The 18ID BioCAT microprobe for X-ray imaging, microXAFS and microdiffraction studies on biological samples

R. A. Barrea[*,1], M. Davidson[2], J. Orgel[1], T. Weng[1], E. Kondrashkina[1], D. Gore[1], R. Heurich[1], M. Vukonich[1], and T.C. Irving[1]

[1]The Biophysics Collaborative Access Team (BioCAT), Dept of Biological Chemical, and Physical Sciences, Illinois Institute of Technology, Chicago, IL, 60616

[2]University of Florida, College of Engineering, Gainesville, FL 32611-6550

Microfocus capabilities have been recently incorporated at BioCAT that allow x-ray imaging, microXAFS and microdiffraction studies on biological samples. The microprobe optics comprises a pair of platinum coated silicon KB mirrors, 4x0.5x0.2 inches. The energy range of the BioCAT microprobe is 3.5 keV up to 17 keV. Sample holder is mounted in a XYZ high precision positioner (0.1 micron). A set of fluorescent detectors: Ketek Si drift detector with polymer window for light elements detection, Fe and Zn Bent Laue analyzers and a Ge detector. A high sensitivity CCD detector designed specifically for synchrotron time–resolved applications is used for microdiffraction experiments. The combination of the x-ray microbeam and the existing fast scanning capabilities of the BioCAT beamline allow performing x-ray imaging and microXAFS measurements. The system allows measuring samples with different spatial resolutions. 100 microns, 20 microns and 3.5 microns beam sizes are commonly used.

This paper reports the commissioning results of the KB mirrors and the first results of x-ray fluorescence mapping, microXAFS and microdiffraction at the BioCAT 18ID undulator beamline. A 3.5 x 3.5 micron^2 beam at 10 keV was measured by means of a knife edge Ni thin film. Comparison of standard 2D step scans and fast continuous scans will be presented. Examples of x-ray fluorescence mapping of neurodegenerative brain tissue and microEXAFS at the Zn K edge in brain tissue will be shown. Micro x-ray diffraction experiments of fibrous collagen specimens has been performed. The setup allows to scan the sample for regions of greater crystalline areas and reduce spatial spread of reflections originating from fibrous crystallites of small dimensions (~15-50 nm) and therefore obtain a better signal to noise ratio.

* e-mail: barrea@bio.aps.anl.gov