# DY 17: Glass II (joint session with DF)

Time: Tuesday 14:30–17:50 Location: H23

DY 17.1 Tue 14:30 H23

**Mikrostrukturierung silbernanopartikelhaltiger Gläser durch elektrische Felder** — •Stefan Wackerow[1], Amin Abdolvand[2], Gerhard Seifert[1] und Heinrich Graener[1] — [1]FG Optik, Institut f. Physik, MLU Halle-Wittenberg, Hoher Weg 8, 06120 Halle — [2]LPRC, University of Manchester, UK

Silbernanopartikel haben eine charakteristische Absorptionsbande im optischen Spektralbereich, die durch Oberflächenplasmonen hervorgerufen wird. Silberpartikel in Glas finden Anwendung als Farbfilter, bzw. in Form elliptischer Partikel als Polarisatoren. Mögliche neue Anwendungen sind mikroskopische optische Bauelemente, die die besonderen optischen Eigenschaften der Partikel ausnutzen.

Ein technisch einfacher Weg zur Erzeugung von Strukturen in silberpartikelhaltigen Gläsern ist die Auflösung von Partikeln in starken elektrischen Feldern. Dazu werden zwei Elektroden auf das Glas gepresst und bei einer Temperatur um $250°C$ an diese eine Spannung von etwa $1kV$ angelegt. Unter der Anode entsteht dadurch ein kationenarmer Bereich, der eine um mehrere Größenordnungen geringere Leitfähigkeit als das unveränderte Glas hat. Über diese wenige $\mu m$ dicke Schicht fällt der größte Teil der anliegenden Spannung ab, wodurch Feldstärken um $10^8 V/m$ erreicht werden. Diese starken elektrischen Felder führen zur Ionisierung und Zerstörung der Partikel.

Benutzt man als Anode einen leitfähigen photonischen Kristall aus makroporösem Silizium, erhält man im Glas eine Partikelverteilung, die der inversen Struktur des photonischen Kristalls entspricht und die theoretisch eine photonische Bandlücke aufweisen kann.

DY 17.2 Tue 14:50 H23

**Characterization of silver nanoparticles in glasses by X-ray absorption spectroscopy** — •Jörg Haug, Manfred Dubiel, Holger Kruth, and Angelika Chassé — Department of Physics, Martin Luther University Halle-Wittenberg, Friedemann-Bach-Platz 6, D-06108 Halle, Germany

Glasses containing metal nanoparticles are of interest because of their specific linear and non-linear optical properties. In the present work, there are represented structural investigations of Ag nanoparticles as well as of neighbourhood of Ag ions embedded in the glass matrix by means of EXAFS spectroscopy at the Ag K-edge. In a first step, EXAFS investigations are reported concerning the thermal expansion behaviour of bulk silver to test this method for investigations of nanoparticles. In a second step, in situ experiments at elevated temperatures of particle generation are described in order to evaluate the elementary processes of particle formation as well as the specific structure of nanoscaled particles.

DY 17.3 Tue 15:10 H23

**Finite size effect of the conductivity of sputtered lithium-borate glasses** — •Frank Berkemeier, Mohammad Reza Shoar Abouzari, and Guido Schmitz — Westfälische Wilhelms-Universität Münster, Institut für Materialphysik, Wilhelm-Klemm-Str. 10, 48149 Münster

The specific dc-conductivity of ion-conducting, sputtered glass films of the compositions $x\,Li_2O \cdot (1-x)\,B_2O_3$, with $x = 0.15$, 0.20 and 0.35, are determined by temperature dependent impedance spectroscopy. The thickness of the films varies between 7 nm and 1000 nm. In the case of relatively thick glass films ($> 100$ nm) each glass composition shows a specific dc-conductivity independent of the film thickness. For glasses with less than 20% alkali oxide, a significant increase of the specific dc-conductivity of about three orders of magnitude is observed, when decreasing the film thickness down to some nanometers. Three different models are suggested to explain this non-trivial 'finite size effect': structural modifications at the interfaces between glass layer and metallic electrode, formation of space-charge regions at the interfaces, and the existence of ion-conducting pathways inside the glass layers. Computer simulations based on percolation theory are presented to show the link between the experimental data and the assumption of conducting clusters inside the glass films.

DY 17.4 Tue 15:30 H23

**Evidence for fast interfacial ion conduction in nanostructured solid electrolytes** — •Ahmet Taskiran[1], Andre Schirmeisen[1], Harald Fuchs[1], Hartmut Bracht[2], and Bernhard Roling[3] — [1]Physikalisches Institut,Wilhelm-Klemm-Str.10,48149 Münster,Germany — [2]Institut für Materialphysik,Wilhelm-Klemm-Str.10,48149 Münster,Germany — [3]Intsitut für Physikalische Chemie,Hans-Meerwein-Str.,35032 Marburg,Germany

Solid ion conductors are used for applications like super-capacitors, high storage batteries and chemical sensors. Recent investigations have revealed that the overall conductivity can be enhanced by creating interfaces between different phases of the ion conductor. However, more detailed investigations have to be carried out on the nanoscopic length scale in order to understand the ion transport mechanism in the bulk and at the interface. We use electrostatic force microscopy (EFM) operating in the non-contact mode to measure the ionic conductivity in nanoscale volumes. In this method the temperature dependent ion conductivity was monitored in the range from 100 K to 675 K, yielding the activation energies of the ion hopping processes [1]. This work mainly focuses on the interfacial conductivity between the nanocrystallites and the glass phases of a partially crystal. LiAlSiO sample. Additionally to the activation energies found for the nanocrystallites and glass phase, which are in good agreement with macroscopic results [2], we identified a third activation energy, which can be attributed to the interfacial ion conductivity. [1] Schirmeisen et al., Appl. Phys. Lett. 85(2004)2053 [2] Roling et al., Phys.Chem.Chem.Phys. 7(2005)1472

