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:** Synchrotron Nano-Tomography Characterization of Nanoparticle-Induced Pore Elimination in Laser Additive Manufacturing	**Experiment number**: ME-1640
Beamline: ID16B	**Date of experiment**: from: 13 June 2023 to: 15 June 2023	**Date of report**: 18 September 2023
Shifts: 6	**Local contact(s)**: Julie Villanova (email: julie.villanova@esrf.fr) Olga Stamati (email: olga.stamati@esrf.fr)	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Lianghua Xiong, Shanghai Jiao Tong University (Remote)

Shanzhi Tang, Institute of High Energy Physics (Onsite)

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Bingbing Zhang, Institute of High Energy Physics (Onsite)

Report:

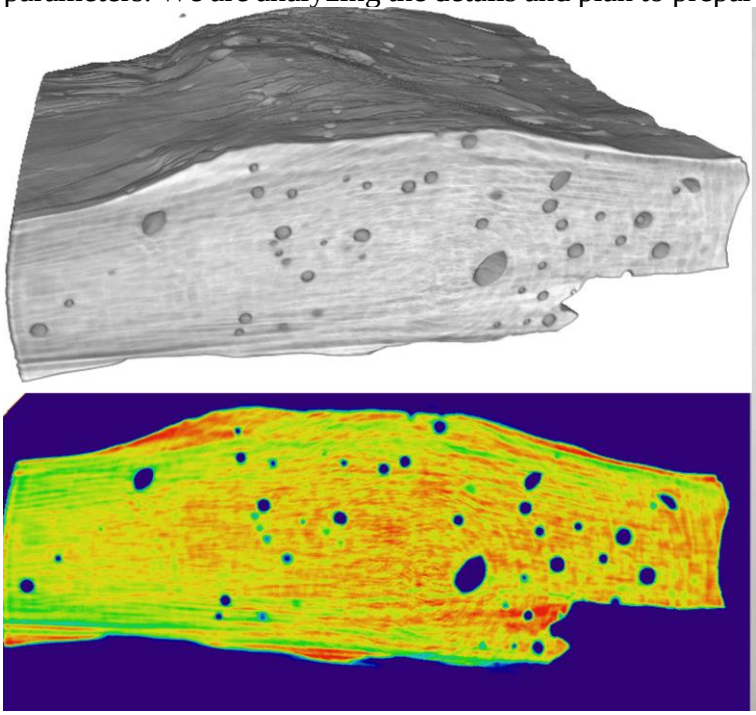
Laser additive manufacturing of Nickel-based superalloys three-dimensionally prints customized and complex geometries layer-by-layer, but greatly suffers from the solidification cracking during repeatedly melting and solidifying. Ceramic nanoparticles introduced into metal matrices provide an intriguing route to solve cracking issue; however, the mechanism of nanoparticles with a dense uniform dispersion remains unknown. Here, we propose to apply high-energy nano-tomography to 3D characterize the dispersed nanoparticles in metal matrices. The effect of processing parameters of laser AM process on the nanoparticle dispersion will be explored. The deformation behavior of metal-nanoparticle composites will be investigated. Consequently, the mechanism of nanoparticle dispersion will be revealed and provide guidelines for processing optimization and improvement.

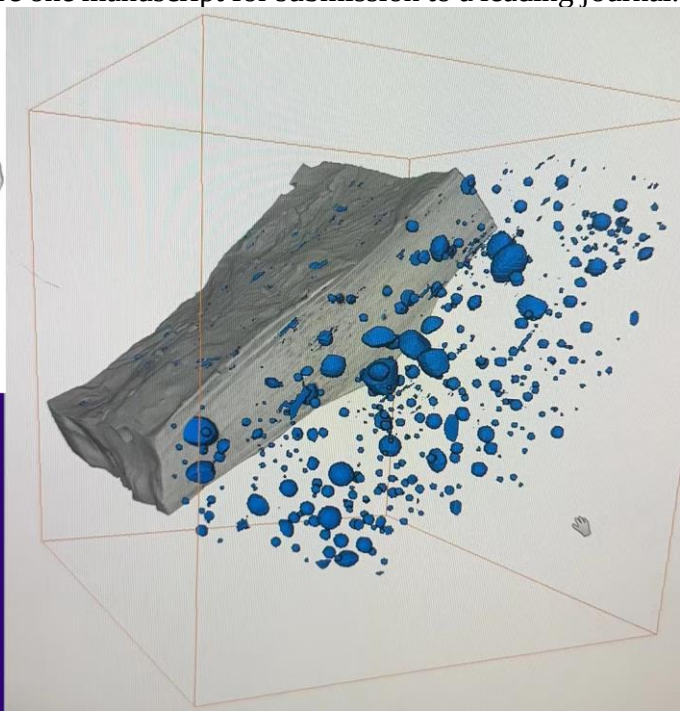
For this experiment, we have tested two types of samples as follows: HEO with/without high pressure treatment; ZrCuAgAl with/without high pressure tortion treatment.

