mon	12:00–12:30	H 0105	**Controlling and mapping domain wall behaviour in ferroelectrics** — •John Martin Gregg, Jonathan Whyte, Raymond McQuaid, Michael Campbell, Amit Kumar, Roger Whatmore

Invited Talks of the Joint Symposium "On-Surface Polymerization" (SYOP)

See SYOP for the full program of the symposium.

SYOP 1.1	Mon	15:00–15:30	H 0105	**Formation mechanisms of covalent nanostructures** — •Jonas Björk
SYOP 1.2	Mon	15:30–16:00	H 0105	**Selective C-H Activation and C-C coupling on Metal Surfaces** — •Lifeng Chi
SYOP 1.3	Mon	16:00–16:30	H 0105	**On-Surface Synthesis on Insulating Substrates** — •Angelika Kuehnle
SYOP 1.4	Mon	16:45–17:15	H 0105	**On-surface polymerization - a synthetic route to 2D polymers** — •Markus Lackinger
SYOP 1.5	Mon	17:15–17:45	H 0105	**On-surface azide-alkyne click chemistry and a novel metal-organic network based on Cu adatom trimers** — •Trolle Linderoth

Invited Talks

MI 1.1	Mon	9:30–10:15	EMH 225	**High-resolution electron cryo-microscopy of macromolecular protein complexes** — •Werner Kühlbrandt
MI 1.2	Mon	10:15–11:00	EMH 225	**Electron Cryotomography of Archaea** — •Bertram Daum
MI 3.1	Mon	15:00–15:45	EMH 225	**Orientations, texture, properties - applications of electron backscatter diffraction** — •Karsten Kunze
MI 5.1	Tue	10:30–11:15	EMH 225	**Dynamic Light Scattering on Polymer Gels** — •Bernhard Ferse, Franziska Krahl, Doreen Beyer, Karl-Friedrich Arndt, Andreas Richter
MI 9.1	Wed	11:45–12:30	EMH 225	**Experiments with the intense and brightness enhanced positron beam at NEPOMUC** — •Christian Piochacz, Thomas Gigl, Niklas Grill, Markus Reiner, Samantha Zimnik, Christoph Hugenschmidt

Sessions

MI 1.1–1.5	Mon	9:30–11:45	EMH 225	**Microanalysis and Microscopy of Biological Materials**
MI 2.1–2.5	Mon	12:00–13:15	EMH 225	**Analytical Transmission Electron Microscopy and Atom Probe Tomography**
MI 3.1–3.5	Mon	15:00–16:45	EMH 225	**Analytical Scanning Electron Microscopy**
MI 4.1–4.2	Tue	9:30–10:00	C 243	**On-Surface Polymerization (contributed Session to the Symposium SYOP, joint Session with CPP)**
MI 5.1–5.1	Tue	10:30–11:15	EMH 225	**International Year of Light**
MI 6.1–6.2	Tue	11:30–12:00	EMH 225	**Scanning Probe Microscopy**
MI 7.1–7.5	Wed	9:30–10:45	EMH 225	**X-ray Imaging, Tomography and X-ray Optics**
MI 8.1–8.2	Wed	11:00–11:30	EMH 225	**Ionenstrahlmethoden**
MI 9.1–9.3	Wed	11:45–13:00	EMH 225	**Positron Annihilation Studies of Condensed Matter**
MI 10.1–10.9	Wed	15:00–17:30	Poster B	**Poster: Microanalysis and Microscopy**

Mitgliederversammlung des Fachverbandes Mikrosonden

Montag 17:30 EMH 225

- Bericht des Fachverbandsvorsitzenden
- Planung der DPG-Tagung 2016
- Verschiedenes

MI 1: Microanalysis and Microscopy of Biological Materials

Chair: S. Henning, Halle

Time: Monday 9:30–11:45 Location: EMH 225

Invited Talk MI 1.1 Mon 9:30 EMH 225

High-resolution electron cryo-microscopy of macromolecular protein complexes — •Werner Kühlbrandt — MPI of Biophysics, Frankfurt, Germany

We are witnessing a revolution in determining the structure of large protein complexes by electron cryo-microscopy (cryo-EM), precipitated by a new generation of direct electron detectors. The sensitivity and fast readout rate of these new cameras means that beam-induced movements can be overcome routinely. Three-dimensional density maps of a quality similar to or better than that achieved by x-ray crystallography are obtained. Two examples will be presented: the 3.3 Å structure of the nickel-iron hydrogen transferase Frh, an archaeal multi-enzyme complex involved in methanogenesis, and the 6.2 Å structure of an intact, functional mitochondrial F1-Fo ATP synthase. Both have defeated protein crystallography for years or decades.

The mitochondrial ATP synthase is an ancient nanomachine in the energy-converting membranes of all living organisms. In order to understand how this massive multiprotein assembly works in the cellular context, it is necessary to obtain detailed views of it in the membrane, which was achieved by electron cryo-tomography (cryo-ET) of whole mitochondria. The new direct electron detectors enabled us to obtain an 18 Å map of the ATP synthase in situ, doubling the resolution attained with conventional CCD detectors. Our results provide unique new insights into the functional arrangement of large membrane protein complexes in biological energy-converting membranes.

Invited Talk MI 1.2 Mon 10:15 EMH 225

Electron Cryotomography of Archaea — •Bertram Daum — Max-Planck Institut für Biophysik, Frankfurt/Main, Deutschland

Electron cryotomography is an electron microscopic technique capable of visualising cellular structures in three dimensions. By combining newly developed direct electron detectors and subtomogram averaging of repetitive particles, it is possible to acquire in situ structures of proteins complexes at sub-nanometre resolution. We employ this powerful technique to investigate membrane protein complexes involved in cell-cell interactions as well as viral infection of Archaea, a group of microorganisms that next to Bacteria and Eukaryotes forms the third branch of evolution, and often populates extreme environments.

MI 1.3 Mon 11:00 EMH 225

Microstructure diagnostics of fluoride interaction with human dental tissue — •Matthias Petzold, Lutz Berthold, and Andreas Kiesow — Fraunhofer Institute for Mechanics of Materials IWM Halle, Walter-Huelse-Strasse 1, 06120 Halle, Germany

In dentistry, fluoride compounds play a crucial role particularly for caries prevention. Topical treatments of teeth using e.g. fluoridated tooth pastes or mouth rinses result in surface microstructure changes. In addition to clinical and (bio-)chemical studies, methods like electron microscopy and X-ray analyses allow contributing to establish more substantiated models of how fluorides interact with the tooth surface. In the presentation, a short introduction is given on current understanding of topical fluoridation of dental enamel and dentine. Results of case studies on calcium fluoride-like precipitate formation on dental enamel after treatment with amine fluoride-containing products will be presented. In addition, findings from HR-TEM/EDX studies comparing different fluoride compounds are discussed that contribute to a deeper understanding of the effects of pH and fluoride compound on fluoride interaction modes. In addition to calcium fluoride-like reaction products formed at the tooth surface, attention is also given to the microstructure of the dental enamel beneath the surface layers. The results presented will be compared to current models published in literature regarding the mode of action of fluorides. In this context, open questions and future research needs regarding fluoride interaction with dental enamel and dentine will also be highlighted.

