Polycapillary Optic for Liquid-Metal-Jet X-Ray Tubes

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The power and brightness of electron-impact micro-focus X-ray tubes have long been limited by thermal damage in the anode. This limit is overcome by the liquid-metal-jet anode (MetalJet) technology that has previously demonstrated [1] brightness in the range of one order of magnitude above current state-of-the art sources. This is possible due to the regenerative nature of this anode and the fact that the anode is already molten, which allows for significantly higher e-beam power density than a conventional solid anode.

Over the years, state of the art x-ray optics such as multilayer mirrors, polycapillary optics and monocapillary optics has been developed [2, 3]. These optics focuses the x-rays, greatly enhancing the flux density available for measurements. With the MetalJet x-ray source technology, electron spot sizes in the micro-focus regime can be achieved with very high brightness, which put high demands on the x-ray optics. In applications where a focused or collimated beam is needed, the MetalJet x-ray tube together with high quality x-ray optics open new dimensions of intensity, allowing for faster measurements and ground breaking discoveries.

This presentation will show the capabilities of polycapillary optics, when coupled with the high brightness MetalJet x-ray source. Specifically, the presentation will cover updates on the MetalJet technology, as well as measurements of focused flux, flux density, focus size, and other relevant performance measures such as the pointing accuracy of capillary optics, all as function of photon energy. These results will also be compared to what is possible to achieve with other types of optics coupled to the MetalJet source including a discussion of advantages and disadvantages.

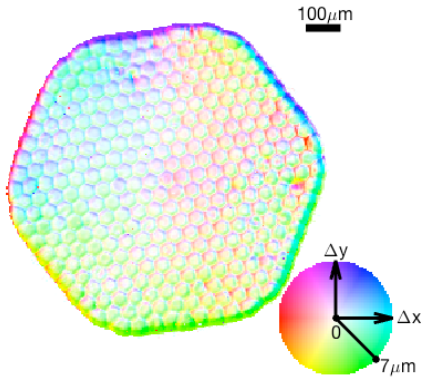

Figure 1: Capillary pointing accuracy measured with edge scans and a medipix detector. Color indicates local pointing deviation, magnitude and direction relative to focus center. Scale bar refers to positions on optic exit.

[1] O. Hemberg, M. Otendal, and H. M. Hertz, Liquid-metal-jet anode electron-impact x-ray source, Applied Physics Letter, 2003, 83, 1483.
[2] C. A. MacDonald, Focusing Polycapillary Optics and Their Applications, X-Ray Optics and Instrumentation Volume 2010 (2010), Article ID 867049, 17 pages.
[3] C. Morawe, M. Osterhoff, Hard X-Ray Focusing with Curved Reflective Multilayers, X-Ray Optics Group, Volume 2010 (2010), Article ID 479631, 8 pages.