DY 28 Glass I (joint session with DF)

Time: Tuesday 09:30–12:10 Room: MÜL Elch

Invited Talk DY 28.1 Tue 09:30 MÜL Elch

Towards a Statistical Mechanics for Network Glasses — •Reimer Kühn[1], Jort M. van Mourik[2], Martin Weigt[3], and Annette Zippelius[4] — [1]King's College London, UK — [2]Aston University, Birmingham, UK — [3]Institute for Scientific Interchange, Torino, Italy — [4]Universität Göttingen, Germany

We introduce models of heterogeneous systems with finite connectivity defined on random graphs, to capture effects of finite coordination characteristic of finite dimensional systems. Our models use a description in terms of small deviations from a set of reference positions, appropriate for the description of low-temperature phenomena. A Born-von-Karman type expansion with random coefficients is used to model glassy systems. Gel-phases can be described when anharmonicities are absent. The key quantity in the theoretical analysis is a distribution of effective single-site potentials. For gels, where anharmonicities are absent in the interactions, the single-site potentials are harmonic as well, and their distribution is equivalent to the distribution of localization lengths used earlier for the description of such systems. With frustration in the interactions and anharmonicities present, the systems develop glassy phases at low temperature, characterized by an ensemble of single- and double-well potentials, the latter with a broad spectrum of barrier heights and asymmetries. The double well potentials are responsible for the universal glassy low-temperature anomalies, as previously described for fully connected systems

DY 28.2 Tue 10:10 MÜL Elch

Nanostructured Solid Electrolytes analyzed by Time-Domain Electostatic Force Spectroscopy — •Ahmet Taskiran[1], Andre Schirmeisen[1], Harald Fuchs[1], Bernhard Roling[2], Hartmut Bracht[3], Frank Natrup[2], and Sevi Murugavel[2] — [1]Physikalisches Institut, Wilhelm-Klemm-Str.10, 48149 Münster, Gemany — [2]Institut für Physikalische Chemie, Corrensstr..30, 48149 Münster, Gemany — [3]Institut für Materialphysik, Wilhelm-Klemm-Str.10, 48149 Münster, Gemany

Ion conducting solid materials are widely used as solid electrolytes in, e.g,. batteries. An important prerequisite for further progress in this field is a better understanding of ion transport mechanisms on nanoscopic length scales. We are using an atomic force microscope (AFM) operated in the non-contact mode for electrostatic force spectroscopy to measure the ion conductivity in nanoscale volumes of homogeneous and heterogeneous solid electrolytes. The measurements are carried out at sample temperatures ranging from 200 K to 675 K and at different positions on the sample. The relaxation times at different temperatures follow the Arrhenius model,which yield the activation energy of the ion hopping processes [1]. Furthermore the local variation of the relaxation strength provides us with information on the different phases and interfaces in the sample. In our work we focus on nanostructured solid electrolytes. We find that the activation energies for the ions in the nanocrystallites and in the glass regions are different, in agreement with macroscopic results [2]. [1] Schirmeisen et al., Appl.Phys.Lett. 85,2053 [2] Roling et al., Phys.Chem.Chem.Phys. 7,1472

DY 28.3 Tue 10:30 MÜL Elch

Ionic Motion in Ion Beam Sputtered Borate Glasses — •Frank Berkemeier, Reza Abouzari, Tobias Stockhoff, and Guido Schmitz — Westfälische Wilhelms-Universität, Institut für Materialphysik, Wilhelm-Klemm Straße 10, 48149 Münster

Ion-conducting, amorphous thin films with a thickness of $20 - 500\,\mathrm{nm}$ are prepared by ion beam sputtering using glass targets of the compositions $0.2\,A_2O \cdot 0.8\,B_2O_3$, with A = Li, Na, Rb. The glass layers are deposited on a silicon substrate between two sputtered electrodes of Ag, Al, or Al-Li alloy. TEM cross-section investigations show a homogeneous thickness and a homogeneous, amorphous structure of the films. Chemical analysis, performed by EELS, gives alkali oxide concentrations comparable to those of the target material. Temperature-dependent impedance spectroscopy allows to differentiate between different electrical properties of the samples and to determine the specific dc-conductivities of the glass layers. Layers thicker than 100 nm show dc-conductivities which are about one order of magnitude higher than those of the target materials and activation enthalpies about $20\,\mathrm{kJ\,mol^{-1}}$ less compared to the targets. Additionally, layers thinner than 100 nm show a non-trivial increase in dc-conductivity with decreasing film thickness, which we attribute to the increasing influence of the glass-electrode interfaces.

