A NOTE ON THE SIMPLE TECHNIQUES TO MEASURE THE UNIFORMITY OF THE BETA-RAY SOURCE DEPOSIT

Introduction :

A THIN uniform source deposit of β-emitting isotype on thin backing is always desirable for the work in β-ray spectroscopy. The purpose of using thin source on thin backing is to diminish the influence of absorption of the β-rays in the sample and the influence of back scattering. The importance of obtaining a uniformly distributed deposit lies especially in the study of low energy region where the closely spaced conversion lines are to be resolved (Mishra, R. K., 1971–72). A non-uniform source deposit results in partial absorption of the beta particles which gives rise to energy spread in the measured spectrum. Quite a uniform source deposit is obtained when it is prepared by the ion collection method (Yaffe, L. 1962). When this method seems inconvenient, the electrospraying method proves to be always useful.

This note describes some techniques to measure the uniformity of the β-ray source deposit. An indirect method of testing the uniformity of the source deposit is to compare the resolution of the conversion line emitted from the source prepared by ion collection method to that prepared by electrospraying method. The comparison of resolution of lines gives a measure of the comparative uniformity of the two source deposits. That is, if the two lines have similar resolutions, then the deposits may be equally thin and uniform, equally thin and equally non-uniform, equally thick and equally uniform or equally thick and equally non-uniform. The other method which is simple, is to collimate the β-rays and scan the source deposit in order to see if the counting rate remains constant throughout the region.

Experiments

Figure 1 shows the ThB–F conversion line measured with a prolate spheroidal field β-ray spectrometer, when the source was prepared by electrospraying method on a thin film of VYNS resin. Figure 2 shows the ThB–F conversion line when the source was deposited by ion collection from thoron on a 5 mm metallic button. The percentage resolution of the line in the former case was 0·776 ± 0·00025 at the transmission of 4% of 4π while in the latter case it was 0·86 ± 0·005. The two resolutions are comparable, which show that the source prepared by electrospraying method is as thin as in the latter case.