MI 1.4 Mon 11:15 EMH 225

Characterizing the Material Bone by Combining Microscopy Methods and X-ray Scattering — •Wolfgang Wagermaier — Max Planck Institute of Colloids and Interfaces, Department of Biomaterials, Potsdam, Germany

The structure of bone at all hierarchical levels continuously adapts during growth and healing. The local characteristics of mineral particles and the organic matrix in bone can be investigated to elucidate basic biological processes. Scanning electron microscopy is used to quantify the amount of mineral, while size and orientation of mineral particles are characterized using small and wide angle X-ray scattering. A combination of rhodamine staining and confocal laser scanning microscopy enables a three-dimensional visualization of voids in bone, housing blood vessels and bone cells. This combination of methods enables a visualization of soft and hard tissue components and to estimate their properties in relation to the spatial tissue organization.

MI 1.5 Mon 11:30 EMH 225

Mikromechanische Untersuchungen zur Mikrorissbildung im Knochen in TEM und ESEM — •Jessica Klehm[1], Jörg Brandt[2] und Sven Henning[1] — [1]Fraunhofer Institut für Werkstoffmechanik IWM Halle — [2]Department für Orthopädie, Unfall- und Wiederherstellungschirurgie; Universitätsklinikum Halle (Saale)

Mikromechanische Analysen zu mikro- und nanoskopischen Strukturveränderungen bei Deformation und Bruch sind ein wichtiges Werkzeug zur Aufklärung von Struktur-Eigenschaftsbeziehungen in Werkstoffen und Biomaterialien. Die elektronenmikroskopische Untersuchung von Risseinleitungs- Risswachstums- und Rissstoppmechanismen im Knochen trägt dazu bei, den Einfluss von Erkrankungen des Stütz- und Bewegungsapparates (z.B. Osteoporose oder nekrotische Veränderungen) oder medikamentöser Therapieen auf das Frakturrisiko besser abschätzen zu können. Dabei werden in vivo entstandene Mikrorisse mit experimentell unter mikroskopischer Beobachtung erzeugten Deformationsstrukturen verglichen und mit der lokalen Mineralkonzentration und der Nanostruktur des Knochens am Ort der Messung korreliert.

Das Material "Knochen" wird dabei als biolgisch synthetisierter Nanokomposit-Werkstoff behandelt, bei dem eine organische, duktile, faserartige Komponente (Kollagen) mit steifen, plättchenförmigen Nanokristalliten (Hydroxylapatit) kombiniert ist. Als eigenschaftsbestimmendes Strukturelement wird die mineralisierte Kollagenfibrille identifiziert. Der dominierende mikromechanische Prozess wird als crazeartiger Prozess beschrieben.

MI 2: Analytical Transmission Electron Microscopy and Atom Probe Tomography

Time: Monday 12:00–13:15 Location: EMH 225

MI 2.1 Mon 12:00 EMH 225

Imaging Phase Transition of LiMn2O4 Nanowire Battery by in-situ TEM — •Soyeon Lee[1,3], Yoshifumi Oshima[2,3], and Kunio Takayanagi[1,3] — [1]Tokyo Tech., Tokyo, Japan — [2]JAIST, Ishikawa, Japan — [3]JST-CREST, Tokyo, Japan

In order to understand mechanism of phase transition in the electrode and transport of lithium ions, a nano model battery with a single LiMn2O4 (LMO) nanowire as positive electrode was developed specially for in-situ transmission electron microscope (TEM) observation. The LiMn2O4 (LMO) nanowire was free standing, contacted with ionic liquid electrolyte (ILE) on a Li4Ti5O12 negative electrode by one side of the wire. The nanowire battery was charged and discharged by cyclic voltammetry in the range of 2.7-5.2 V (vs Li/Li+) at high charge rate (fully charged within 24 minutes) in TEM. The local structure change of LMO was successfully imaged by TEM imaging and transmission electron diffraction (TED) at the position far from LMO/ILE interface by about 50 μm: The phase transition region from lithium rich phase to poor phase was observed. The transition region moved continually during whole charge-discharge cycle by changing local structure. The two domains had different orientation: Li-rich phase, (100); Li-poor phase, (11-1). Interestingly, the domain orientation of one phase was also changed into that of the other. Our developed nanowire battery worked reversibly without capacity fading for high-rate charge/discharge operation. The reversible cycle without capacity fading is considered that the transition region acted as a mediator between two phases.

MI 2.2 Mon 12:15 EMH 225

In-situ Transmission Electron Microscopy Study of Ge(8-n)Sn(n)Sb2Te11 — Dietrich Häussler[1], •Torben Dankwort[1], Lorenz Kienle[1], Christine Koch[2], Wolfgang Bensch[2], and David C. Johnson[3] — [1]Institut für Materialwissenschaft, CAU Kiel — [2]Institut für Anorganische Chemie, CAU Kiel — [3]University of Oregon, Eugene, USA

(GeTe)x(Sb2Te3)y - known as phase change materials (PCM) - are of large interest for applications in data storage devises like blu-ray discs. We report on a novel type of short range ordering phenomena for Ge(8-n)Sn(n)Sb2Te11 (n=2, n=4). Amorphous, stoichiometric thin films of such compositions and with thicknesses <40 nm were directly deposited on carbon coated Ni grids using molecular beam epitaxy. In-situ heating TEM experiments revealed an exceptional growth of large grains with sizes >500 nm starting at 130°C. Furthermore, diffuse scattering was observed in electron diffraction patterns, which implies short range order phenomena unknown for PCMs so far. In-situ heating experiments indicate that close to 150°C diffuse scattering is altered to an ordered superlattice structure. This is in accordance with the resistance-temperature behavior, which is characterized by a remarkable additional resistance drop at ~150°C (heating rate of 5 K/min). Possibly, these results suggest that the diffuse scattering is an indication for a new intermediate phase.

MI 2.3 Mon 12:30 EMH 225

Exploring the properties of individual nanomagnets: EMCD on FePt nanocubes — •Sebastian Schneider[1,2], Darius Pohl[1], Thomas Schachinger[3], Stefan Löffler[3], Peter Schattschneider[3,4], and Bernd Rellinghaus[1] — [1]IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany — [2]TU Dresden, Institut fur Festkörperphysik, D-01062 Dresden, Germany — [3]Vienna University of Technology, USTEM, A-1040 Vienna, Austria — [4]Vienna University of Technology, Institute of Solid State Physics, A-1040 Vienna, Austria

Electron magnetic chiral dichroism (EMCD) is the electron wave analogue of X-ray magnetic circular dichroism (XMCD). It offers the possibility to study magnetic properties at the nanoscale in a transmission electron microscope (TEM). In a 'classical' EMCD setup, the sample is illuminated with a plane electron wave and acts as a beam splitter. Although this method is meanwhile well established, only very few EMCD spectra were so far obtained from individual nanoparticles. We report on EMCD measurements on individual FePt nanocubes with a size of roughly 30 nm and compare our experimental findings with simulations. The dichroic signals at the L_3 and L_2 edges are expected to be as small as 10 % of the total scattering intensity. Our experiments are supported by simulations utilizing the WIEN2k program package, based on which FePt cubes with a thickness, that should provide maximal EMCD signals, are chosen for the experiments. The experiments indeed reveal a small but reproducible dichroic signal that agrees well with the results of the theoretical calculations.

