ESRF	**Experiment title:** Collective excitations in a strong glass: B_2O_3	**Experiment number:** HS-195
Beamline: ID16	**Date of experiment:** from: 4/4/97 to: 12/4/97	**Date of report:** 25/2/98
Shifts: 27	**Local contact(s):** A. Mermet, C. Masciovecchio	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
*L. Börjesson, Dept. of Applied Physics, Chalmers Univ. of Technology, S-412 96 Göteborg, Sweden
L. M. Torell, Dept. of Physics, Chalmers Univ. of Technology, S-412 96 Göteborg, Sweden
* G. Roucco, Univ. di L'Aquila and Inst. Nazionale di Fisica della Materia, I-67100 L'Aquila, Italy
* F. Sette, Inelastic scattering group/ESRF, BP 220, F-38043 Grenoble, France
*A. Matic, Dept. of Applied Physics, Chalmers Univ. of Technology, S-412 96 Göteborg, Sweden

Report: In this work we have performed inelastic x-ray scattering experiments (IXS) on the strong glass former B_2O_3 in order to determine the behavior of collective excitations at finite wave vectors. The aim was to compare this glass system with other recent measurements on other glass formers (e. g. SiO_2[1] and CKN[2]) and also complement a series of neutron[3] and light scattering [4] experiments on this material. The IXS spectrum for B_2O_3 is dominated by a strong elastic peak, which at room temperature masks all inelastic contributions. To increase the inelastic signal the experiments were performed at T=543 K which is around the glass transition temperature. The elevated temperature induces a higher phonon population and hence increases the inelastic signal. Typical spectra are displayed in fig. 1a where the Si (11 11 11) monochromator and analyzer system were used giving the highest possible resolution. To extract the position and width of the inelastic peaks the spectra were fitted using the DHO-model[5], results are shown in fig. 1b. For small q-values the energy of the inelastic peaks show a linear dispersion relation from which the sound velocity of the system can be determined. The calculated sound velocity from this experiment is somewhat lower than the one obtained from other methods (3000 m/s compared to 3252 m/s). These experiments show the existence of propagating collective excitations also in the strong glass former B_2O_3 up to high energy and momentum transfers (energies

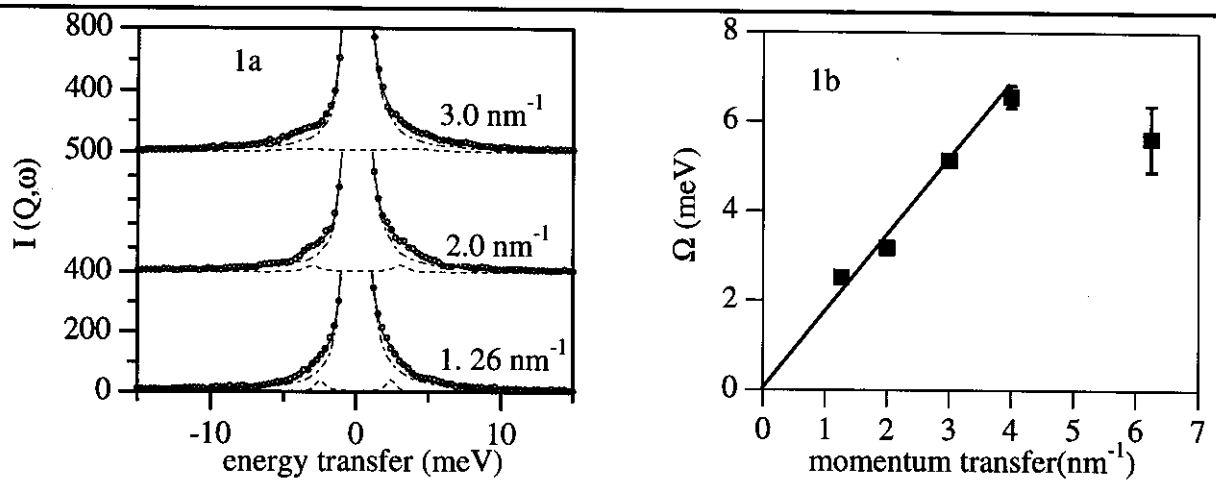

Fig. 1 Results from IXS experiments on B_2O_3. a) Typical spectra at different q-values at T=543K. b) The dispersion relation for the inelastic peaks. The line is just a guide to the eye.

higher than the boson peak energy). The detailed analysis of this experiment will include a comparison of this data with neutron and light scattering data and also IXS experiment on glasses with a different fragilities.

Also as a part of this experiment we performed complementary measurements on the fragile glass CKN using the high resolution set up to confirm previous results[2]. Also this experiment used the high resolution set up (Si (11 11 11)) giving a better contrast than the previous measurements (Si (9 9 9)). Fig. 2 shows a typical spectra for this glass.

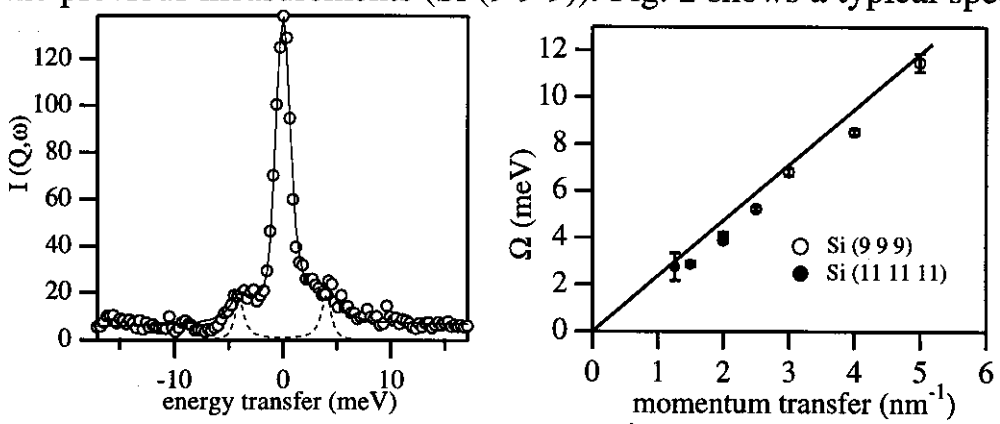

Fig. 2 *left:* Typical IXS spectrum from CKN at q=2 nm^{-1} at T=293 K. *right:* results from DHO-analysis from this experiment (Si (11 11 11)) and the previous one (Si (9 9 9)). The line is just a guide to the eye.

The results obtained from fitting using the DHO-model agreed with the previous experiments, however the widths were more reliable from this experiment due to the higher inelastic/elastic contrast. Compared to B_2O_3 the elastic peak is less intense and the inelastic peaks are easily observed. In CKN the linear region of the dispersion relation extends to even higher energy and momentum transfers than for B_2O_3, fig. 2.

References

[1] Benassi P. et al, Phys. Rev. Lett. 77, 3835 (1996)

[2] Börjesson L. et al to be published

[3] Börjesson L., ILL annual report (1995)

[4] Sidebottom D. et al, Phys. rev. Lett. 71, 2260 (1993)

[5] Fak B. et al, ILL Report No. 92FA008S (1992)