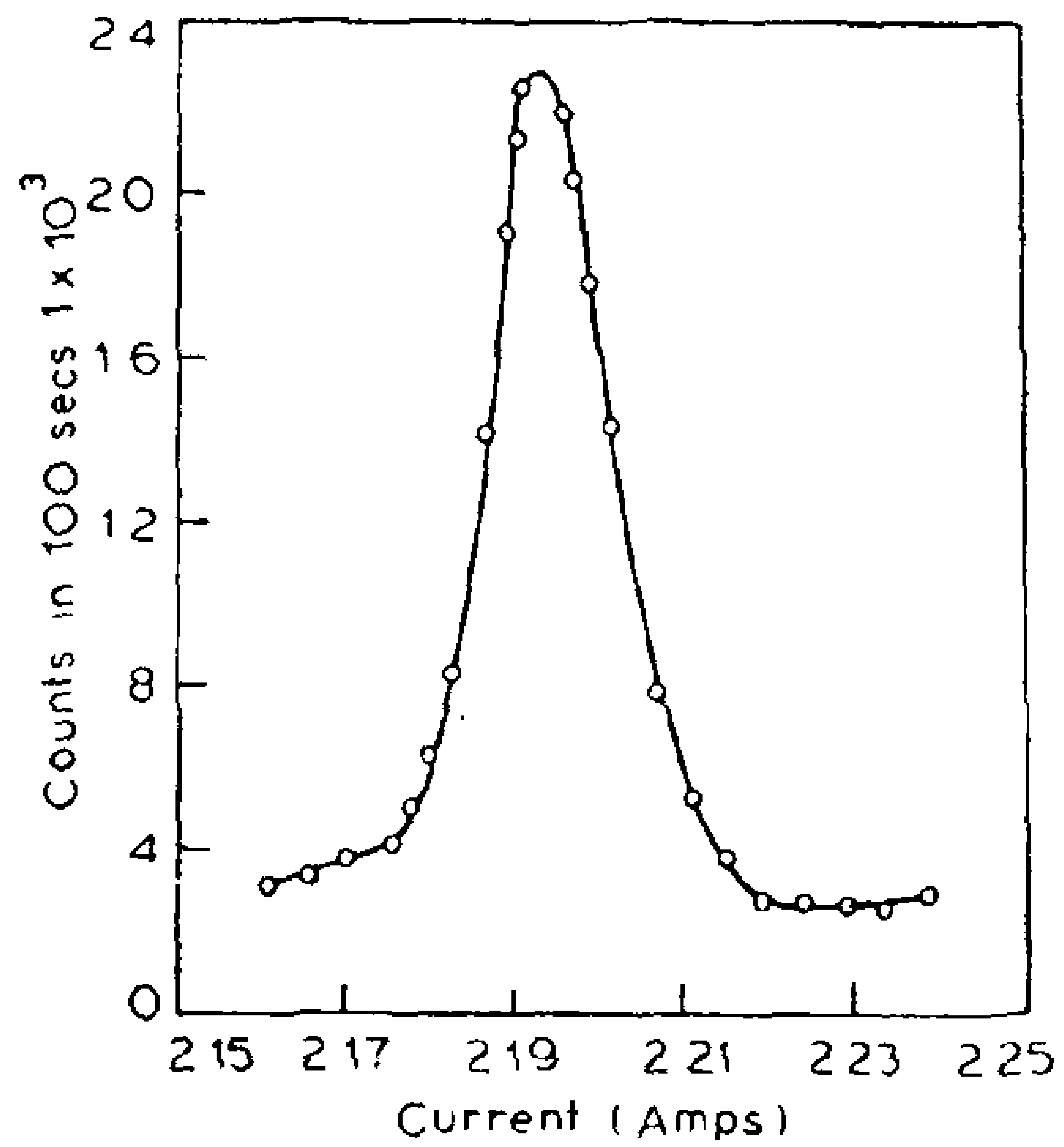

FIG. 1. The ThB–F conversion line measured with the prolate spheroidal field β-ray spectrometer. The source was prepared by electro-spraying method.

