MicroStrip Gaseous Chamber for Realtime X-ray Imaging Detector at RIKEN Beamline I

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We have been developing the two-dimensional MicroStrip Gaseous Chamber (MSGC) for a realtime X-ray imaging detector at RIKEN Beamline I (BL45XU) [1, 2]. As reported last year, the prototype MSGC having anode-, cathode- and back-strips with an interval of 200 μm in a detection area of 50 mm × 50 mm has succeeded in attaining the fine position resolution of about 100 μm. Based upon this result, an advanced model of MSGC with a larger detective area of 100 mm × 100 mm was newly constructed during the current year.

A fast data acquisition system has been also developed specifically for the advanced MSGC in order to carry out time-resolved X-ray imaging [3]. The 1024 signals from the anode- and back-strips are individually read out as differential ECL signals with 16 IC-boards (64 strips/board), which consists of pre-amplifiers (LeCroy-MQS104) and discriminators (LeCroy-MVL407). These signals are encoded to x- and y-position data by CPLD (Complex Programmable Logic Device) on VME boards. One X-ray event has 32 bits data size consisting of x-, y-position and timing. These data are stored as event-by-event data on a memory board (512MB maximum) through the VME-bus. The raw data are reconstructed to the two-dimensional image data by an off-line analyzer program on SunOS. Since this system is operated with a clock cycle of 10 MHz, the data taking rate could reached 3.2 Mcps. Therefore, it is possible to take time-resolved X-ray images at sub-millisecond order. For a demonstration of time-resolved experiment, transmission images of a moving metal pendant were taken with the prototype MSGC [3].

The preliminary on-beamline experiment of the new MSGC system was performed, December 1997, at the SAXS experimental station of RIKEN beamline I with the samples of collagen of chicken's tendon, frog skeletal muscle and lysozyme solution. Figure 1 shows the observed two-dimensional diffraction patterns for SAXS of collagen. The energy of incident beam was 12.4 keV and the camera length was 2.2 m.

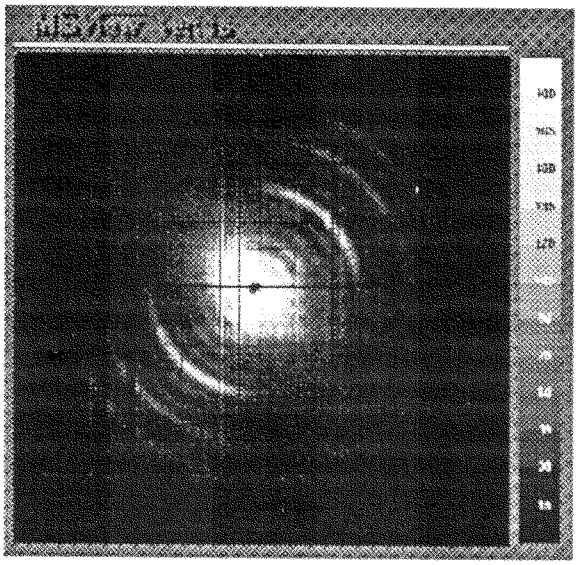

Fig. 1: Small angle diffraction pattern of collagen irradiated with 12.4 keV X-ray.

In the advanced MSGC, a transmission image of universal printed circuit board with a large number of holes was taken for a check of spatial distortion, where the diameter of holes and the pitch were 0.8 mm diameter and 0.1 inch, respectively. As a result, it was confirmed that the image distortion occurring in the new model is highly suppressed to below 0.5 % level. The spatial uniformity and time stability are under investigation.

References

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