DY 28.4 Tue 10:50 MÜL Elch

Theoretical model of the conductivity of alkali glasses — •Joachim Sohns and Michael Schulz — Abteilung theoretische Physik, Albert-Einstein-Allee 11, 89069 Ulm

Our aim is to formulate a model of the conductivity of glasses which reproduces the mixed alkali effect. Therefore we analyze the conductivity of an ensemble of charged particles in a random environment. As in a former model this environment was static, the model proposed here includes the dynamics of the glass environment. The memory effects are described by the mode-coupling theory. A nonequilibrium Green function determines the properties of the alkali system. Finally the conductivity of the system is calculated. Furthermore, we give some ideas how feedback mechanisms between the ions and the glass environment may be included in the theoretical description.

DY 28.5 Tue 11:10 MÜL Elch

Glasses, Clusters, and Philosophy — •Andreas Reiser, Gernot Kasper, Siegfried Hunklinger, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, Im Neuenheimer Feld 227, 69120 Heidelberg

Dielectric relaxation studies can reveal information on structural or chemical processes in liquids, soft matter, and partly crystalline or amorphous solids. Glass formers can belong to all of these groups, depending on the external control parameters temperature, pressure, and more generally on the thermodynamic present and history. We have measured the dielectric permittivity of several prototypical organic glass formers as a function of frequency, temperature, and pressure. Isobaric, isothermal and isochoric routes in the temperature-pressure plane were taken. We show basic scaling properties of the dielectric function. For data interpretation a cluster-based approach is discussed with respect to crystallization.

DY 28.6 Tue 11:30 MÜL Elch

Collective Single Particle Jumps Below The Glass Transition — •Katharina Vollmayr-Lee — Institut für Theoretische Physik, Universität Göttingen,Friedrich-Hund-Platz 1, D-37077 Göttingen,Germany

We study a binary Lennard-Jones mixture below the glass transition via molecular dynamics simulations. To investigate the dynamics of the system we define single particle jumps via their single particle trajectories. To study how the single particle jumps are correlated in time and space we investigate (I) clusters of simultaneously jumping particles and (II) temporally extended clusters, i.e. clusters of jump events for which the jumping particles are spatially nearby and the jumps occur at consecutive times. We find highly collective jump processes. The distribution of cluster sizes $P(s)$ is independent of temperature and follows a power law $P(s) \sim s^{-\tau}$ with $\tau \approx 2.7$ in case (I) and $\tau \approx 2.2$ in case (II). By studying the average coordination number within the clusters as a function of the cluster size, we find that the shape of the clusters is string-like.

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DY 28.7 Tue 11:50 MÜL Elch

Optical Properties of Colloidal Suspension of Silver Nanoparticles* — •Helge A. Eggert[1], Jim R. Adleman[2], Demetri Psaltis[2], and Karsten Buse[1] — [1]Institute of Physics, University of Bonn, Wegelerstr. 8, 53115 Bonn — [2]Department of Electrical Engineering, California Institute of Technology, Pasadena, CA 91125

Colloidal suspensions of silver nanoparticles are an interesting optical material because of homogeneity, stability, and tailored absorption properties. To understand the thermal and nonlinear-optical response, holographic gratings are recorded in such colloidal suspensions of silver nanoparticles utilizing interfering nanosecond pulses (wavlength λ=532 nm, puls duration 6 ns, intensity 10 GW/m^2). The diffraction efficiency is measured with continuous-wave light (λ=633 nm). An instantaneous response together with a longer lasting but also transient grating are observed: The nanoparticles absorb the pump light and heat up, which yields a response on the time scale of the laser pulse. Heat is transferred to the solvent, and a delayed thermal grating appears. The final decay time constant of this grating depends quadratically on the period length of the interference pattern and has a typical value of 1 μs for grating spacings of several micrometers.

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Prize Talk

The prize talk (Max-Planck-Medaille) by Prof. Götze takes place Tuesday, 13:15, HSZ 04. The title of the talk is “Glassy Relaxation: a Paradigm for Condensed-Matter Dynamic”. See the plenary section for the abstract.