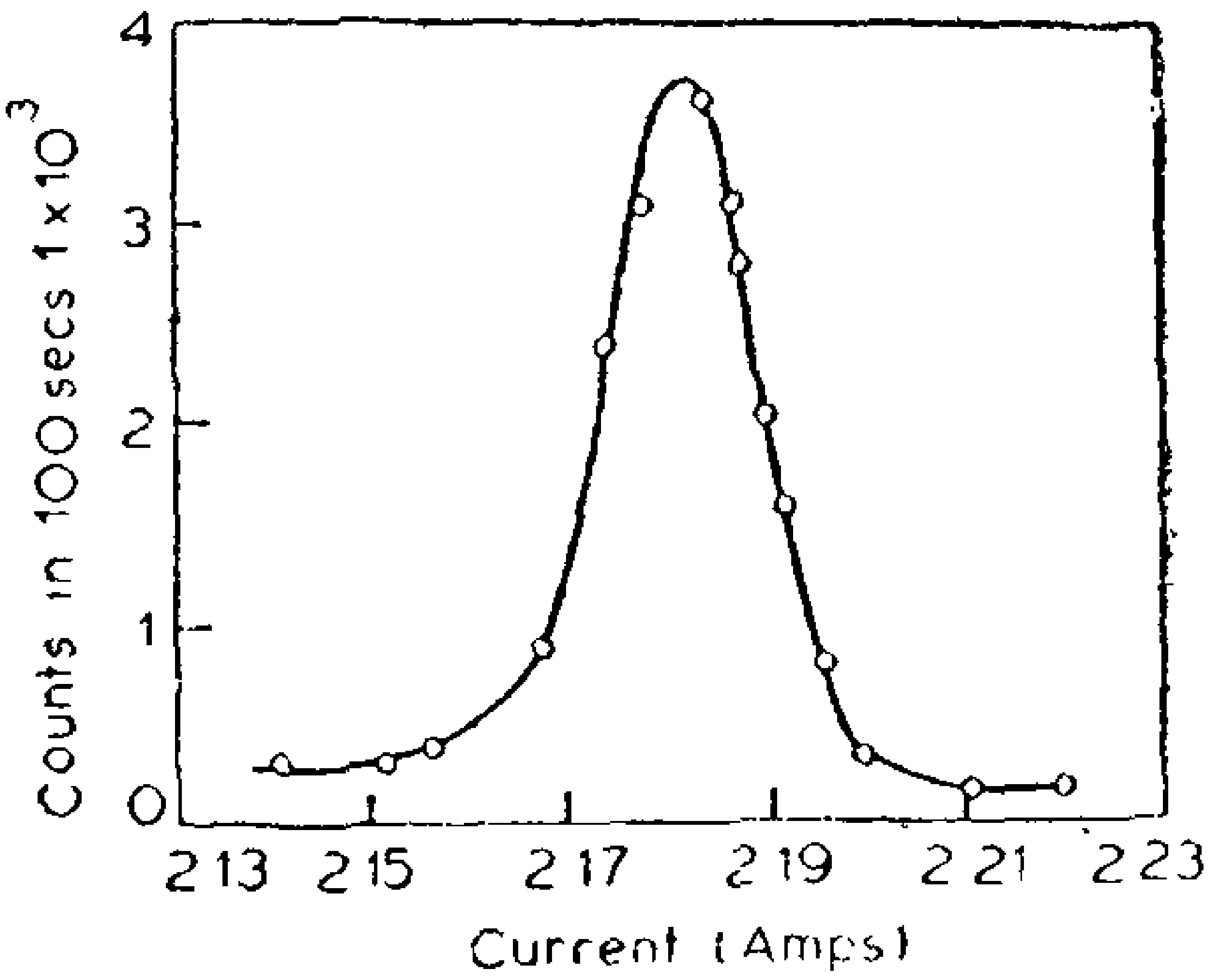

FIG. 2. The ThB–F conversion line measured with the β-ray spectrometer. The source was prepared on a metallic button of 5 mm diameter by ion collection from Thoron.

An alternative method which was applied for the uniformity test of the β-ray source deposit of ^{144}Ce is shown in Fig. 3. The arrangement consist of a photomultiplier EMI 9514B fitted with a fast plastic scinillator NE104. A lead collimator (5″ × 4″ × ½″) was placed in front of the scintillator. In order to get rid of charge collection on the lead, copper sheets of 1 mm thickness (5″ × 4″) were included which were earthed. This arrangement was done in order to improve the collimation. The number of counts from the entire region of the source deposit was scanned. The standard curve between thec ounting rate and distance has been shown in Fig. 4. The flat top of the curve explains the uniform deposit of the β-ray source. The size of the β-ray source deposit was estimated to be about 6 mm in diameter.

