EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

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:** Relationship between liquid atomic structure and glass forming ability of Mg-based metallic glasses.	**Experiment number**: 16-01-675
Beamline:	**Date of experiment**: from: 15 November 2006 to: 18 November 2006	**Date of report**: 1 September 2009
Shifts:	**Local contact(s)**: A. Labrador	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

*E. Pineda, *T. Pradell

Departament de Física i Enginyeria Nuclear, Universitat Politècnica de Catalunya.

Canal Olímpic s/n 08860 Castelldefels, Barcelona. Spain.

*P. Bruna, *D. Crespo

Departament de Física Aplicada, Universitat Politècnica de Catalunya.

Canal Olímpic s/n 08860 Castelldefels, Barcelona. Spain.

Report:

Different metallic compositions in amorphous state were studied by X-ray diffraction during annealing. The samples were obtained as ribbons by melt-spinning, the thickness of the ribbons ranged from 30 to 140 μm depending on the alloy. The ribbons were cut in pieces 1 cm long and introduced into a Linkam hot stage, fixed in a metallic washer. The scattering intensity was collected by a 2-dimensional ADSC Q210r CCD detector perpendicular to the incident beam in transmission geometry, the time-resolution of the X-ray detector allowed us to follow the structural changes of the samples throughout the annealing process. Various annealing protocols with heating and cooling rates of 10-20 K/min were applied, and spectra were acquired every 5 s. Nearly 9000 spectra were recorded during the experiment. The annealing was performed under nitrogen flow in order to minimize the oxidation of the samples. The radiation energies used were of 7.05, 8.95 and 15 keV.

The obtained spectra were used to determine the volume change and the radial distribution function of the alloys at different points during the annealing protocols. This allowed us to study the thermal dilatation, the free volume change and the crystallization occurred during the annealing and the corresponding strutctural changes. Figure 1 shows the volume change of the alloy calculated from the variation of the main diffraction peak position for one of the studied alloys, and figure 2 shows the structure factor and the total radial distribution function at one point of the annealing protocol for the same alloy.

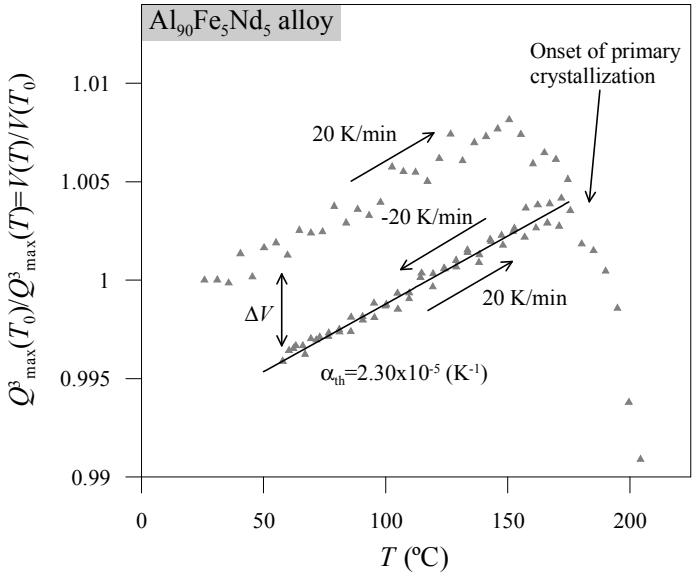

Figure 1.
Mean atomic volume change of $Al_{90}Fe_5Nd_5$ alloy during a heating-cooling-heating cycle at 20 K/min.

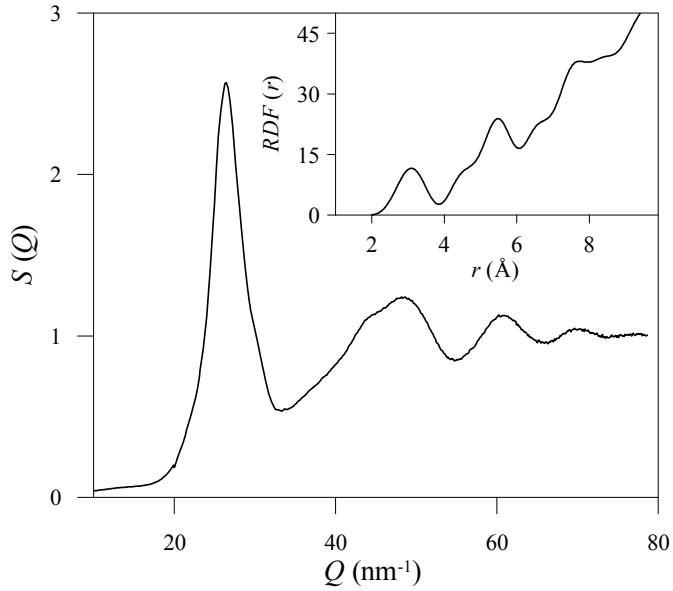

Figure 2.
Total structure factor S(Q) and the corresponding radial distribution function RDF(r) for the $Al_{90}Fe_5Nd_5$ alloy.

Results have been published in:

E. Pineda, I. Hidalgo, P. Bruna, T. Pradell, A. Labrador & D. Crespo
Structural study of conventional and bulk metallic glasses during annealing
Journal of Alloys and Compounds Vol. 483 (2009) 578-581.
(DOI: 10.1016/j.jallcom.2008.07.194)

E. Pineda, F. Boneu, P. Bruna, T. Pradell, A. Labrador & D. Crespo
Structural evolution of metallic glasses during annealing through in situ synchrotron X-ray diffraction
Journal of Non-Crystalline Solids Vol. 354 (2008) 5140-5142.

Results have been presented in the following conferences:

III Reunión Nacional AUSE (Meeting of the Synchrotron Users Association of Spain). July 2007. *Structural change of conventional and bulk-forming metallic glasses during annealing*. E. Pineda, I. Hidalgo, P. Bruna, T.Pradell, A. Labrador & D. Crespo.

ISMANAM 2007. 14th International Symposium on Metastable and Nano Materials. August 2007. *Structural study of conventional and bulk metallic glasses during annealing*. E. Pineda, I. Hidalgo, P. Bruna, T. Pradell, A. Labrador, S. Preda & D. Crespo.

EUROMAT 2007, European Congress and Exhibition on Advanced Materials and Processes. September 2007. *In Situ Synchrotron X-Ray Diffraction Study during Annealing of Conventional and Bulk-Forming Metallic Glasses.* E. Pineda, I. Hidalgo, P. Bruna, T. Pradell, A. Labrador & D. Crespo.