	Experiment title: Measurement of the Gruneisen parameter for the high-frequency acousticexcitations in glassy glycerol	**Experiment number**: HD189
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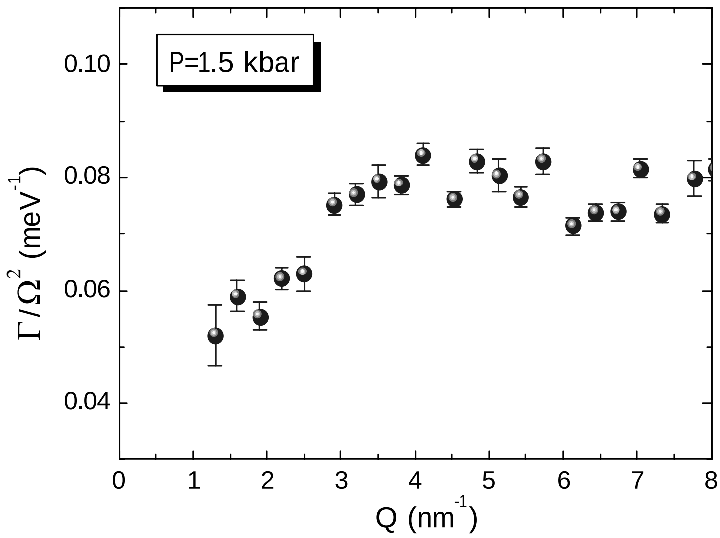
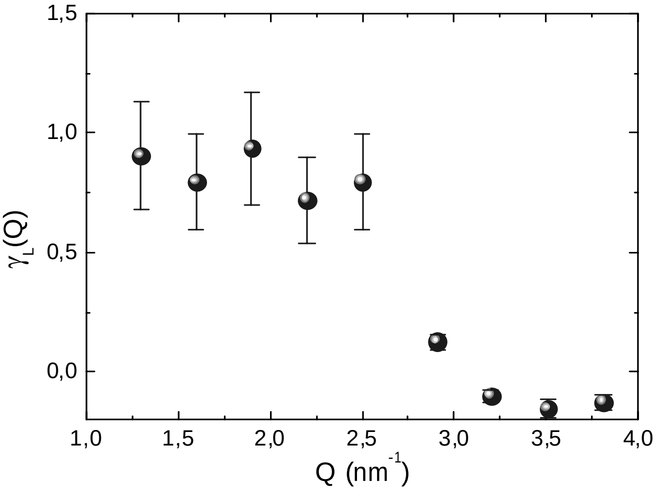
Report:

Inelastic X-ray scattering is an excellent tool to investigate the mechanisms underlying the sound attenuation in disordered systems. The high energy resolution achievable (~1.3 meV) allowed us to perform a detailed study of the longitudinal acoustic-like modes in a glass of glycerol under pressure. The data have been collected at T=150 K for two different pressures (1.5 and 4.5 kbar). They have been fitted with a damped harmonic oscillator model (DHO) convoluted with the instrumental resolution in order to gain information on the frequency Ω and the width Γ of the Brillouin doublet. The latter quantity gives direct information on the sound damping in glasses.



In Figure 1 the width of the Brillouin peaks divided by Ω^2 as a function of the exchanged momentum in the scattering process is shown. There are two clear different regimes: a) the high Q range, above about 3 nm^{-1}, corresponds to the well know quadratic dependence of the sound attenuation, which is temperature independent and related to the structural disorder; b) at low Q a regime governed by a higher power law dependence ($\Gamma\sim\Omega^4$) clearly appears. This particular behavior has been found also in other glasses [1-3], but its origin is still unclear. The present on is the first evidence of the existence of this regime in a molecular glass like glycerol.



On increasing the pressure, the sound velocity of the glass increases, thus pushing the vibrational dynamics to higher energies. From the shift of the excitation frequency with pressure, we estimate the Grüneisen parameter $\gamma_L(Q)$. In Figure 2 preliminary results on the dependence of the Grüneisen parameter on Q are reported. It is of interest here to note that this parameter has a constant non-zero value up to Q~2.5 nm^{-1}, thus in the same range where the Brillouin width shows the Ω^4 behavior. This result suggests a possible role of the anharmonicity in the attenuation process at low-Q, while at high-Q the vibrational dynamics shows basically a harmonic behavior. Further investigations are necessary to shed light more accurately on this point.

References

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