DY 17.5 Tue 15:50 H23

**Thickness-dependence of dc-conductivity in $Li_2O - B_2O_3$ Glasses** — Mohammad Reza Shoar Abouzari, Frank Berkemeier, and •Guido Schmitz — Institut für Materialphysik, Universität Münster, Wilhelm-Klemm Str. 10, D-48149 Münster

Thin films of $(x)Li_2O \cdot (1-x)B_2O_3$ glasses with different concentrations of $Li_2O$, $0.15 < x < 0.35$, are prepared by ion-beam sputtering.The thickness of glass films vary from 1400 nm down to 7 nm. Thin metallic films of Al Li on each sides of glass film serving as metallic electrodes. To determine dc-conductivity of glass layers we used impedance spectroscopy at different temperatures. Considering the system of glass layer and electrodes as two parallel (R+CPE) circuits, the measured data are described by Nyquist diagrams and the specific dc-conductivities of the glass layers are determined. It is observed that the specific dc-conductivity depend significantly on the layer thickness. For x = 0.2, the specific dc-conductivity of layers with a thickness between 700 nm and 100 nm is constant, while it increases monotonously for thinner layers with a thickness of 100 nm down to 7 nm with decreasing of the thickness. The increase of dc-conductivity amounts to three orders of magnitude. The obtained result for x = 0.15 shows the thickness dependency of the dc-conductivity up to 300 nm. It seems that this peculiar behaviour of the glass films stems from finite size effects disappears with increasing of layer thickness.

DY 17.6 Tue 16:10 H23

**A binary Yukawa mixture under shear: A computer simulation study** — •Jochen Zausch and Jürgen Horbach — Inst. f. Physik, Universität Mainz, Staudinger Weg 7, 55099 Mainz

Extensive Non-Equilibrium Molecular Dynamics (NEMD) simulations are performed to investigate a binary mixture of like-charged colloids under shear. The interactions between the colloidal particles are modelled by an effective screened Coulomb (Yukawa) potential, without considering explicitly any solvent degrees of freedom. The system is coupled to a DPD thermostat while determining dynamic properties in equilibrium. The DPD thermostat is also used for the NEMD runs where the system is sheared by means of Lees-Edwards boundary conditions. We investigate the dynamic properties in equilibrium and at different constant shear rates in steady state. Moreover, we study how the sheared system relaxes back to equilibrium when we suddenly switch off the shear. To this end, we consider a dynamic four-point susceptibility that measures fluctuations around the mean dynamics.

DY 17.7 Tue 16:30 H23

**Free energy fluctuations in the Sherrington Kirkpatrick spin glass** — •Martin Goethe and Timo Aspelmeier — Institut für Theoretische Physik, Georg-August-Universität Göttingen, Germany

A new numerical method of calculating the sample to sample fluctuations $\Delta F$ of the free energy in the Sherrington Kirkpatrick spin glass will be presented which is based on an interpolating Hamiltonian

and works for all temperatures $0 < T < \infty$. By its use the scaling behaviour of $\Delta F$ in the spin glass phase is obtained. It strongly disagrees with previous numerical studies at zero temperature. Finally possible explanations for the difference and arising consequences will be discussed.

DY 17.8 Tue 16:50 H23

**Free energy fluctuations and chaos in mean-field spin glasses** — •Timo Aspelmeier — Institut für Theoretische Physik, Universität Göttingen

The sample-to-sample fluctuations $\Delta F$ of the free energy in the mean-field Ising spin glass are a long standing unsolved problem in spin glass physics. Here we show that $\Delta F$ is intimately connected to an apparently unrelated phenomenon, namely chaos in spin glasses. Chaos in spin glasses, first suggested within the droplet model for finite-dimensional spin glasses, also exists for the mean-field spin glass. This opens up a new way to calculate $\Delta F$ analytically. Since $\Delta F$ is related not only to chaos but also to domain wall energies in finite dimensional spin glasses, our results have direct bearing on spin glass physics in finite dimensions.

DY 17.9 Tue 17:10 H23

**Long-time behavior of the velocity autocorrelation function in the overlapping Lorentz model** — •Thomas Franosch and Felix Höfling — Arnold-Sommerfeld-Center for Theoretical Physics, LMU München, Germany

The long-time behavior of transport coefficients in the overlapping Lorentz model in two and three dimensions is investigated by means of extensive Molecular Dynamics simulations. The behavior of the velocity auto-correlation function can be rationalized in terms of a competition of the critical relaxation due to the underlying percolation transition and the hydrodynamic power-law anomalies. In two dimensions and in the absence of a diffusive mode, another power law anomaly due to trapping is found with an exponent -3 instead of -2. Further, the logarithmic divergence of the super Burnett coefficient is corroborated in the dilute limit; at finite density, however, it is dominated by a linear divergence.

DY 17.10 Tue 17:30 H23

**The Jamming Transition in Granular Systems** — •Matthias Sperl[1], Trushant Majmudar[1], Stefan Luding[2], and Robert Behringer[1] — [1]Duke University — [2]TU Delft

Recent simulations have predicted that near jamming for collections of spherical particles, there will be a discontinuous increase in the mean contact number, Z, at a critical volume fraction, $\phi_c$. Above $\phi_c$, Z and the pressure, P, are predicted to increase as power laws in $\phi - \phi_c$. In experiments using photoelastic disks we corroborate a rapid increase in Z at $\phi_c$ and power-law behavior above $\phi_c$ for Z and P. Specifically we find power-law increase as a function of $\phi - \phi_c$ for $Z - Z_c$ with an exponent beta around 0.5, and for P with an exponent $\psi$ around 1.1.