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

Deadlines for submission of Experimental Reports

Experimental reports must be submitted within the period of 3 months after the end of the experiment.

Experiment Report supporting a new proposal ("relevant report")

If you are submitting a proposal for a new project, or to continue a project for which you have previously been allocated beam time, you must submit a report on each of your previous measurement(s):

- even on those carried out close to the proposal submission deadline (it can be a *"preliminary report"),*
- even for experiments whose scientific area is different form the scientific area of the new proposal,
- carried out on CRG beamlines.

You must then register the report(s) as "relevant report(s)" in the new application form for beam time.

Deadlines for submitting a report supporting a new proposal

- 1st March Proposal Round - **5th March**
- 10th September Proposal Round - **13th September**

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.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the experiment number 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:** EASI-STRESS Benchmark and validation	**Experiment number**: ME/1592
Beamline: ID15A	**Date of experiment**: from: 12 Jul 2022 to: 19 July 2022	**Date of report**: 12 September
Shifts: 21	**Local contact(s)**: Mohamed Fares Slim	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Wen Cui*, Henry Royce Institute, Department of Materials, University of Manchester
Philip J Withers, Henry Royce Institute, Department of Materials, University of Manchester
Matthew J Roy, School of Mechanical, Civil and Aerospace Engineering, University of Manchester

Report:

The experiment was conducted at high energy synchrotron beamline ID15A, experimental hutch EH2 (materials engineering) with energy dispersive diffraction (EDD) setup. White beam with an effective energy up to 300 KeV was employed. The beam is sized and shaped in both horizontal and vertical directions by two slits, resulting in a diamond-shaped gauge volume of $0.15\times0.15\times2.7mm^3$. Samples were measured in a Debye-Scherrer geometry, under transmission mode, with data acquired using two solid state Ge detectors sitting in the vertical and horizontal directions. The diffraction angle and the energy were respectively calibrated using a standard powder and a radioactive source prior to the experiment. A Eulerian cradle was used to orientate the sample into different orientations.

A selection of ferrite or austenitic steel benchmark specimens with pre-introduced residual stresses and various stress-free reference samples were measured to capture the strain distrubition across key locations at each componenet. Strain were captured at three or more directions in order to facilitate furthre stress calculation. Results will be translated into stress using Hook's Law and be compared with results obtained from other residual stress measurmenet techniques for benchmark purpose.

Preliminary results suggest that the stress values relies on the accuracy of d0 values, which seem to vary at different locations or directioins. Hence, advanced data analysis employing different d0 values at different locations for stress calculation is essential. The stress distribution determined from the synchrotron technique will be compared with results to be obtained from neutron diffraction, as well as from popular lab techniques including laboratory XRD diffraction, hole drilling and contour method. Currently we are planning on these expeirments and analysing results from different techniques.

At least one publicatioin is expected to be written based on results obtained from this expeirment, and the outcome will be used to guide both industries and academics in determining the best practices for residual stress measurement.