Broadband X-ray Nanotomography Imaging at the Coherent X-ray Scattering Beamline Cateretê of the Brazilian Synchrotron Facility SIRIUS

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The novel 4th generation synchrotron facilities and x-ray free-electron lasers are leading to the development of new X-ray methods of microscopy. Among these techniques, coherent diffractive imaging (CDI) is one of the most promising, enabling nanometre-scale imaging of non-crystallographic samples. In this contribution, we present an approach that enables coherent diffractive imaging using broadband illumination. The method is implemented at the Cateretê beamline [1] at the SIRIUS 4th generation synchrotron source based multibend achromat lattice [2]. Experimental validations using broadband hard X-ray radiation on zeolites and polymeric ultrafiltration membranes show the capabilities of the technique in terms of spatial and temporal resolutions.

3D Ptychography experiments performed with broadband and monochromatic illuminations on a hollow fibre (HF) membrane allowed to access 3D nano-architecture in a 22 x 26 µm field-of view (FOV), and compare the resolutions achieved to map the porous network with 41 nm pixel size. The results demonstrate the capabilities of broadband illumination in ptychography, and its use for faster data acquisition reaching as high resolution as monochromatic illumination.

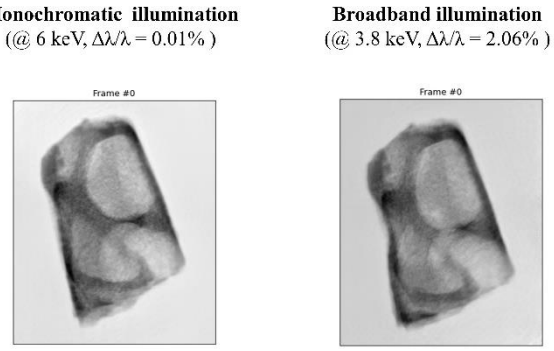

Figure 1. Comparative projections of ptychographic reconstructions of HF membrane. Performed with monochromatic illumination at 6 keV (left) and broadband illumination ("pink beam") using direct illumination from the first undulator harmonic with peak at 3.8 keV (right). Achieve FOV of 22 x 26 µm and pixel size of 41 nm.

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