3rd International Conference on Tomography of Materials and Structures
Lund, Sweden, 26-30 June 2017, ICTMS2017-183

STATUS OF THE TOMOGRAPHY BEAMLINE ANATOMIX AT SYNCHROTRON SOLEIL

M. Scheel[1], J.-L. Giorgetta[1], V. Le Roux[1], V. Joyet[1], S. Chaouchi[1], G. Cauchon[1] & T. Weitkamp[1]

[1] Synchrotron SOLEIL, L'Orme des Merisiers, Saint-Aubin, B.P. 48, 91192 Gif-sur-Yvette, France

Keywords: x-ray nanotomography, x-ray microscopy, x-ray phase contrast imaging, in-situ, beamline

Summary: ANATOMIX is a 200-m-long undulator beamline for full-field tomography techniques in the energy range between 5 and 25 keV. It is currently under construction at Synchrotron SOLEIL, the French national light source in the greater Paris region.

1. INTRODUCTION

To complement existing synchrotron tomography facilities in Europe and elsewhere in the world, Synchrotron SOLEIL, the national French synchrotron light source, is building a new undulator beamline named *ANATOMIX* [1], fully dedicated to radiographic techniques, in the photon energy range from 5 to approximately 25 keV. The beamline design is optimized for high spatial resolution and high sensitivity to small density variations in the sample. Acquisition rates of up to 1 tomography scan per second are envisioned for the fastest experiments.

A consortium of 17 research teams representing user communities from the fields of advanced materials, biomaterials and biomedical research has been accompanying the beamline construction from the beginning.

2. TECHNICAL ASPECTS

To obtain a sufficiently large and coherent X-ray beam, *ANATOMIX* is a long beamline (200 m). Its source is an undulator located in a straight section of the SOLEIL storage ring that it shares with the undulator of another beamline, the scanning nanoprobe *Nanoscopium*. The X-ray beams of both beamlines are separated by only several milliradians, which implies that both beamlines have a common front end, share the floor space along the beam path and are subjected to a number of other constraints. The advantage is that a single extension building (Figure 1b) can host both beamlines.

ANATOMIX will feature experimental end stations both for parallel-beam micro-tomography (with a beam width of up to at least 40 mm) and for zone-plate transmission X-ray microscopy (down to pixel sizes of 30 nm). X-ray beam-conditioning optics of different types can be used alternatively to optimize the beam to the needs of the experiment, both spectrally and geometrically. Thus, a horizontally-focusing mirror can be used to obtain a particularly wide beam at the sample positions. On the other hand, the beam can be collimated using refractive lenses. The beamline design gives access to different spectral modes including the direct white beam and monochromatization with a double-crystal monochromator (Si-111) or a multilayer monochromator.

The experimental stations will be located in two separate experimental radiation safety hutches (EH3 and EH4, Figure 1a), located one after the other (i.e., in series), at distances from the source of, respectively, 170 and 200 m. Parallel-beam microtomography will be available in each of the two hutches; EH3 will host the X-ray optics and sample environment for the zone-plate transmission X-ray microscope (TXM).

3. CURRENT STATUS

As of early 2017, part of the beam-steering optics in the optics hutches are installed and commissioned. Delivery of the monochromators is scheduled for the second half of 2017. The equipment in the experimental stations is partly in the manufacturing phase, partly under design. The microtomography sample stages are scheduled to be delivered in fall 2017. Different detector optics based on indirect detection (scintillator/lens-based) have been designed in-house at

SOLEIL and are awaiting fabrication. These optics will be used with at least three different digital detectors purchased for different use cases.

The X-ray beam has been observed in all optics hutches and in EH3, the first experimental hutch. The beam transfer line linking EH3 to EH4 remains to be built.

The final X-ray source, a cryogenically-cooled U18 undulator, is currently under construction and scheduled for installation in January 2018. A temporary U20 (non-cryo) undulator is used for commissioning of the beamline while the U18 is not yet available.

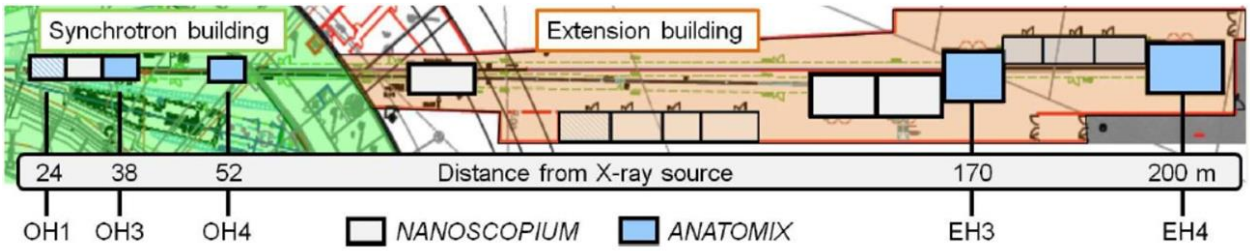
The beamline is expected to enter into user operation in 2018.

Acknowledgments

The construction of ANATOMIX is largely funded by the French National Research Agency (ANR) through the EQUIPEX investment program, project "NanoimagesX", grant no. ANR-11-EQPX-0031. The consortium comprises 17 partner units from public research and industry.

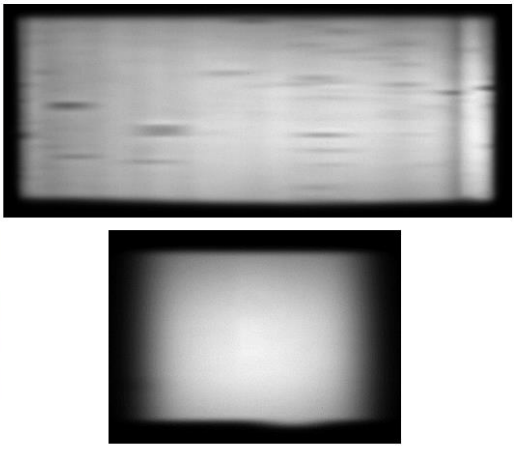
References

[1] T. Weitkamp, M. Scheel, J.-L. Giorgetta, V. Joyet, V. Le Roux, G. Cauchon, T. Moreno, F. Polack, A. Thompson & J.-P. Samama, The tomography beamline ANATOMIX at Synchrotron SOLEIL, *Journal of Physics: Conference Series*, Proceedings of the 13th International Conference on X-Ray Microscopy (XRM 2016), 15–19 August 2016, Oxford, UK, in press.



(a)

(b)



(c)

Figure 1: (a) Floor plan of ANATOMIX and its neighbor beamline *Nanoscopium*. Hutches are numbered jointly with Nanoscopium. (b) Aerial view of SOLEIL with satellite building for ANATOMIX and Nanoscopium on the lower right. (c) First X-ray beam in experimental hutch EH3, September 2016. Top: wide beam (> 40 mm) reflected by mirror. Bottom: white beam of size 20 mm (horizontal) by 15 mm (vertical).