Development of the Beam Monitors

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1. Introduction

It is necessary to precisely monitor the position and intensity of synchrotron radiation (SR) beams from an insertion device not only in SR experiments but also in operation of the 3rd generation SR sources. The beam monitor further plays important roles on the beamline as follows; a) feedback to the inter-lock system, b) independent tuning of insertion devices, and c) adjustment of exact beam axis in the experiments using the SR beam. Many kinds of beam monitors have been studied and constructed. For example, a pair of triangular photo-emission electrodes with an analogue electric arithmetic circuit to monitor the SR beam position have been applied at several facilities[1-3]. They are successfully available for the SR beams from bending magnet sources with a μm order resolution, but they are not available for the SR beams from an undulator. Thus, new type beam monitors in SPring-8 have been investigated for the beams from the insertion device. In this report, developments of two the beam monitors are shown, a wire type beam monitor and an area type beam monitor.

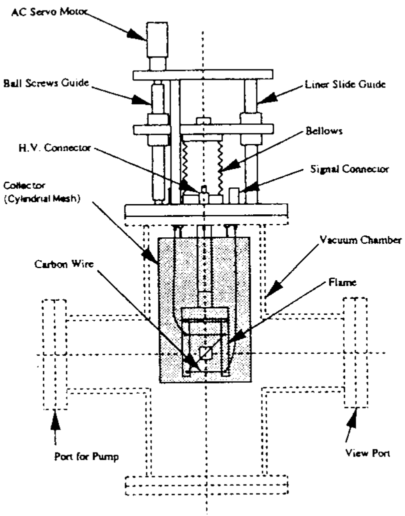

Fig. 1 A schematic illustration of the wire type beam position monitor.

2. The wire type monitor

The wire type beam monitor was designed[4] considering the following conceptions; a) monitoring the beams from the undulator, b) having excellent heat-stable, c) having no water-cooling system d) measuring of a core of the beam, and e) measuring the beam position and intensity simultaneously. We adopted a carbon wire as a probe material to fulfill the requests. Graphite is a material suitable for the wire because of the high electrical conductivity and high sublimation temperature. If the wire is made of graphite we don't need any cooling systems, and the heat load on the wire can be taken away through thermal radiation. Figure 1 shows a schematic illustration of the wire beam monitor. A graphite wire of 0.1 mm in thickness and 0.5 mm in width is fixed on the base plate of the flame with silver paste. To scan the beam profile, the frame is connected to a linear guide to move up and down with high resolution of 1 μm by a ball-screw drive with a servomotor. The wire is surrounded with a cylindrical collector made of copper mesh. Figure 2 shows the test result obtained for the beams from the x-ray undulator at 20 mm gap on AR-NE3, KEK. The bias voltage of 1000 V was applied to the collector. The FWHM of the scanned profile was 2.7 mm, which almost corresponded to a

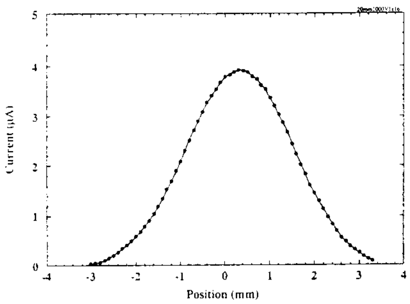

Fig. 2 Photo-electron current versus wire monitor position. The graphite wire of 0.1 mm (thickness) and 0.5 mm (width) is fixed on the base plate of the flame with silver paste.

convolution between the SR power distribution and the wire width. This indicates that the signal of the monitor was dependent on the radiation power but not on the SR spectrum.

3. The area type monitor

The blade type beam monitor was preliminary investigated for the measurement of the beam position. However, they had some problems that the variation of the beam shape according to the change of K-value of the insertion device caused a position error[5]. In order to solve the problem, we study another type of monitor, the area type beam monitor. Figure 3 shows the schematic illustration of the area type beam monitor. The monitor has a pair of graphite foils which are split horizontally or obliquely. The beam position was monitored by measuring photo-electron current occurred by photoelectric effect[6]. In this method, it was possible to remove the position error caused by the beam shape, because the photoelectric current signal corresponded to the integrated value of current occurred on each foil. Further, we examine improvement of the cooling performance by employing the high oriented graphite[7]. Figure 4 shows the result of measuring the beams from the x-ray generator, which had a copper target and operated at 50 kV and 60 mA. The monitor was located at 45 cm from the x-ray source, and the beam was collimated to 2 mm^2 with the x-y slit just before the monitor with a pair of triangular isotropic graphite foils of 0.2 mm in thickness. The maximum value of photoelectric current , as shown in Fig.4, was only 0.23 pA on the conventional x-ray generator, but it might be get several µA order in SPring-8. It found that the area type beam monitor shows wide normalized linearity aroundabout 2 mm. It is suitable for the area type

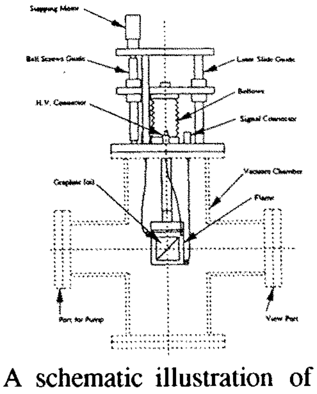

Fig. 3 A schematic illustration of the area type beam position monitor.

beam monitor to locate in the beam transfer channel or to be settled combined with the filters avoidably heat load, because of sensitivity for the background noise.

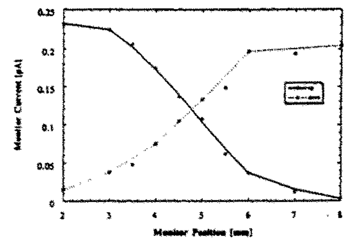

Fig. 4 Photo-electron current versus wire monitor position. The monitor was located at 45 cm from the x-ray source with a copper target and operated at 50 kV and 60 mA. The beam was cut to 2 mm^2 with the x-y slit just before the monitor with a pair of triangular isotropic graphite foils of 0.2 mm (thickness).

4. Conclusion and Discussion

We finished the initial studies of the beam monitors which can measure the beam position and intensity on the insertion device, particularly the undulator. We still have some problem to be solved as follows; 1) coherent effects, 2) background noise from the bending magnet and fringing field effects, 3) background from the front-end units and around transport vacuum chambers, 4) high heat load problem in high vacuum system and cooling system, and 5) reliability of the supports of the beam monitor

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