EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

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: 3D Eigenstrain Reconstruction of Residual Stresses Using the Strain Tomography Technique in Laser Powder Bed Fusion Printed Bodies**	**Experiment number**: MA-5208
Beamline: ID15A	**Date of experiment**: from: 30 April 2022 to: 04 May 2022	**Date of report**: 30 July 2022
Shifts: 10	**Local contact(s)**: SLIM Mohamed	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

UZUN Fatih, The University of Oxford

LIOGAS Kostas, The University of Oxford

WANG Zifan, The University of Oxford

BESNARD Cyril, The University of Oxford

Report:

The finished experiment aimed to use diffraction data for strain tomography technique that provide 2D planar distribution of residual strains. The experiment was completed successfully and the collected diffraction data has been used for mapping planar distribution of residual strains form 5 planes that are called as top, top middle, middle, bottom middle and bottom. This arrangement of planes cover the whole volume of 30 mm tower shaped sample with a step size of 7.5 mm. An example illustration of distribution of calculated residual strains is given in Figure 1. The high quality of experimental data allowed allowed determination of boundaries of rectangular body accurately and distributon of residual strain show tensile strains in the central parts as it is expected.

The result of strain tomography calculations are being used for eigenstrain reconstruction residual strains in the whole volume that include planes that were not scanned for maping strain distribution. Currently, the eigenstrain model has been modified for 3D eigenstrain reconstruction and a very good match between strains calculated by strain tomography technique and reconstructed by eigenstrain reconstruction is achieved.

The reliability of 3D eigenstrain model has been analysed using numerical experiments. The results of these tests will be presented with strain tomography calculations and the recostruction of residual strains in the rectangular additively manufactured specimen. This novel approach that aims the non-destructive and 3D reconstruction of residual strains is planned to be published in high impact journals. The corresponding manuscript is being prepared.

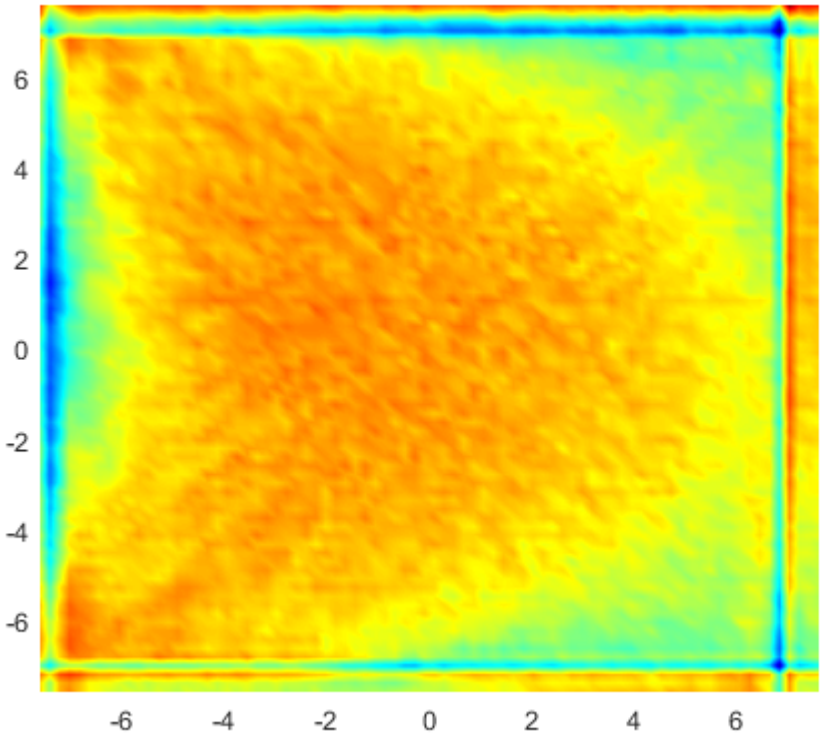

Figure 1. The illustraion of distributon of residual strains calculated by using strain tomography technique.