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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:** FaME38 - Development of Materials Engineering at ESRF, Strain Scanning on ID11, ID15 and ID31	**Experiment number**: ME773
Beamline: ID15A	**Date of experiment**: from: 18 May 2004 to: 25 May 2004	**Date of report**:
Shifts: 21	**Local contact(s)**: Thomas Buslaps	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

A Steuwer*, FaME38

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DJ HUGHES, FaME38
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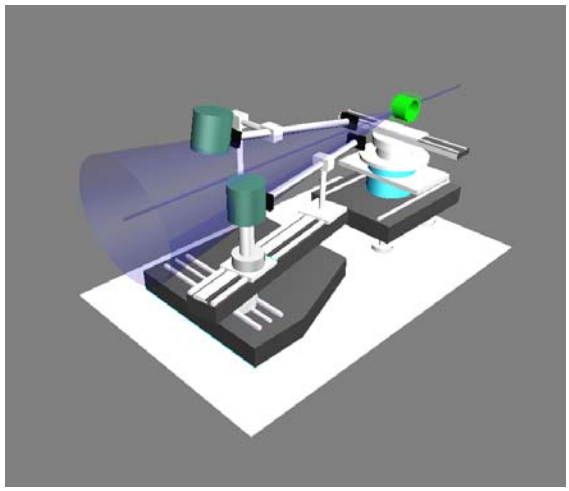
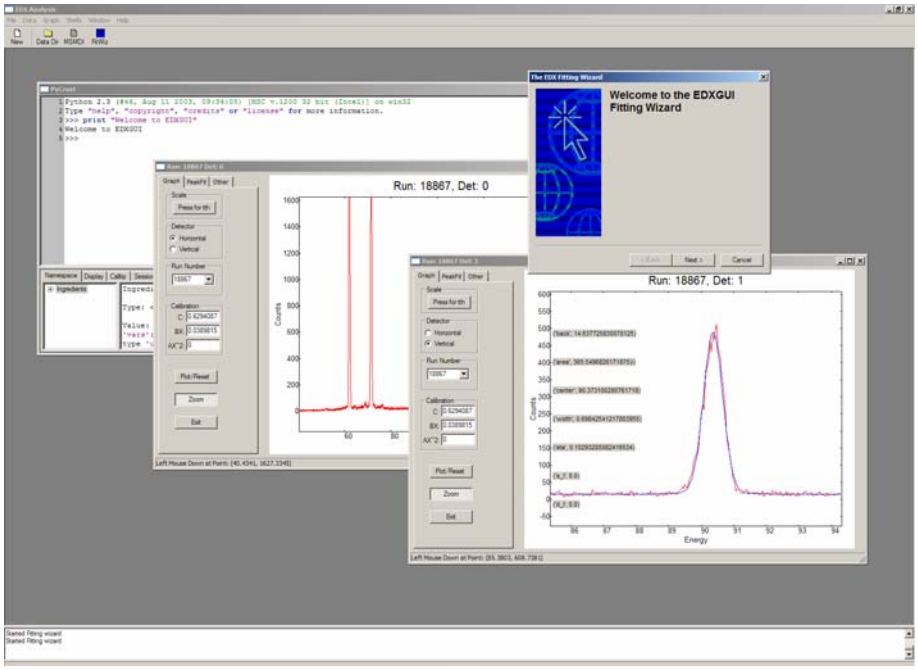
Report:

During this beam time allocation, FaME38 continued development of the two-detector energy-dispersive synchrotron X-ray diffraction set-up. A schematic of this set-up is shown on the right, below. This set-up has proven to be very beam time-efficient. The use of two detectors simultaneously improves the efficient use of beam time by at least a factor of two. Two directions of strain are measured simultaneously at nearly the same gauge volume (to within 50μm). No additional alignment between a change of orientation is required. The set-up was tested for strain scanning ability, since at very low diffraction angles the method becomes increasingly sensitive to grain size and microstructure. Using very narrow slits, and adopting different grain-averaging techniques this effect has been somewhat alleviated. Typical counting times of ~50s are mainly dominated by the limited count rate of the solid-state Ge-detectors, and in many cases additional attenuation of the incident beam was necessary in order not to saturate or overload the detectors. The main advantages of this method: large set-up space for complex sample environment and ability to carry heavy weight, very good penetration (at E>100keV), two directions of strain (if necessary) at high speeds of data acquisition (additional detectors could be installed), the ability to perform full diffraction pattern (allowing the monitoring of e.g. fast phase transitions). Disadvantages: microstructure sensitivity, very elongated gauge volume.



The improved resolution at very narrow slit openings and small grain sizes make this method a suitable candidate for nano-structural investigations.

Using scripts that have been developed previously, FaME38 have further created software tools, including a Graphical User Interface (GUI) which allows the rapid near-on-line data analysis. The GUI is the front-end to a range of Python scripts and has been developed bearing platform independence and portability in mind. It allows the visualisation and manipulation of large sets of EDXRD patterns, and we are continuing the development to implement a pattern-refinement software routine in order to develop dedicated user-friendly software.



A Case study

In this part of experiment, the feasibility of undertaking fast bi-directional strain measurements was tested in the real situation. We studied the effect of mechanical tensioning on Friction Stir Welds in thin aluminium sheets using the two-detector set-up in the energy dispersive mode shown in the illustration above, which measures two directions of strain (longitudinal and transverse) simultaneously. Below is shown a typical diffraction pattern as a function of energy (left), and the residual longitudinal stresses as a function of applied tension in % yield stress (right). The experiment, a collaboration between FaME38 and BAE Systems Advanced Technology Centre, Bristol, UK, was completed in less than 1 shift of beam time. The results are currently being prepared for publication.