MI 2.4 Mon 12:45 EMH 225

How electrostatic simulations improve the understanding of APT measurement results — •Christian Oberdorfer, Daniel Beinke, and Guido Schmitz — Institute of Materials Science, University of Stuttgart, Germany

Simulations represent a complementary approach to atom probe experiments. By flexible electrostatic modeling, the field evaporation and the ion trajectories are calculated. Important insights into the presence and the origin of measurement artifacts may be revealed in this way.

Numeric treatment is rigidly based on the representation of atoms by Wigner-Seitz cells. Field evaporation is assumed to be induced by polarization forces acting on the atomic cells. Evaluation of the force represents an essential cornerstone to a more realistic prediction of the field evaporation sequence.

Investigated trajectory aberrations show a decisively limited resolution of the computed 3D reconstruction if the standard protocol based on geometric back-projection is followed. The applied point-projection neglects important information of the detailed surface field and fails for this reason.

MI 2.5 Mon 13:00 EMH 225

Accurate volume reconstruction by numerical calculation of trajectories — •Daniel Beinke, Christian Oberdorfer, and Guido Schmitz — Institute of Materials Science, University of Stuttgart, Germany

A new approach for the reconstruction of atom probe data is presented. It is based on the calculation of realistic trajectories of evaporated ions. To this end, a Voronoi tessellation of the simulation space is used in order to bridge several orders of magnitude in distance. Compared to other reconstruction techniques, the order of reconstruction is inverted, which means that last detected atoms are reconstructed first. Consequently the emitter shape is known at each reconstruction step.

Based on numerical model emitters with particles or layers of heterogeneous evaporation threshold, we demonstrate that this new concept has indeed the natural potential to overcome artifacts of local magnification, such as depleted zones at interfaces or distorted particle shapes. Still issues in detail, scoping with the finite detection efficiency, finite aperture size, and the limitation in computing resources have to be resolved before practical application to experimental data sets.

MI 3: Analytical Scanning Electron Microscopy

Time: Monday 15:00–16:45 Location: EMH 225

Invited Talk MI 3.1 Mon 15:00 EMH 225

Orientations, texture, properties - applications of electron backscatter diffraction — •Karsten Kunze — ScopeM, ETH Zürich, Switzerland

Electron Backscatter Diffraction (EBSD) is the most widespread method for crystallographic characterisation at the microscale in the scanning electron microscope (SEM). The EBSD pattern contains information about the crystallographic phase and orientation as well as on the defect content of the material. Automated acquisition and analysis of EBSD patterns allows to map crystal orientations and phases, intergranular and intragranular microstructures, grain boundary misorientations, all at size scales between some ten nanometers to some ten millimeters. Crystallographic preferred orientations (CPO or texture) give rise to anisotropy in bulk tensorial properties. The presentation will review some of the recent developments with applications in Earth and materials sciences.

MI 3.2 Mon 15:45 EMH 225

Monte Carlo Simulations for Transmission Kikuchi Diffraction — •Nathanael Jöhrmann and Michael Hietschold — Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz

Transmission Kikuchi Diffraction in a Scanning Electron Microscope is an interesting modification of Electron Backscatter Diffraction to get information about crystalline structures with high spatial resolution. However, it is not easy to decide about optimal parameters for sample thickness, sample tilt, working distance or acceleration voltage. In addition, for each new sample material it might be necessary to choose a completely different set of parameters. Since the sample preparation for Transmission Kikuchi Diffraction is difficult, it is desirable to know beforehand, if the lateral resolution would improve significantly in comparison to Electron Backscatter Diffraction.

To avoid time consuming experiments, we use Monte Carlo simulations to predict the influence of sample thickness, sample position and acceleration voltage on the detector signal, exposure time and expected lateral resolution.

MI 3.3 Mon 16:00 EMH 225

A Mirror-Corrected Scanning Electron Microscope — •Peter Gnauck and Markus Boese — Carl Zeiss Microscopy, Oberkochen, Germany

In materials science and biological research the Scanning Electron Microscope (SEM) has a long tradition. In recent years the interest in the imaging of sensitive samples and the material contrast at a high lateral resolution has grown. Lowering the primary electron energy helps to reduce the sample damage. On the other hand the interaction volume is decreased, thus increasing the lateral information from the backscattered electron signal.

However, the low primary electron energy is extremely demanding to the electron optics, if not too much of the lateral resolution should be lost due to the increased wavelength of the electrons. In a suitable instrument typically the spherical and the axial chromatic aberration have to be corrected. Additionally, innovative detector schemes can provide enhanced analytic capabilities and can avoid limitations by signal noise and residual instrumental instabilities.

We will discuss a mirror-corrected SEM, offering high-resolution analytics with efficient productivity to visualize even the most sensitive materials by use of electrons with energies far below 1keV. At these energies the resolution of conventional instruments is very poor, but compensating for the primary aberrations of the objective lens can overcome this obstacle. The aberration correction by means of an electron mirror significantly increases the resolution especially for low energies; this has been proven in a unique spectro-microscope.

MI 3.4 Mon 16:15 EMH 225

Detecting the chemical shift of X-ray lines of Lithium, Boron and Carbon using a novel wave-length dispersive X-ray spectrometer — •Jürgen Heindl — JEOL (Germany) GmbH; Oskar-v.-Miller-Str. 1a; 85386 Eching; Deutschland

A novel parallel detecting wave-length dispersive x-ray spectrometer was developed by JEOL Ltd. Tokyo, Japan. This Soft X-ray Emission Spectrometer (SXES) is sensitive to extreme soft X-ray like the Li-K-line and opens access to qualitative as well as quantitative analysis of Li-alloys and Li-ion batteries e.g. The energy resolution of this spectrometer is high enough to observe the line shift induced by different chemical environment of the individual element (chemical shift) as well as the line shape of selected x-ray lines.

Recent application examples will be shown of Li quantification, the chemical shift of B-K- and C-K-line and the chemical dependency of the line shape of the Si-L-line in different Si compositions.

