

The Behavior of Ionization Chambers under the Irradiation of High Flux X-ray Beams

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Ionization chambers are widely in use as X-ray beam monitors in various synchrotron radiation experiments. When they are irradiated with high flux X-ray beams, however, the proportionality of the ionization current measured to the incident X-ray beam intensity can be degraded due to the enhanced recombination process of the electron-ion pairs generated along the incident beam. We have observed the non-linearity based on this mechanism in an ionization chamber filled with heavier rare gases such as argon, krypton, and xenon with the X-ray intensity higher than 10^{12} X-ray photons/sec at 14 keV at the BL47XU [1, 2].

One of the approaches towards this problem is to fill an ionization chamber with lighter media such as helium-mixed nitrogen gas so as to decrease the electron-ion density, thus preventing the electron-ion from recombining. We have experimentally verified that the saturation characteristics of the ionization current is superior in helium-mixed nitrogen gas to those in the heavier ones, and have searched an optimized concentration of helium in nitrogen gas in this respect [2, 3].

During the course of improving the performance and functionality of an ionization chamber further, the knowledge on the spatial

distribution of the electron-ion pairs created along the incident beam (*i.e.*, ionization profile) is considered to be fundamental information. By using an ionization chamber equipped with a segmented anode, we have succeeded in measuring the ionization profile vertically and horizontally projected onto anode plane in nitrogen gas at 1 atm [3].

In the present work, we have also demonstrated that an ionization chamber can be position-sensitized by substituting the anode with a backgammon type electrode. It is our expect that position-sensitive ionization chambers can be useful instruments in many fields of synchrotron radiation experiments, since they can monitor the position of the incident X-ray beam non-destructively.

References

- [1] K. Sato *et al.*, SPring-8 Annual Report 1997, (1997) 225.
- [2] K. Sato, Proceedings of "International Workshop on High Flux X-ray Detectors," p. 91, August 24-26, 1998, SPring-8, Hyogo, Japan.
- [3] K. Sato *et al.*, 9-Z-05, Annual Meeting of the Japanese Society for Synchrotron Radiation Research, 1999, PF/KEK, Tsukuba, Japan (to be presented).