The Position-Sensitive Ionization Chamber for Synchrotron Radiation Experiments

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The position-sensitive ionization chamber has been developed with backgammon-type-segmented electrodes. This novel detector possesses a linear range of 8 mm over 10 mm stroke for determining the incident position of an X-ray beam. The position resolution was found to be better than 10 um, probably close to the sub-micrometer region.

The ionization currents collected on segmented electrodes can provide information on beam position and beam intensity at one time. Since an incident X-ray exponentially attenuates along its incident direction, the amount of charge generated will be a function of the position in this direction as well. Segmenting the electrode should, therefore, be performed in such a way that the ionization current measured on the segmented electrodes is only a function of the position of the incident X-ray, but is as insensitive as possible to the attenuation length.

To fulfill this condition, a zigzag-shape of segmented electrode called "backgammon-type electrode" has been implemented into an ionization chamber. The ionization chamber thus position-sensitized was examined with an X-ray beam at the BL44B2 of the SPring-8 facility.

As an immediate application of PSIC we observed the nature of the beam drift. The vertical position and the intensity of the X-ray beam transported to the beamline were continuously monitored over 60 minutes as shown in Fig. 2. It can be clearly seen in this figure that the position variation observed with the PSIC is almost identical to the ionization current observed with the ionization chamber after a collimator. This experimental observation can be regarded as evidence for the statement that the X-ray beam at the beamline is vertically moving. Also suggested in this observation was the possibility that the ultimate position resolution of the PSIC reached sub-micron level, since it succeeded in resolving the fine structure of 1 um level appearing on the curve.

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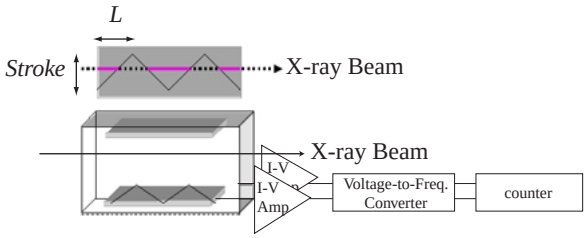

Fig. 1. Schematic Diagram of PSIC.

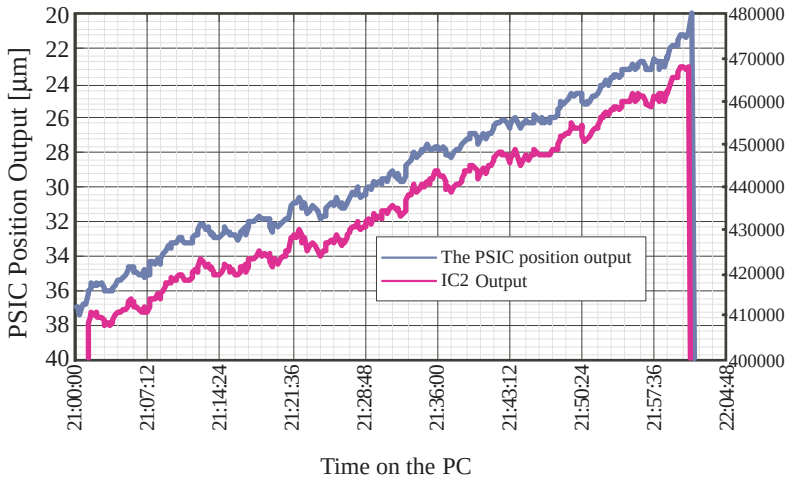

Fig. 2. Comparison of the time variance of the PSIC position and IC2 output.