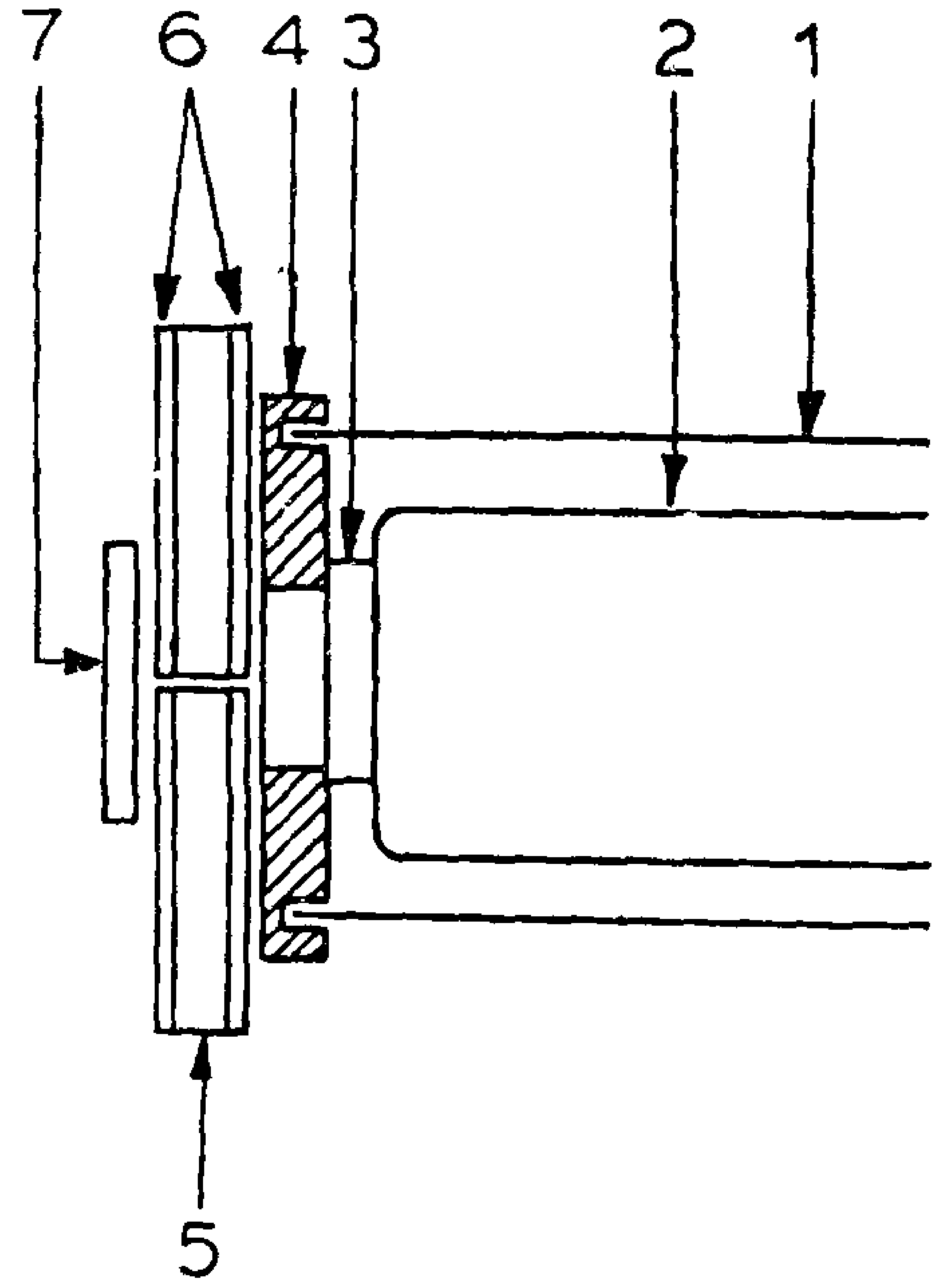

FIG. 3. Arrangement for the uniformity test of the β-ray source deposit prepared by electrospraying method. 1. Supporting brass rods, 2. Photomultiplier (EMI 9514B), 3. NE104 plastic scintillator, 4. Ebonite ring 5. Lead sheet of dimension (5″ × 4″ × ½″) and a hole of 0·5 mm diameter. 6. Copper sheets of 1 mm thickness (5″ × 4″). 7. Source deposited on the thin film fixed to aluminium ring. The ring is moved by a micrometer (not shown in the figure).

Conclusion

Both the methods are suitable to measure the uniformity of the β-ray source deposit. However, the latter method appears to be more convenient.

The author wishes thanks to Professor H. O. W. Richardson of Bedford College, London University, for his valuable discussions.

