ESRF	**Experiment title:** Is there a contrasting nature beyween the nature of acoustic excitations in glasses and crystals	**Experiment number**: HS-2896
Beamline: ID16	**Date of experiment**: from: 22/2-06 to: 28/2-06	**Date of report**: 23/3-06
Shifts: 18	**Local contact(s)**: Giulio Monaco	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

*Aleksandar Matic, Chalmers University of Technology, Göteborg, Sweden

*Claudio Mascivecchio, Sincrotrone Elettra, Trieste, Italy

* Silvia Santucci, Sincrotrone Elettra, Trieste, Italy

Report:

A natural way to directly quantify differences in the nature of acoustic excitations in glasses and crystals is to investigate glass-forming substances that can also be obtained in the crystalline state. The aim of the present experiment was to investigating three classical glass-forming systems, of different microstructure, that can also be obtained in the crystalline form: glycerol, ortho-terphenyl (OTP) and alpha-cristobalite (SiO_2). These three materials represent archetypal glass formers belonging to the classes of covalent network formers (SiO_2), hydrogen bonded glasses (glycerol) and molecular glass formers (OTP). They also span the whole range in the strong-fraglie scheme, with SiO_2 as one of the strongest, glycerol an intermediately strong glass former and OTP the most fragile one.

During the experiment we performed inelastic x-ray scattering experiments on crystalline and glassy glycerol and crystalline OTP. Both these substabces can be obtained in glassy and crystalline phases in-situ the cryostat with proper thermal tratement. For glycerol we obtained full disperson curves (1-15 nm^{-1}) of the at two temperatures (T=150 and 50 K) for the crystal phase and also full dispersion curves for the glass (T=150 K). This will allow us perform a direct quantitative analysis of the influence of structural disorder on the high frequency acoustic excitations. From the temperature dependence of the line-width of the crystal we can discriminate between homogeneous and inhomogeneous contributions. Figure 1 shows and example of the experimental spectra for crystalline glycerol. The preliminary analysis shows that the both the energy and the line-width of the excitations are the same in the glass and the crystal. This confirms our previous findings for glassy and crystalline ethanol [1]. Moreover the line-width of the crystal is shown to be temperature independent, inhomogeneous broadening, as was also earlier observed for the glass phase [2], pointing to a common origin of the line-width for the two phases.

We also performed measurements on the OTP crystal at one of three spectrometer settings and verified that the cristobalite sample would give a good signal in the experiment. Unfortunately, the integration time required for the glycerol and OTP crystals were longer than expected why we were not able to complete the experiment within the scheduled time (note also that only 18 of 21 shifts were scheduled for the experiment). We have recently submitted an application for continued beamtime for this project to be able to determine the generallity of the finding of a crystallike nature of acoustic excitations in glasses

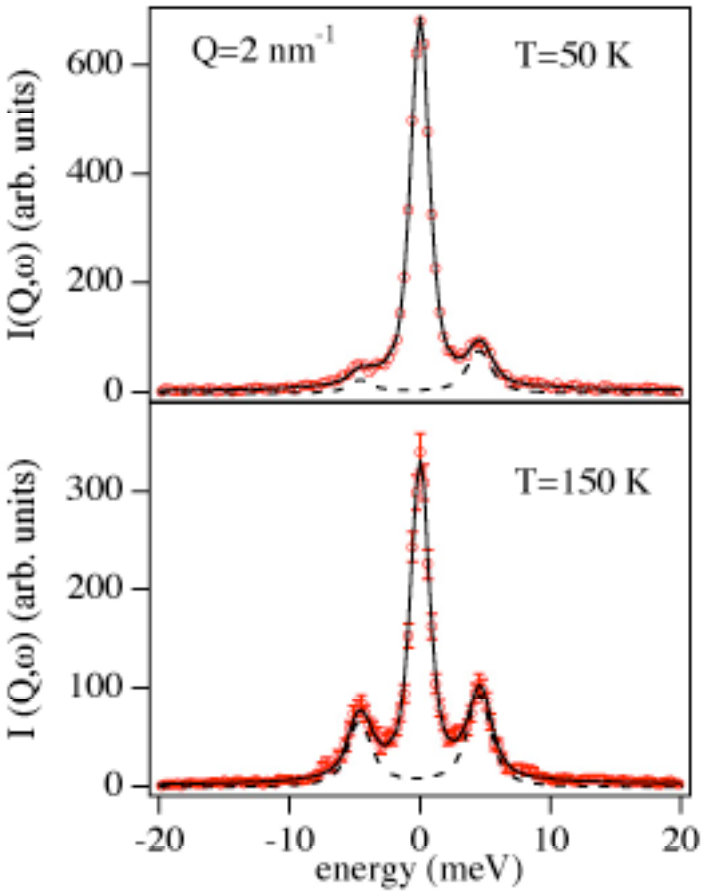

Figure 1. IXS spectra of crystalline glycerol at 2 nm-1 and T=150 and 50 K.

References:

[1] A. Matic, C. Masciovecchio, D. Engberg, G. Monaco, L. Börjesson, S.C. Santucci and R. Verbeni, Physical Review Letters, 93, 145502 (2004)
[2] G. Ruocco, et al, *Phys. Rev. Lett.* **83**, 5583 (1999)