Tests of the Small-angle Beamline for X-ray Diffraction Experiments on Skeletal Muscles.

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BL45XU is a RIKEN beamline for structural biology and its branch A is a small-angle scattering/diffraction station. X-rays from an undulator (3.7 cm period, 40 poles) are monochromatized by two diamond crystals. The X-ray beam is focused by horizontal and vertical bent mirrors. We made the first experiments to record X-ray diffraction patterns from skeletal muscle specimens using this station. As the X-ray diffraction patterns from skeletal muscles have been studied extensively using X-rays from laboratory X-ray sources and synchrotron radiation, they are one of the best specimen to evaluate the quality of an X-ray beam.

The first specimen employed for the test was a whole sartorius muscle from bullfrog. A 10-sec exposure on an imaging plate gave an intense, detailed diffraction pattern extending well beyond 1/4 nm^{-1}. The small focus (about 0.3 mm vertically, 0.5 mm horizontally) allowed us to observe many fine peaks along the meridian.

Using an X-ray image intensifier (Hamamatsu Photonics, V5445P) with a cooled CCD camera (C4880-17) with 1000×1018 pixels, a diffraction pattern was recorded in 30 msec. Reflections down to the 5.1-nm actin layer-line were be observed. The equatorial (1,0) and (1,1) reflections were recorded in a 5-msec exposure.

The second specimen was a single skinned fiber from a sartorius muscle of bullfrog (diameter 0.10-0.15 mm). A diffraction pattern was recorded using the X-ray image intensifier and the cooled CCD camera. In a 12-sec exposure, layer-lines down to the 5.1-nm actin layer-line were recorded.

These results show that BL45XU-A is an excellent small-angle station. The beam focus is smaller than that in the small-angle station (BL15A) in Photon Factory, KEK, and the flux is comparable. Thus, the flux density is higher and this makes BL45XU-A suitable for experiments on small specimens such as single muscle fibers. Since these experiments were made at the ring current of less than 20 mA, the flux in the full operation of the storage ring (100 mA) is expected to provide higher photon flux than in the present study.