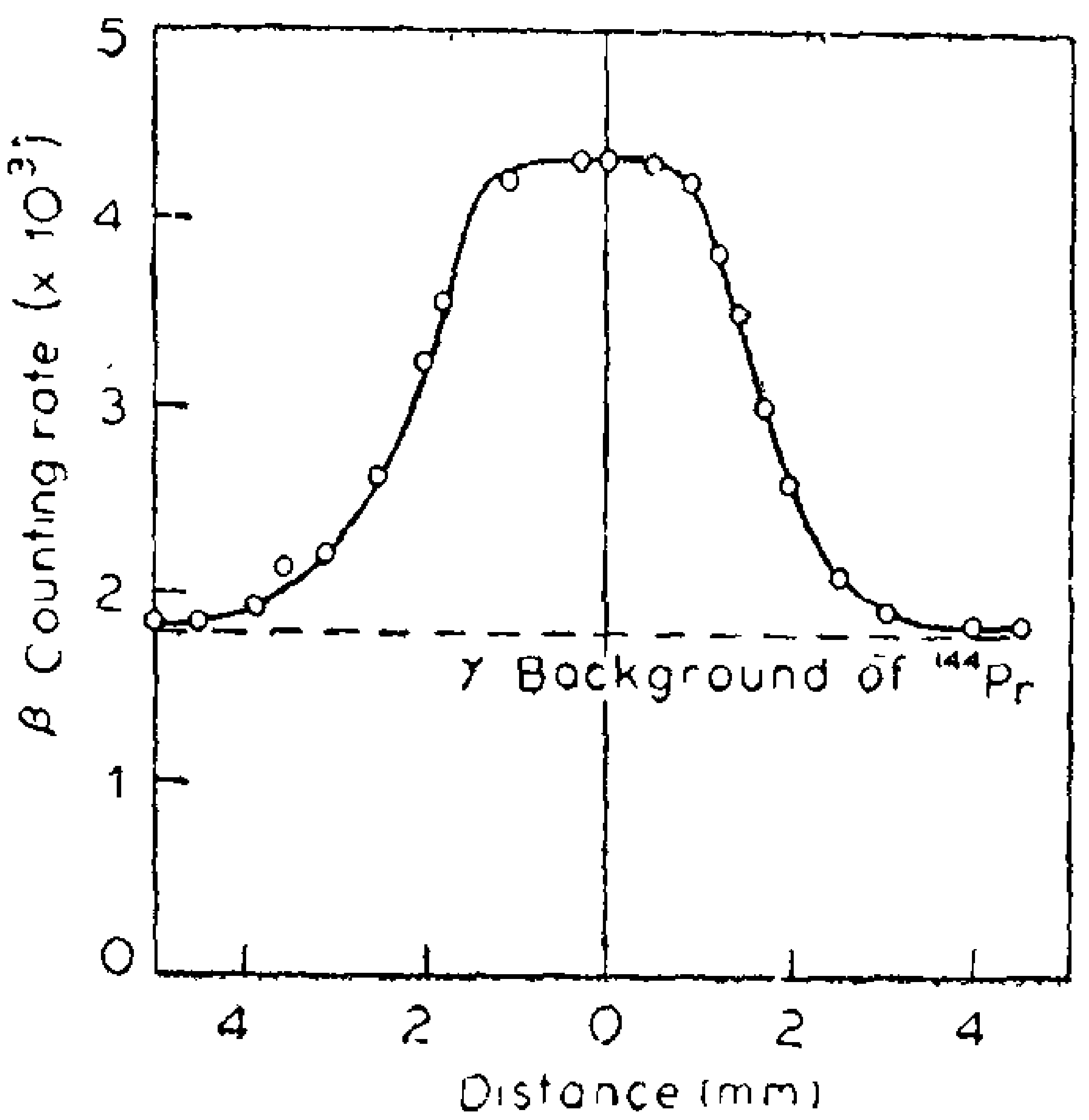

FIG. 4. Uniformity plot of ^{144}Ce source deposit.

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A POSSIBLE CAUSE OF MIDLATITUDE SPREAD-F DURING MAGNETIC STORMS

IT is widely considered that the disturbed ionospheric condition known as spread-F (appearance of diffuse echoes on ionograms) is due to partial reflections from small field aligned irregularities in F-region ionization.[1] However, following the work of King[2] in which he argued that spread-F, irrespective of latitude, is not due to partial reflections from small field aligned irregularities, but is due to total reflection from large sheets of ionization, opinions are divided in literature as to the cause of spread-F[3,4]. Recently, Nichol[5] noticed a close similarity in the occurrence of spread-F at higher midlatitudes and the formation of midlatitude inospheric trough in the Australian sector which lead him to suggest that spread-F at higher midlatitudes is due to multiple reflections off the steep ionization contours at the edges of the trough (reflection from the ionization gradients at