EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** **Collective dynamics of very high-density amorphous ice**	**Experiment number**: HS-2577
Beamline: ID16	**Date of experiment**: from: 25/02/2005 to: 04/03/2005	**Date of report**: 26/02/2006 *Received at ESRF:*
Shifts: 18	**Local contact(s)**: G. Monaco and H. Requardt	

Names and affiliations of applicants (* indicates experimentalists):

M.M. Koza, B. Geil, M. Scheuermann, H. Schober, H. Requardt, G. Monaco

Report:

Please note that the current experiment is a continuationand repitition of HS-2231 during which we have experienced technical problems with the instrument.

The scientific aim of these measurements is the test of the extraordinary properties of collective vibrations in the amorphous ice structures. In addition to the well reported spectra of low-density (LDA: ~31 molec./nm^3) and high-density amorphous (HDA: ~39 molec./nm^3) structures [1,2], we have studied the inelastic response of a very high-density (vHDA: ~41 molec./nm^3) amorphous ice modification. Recently, vHDA as well as LDA has been identified as the only homogeneous amorphous ice structures [3,4], making them highly interesting for testing concepts introduced to explain the strong attenuation of sound waves in amorphous materials [5].

The inelastic beamline ID16 has been utilized for this purpose in a Si(111111) mode giving an energy resolution of 1.5 meV with an incoming energy of 21.7 keV. The energy–momentum phase space has been sampled in constant Q mode between $1.25 \leq Q \leq 16.25 nm^{-1}$ with dQ = 0.75 nm^{-1} and $20 \leq E \leq 40$ meV with dE= 0.25 meV. In addition, we have measured the crystalline modification ice VI as a reference with dQ = 0.75 nm^{-1} at $2.0 \leq Q \leq 15.5 nm^{-1}$.

Throughout the entire sampled phase space the collective excitations in vHDA proved to be well defined. At lowest Q – numbers as it is indicated in Fig. 1 the acoustic longitudinal branch does not show any extraordinary broadening as observed in standard glass formers [5]. This behavior is reminiscent of the features found in LDA and interpreted as the consequence of the unusually low entropy of this structure and hence it’s homogeneity.

When following the acoustic mode to higher momentum transfers, detailed features become detectable in the line shape of the spectra, which are equally observed in crystalline counterparts [4]. As for the crystalline structures, detailed phonon selection rules depending on symmetry arguments are responsible for their complex inelastic response. It is therefore tempting to assume that the microscopic structure of vHDA is determined by well defined symmetry arguments on a local scale, as it has been deduced for LDA.

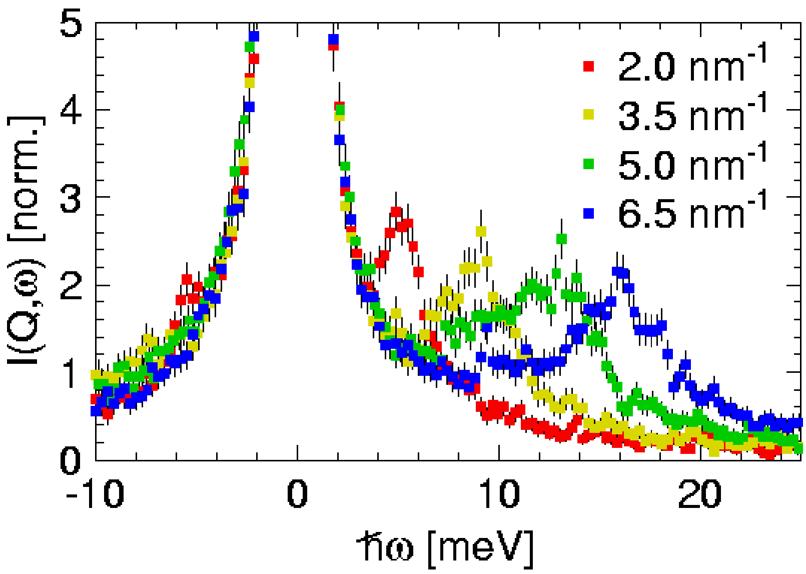

Fig. 1 Selected spectra of vHDA taken at the indicated Q-numbers. Please note the well defined, sharp dispersive mode indicating a long life time of the acoustic longitudinal mode, marking the vHDA structure as highly homogeneous.

References:

[1] M.M.Koza et al. Phys.Rev.Letters 94, 125506, (2005)
[2] M.M.Koza, T.Hansen, R.May, H.Schober, arXiv:cond-mat/0602207
[3] H.Schober, M.M.Koza, A.Toelle, C.Masciovecchio, F.Sette, F.Fujara, Phys.Rev.Lett. 85, 4100, (2000)
[4] M.M.Koza, H.Schober, B.Geil, M.Lorenzen, H.Requardt, Phys.Rev. B 69, 24204, (2004)
[5] F.Sette, M.Krisch, C.Masciovecchio, G.Ruocco, G.Monaco, Science 280, 1550, (1998)