MI 3.5 Mon 16:30 EMH 225

Quantitative EDS with focus on the nanometer scale for combinations of light and heavy elements. — •Meiken Falke, Igor Nemeth, Andi Kaeppel, and Ralf Terborg — Bruker nano GmbH, Am Studio 2D, 12489 Berlin, Germany

Quantitative spatially resolved chemical characterization of mixtures of light and heavy elements in the electron microscope is a challenge. Complicating factors are e.g. preparation artefacts, radiation damage and signal absorption. Energy dispersive X-ray spectroscopy (EDS) is one technique for composition analysis of bulk and electron transparent samples. For bulk analysis sophisticated absolute EDS quantification methods have been developed. Multiple detector arrangements at high solid and take-off angles speed up and simplify the analysis in case of complex topography or beam sensitivity and limit the need for sample preparation. For quantitative analysis of electron transparent objects the Cliff-Lorimer method is widely used and can provide data on the accuracy level of a few at%. Using large solid and take-off angles, even the ppm level can be accessed. The results are valid only relative to a suitable standard of similar thickness and composition though. An alternative is the Zeta-factor method, Ref 1. It additionally includes information on the beam current and accommodates the use of any standard with known composition, thickness and density. This method can deliver absolute quantification while accounting e.g. for absorption effects. Examples for all techniques mentioned above will be shown. Ref.1 Watanabe M. & Williams D.B, J. of Micr. Vol. 221, 2006, 89.

MI 4: On-Surface Polymerization (contributed Session to the Symposium SYOP, joint Session with CPP)

Time: Tuesday 9:30–10:00 Location: C 243

MI 4.1 Tue 9:30 C 243

Covalent Coupling via Dehalogenation on Ni(111) supported Boron Nitride and Graphene — •Claudius Morchutt[1,3], Jonas Björk[2], Rico Gutzler[3], and Klaus Kern[1,3] — [1]Max Planck Institute for Solid State Research, Heisenbergstrasse 1, 70569 Stuttgart, Germany — [2]Department of Physics, Chemistry and Biology, IFM, Linköping University, 58183 Linköping, Sweden — [3]Institut de Physique de la Matière Condensée, Ecole Polytechnique Fédérale de Lausanne, 1015 Lausanne, Switzerland

Surface-assisted covalent coupling of organic molecules represents a bottom-up approach for growing defined 2D nanostructures which are promising candidates for a variety of potential applications such as membranes for gas storage/separation, active elements in (opto)electronic devices, and catalysis. Taking a step back from the standard synthesis on (coinage) metal surfaces we explored the polymerization of 1,3,5-tris(4-bromophenyl)benzene via dehalogenation on Ni(111) supported hexagonal boron nitride and graphene by scanning tunneling microscopy and density functional theory calculations. No polymerization is observed on bare Ni, whereas on h-BN/Ni(111) and graphene/Ni(111) molecules debrominate and couple into oligomers after annealing. DFT calculations reveal that both surfaces act as a heterogeneous catalyst and reduce the dehalogenation barrier significantly. They furthermore show a strong interaction between h-BN (graphene) and surface-stabilized radicals, which in turn explains the limited oligomer size as a consequence of a diffusion-limited process.

MI 4.2 Tue 9:45 C 243

Polymerization of polyelectrolyte poly-L-lysine on charge-patterned silicon wafers — •Heidemarie Schmidt[1], Martin Müller[2], K. Wiesenhütter[3], B. Urban[2], A.-D. Müller[4], I. Skorupa[1,3], W. Skorupa[3], M. Rüb[5], and O.G. Schmidt[1,6] — [1]TU Chemnitz — [2]IPF Dresden — [3]HZDR — [4]Anfatec Instruments AG — [5]FH Jena — [6]IFW Dresden

The local modification of silicon surfaces by adsorbing polyelectrolytes has been predicted to become ubiquitous in the engineering of smart carriers for biosensors, tissue engineering, and directed cell growth [1]. We have implanted phosphorous ions in ca. 200-1000 nm thick layers of a silicon wafer, in order to realize a defined stripe-like microscopic pattern of surface-near electrostatic forces [2]. The estimated density of localized charges between the ca. 2-3 nm thick native silicon dioxide and the silicon wafer ranges from 10^14 to 10^18 m^-2 and is much larger and stable than charges from silanol groups at an ordinary silicon dioxide surface. Using combined Atomic and Kelvin probe force microscopy measurements we could show that cationic model polyelectrolyte poly-L-lysine (PLL) [3] with a single chain length of 200 nm is preferentially adsorbed in agglomerates with chain lengths of 1-2 micrometer on the implanted microsized regions of the silicon carrier at pH = 11. The unimplanted regions of the silicon wafer were comparatively weakly adsorbing the PLL. [1] H. Schmidt et al., Appl. Surf. Sci. 281 (2013) 24-29, [2] C. Baumgart et al., Phys. Rev. B. 80 (2009) 085305, [3] Advances in Polymer Science 255 & 256 (Ed.: Martin Müller), Springer, 2014

MI 5: International Year of Light

Time: Tuesday 10:30–11:15 Location: EMH 225

Invited Talk MI 5.1 Tue 10:30 EMH 225

Dynamic Light Scattering on Polymer Gels — •Bernhard Ferse[1], Franziska Krahl[2], Doreen Beyer[3], Karl-Friedrich Arndt[4], and Andreas Richter[1] — [1]TU Dresden, Institut für Halbleiter- und Mikrosystemtechnik, Polymere Mikrosysteme, D-01062 Dresden, Germany — [2]Institut für Luft- und Kältetechnik gGmbh, Bertolt-Brecht-Allee 20, D-01309 Dresden, Germany — [3]TU Dresden, Molekulare Funktionsmaterialien, D-01062 Dresden, Germany — [4]TU Dresden, Physikalische Chemie der Polymere, D-01062 Dresden, Germany

Polymer gels, especially hydrogels, form a class of soft matter between liquids and solids. In swollen state more than 99% of the gel can consist of the swelling agent, nevertheless, it can still keep in an elastical way its predestined shape and geometry. Under pressure, the swelling agent stored in the gel will not be released into the environment. Therefore gels can be regarded as solids.

Due to the fact that hydrogels are not homogenous, fully-connected polymer networks, but contain several types of spatial inhomogeneities, the mechanical properties of gels are two weak to withstand large deformations.

Remarkable progress in understanding the gelation mechanism and moreover the network structure leads to the development of hydrogels with enhanced mechanical properties.

The crosslinking of macromolecules is associated with a change in the mobility of the network chains due to the collective diffusion of gels. This can be observed by dynamic light scattering, which is a non-destructive method to monitor the formation of network structures. The investigation of the gelation mechanism and the inhomogeneities of polymer gels is of recent scientific interest in order to better understand the structure-property relationship of gels.