Sample	Nano-CT	Micro-XRF	3D XRD
1. HEO-4C-HP			
2. HEO-4C-as-cast-1	Yes	Yes	Yes
3. HEO-4C-as-cast-2	Backup		
4. ZrCuAgAl-as-cast	Yes		
5. ZrCuAgAl-as-cast-backup	Backup		
6. ZrCuAgAl-HPT	Yes		

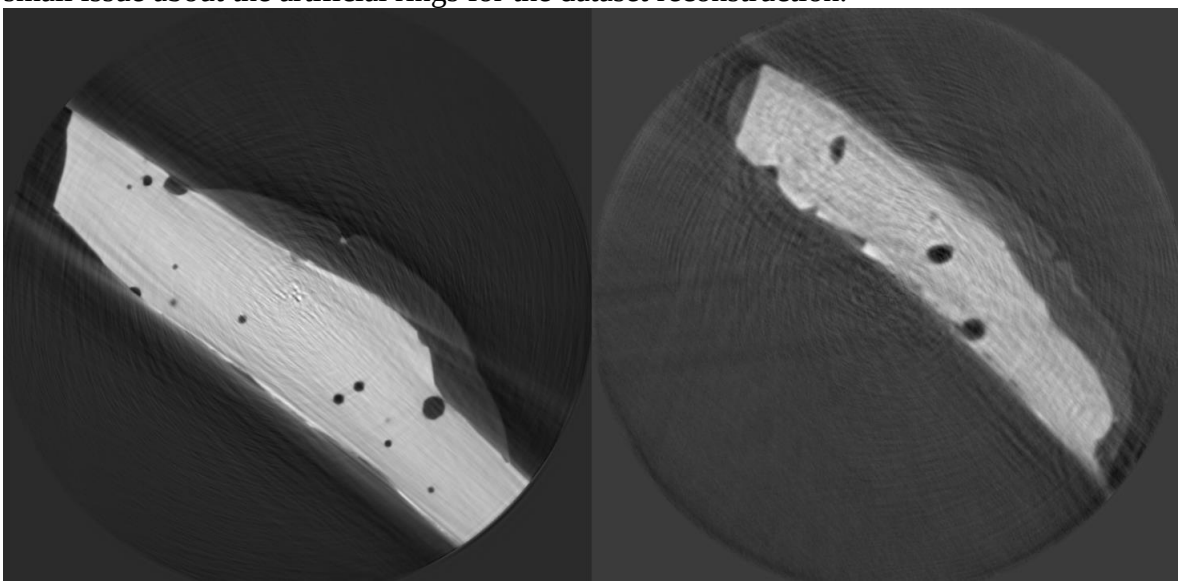
We have done the nano-CT measurements. Thanks to the extreme bright and high-quality beam, the measurements were very successful and we have obtained high-quality datasets of our measured samples. For the 25 nanometer spatial resolution, we can clearly observe the internal structure of our measured samples. There

are different fine structure, like the distribution and size and morphology of internal defects due to the processing parameters. We are analyzing the details and plan to prepare one manuscript for submission to a leading journal.





But we have these samples left for microXANES and microXRD measurements. If we continue finishing these measurements, the atomic-level microstructure-property correlation could be obtained. There is one small issue about the artificial rings for the dataset reconstruction.



We plan to resolve this issue in the next-round beamtime experiments at the delicate beamtime.