MM 61: Liquid and Amorphous Materials III

Time: Thursday 15:30–16:45 Location: C 243

MM 61.1 Thu 15:30 C 243

Spectroscopic imaging pump-probe ellipsometry on fused silica after femtosecond laser irradiation — •Theo Pflug, Markus Olbrich, and Alexander Horn — Laserinstitut Hochschule Mittweida, 09648 Mittweida, Germany

Focused ultrashort-pulsed laser radiation enables the processing of transparent dielectrics such as glass even if the photon energy is lower than the energy band gap of the material. The underlying nonlinear physical processes, namely multiphoton-, tunnel-, and avalanche-ionization, have already been investigated in numerous experimental and theoretical studies and depend strongly on the transient optical properties of the material during irradiation. In this paper, we present a pump-probe setup combined with an imaging ellipsometer that allows to measure the transient complex refractive index of the excited material with a temporal, spectroscopic, and spatial resolution. The comparison of the measured transient optical properties of fused silica with various theoretical models for describing the dielectric function from the literature allows the validation of these models, and therefore a better insight into nonlinear excitation processes.

MM 61.2 Thu 15:45 C 243

Evaluation of optical anisotropy on the surface of stressed glass using a reflective polarimetric setup — •Felix Müller, Hainer Wackerbarth, and Georgios Ctistis — Institut für Nanophotonik Göttingen, Hans-Adolf-Krebs-Weg 1, 37077 Göttingen

The rising requirements on glass in its wide range of usage embrace stability and functionality. An important factor to achieve these is the precise adjustment of desired or undesired residual stress corresponding to the application. In order to determine surface stress with a non-contact, non-destructive and automatable method we have come up with a polarimetric approach. In contrast to the well-established transmission polarimetry, the challenge to be surface sensitive demands a much higher resolution of polarisation states and a more complicated measurement data analysis due to the oblique incidence. We have managed to distinguish surface stress differences in the range of 1 MPa by applying external stress for different orientations of two of the principle axes in the surface plane. Furthermore we have reached a spatial resolution of the laser spot size of 1 mm and are able to scan qualitative stress maps on certain areas of the sample's surface. The polarimetric surface stress measurement considers the relation between the incoming and outgoing polarisation state. A comparison enables to refer the measured state to the material's reflection properties, as described by a reflection matrix in the Müller-Stokes-formalism. Therefore, quantifying surface stress from those measurements underlies, additionally to a sufficient set of measured parameters, the relation between the Fresnel reflection matrix and the type and reason of the sample's anisotropy.

MM 61.3 Thu 16:00 C 243

X-ray photon correlation spectroscopy on metallic glass formers under non-isothermal temperature scan conditions — •Maximilian Frey[1], Ralf Busch[1], and Eloi Pineda[2] — [1]Chair of Metallic Materials, Saarland University, Campus C6.3, 66123 Saarbrücken, Germany — [2]Department of Physics, Institute of Energy Technologies, Universitat Politècnica de Catalunya - BarcelonaTech, 08019 Barcelona, Spain

Using high flux synchrotron radiation (ESRF, ID10), we study a Pt-based metallic glass former via X-ray photon correlation spectroscopy (XPCS) upon temperature scanning through the glass, glass transition and supercooled liquid (SCL). In the equilibrium SCL, the obtained intensity autocorrelation functions, g2, are well-described by a conventional Kohlrausch-William-Watts (KWW) model. Yet, in the glass and especially the glass transition region, this approach fails. Instead, we demonstrate that a multiplication of two KWW functions allows to describe the complex decay shape. Within the glass transition region, the fit parameters of the two separate KWW fits decouple massively. While one KWW component models the compressed shape of glass-typical non-equilibrium dynamics, the other fit maintains stretched liquid-like characteristics. We demonstrate that the compressed decay can be likely addressed to ballistic-like atomic motions while the stretched component apparently reflects (sub-)diffusive atomic motions, which are both superimposed in the non-equilibrium.

MM 61.4 Thu 16:15 C 243

In-situ measurement of thermodiffusion in liquid alloys — •Elke Sondermann, Asbjørn Krüger, and Andreas Meyer — Institute of Material Physics in Space, German Aerospace Center (DLR), 51147 Cologne, Germany

Thermodiffusion, also called Soret effect, describes the formation of a concentration gradient induced by a temperature gradient. This cross-coupling effect of heat and mass transfer influences the homogeneity of doped semiconductors and grown crystals as well as the microstructure formation in alloys. The calculation of thermodiffusion by molecular dynamic simulation can be very sensitive to the specific potential. To validate models for thermodiffusion in liquid alloys, reliable measurements are needed.

Using x-ray radiography in combination with a high temperature furnace, thermodiffusion in liquid Al-Ag has been measured. This technique enables in-situ observation which excludes disturbances by solidification and reveals possible error sources as e.g. free surfaces. Thanks to the time-resolved information from x-ray radiography, the interdiffusion coefficient could simultaneously be measured and is in good agreement with previous interdiffusion measurements in this concentration range. The measured Soret coefficient is compared with the values predicted by the current theoretical models, which are found to be off by at least a factor of two.

MM 61.5 Thu 16:30 C 243

Fe and Zr diffusion in columnar Cu-Zr nano-glasses — •Christian Aaron Rigoni[1], Hendrik Voigt[1], Evgeniy Boltynjuk[2], Anoosheh Akbari[1], Bonnie Tyler[3], Sergiy Divinski[1], Harald Rösner[1], Horst Hahn[2,4], and Gerhard Wilde[1] — [1]University of Münster, Institute of Materials Physics, Münster, Germany — [2]Institute of Nanotechnology, Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany — [3]University of Münster, Physikalisches Institut and Center for Soft Nanoscience, Münster, Germany — [4]University of Oklahoma, CBME and AME, Norman, OK73019, US

The concept of nano-glasses is to combine the beneficial characteristics known from defects in a crystalline material with an amorphous structure of a glassy alloy, with a focus on the presence of glass-glass interfaces. The presented study investigates anomalous diffusion along such interfaces in magnetron-sputtered Cu60Zr40 columnar nanoglasses. A combination of the radiotracer technique and time-of-flight secondary ion mass spectroscopy is used to measure the solute diffusion of Fe and self-diffusion of Zr atoms. The obtained results are directly compared to a homogenous glass with a similar composition, revealing enhanced diffusivities which are interpreted in terms of an excess free volume located at the glass-glass interfaces. The diffusion studies are directly supported by the structural observations made by TEM, documenting the existence of two different amorphous phases and correspondingly glass-glass interfaces in the columnar Cu-Zr nanoglass.