MI 6: Scanning Probe Microscopy

Time: Tuesday 11:30–12:00 Location: EMH 225

MI 6.1 Tue 11:30 EMH 225

The ReactorAFM: a high-pressure high-temperature NC-AFM for catalysis — Sander B. Roobol, •Matthijs A. van Spronsen, Mirthe Bergman, Peter C. van der Tuijn, Raymond C.T. Koehler, Joost W.M. Frenken, and Irene M.N. Groot — Huygens-Kamerlingh Onnes Laboratory, Leiden University, The Netherlands

To gain fundamental understanding of the mechanisms in catalytic reactions, it is essential to study gas-surface interactions by in-situ microscopy. The ReactorAFM is a novel instrument enabling atomic-scale imaging of oxide-supported metallic nanoparticles under high-pressure, high-temperature conditions. The ReactorAFM is a tuning fork based NC-AFM embedded in a 0.5 ml flow reactor, housed in a UHV system. The instrument operates from room temperature to 600 K and from UHV to 6 bar. A gas system mixes up to 5 gases and controls the flow and pressure, while a mass spectrometer is used for on-line analysis of the reaction products, enabling direct correlation of catalyst structure with reactivity. The force sensor is a miniature quartz tuning fork, which is mounted in the qPlus configuration and has a resonance frequency of 96 kHz. The micro-sized tip is grown by electron beam induced deposition and consist of polycrystalline Pt with carbon impurities. The design of the instrument and the challenges of NC-AFM at high pressure and high temperature conditions will be discussed. In addition, the performance of the instrument is characterized and images of single crystal samples and supported nanoparticles in catalytically relevant conditions will be shown.

MI 6.2 Tue 11:45 EMH 225

Multifrequency AFM with Self-sensing Tunneling Magne-

toresistive (TMR) Cantilevers — •Gerald Göring[1], Tobias Meier[2], Alexander Förste[3], Ali Tavassolizadeh[4], Karsten Rott[5], Dirk Meyners[4], Roland Gröger[3], Günter Reiss[5], Eckhard Quandt[4], Thomas Schimmel[1,3], and Hendrik Hölscher[2] — [1]Institute of Applied Physics, Karlsruhe Institute of Technology (KIT) — [2]Institute of Microstructure Technology, Karlsruhe Institute of Technology (KIT) — [3]Institute of Nanotechnology, Karlsruhe Institute of Technology (KIT) — [4]Institute for Materials Science, Christian-Albrechts-Universität zu Kiel — [5]CSMD, Physics Department, Bielefeld University

We describe self-sensing tunneling magnetoresistive (TMR) cantilevers which can be utilized for multi-frequency AFM. Furthermore, we achieve a large scan-range with a nested scanner design of two independent piezo scanners: a small high resolution scanner with a scan range of 5x5x5 μm^3 is mounted on a large area scanner with a scan range of 800x800x35 μm^3. In order to characterize TMR sensors on AFM cantilevers as deflection sensors, the AFM is equipped with a laser beam deflection setup to measure the cantilevers deflection independently. Images obtained on different samples such as calibration standard, optical grating, EPROM chip, self-assembled monolayers and atomic step-edges of gold demonstrate the high stability of the nested scanner design and the performance of self-sensing TMR cantilevers.

MI 7: X-ray Imaging, Tomography and X-ray Optics

Time: Wednesday 9:30–10:45 Location: EMH 225

MI 7.1 Wed 9:30 EMH 225

XFEL nanobeam characterization by scanning coherent x-ray microscopy — •Andreas Schropp[1], Robert Hoppe[2], Jens Patommel[2], Frank Seiboth[2], Hae Ja Lee[3], Bob Nagler[3], Eric C. Galtier[3], Jerome B. Hastings[3], and Christian G. Schroer[1] — [1]DESY Photon Science, Notkestr. 85, 22607 Hamburg, Germany — [2]Institute of Structural Physics, Technische Universität Dresden, 01062 Dresden, Germany — [3]SLAC National Accelerator Laboratory, 2575 Sand Hill Road, Menlo Park, CA 94025, USA

The characterization of XFEL-nanobeams is often crucial for the correct interpretation of experimental results. To date, this step was primarily implemented by imprint techniques giving rather rudimentary postmortem information of the intensity distribution. In this contribution, we present results obtained by scanning coherent x-ray microscopy (ptychography) during different beamtimes at the MEC- and XPP-instrument of the LCLS. This method has the advantage that the full caustic of the nanofocused beam can be numerically retrieved yielding the complete information on the focused XFEL-beam. Additionally, the retrieved complex-valued wave field could be refined for individual XFEL-pulses.

In the future, we are planning to implement the technique as a real-time diagnostic to spatially characterize XFEL-nanobeams and a first step towards this goal was conducted by implementing a fast detector for the measurement of the diffraction patterns. In combination with fast data processing routines running on GPU's a real-time visualization of nanofocused XFEL-beams is within reach.

MI 7.2 Wed 9:45 EMH 225

Multi plane probe retrieval in X-ray nearfield imaging — •Johannes Hagemann[1], Anna-Lena Robisch[1], David Russell Luke[2], Carolin Homann[2], Thorsten Hohage[2], Peter Cloetens[3], and Tim Salditt[1] — [1]Institute for X-Ray physics, G. A. U. Göttingen — [2]Institute for Numerical and Applied Mathematics, G. A. U. Göttingen — [3]European Synchrotron Radiation Facility

The probe, i.e. the impinging X-ray beam on the sample, is the main actor in X-ray imaging experiments when it comes to image quality. Knowledge about the probe helps to characterize the optics in use and to circumvent problems associated with the standard flat field correction. Additionally we can characterize beam properties as the degree of coherence or the size of the focal spot. We present reconstructions of the probes of different ESRF beamlines (ID16, ID19, ID22) which were used for X-ray imaging experiments. Gaining information about the probe is an example of the phase retrieval problem which is solved here by multiple detector plane positions [1]. This experimental scheme yields reconstructions without using an additional test sample.

[1] Hagemann, J. et al. Opt. Express 22, 11552 (2014)

MI 7.3 Wed 10:00 EMH 225

Cone Beam X-Ray Imaging and Tomography with Anisotropic Source Sizes — •Malte Vassholz and Tim Salditt — Institute for X-Ray Physics, Georg-August-Universität Göttingen, 37077 Göttingen, Germany

Nanoscale x-ray imaging and tomography are important methods for analysing hard and soft matter. However, it requires x-ray probes with high brilliance and small source sizes and is therefore carried out at synchrotrons. Towards the goal of nanoscale resolution we have tested the applicability of x-ray waveguide optics. While two dimensional waveguides provide an excellent probe but insufficient flux, planar waveguides provide an anisotropic probe with sufficient flux. The central challenge is to get isotropic resolution from probes with anisotropic source sizes. We have investigated new data-aquistion schemes and advanced three-dimensional reconstruction methods for imaging and tomography with anisotropic sources.

MI 7.4 Wed 10:15 EMH 225

Lithographically fabricated waveguides for x-ray coherent imaging — •Sarah Hoffmann, Hsin-Yi Chen, Henrike Neubauer, Mike Kanbach, and Tim Salditt — Röntgenphysik, uni-Göttingen, Friedrich-Hund Platz 1, 37077 Göttingen

Nanoscale x-ray sources as provided by x-ray channel waveguides enable a multitude of novel applications such as diffraction, high resolution spectroscopy, microscopy and holography [1,2]. We report on imaging experiments and the fabrication process of these hard x-ray waveguides deployed at the synchrotron sources at DESY and ESRF. Among other techniques e-beam lithography, reactive ion etching and Silicon wafer bonding are involved within the fabrication of two-dimensional, sub-100 nm sized waveguide channels. Both waveguide geometry and material can be adapted to meet the requirements of a specific experiment, such as the photon energy (7.9-17.5 keV), the desired source size, or the application of a reference beam in a holography setup. As the tunability of the optical properties provided by the waveguides, such as the coherence of the beam, its divergence or the waveguide transmission, depends sensitively on the precise control over the (several) process steps, an iterative process of diagnostics and optimization is essential.

