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 via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can 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:** In situ study of recovery and grain growth in novel aluminium nano-composite	**Experiment number**: MA-3159
Beamline:	**Date of experiment**: from: 02/11/2016 to: 07/11/2016	**Date of report**: 01/03/2018
Shifts:	**Local contact(s)**: Thomas Buslaps, Veijo Honkimaki	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Andras Bobrély, **Hao Yuan**, Ecole de Mines de Saint-Etienne, France

Zhe Chen, Shanghai Jiao Tong University, China

Report:

A new method for combined in situ texture and microstructure analysis of deformed metals using high-energy x-ray diffraction has been developed. A publication on the method was accepted in Journal of Applied Crystallography. Below is the abstract of this publication.

It is shown that high-energy X-ray diffraction allows a fast and accurate texture and microstructure analysis of crystals, which can help setting up optimal industrial procedures for materials manufacturing. The paper presents the experimental and theoretical aspects of quantitative texture analysis using high-energy synchrotron beams. Compared to classical laboratory methods intensity corrections are less important, however, the most important correction, related to the Lorentz factor, can introduce relative fraction changes up to about 40% compared to the uncorrected case. ODF resolution also influences the results. For example, the usual 5° resolution leads to relative deviations up to 30% in the fraction of some components. The method allowed detecting small changes taking place during the recovery and continuous recrystallization of a cold-rolled Al-TiB_2 nanocomposite. Texture information was combined with results of line profile analysis evidencing the evolution of the average dislocation density and coherent domain size of the selected grain families.

Furthermore, new results were obtained concerning the evolution of the fraction of different texture components during recovery and recrystallization (Fig. 1). Four different heating rates and two materials AlScZr and AlScZr-5%TiB2 composite have been investigated. The fraction of almost all texture components increases during recovery (excepting Brass, Goss and Cube, which remain almost constant) The final recrystallized texture in the alloy is a typical Cube texture, while 45° rotated Cube is characteristic for the composite (Fig. 2). The texture of the alloy depends on the heating rate (Fig. 3), while for composite does not depend on it indicating a different origin. Based on EBSD investigation we could show that the 45° rotated Cube is due to particle stimulated nucleation (the influence of TiB2 particle in the matrix).
The different recrystallization texture of the AlScZr alloy is related to the differently recovered dislocation structure at different heating rates. The texture of the sample heated at a highest rate (500°C/min) deviates

the most from the Cube. In this case more stored energy remained in the material, which favors a more random orientation of recrystallization nuclei. Hao Yuan defended his PhD thesis on the 26/02/2018, these results will be submitted to Acta Materialia.

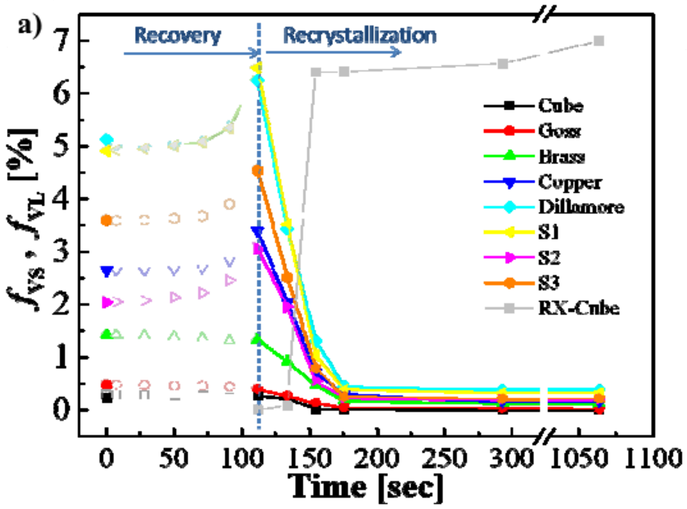

Fig. 1 Variation of the volume fraction of cold-rolled texture components (Cube, Goss, Brass, Copper, Dillamore & S) for the AlScZr alloy (a) and for the AlScZr-TiB2 composite (b) as a function of annealing time. The fraction of recrystallized grains is shown in gray (RX-Cube for the alloy and ND-Cube for the composite).

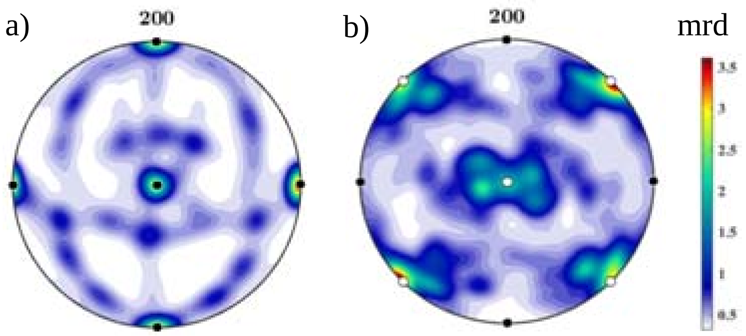

Fig. 2. 200 pole figures of the recrystallized a) AlScZr alloy and b) AlScZr-TiB2 composite. The alloy has a typical Cube texture, while the composite a 45° rotated Cube.

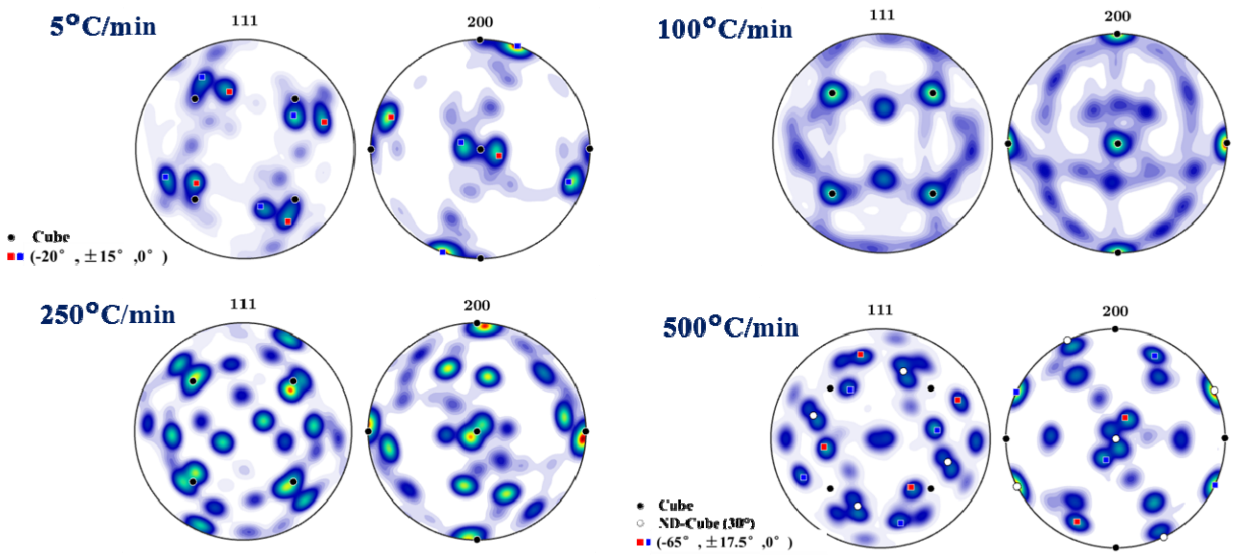

Fig. 3. 111 & 200 pole figures of the recrystallized AlScZr at different heating rates.