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:** Nanoimaging of pellistors on extended length scale with multi-probe ptychographic tomography	**Experiment number**: MA-5733
Beamline: ID13	**Date of experiment**: from: 26.07.2023 to: 02.08.2023	**Date of report**: 11.09.2023
Shifts: 18	**Local contact(s)**: Manfred Burghammer	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Maik Kahnt, MAX IV

Pablo Villanueva Perez, Lund University

Runqing Yang, Lund University

Report:

Preliminary Results:

Multi-beam ptychography (MBP) is, for the first time, implemented at ID-13, ESRF. The experimental setup is integrated into the hutch on machine day (Fig 1. a). We characterize the lens array (Fig 1. b) with Siemens star, and the focal spot for a single lens array can achieve 265nm(V) x 310nm(H), as Fig 2 shows.

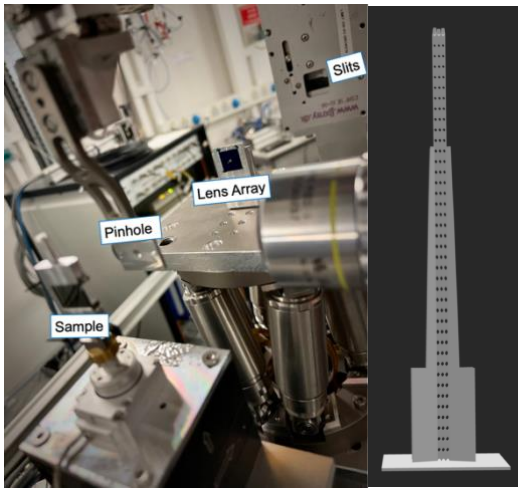

Fig 1. a) Experimental Setup; b) Lens Array

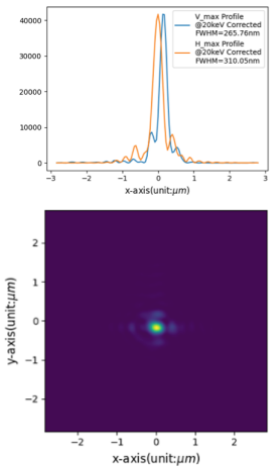

Fig 2. Focal spots of the single lens array without phase plate

This experiment aims to unravel the 3D structure of Rh-based ceramic pellistors using MBP tomography. However, because of the detector saturation problem, we had to attenuate the beam and use multiple exposures at a single scan position. This increased each projection's time to approximately 30 min (7427 steps). Because of this, it was not feasible to collect a full tomogram dataset with 1309 projections, which would take 27 shifts.

Therefore, we collected a projection of the pellistor and checked experimental conditions for other 2D samples with the sub-mm field of view.

We successfully reconstructed several 2D samples (e.g., Pellistor, Siemens star, Microchip, gold particles on Si3N4 membrane) during the beamtime with 3x2 and 3x4 beams. Fig. 3 shows the reconstructed phase of the Siemens star with 3x2 beams. Fig. 4 shows the reconstructed gold particles on the Si_3N_4 membrane with 3x4 beams. Each scan covers a 130 μm x 100 μm area with 0.1s exposure time.

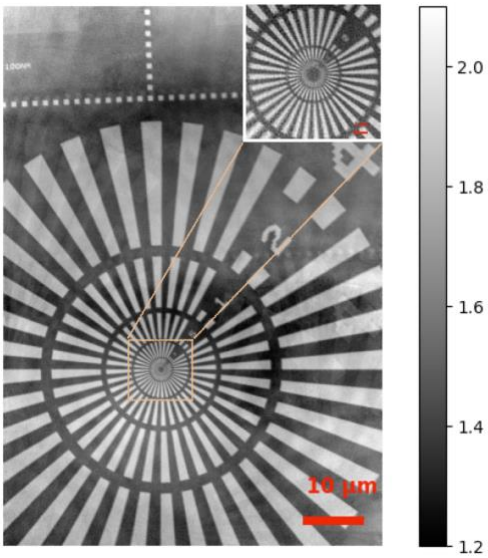

Fig 3. Reconstructed Siemens Star with 2x3 beams

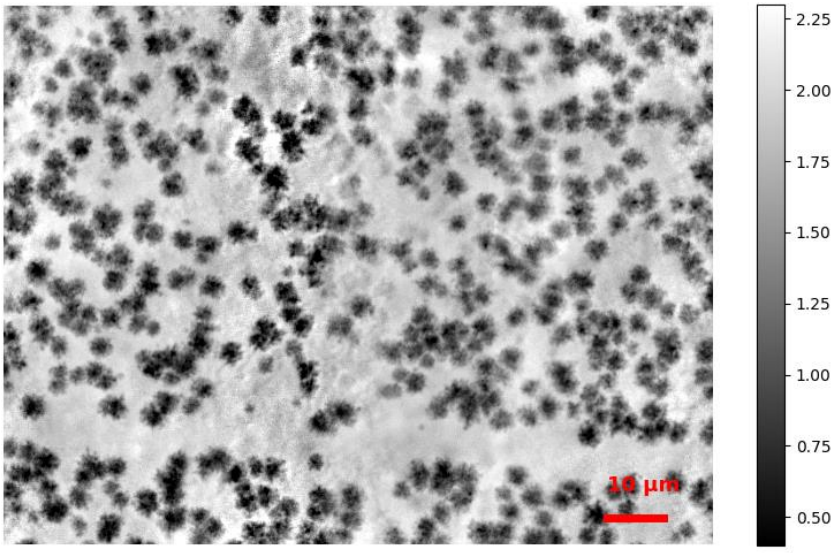

Fig 4. Reconstructed gold particles on the Si_3N_4 membrane with 3x4 beams

Conclusion:

Thanks to Manfred and ID13 beamline scientists' help, we successfully integrated the MBP setup at ID13 and for the first time performed MBP with unprecedented energy of 20 with a 3x4 lens array. However, we did not reach the main goal due to the increased time needed per projection, due to technical difficulty with detector acquisition. All in all, according to our reconstruction result, MBP offers a great opportunity to increase sample size and to speed up scan acquisition in hard X-ray nano-tomography.