[1] A. Jarre et al., Phys. Rev. Lett. 94, 074801 (2005)
[2] C. Krywka et al., J. Appl. Cryst. 45, 85-92 (2012)
[3] A. Kohlstedt et al., Appl. Phys. A 91, 6-12 (2008)
[4] H. Neubauer et al., J. Appl. Phys. 115, 214305 (2014)

MI 7.5 Wed 10:30 EMH 225

Refraktive Röntgenlinsen aus Lamellen konstanter Dicke — •Jens Patommel[1], Frank Seiboth[1], Maria Scholz[1,2], Robert Hoppe[1], Felix Wittwer[1], Juliane Reinhardt[1,2], Jens Seidel[3], Martin Knaut[4], Andreas Jahn[4], Karola Richter[4], Johann W. Bartha[4], Gerald Falkenberg[2] und Christian G. Schroer[2,5] — [1]Institut für Strukturphysik, Technische Universität Dresden, 01062 Dresden — [2]Deutsches Elektronen-Synchrotron DESY, 22607 Hamburg — [3]Fakultät für Mathematik, Technische Universität Chemnitz, 09107 Chemnitz — [4]Institut für Halbleiter- und Mikrosystemtechnik, Technische Universität Dresden, 01062 Dresden — [5]Fachbereich Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Herkömmmliche refraktive Röntgenlinsen bestehen aus Silizium, weil für röntgenoptisch besser geeignete Materialien wie Diamant oder Saphir keine geeigneten Ätzprozesse für die Mikrostrukturierung zur Verfügung stehen. Wir präsentieren ein Linsendesign, das es gestattet, die Linsen mittels Abscheidungsverfahren wie z.B ALD herzustellen, wodurch das Verwenden anderer Materialien als Silizium möglich wird. Diese sogenannten refraktiven lamellaren Linsen (RLL) bestehen aus einem Stapel von Lamellen konstanter Dicke, die derart gekrümmt sind, dass sie in der Projektion entlang der optischen Achse eine Parabelform ergeben und somit einer Sammellinse entsprechen. Simulationen und erste Experimente mit diesen Linsen aus Saphir haben gezeigt, dass sie kleinere Fokusse mit höherem Fluss als herkömmliche Siliziumlinsen erzeugen können.

MI 8: Ionenstrahlmethoden

Time: Wednesday 11:00–11:30 Location: EMH 225

MI 8.1 Wed 11:00 EMH 225

Ionenfeinstrahlen hochgeladener Ionen zur Analytik von Festkörperoberflächen und von Flüssigkeiten — •Günter Zschornack[1,2], Mike Schmidt[2], Jacques Gierak[3], Ulrich Kentsch[2] und Erik Ritter[2] — [1]TU Dresden, Fachrichtung Physik und HZDR, Institut für Ionenstrahlphysik und Materialforschung — [2]Dreebit GmbH, Großröhrsdorf — [3]LPN/CNRS Marcoussis, Frankreich

Beschrieben wird eine neue Generation von Ionenfeinstrahlanlagen (IFA) unter Verwendung hochgeladener Ionen (HCI) aus einer HCI-Kompaktquelle (EBIS). Mit diesen wird es möglich, bei kurzen Umrüstzeiten die Projektilart zu wechseln und Ionenfeinstrahlen für alle Edelgase als nicht-toxische Projektile anzubieten. Die Kombination einer EBIS mit einem Wienfilter ermöglicht es für IFA unter Nutzung des Beschleunigungspotenzials der ionenoptischen Säule unterschiedliche Ionenenergien zu realisieren. Damit können über die Projektilenergie verschiedene Implantationstiefen in Festkörpern realisiert werden. Die Entwicklung eines HCI-FIB ermöglicht es in Verbindung mit einem TOF-SIMS-Spektrometer chemische Landkarten von Proben zu erhalten. Durch den Einsatz diverser Projektile mit verschiedenen Ladungszuständen kann eine der Probe angepasste optimale Analyseform gefunden werden und es können biologische oder soft matter Proben schonend analysiert werden. Weiter wird gezeigt dass neben Festkörperoberflächen auch flüssige Proben hinsichtlich Ihrer Element- und Isotopenzusammensetzung charakterisiert werden können.

MI 8.2 Wed 11:15 EMH 225

Latest developments in ultra-high 2D and 3D SIMS imaging using novel ion sources and a new TOF-SIMS/FIB system — •Sven Kayser, Derk Rading, Felix Kollmer, Rudolf Möllers, and Ewald Niehuis — ION-TOF GmbH, Heisenbergstr. 15, 48149 Münster, Deutschland

Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) is a very sensitive surface analytical technique. In recent years bismuth clusters have become the standard primary ion species for all imaging applications providing a lateral resolution of down to 60 nm.

The combination of high resolution primary ion beams with conventional high dose sputter beams allows for the 3D analysis of inorganic samples. Unfortunately, this dual beam approach has its limitations for the analysis of extremely rough samples and samples with voids. To overcome this limitation we have developed a new TOF-SIMS/FIB system which makes 3D tomography SIMS analysis of rough or porous samples possible.

In addition new sputter ion sources were developed using large argon clusters for dual beam depth profiling of organic materials. With the new sources the preservation of molecular information under high-dose sputtering conditions has become possible.

In this contribution we will present the latest results in high-resolution 2D and 3D TOF-SIMS imaging and shall discuss examples from the field of organic depth profiling.

MI 9: Positron Annihilation Studies of Condensed Matter

Time: Wednesday 11:45–13:00 Location: EMH 225

Invited Talk MI 9.1 Wed 11:45 EMH 225

Experiments with the intense and brightness enhanced positron beam at NEPOMUC — •Christian Piochacz, Thomas Gigl, Niklas Grill, Markus Reiner, Samantha Zimnik, and Christoph Hugenschmidt — Heinz Maier-Leibnitz Zentrum (MLZ) and Physik Department E21, Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany

At the intense positron source NEPOMUC at the Heinz Maier-Leibnitz Zentrum (MLZ), four different spectrometers are installed permanently and one beam port is open for positron experiments provided by external users. The NEPOMUC remoderator enhances the brightness of the primary beam due to stochastic cooling of the positrons in a W(110) single crystal. Although the beam intensity is reduced to about 6 % the remoderation is a uniquely efficient technique to reduce the beam diameter and the energy spread considerably. Therefore, it is crucial for experiments with high lateral resolution and exceptional time resolution. However, there are also some experiments which are not as sensitive onto the beam quality but need as many positrons as possible. To meet the different demands of current and future experiments, the approved NEPOMUC positron remoderator was relocated and two novel beam switches were installed in order to provide the primary, high intensity beam or the remoderated, high brightness beam within short switching times. Within this contribution the NEPOMUC positron beam facility and some selected experiments are presented. Special attention is set to emphasize the benefit of the high intensity and high brightness beam, respectively.

