MICRO-COMPUTED TOMOGRAPHY (MCT): A BR–GHT NEW X-RAY BEAMLINE

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Summary: The Micro-Computed Tomography (MCT) beamline is currently being built at the Australian Synchrotron. This presentation will describe the capabilities, current status and future plans for this exciting new research facility.

1. INTRODUCTION

Micro-Computed Tomography (MCT) has been announced as one of the first two new beamlines to be constructed at the Australian Synchrotron as part of the BR–GHT program. The Australian Synchrotron is a key piece of national research infrastructure, operated by ANSTO, and currently with 10 operational beamlines. The BR–GHT program encompasses 8 new beamlines to be constructed over a 7 year period. MCT will complement the existing X-ray tomography capability provided by the Imaging and Medical Beamline (IMBL), and will target applications requiring higher (sub-micron) spatial resolution and involving commensurately smaller samples.

2. EXPERIMENTAL METHOD

MCT will be a bending-magnet beamline (length ~35 m) operating in the 8 to 40 keV range, based on a double-multilayer monochromator. This monochromator will be able to be removed from the X-ray beam path, enabling studies with a filtered white beam when required. A single-bounce mirror with Rh and Pt stripes will also be included in the photon-delivery system to provide for harmonic rejection in the monochromatic-beam case, and as a means of shaping the filtered white beam on the high-energy side. This mirror will be capable of operation in flat or bent (concave or convex) modes. MCT will be capable of employing various phase-contrast modalities (such as propagation-based) in addition to conventional absorption contrast, and be equipped with a robotic stage for rapid sample exchange. A number of sample environmental stages, such as for high temperature or the application of loads, will be available.

Anticipated application areas for non-destructive three-dimensional sample characterisation include biomedical/ health science, food and soft matter, energy and environment, manufacturing and materials science, and paleontology.

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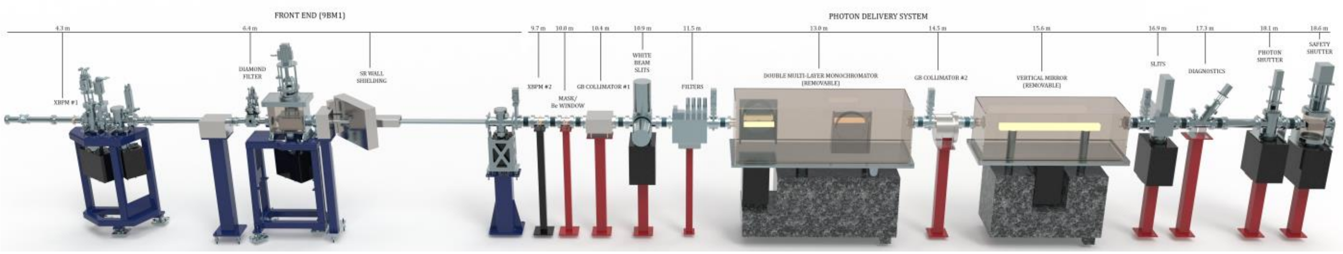
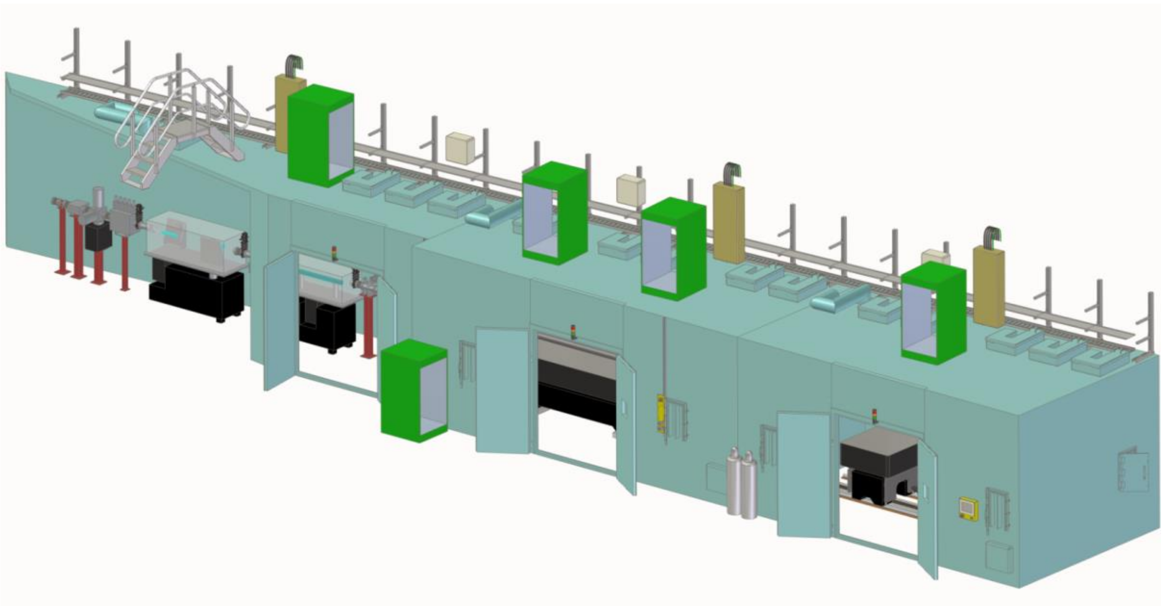
3. RESULTS

The design, procurement, installation and commissioning phases of the MCT build have a four-year schedule, with the official user program to begin on 1st July 2021. The contract for the double-multilayer monochromator has been finalised. This monochromator will have three multilayer stripes on each optic: Ru/C for operation in the 8 to 23 keV range with ~3% energy bandpass; W/Si for the 22 to 40 keV range with ~3% bandpass; V/B_4C for 8 to 25 keV with ~0.5% bandpass. The final, narrow bandpass, stripe is primarily for use with Fresnel zone-plate optics to achieve even higher spatial resolution, with concomitant smaller field-of-view.

Details of design spatial resolutions, contrast, frame rates, fields-of-view, and so on, for different imaging modalities will be presented. Data-collection strategies and pipelines for data processing, reconstruction, segmentation, visualisation and analysis via high-performance computing facilities will be discussed.



(a)



(b)

Figure 1: (a) Rendered view of MCT beamline front-end and photon-delivery system. (b) Rendered view of the three MCT hutches, photon-delivery system and 2 experimental stations, centred at approximately 14 m, 24 m and 31 m from the source respectively.