X-ray Phase-Contrast Microscopy and Microtomography using a Lab-Based System

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We have developed an X-ray microscope, the XuM, based on a scanning electron microscope in which the fine focus of the electron beam is used to produce a submicron x-ray source down to 100nm in size [1,2]. This is used in a point projection imaging regime in which the sample is much closer to the x-ray source than to the detector. This geometry results in natural magnification, and, due to the small source-size and large gap between sample and detector, it also produces in-line phase-contrast.

Whereas conventional x-ray imaging relies solely on x-ray absorption, inline phase-contrast exploits the refraction of x-rays by a sample to enable imaging of non- or weakly absorbing specimens and to enhance the visibility fine features, edges and boundaries. Extending this form of imaging to microscopy and microtomography enables us to look inside a weakly-absorbing microscopic samples without cutting them physically at resolutions down to <100nm (imaging) or 1 or 2 microns (tomography).

We will show examples of microscopy and microtomography of a wide variety of specimens using this instrument. The importance of phase-retrieval in tomographic reconstruction, and methods of improving tomographic resolution will be discussed. These techniques are equally relevant to synchrotron-based applications.

Some References

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2. S.C. Mayo, T.J. Davis, T.E. Gureyev, P.R. Miller, D. Paganin, A. Pogany, A.W. Stevenson, S.W. Wilkins, Optics Express, **11,** (2003), pp. 2289-2302.

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