EUROPEAN SYNCHROTRON RADIATION FACILITY

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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:** Investigation of grain subdivision and evolution of dislocation density in tensile deformed Al-Mg alloy.	**Experiment number**: MA-23
Beamline: ID11	**Date of experiment**: from: 04.05.2006 to: 09.05.2006	**Date of report**: 31.08.2006
Shifts: 15	**Local contact(s)**: Jonathan Wright	*Received at ESRF:* *15*

Names and affiliations of applicants (* indicates experimentalists):

Preliminary results as reference for new request of beam time

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Report:

The aim of the investigation was to collect experimental data for the validation of a multiscale modelling approach developed to predict the plastic deformation and recrystallization behaviour of crystalline materials, a FP6-NMP-NSF Specific Targeted Research Project (STREP) performed by a consortium consisting of three European (Ecole des Mines de Paris, Imperial College London and Eötvös University Budapest) and two American universities (Carnegie Mellon and Princeton University).

The granular structure of a polycrystalline Al-0.5Mg alloy reconstructed based on the present measurements should serve as input data into the so called *digital material* model [1,2] used for crystal plasticity simulations. The initial plan was to perform in-situ tensile tests with the equipment available at the beamline, however, the goniometer on which the stress rig of 130 kg was installed, ceased to function after four 2D scans. So, the aim to follow lattice rotations and elastic strains of single grains could not be accomplished. In that situation we have measured two sets of ex situ samples, one which was deformed in tension up to medium strains (of 0, 0.05, 0.1, 0.15 and 0.2) and a second set deformed in plane strain compression until large strains (of 0.15, 0.3, 0.6 and 1.2).

The evaluations are now focused on a low and high resolution reconstruction of the granular structure of the tensile deformed samples and to determine the applicability limits of the methods. To accomplish these we are currently developing two new programs, similar to GRAINDEX [3] and to the algebraic reconstruction program [4] developed by the Risø group. Software development is done in collaboration with the beamline scientist Jonathan Wright (ESRF) by our post-doc Peter Kenesei, who is full-time employed in the STREP project. Since the project is financed by the European Commission we intend to make the software freely available for ESRF users. (Previous software developed by our group for the manipulation of tomographic reconstructions measured at ID19 ESRF is also freely available from http://metal.elte.hu/tomo3D).

Since our last experiment (10^{th} of May 2006) the following developments were done in the program:

a) Calibration and correction of the measurements done with the Frelon and Sensicam detectors. Corrections taken into account are: dark current, flat field, distortion and background.

b) Different integration possibilities of the measured intensity as a function of 2θ, ω or η angles. For example figure 1 shows ω–η iso-intensity plots of 111 reflections corresponding to different grains of a sample deformed in tension until 0.1 strain (the maximum intensity is equal to 2).

Next task is the identification of single peaks and finding the orientation and center of gravity of each grain according to the algorithm presented in ref. [3]. It is expected to finish this task until the end of September.

We have also started the software development for the high resolution reconstruction. A program for the generation of intensity distributions in case of a known model structure was already developed. In the second step the ART program will be developed for the model structure. We expect the first reconstruction on the real structure to be obtained in December.

For the next round of measurements we intend to use a new stress rig developed in our lab, which has only 6 kg weight. This device allows the tensile deformation of small samples having diameters of about 1 mm. With the new rig and the software that we are currently developing we expect to obtain valuable information that can be used by our partners in the STREP project to validate their numerical simulations.

References

1. Dawson, P. R., *Int. J. Solids Structures*, **37**, 115-130 (2000).
2. R.E. Logé and Y.B. Chastel, *Comput. Methods Appl. Mech. Engrg.* **195**, 6843-6857 (2006).
3. E. M. Lauridsen, S. Schmidt, R. M. Suter and H. F. Poulsen, *J. Appl. Cryst*. **34**, 744-750 (2001).
4. H. F. Poulsen and Xiaowei Fu, *J. Appl. Cryst*. **36**, 1062-1068 (2003).

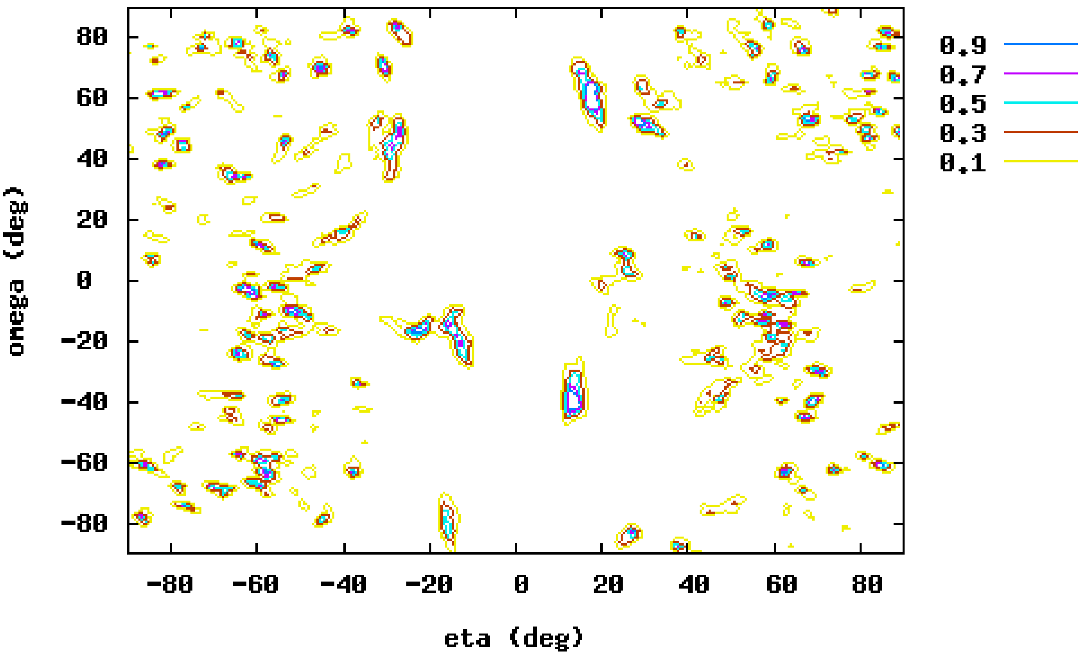

Figure 1. Intensity distribution of the111 peaks (strain of 0.10) in the η–ω space. The intensities are not corrected for the polarization factor 1/sin(2θ)|sin(η)|.
Peaks in a ±20º η interval around 0 are not taken into account for a future analysis [2].