MI 9.2 Wed 12:30 EMH 225

Characterization of High Purity Ni(100)-foils for Positron Moderation in a Novel Positron Microbeam Setup — •Thomas Gigl, Christian Piochacz, Markus Reiner, and Christoph Hugenschmidt — Heinz Maier-Leibnitz Zentrum (MLZ) and Physik Department E21, Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany

The positron beam facility NEPOMUC at the Research Neutron Source FRM II provides the worlds most intense mono-energetic positron beam with an intensity of 10^9 moderated e^+/s. The CDB spectrometer at NEPOMUC enables depth dependent and spatially resolved defect studies by using conventional doppler broadening spectroscopy (DBS), and element-specific measurements with coincident DBS. In order to investigate the near-surface region and the bulk of a sample, the positron implantation energy can be increased to 30 keV. The lateral resolution amounts to 300 μm.

For the development of a positron beam with a diameter of $<5\,\mu$m a Ni(100) foil with a thickness of 100 nm for positron re-moderation will be installed in transmission geometry in order to increase the beam brightness. In order to achieve a high yield of re-emitted moderated positrons, the Ni foil has to be annealed and surface contaminations such as carbon and oxygen have to be removed. For this purpose, temperature-dependent XPS measurements for characterizing the surface contaminations, and temperature-dependent DBS was performed to determine the annealing behaviour of the Ni foil. Financial support by BMBF (project no. 05K10WOB) is gratefully acknowledged.

MI 9.3 Wed 12:45 EMH 225

Energy modulation of a pulsed positron beam for depth dependent measurements — •Niklas Grill[1], Marcel Dickmann[2], Christian Piochacz[1], Sebastian Vohburger[1], and Christoph Hugenschmidt[1] — [1]Heinz Maier-Leibnitz Zentrum (MLZ) and Physik Department E21, Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany — [2]Institut für Angewandte Physik und Messtechnik LRT2, Fakultät für Luft- und Raumfahrttechnik, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany

A two-stage bunching unit is used to generate a pulsed positron beam with a frequency of 5 MHz from a continuous beam generated by a ^{22}Na β^+ source. At the first stage a sawtooth-shaped signal is used to compress a large amount of the continuous beam into pulses which are short enough for the following main buncher. This utilizes a sinusoidal function at 20 MHz to ensure a high energy modulation and thus narrow pulses. Via time-dependent electromagnetic fields the potential energy of the bunches is then raised to several keV without altering the velocity of the positrons. Subsequently the positrons can be accelerated towards ground potential, thus allowing a depth resolved measurement of samples at ground potential. This is e.g. necessary for positron re-emission experiments and Positron Annihilation Auger Electron Spectroscopy measurements performed at the NEPOMUC positron beam facility. Due to the low pulsing frequency the setup can also be used to investigate materials with long positron lifetimes, thus enabling non-destructive measurements on e.g. polymers. Within this contribution, details of the setup and first lifetime measurements will be presented.

MI 10: Poster: Microanalysis and Microscopy

Chair: Enrico Langer (TU Dresden), Hartmut S. Leipner (Martin-Luther-Universität Halle-Wittenberg)

Time: Wednesday 15:00–17:30 Location: Poster B

MI 10.1 Wed 15:00 Poster B

Ion Beam Analysis in a Helium Ion Microscope — •Nico Klingner, René Heller, Gregor Hlawacek, Stefan Facsko, and Johannes von Borany — Helmholtz-Zentrum Dresden-Rossendorf, Germany

Helium ion microscopes (HIM) have become powerful imaging devices within the last decade. Their enormous lateral resolution of below 0.3 nm and the highest field of depth make them a unique tool in surface imaging. So far the possibilities to identify target materials (elements) are rather limited.

In the present contribution we will show concepts as well as preliminary studies on the capability, efficiency and the limits of applying (Rutherford) Backscattering Spectrometry (RBS) within a HIM device to image samples with target mass contrast and to analyze target compositions. We will present different concepts of how to realize RBS in a HIM and point out mayor challenges and physical limitation.

MI 10.2 Wed 15:00 Poster B

Investigating Atomic Contrast in Atomic Force Microscopy and Kelvin Probe Force Microscopy on Ionic Systems using Functionalized Tips — •Leo Gross[1], Bruno Schuler[1], Fabian Mohn[1], Nikolaj Moll[1], Niko Pavliček[1], Wolfram Stuerer[1], Ivan Scivetti[2], Konstantinos Kotsis[2], Mats Persson[2], and Gerhard Meyer[1] — [1]IBM Research – Zurich, 8803 Rüschlikon, Switzerland — [2]University of Liverpool, Liverpool, L69 3BX, United Kingdom

We used chlorine vacancies in NaCl bilayers on Cu(111) as a model system to investigate atomic contrast as a function of applied voltage, tip height, and tip functionalization. The local contact potential difference (LCPD) acquired with Kelvin probe force microscopy showed the same qualitative contrast for all tip terminations investigated, which resembled the contrast of the electrostatic field of the sample. We find that the frequency-shift contrast, typically measured by non-contact atomic force microscopy, stems mainly from electrostatic interactions but its tip dependence cannot be explained by the tip dipole alone. With the aid of a simple electrostatic model and by density functional theory we investigate the underlying contrast mechanisms. [1]

[1] L. Gross et al. Phys Rev. B 90, 155455 (2014)

MI 10.3 Wed 15:00 Poster B

Material sensitive coherent diffractive imaging employing a gas discharge plasma EUV source and phase grating for wavelength selection — •Raoul Bresenitz[1], Jan Bussmann[1], Denis Rudolf[1], Michal Odstrcil[2], Detlev Grützmacher[1], and Larissa Juschkin[1,3] — [1]Peter Grünberg Institut 9, JARA-FIT,Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Optical Research Centre, University Southampton — [3]RWTH Aachen University, Experimental Physics of EUV, JARA-FIT, Steinbachstrasse 15, 52074 Aachen, Germany

In diffraction limited microscopy, the resolution scales with the wavelength of the probe, which explains the current interest in EUV and X-ray microscopy. Moreover, many materials exhibit strong absorption edges in this spectral region, which results in elemental contrast. Coherent diffractive imaging (CDI) does not rely on conventional optics which map each point of the sample on a detector, but recovers the shape from its diffraction pattern using phase retrieval algorithms. Due to the required coherence, most CDI experiments were performed at synchrotron and free electron laser facilities. Only few laboratory based experiments, employing either a high harmonic or a soft X-ray laser source, were conducted so far. We discuss the feasibility and prospects of a gas discharge plasma EUV source for CDI experiments in general. In a second step, a phase grating for wavelength selection and monochromatisation will be used. We aim to combine high resolution and elemental contrast in the spectral range between 17 nm and 25 nm.

