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Report

The dynamic structure factor of a permanently densified silica sample has been measured by inelastic X-rays scattering (IXS) as a function of the exchanged wave-vector Q at a fixed temperature $T = 573$ K.

The sample was prepared starting from a commercial grade suprasil block purchased from Silo (Florence). Using an high pressure – high temperature apparatus applying a pressure of 6 GPa and a temperature of 773 K for ten minutes we obtain a homogeneous permanently densified sample whose density was 2,406 ± 0.005 g/cm^3.

The dynamic structure factor has been measured for five Q-sets of the nine analyzer spectrometer arm. The Q-sets were chosen so as to span with great detail (about 12 points in Q) the low wave-vector ($Q < 5$ nm^{-1}) range. We chose an integration time of about 1 minute/point corresponding to a total time of 12 hours/spectrum. The measured spectra, see figure 1, are characterized by a signal to noise ratio which is sufficient to determine the speed of sound with a 1% accuracy.

The spectra have been fitted to a damped harmonic oscillator (DHO) function convoluted to the instrumental resolution plus an elastic line whose shape is given by the resolution itself. The effect of the analyzers slits finite aperture on the line shape has been carefully taken into account in the analysis of the spectra. The analyzer collects the intensity in a range of wave-vectors corresponding to its horizontal slit aperture and this contribution is non-negligible for wave-vectors $Q < 2$ nm^{-1}.

During this experiment we perform also a test measure on a more densified sample, $\rho = 2.67 \pm 0.01$ g/cm^3 obtained with the same HP-HT apparatus using the same temperature but with a pressure of 8 GPa. We chose an integration time of 9 hours for spectra. An experimental spectra on this sample is reported in figure 2.

The analysis on the 6 GPa sample pointed out that the attenuation Γ, measured as the FWHM of the inelastic peaks, changes from a Q^4 to a Q^2 behavior in the boson peak region. Moreover the test measure on the 8 GPa is very promising. The sound velocity is higher than in the 6 GPa sample and the peaks are very well defined. Further study on this sample are desirable in order to better understand the density behavior of both sound velocity and attenuation.

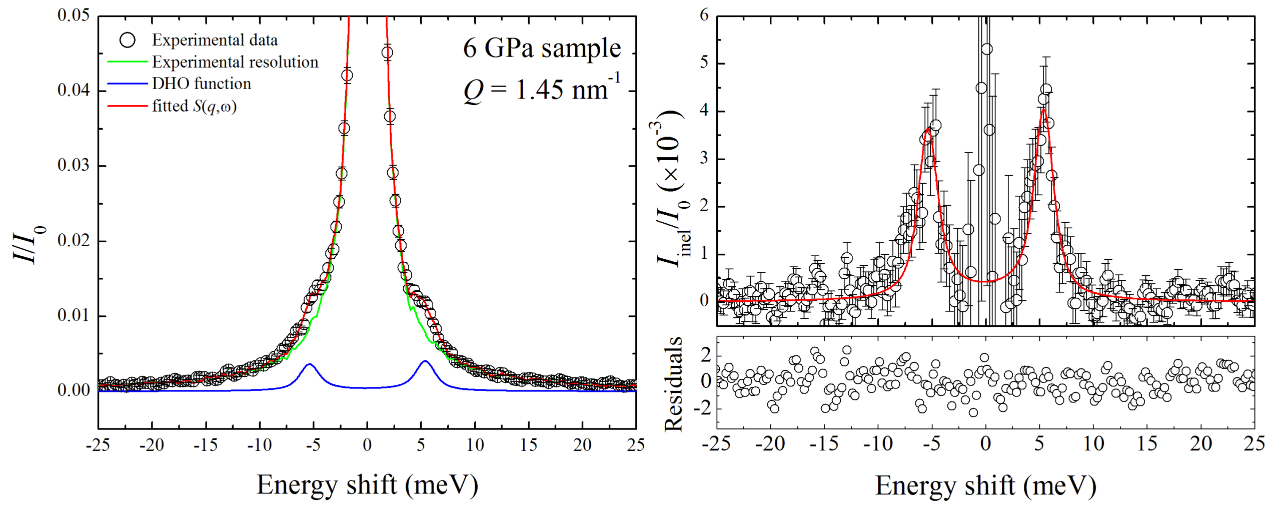

Figure 1 - In the left panel is reported an experimental spectra on the 6 GPa sample at $Q = 1.45$ nm^{-1} (dots). With the continous lines are reported the fitting terms: the experimental resolution (green line), the DHO function (blue line) and the fit function (red line). In right panel is reported with black dots the inelastic intensity (i.e. the experimental intensity subtracted by the elastic one) and with red lines the DHO function. In the panel below is reported the residuals plot.

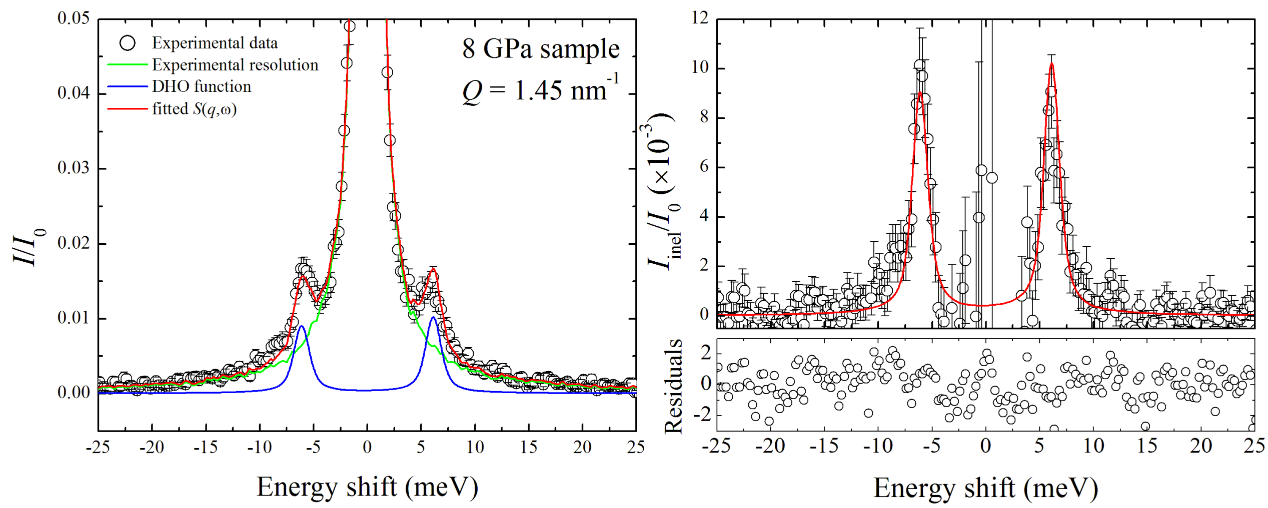

Figure 2 - In the left panel is reported an experimental spectra on the 8 GPa sample at $Q = 1.45$ nm^{-1} (dots). With the continous lines are reported the fitting terms: the experimental resolution (green line), the DHO function (blue line) and the fit function (red line). In right panel is reported with black dots the inelastic intensity (i.e. the experimental intensity subtracted by the elastic one) and with red lines the DHO function. In the panel below is reported the residuals plot.