ELECTRON BEAM PROFILE MEASUREMENTS

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Accurate and speedy measurements of electron beam profiles are very useful not only in accelerator operation but also in almost all the experiments carried out with electron beams. The technique described here makes use of an interesting relation between the size of the discolored spot of polyvinyle chroride film(PCF) and the electron charge irradiated to the film. PCFs are very cheap, flexible and easy to use. The processing and viewing time is relatively short since the observation of the profiles of perfectly discolored spots is very easy. The validity of this technique has been tested by comparing the profiles measured by this technique with those by Zener diode dosimeters or JFET dosimeters.[1,2]

In Fig.1 the horizontal diameter of the beam spot is plotted against the irradiated electron charge. The diameter was determined from the perfectly discolored profile of the beam spot.

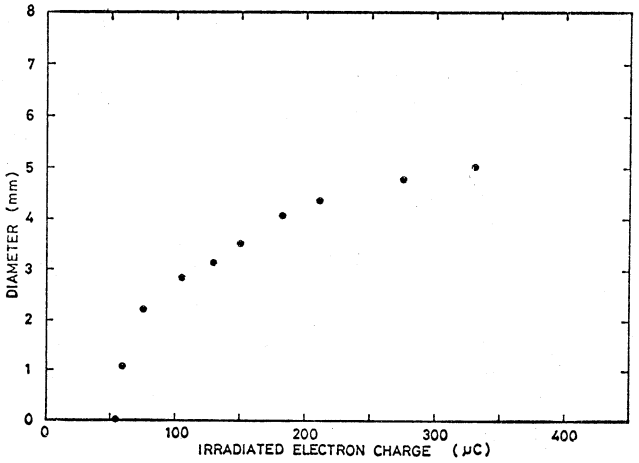

Fig.1 The diameter of the beam spot and the electron charge irradiated to polyvinyle chroride film.

For low dose irradiations, any discolored beam spot can not be observed. As the irradiated dose reaches a threshold, a perfectly discolored spot appears. In the case of 25 MeV electron beams from the 40 MeV ETL linac, the diameter of the perfectly discolored spot increases just above the threshold with increasing the irradiated electron charge. The sudden change in diameter demonstrates that the beam intensity in the center part of the beam is almost uniform. A gentle change found near 3 mm in diameter shows an average beam diameter to be near 3 mm. However, these descriptions on the beam profile are quite quantitative.

In Fig.1 we found a clear threshold dose for which the PCFs

reach the perfect discoloration. Although an irradiated dose in the center of the spot far exceeds the threshold dose, an irradiated dose at the boundary line of the perfectly discolored spot just reaches it. Using Q_0 as the threshold charge found in Fig.1 at which the perfect discolored spot appears and Q_r as an irradiated charge at which the diameter of the spot is 2r, the ratio of the beam intensity I_r at the radius R = r to the beam intensity I_0 at R = 0 can be given as Q_0/Q_r.

$$I_r/I_0 = Q_0/Q_r. \qquad (1)$$

We can obtain a relative beam intensity profile along the horizontal diameter from the data shown in Fig.1 using eq.1. The beam profile measured by this technique is shown in Fig.2 with those by Zener diode dosimeters and JFET dosimeters. Agreement of these profiles is quite good.

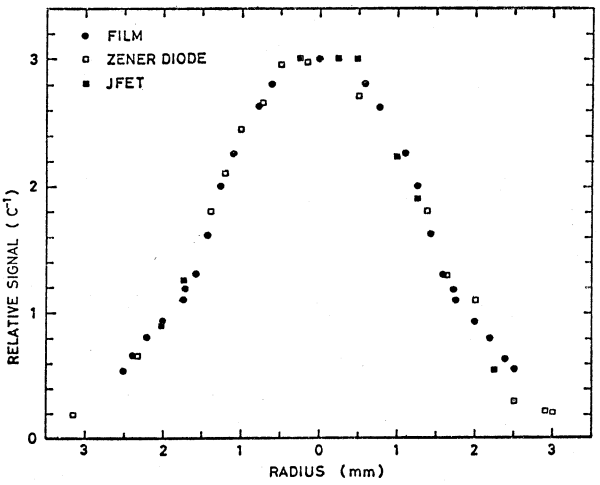

Fig.2

Beam profiles of 25 MeV electron beams measured by polyvinyle chroride films, Zener diode dosimeters and JFET dosimeters.

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1) T. Tomimasu, T. Yamazaki and T. Mikado: Rev. Sci. Instr. 48, 312 (1977)
2) T. Tomimasu and T. Yamazaki: J. Appl. Phys. 47, 1732 (1976)