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<tr><td rowspan="1">ESRF</td><td>Experiment title: The effect of pressurization on the atomic dynamics of rapidly quenched and vapour deposited metallic glasses</td><td>Experiment number:
HC-2544</td></tr>
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<tr><td>Shifts:</td><td>Local contact(s):
B. Ruta</td></tr>
<tr><td colspan="3">Names and affiliations of applicants (* indicates experimentalists):

Dr. V. M. Giordano*
Dr. S. Le Floch*
Institut Lumière Matière, Université Claude Bernard Lyon 1, Bâtiment Kastler, 10 rue Ada Byron, 69622 Villeurbanne CEDEX, France

M. Lüttich*
I. Physikalisches Institut, University of Goettingen, Friedrich-Hund-Platz 1, 37077 Goettingen, Germany & ESRF Grenoble</td></tr>
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Report:

Vapour deposited (VD) metallic glasses (MGs) are a new family of glasses which are supposed to show improved stability with respect to aging and crystallization compared to conventionally produced MGs. We exposed VD MGs as well as conventional – fast quenched (FQ) – MGs to pressures of up to 2 GPa after the preparation process in order to study their atomic dynamics with respect to different residual stresses. For a subset of samples we increased the temperature to higher temperatures than ambient temperature after reaching the aimed pressure in order to facilitate structural changes and minimise the time scale on which they occur. On behalf of that special preparation, we addressed our investigations to the coupling between macroscopic and atomic reconfigurations in FQ and VD MGs. X-ray photon correlation spectroscopy (XPCS) at ID10 is therefore the perfect tool to study atomic reconfigurations while static structural changes were monitored by means of standard diffraction and analysis methods. We found enhanced dynamics of the structural relaxation dynamics of pressurized FQ MG at ambient temperatures while heating it up $>=0.6T_g$ resulted in similar dynamical behaviour as for unpressurized MGs. The FQ MG which was annealed at $\sim 0.6T_g$ while pressurization shows similar behaviour as unpressurized MGs at all temperatures. From this, we can conclude, that the effect of the pressurization is vanished upon heating to temperatures higher than ambient temperature but still deep in the glassy regime.
As the VD samples are much thinner than their FQ equivalents due to their particular preparation method, they broke into smaller parts after applying the pressure and required a more narrow sample holder, respectively. The used disks with an opening of 200 µm are shown in Figure 1, dictating a geometrical constrain to the measurement. As the opening angle 2Φ is only ~54°, performing XPCS measurements at an scattering angle 2Θ=40° requires to illuminate the very edge of the sample, as schematically depicted on the right of Figure 1.

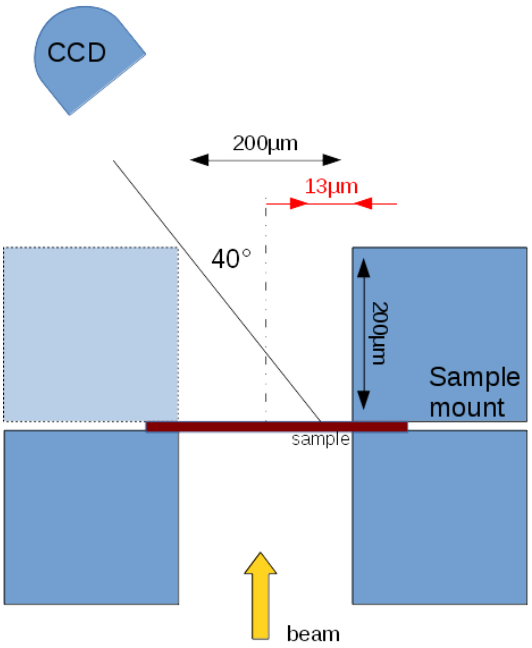

Figure 1: Setup of the sample mount using the sample mount with 200µm diameter of the opening. The only possible illuminated sample position in order to achive the required opening angle is highlighted.

This results in a two-time correlation function (TTCF) with an interference pattern along the time axis, as shown in the sub-figures of Figure 2. Each sub-figure corresponds to different positions on the different VD MGs, mounted in the above described disks. Even measuring on the edge of the sample, as schematically described in Figure 1 leads to the above mentioned type of interference pattern. For future beamtimes, we will produce disks with a larger opening angle in order to suppress interference effects of the x-ray beam on the edge of the confining sample mount.
Analysis and interpretation of data, which was successfully collected on fast quenched MGs, is still ongoing. Furthermore, collected data on the unpressurized VD and FQ MGs, which was taken as reference data in this beamtime, contributes to a publication, which is currently under preparation.

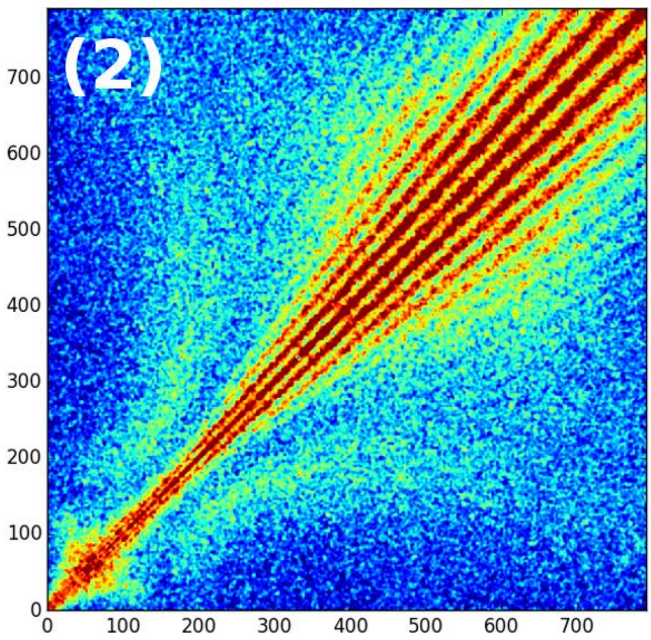

Figure 2: Two-time correlation function of vapour desposited $Cu_{50}Zr_{50}$, mounted between two disks as discribed in Figure 1.