ULTRA-SMALL ANGLE DIFFRACTION EXPERIMENT USING MEDIUM-LENGTH UNDULATOR BEAMLINE.

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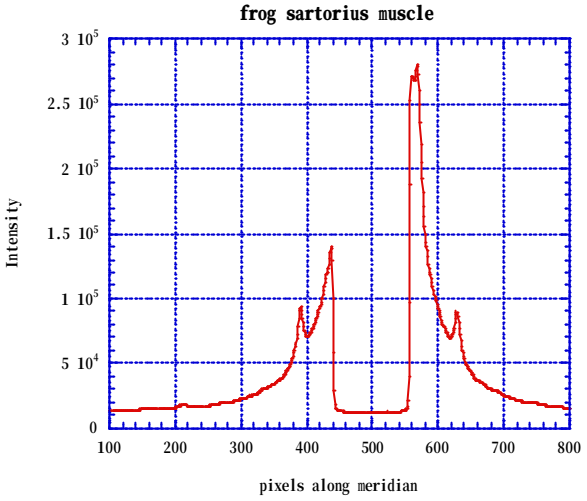
BL20XU is the so-called medium-length undulator beamline. It has two experimental hutches, at 80 m and 240 m from the x-ray source. Since there is a TC slit in the optics hutch, at 48 m from the source, by setting four-quadrant slits and a specimen in the first experimental hutch, and placing a detector in the second hutch, this beamline is potentially ideal for an ultra-small angle scattering camera. We have tried using this beamline to record diffraction and scattering in the s-range of 0.5-3 μm^{-1}.

In our experiment, the TC slit was closed to approximately 100 µm vertically, 500 µm horizontally. The slits in the first hutch (guard slits) were closed to 600 µm vertically, 1200 µm horizontally. A specimen was placed just behind the gurard slits. A 900-mm long helium pipe was placed behind the exit of a long vacuum pipe between two hutches. All windows were made of Kapton. The helium pipe had a beam stop on its downstream window. The height of the beam stop was 10 mm. The x-ray detector was an x-ray image intensifier (Hamamatsu V7739P), which was lens-coupled to a cooled CCD camera (Hamamatsu C4880-50-24A).

A diffraction pattern from a frog sartorius muscle was recorded in a 0.5-sec exposure. The first-order reflection from its sarcomere structure was found close to the edge of the beam stop (at about 0.5 μm^{-1}). The second-order reflection was also strong,



while the 3rd and 4th reflections were weaker than the 5th.

We also studied diffraction and scattering from other various specimens. A wet rat tail tendon gave an equatorial peak at about 2 μm^{-1}, which is interpreted to be a mean distance between microfibrils.

Although the two sets of slits, one in the optics hutch and the other in the hutch 1, worked fine to ensure the small-angle resolution, the guard slits were closed vertically only to about 600 µm because there was weak scatter around the main beam. Also, the apparent vertical beam size at the specimen was larger than the true size because of the vibration of the beam. These factors limited the low-angle resolution to about 2.5 µm. The intensity is more than 100 times higher than in BL20B2 where previous ultra-small angle diffraction experiments were made (1999B0141).