MI 10.4 Wed 15:00 Poster B

CUDA Accelerated Framework for Phase Reconstruction in X-ray Imaging Using SciPAL — •Johannes Hagemann[1], Stephan Kramer[2], and Tim Salditt[1] — [1]Institute for X-ray physics, G. A. U. Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen — [2]MPI for biophysical chemistry, Am Faßberg 11, 37077 Göttingen

The work horses for phase retrieval in coherent x-ray imaging are iterative projection algorithms (GS, HIO, RAAR). The increasing number of pixels in current detectors (up to 4k x 4k) fosters the need for faster implementations. Based on our SciPAL library [1] and our work on phase holography [2,3] we have developed a C++ framework for projection algorithms. SciPAL offers an expression template based interface for mathematical expressions which enables seamless transitions between different parallelization tools like CUDA or OpenMP. By off-loading computations to the GPU it is capable of online phase retrieval.

[1] SciPAL: Expression Templates and Composition Closure Objects for High Performance Computational Physics with CUDA and OpenMP, S. C. Kramer and J. Hagemann, ACM TOPC (to appear).
[2] S. C. Kramer, J. Hagemann, D. R. Luke, Real-Time Phase Masks for Interactive Stimulation of Optogenetic Neurons, arXiv:1302.0120
[3] J. Hagemann et al. Opt. Express 22, 11552 (2014)

MI 10.5 Wed 15:00 Poster B

Sparsity Constraint for Phase Retrieval in X-Ray Imaging — •Anne Pein and Tim Salditt — University of Göttingen, Institute for X-Ray Physics, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

A powerful approach for phase retrieval in x-ray propagation imaging is to exploit prior information of the signal as for example a rough knowledge about the support of the object. Iterative algorithms then alternately project onto constraint sets based on this prior information and the measurement in order to approximate the wave-field directly behind the object.

Recently, Loock and Plonka have proposed to use a priori knowledge that the exit wave-field is sparse in a certain representation system, i.e. that only a few representation coefficients are nonzero, and they have presented promising results with this method by numerical simulations [1]. This approach is implemented based on a shearlet frame system [2]. In this work we present an extensive numerical evaluation of this approach, including a quantitative comparison with other common constraints.

[1] S. Loock, G. Plonka, 'Phase retrieval for Fresnel measurements using a shearlet sparsity constraint', Inverse Problems 30 (2014).
[2] ShearLab 3D Toolbox from http://www.shearlab.org

MI 10.6 Wed 15:00 Poster B

Femtosecond speckle and coherence experiments at the CHG short-pulse facility at DELTA — •Christian Gutt[1], Mario Reiser[1], Sebastian Warsow[1], Tushar Sant[1], Svenja Hilbrich[2], Maryam Huck[2], Shaukat Khan[2], Markus Höner[2], Carsten Mai[2], Arne Meyer auf der Heide[2], Robert Molo[2], Helge Rast[2], and Peter Ungelenk[2] — [1]Department of Physics, Universität Siegen, Walter-Flex-Str. 3, Siegen, Germany — [2]Center for Synchrotron Radiation, TU Dortmund, Maria Goeppert-Mayer Str.2, Dortmund, Germany

The interaction of femtosecond laser pulses with relativistic electrons in an undulator can yield very short and coherent pulses of higher harmonic radiation (coherent harmonic generation, CHG). Using the CHG facility at the synchrotron radiation source DELTA; we performed single-pulse diffraction and speckle experiments with femtosecond pulses of optical and UV light of wavelengths of 400 and 200 nm, respectively. The properties of the speckle patterns allow to deduce the coherence properties of the CHG radiation on a shot-to-shot basis. We find a high degree of spatial and temporal coherence of the CHG-generated radiation compared to the coherence properties of the spontaneous undulator radiation.

MI 10.7 Wed 15:00 Poster B

Chaotic behavior in ASAXS formalisms — •Sören Gayer, Ulla Vainio, and Andreas Schreyer — Helmholtz-Zentrum Geesthacht, Germany

Structures of low scattering length density contrast are inaccessible for small-angle x-ray scattering (SAXS) measurements, even if the different phases are composed of different elements. Fortunately, resonant absorption athe the absorption edges leads to a large dispersion correction of the scattering length of the resonant atoms. This anomalous scattering process can be used to increase the previously low contrast

by a variation of the photon energies.

There exist a number of methods to solve the set of equations obtained by these anomalous SAXS (ASAXS) measurements at several photon energies. To test the behavior of three different methods in the presence of systematic measurement errors, numerical simulations of ASAXS signals of different structures were performed.

These simulations revealed threshold uncertainties in the absolute intensity scale for which the solutions, especially of the partial structure factor and Stuhrmann method, show chaotic behavior.

MI 10.8 Wed 15:00 Poster B

The dependency of an EBSD detectors exposure on electron beam current and primary energy — •Susanne Wolff, Michael Hietschold, Steffen Schulze, and Nathanael Jöhrmann — Technische Universität Chemnitz, Chemnitz, Germany

The investigation of solid samples with a scanning electron microscope (SEM) and a detector for electron backscatter detection (EBSD) is very important for the structural analysis. Here, the analysis of crystallites with less than 100 nm size creates challenges for EBSD analysis technique. Due to the small crystallite size the diameter of the electron beam has to be small enough and a low primary energy is necessary to ensure a small enough interaction volume with the sample. Both demands result in a small electron beam current. Consequently the resulting EBSD diffraction patterns are weak. Therefore, the exposure time has to be extended which is limited by stability of sample and instrument. For that reason the dependence of the EBSD screen exposure time on the settings of a scanning electron microscope has been studied in detail here.

MI 10.9 Wed 15:00 Poster B

Determination of the refractive index of casein micelles — •Sabrina Kröner, Steffen Nothelfer, Florian Foschum, and Alwin Kienle — Institut für Lasertechnologie in der Medizin und Meßtechnik, 89081 Ulm, Germany

Casein micelles are mostly found in dairy products. These micelles consist of α1-, α2-, β- and κ-casein proteins. The refractive index of casein micelles is not known, but constitutes a key parameter to enable the optical characterization of dairy products, like milk as a frequently used product in everyday life.

We determine the refractive index with three different setups and we use Mie theory for the theoretical description of the light scattering. First, with an optimized goniometer setup, single scattered photons were measured angularly resolved. The size distribution and the refractive index were derived from the experimental scattering phase function of the micelles. Second, a collimated transmission setup was used to obtain the extinction coefficient. Under specification of size distribution and concentration of the micelles we derived the refractive index as fit parameter. Third, with a spatially resolved reflectance setup we determine the reduced scattering coefficient and again fit the refractive index. For the measurements we used skim milk, because the protein in commercially available skim milk is expectedly similar to the protein which will be examined at industrial applications. The derived refractive indices show good agreement for all three independent methods.