

## BETA GAGE FOR LOCALIZED MEASUREMENTS ON THIN FILMS

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A gage employing a narrow "pencil" of beta-rays has been developed to determine the thickness of films used as cyclotron targets. The instrument, pictured in Figure 1, allows an estimate of the evenness of films a few  $\text{mg}/\text{cm}^2$  thick by reproducibly scanning the sample with a collimated beta-ray beam  $3/32$  in. in diameter. (auth)

The beta-ray point source of  $\text{Pm}^{147}$  emitting beta rays of 0.23 Mev maximum energy was prepared according to the technique reported previously (1). Approximately 5 millicuries of promethium chloride (2, 3) was deposited carrier-free in a circle about 0.05 in. in diameter on a 0.04 in. thick Lucite disc (Figure 2A). After evaporation to dryness, the source was covered with cellophane tape and was then mounted in a  $7/8$  in thick Lucite collimator (B) with a smooth-walled central hole of  $3/32$  in. diameter. The tape separated the source from the mouth of the collimator hole. A thin Zapon film (C) of about 20 micrograms/ $\text{cm}^2$  covered the other end of the hole to prevent accumulation of dirt.

This source arrangement was supported on a wood cylinder (E) and placed inside a lead pipe (D) of  $1/8$  in. wall thickness. The assembly was then loaded into a 2 in. long brass pipe (F) and

mounted on the base plate (G) of the gage.

A 1/8 in. thick lead disc (H) with a tapered central hole of the same diameter as the collimator hole was placed atop the mounted source assembly. A microscope-type movable stage (I) mounted on the source assembly, made reproducible scanning of thin film samples possible.

A thin-window Geiger-Mueller tube (J) (Nuclear Instrument and Chemical Corp., Chicago, D 34) was suspended above the collimator hole from a sturdy support (N). The tube was connected to a commercial power supply and scaler (Model 163, Nuclear Instrument and Chemical Corp., Chicago) by a US 3B/U shielded cable. It was mounted inside a 1/8 in. thick brass pipe (K) equipped with a guide (L) to allow variation of the distance between the tube and the sample stage. A 0.04 in. thick plastic disc (M) with 1/4 in. central hole covered the tube window to collimate the accepted beam and discard beta-particles scattered in a large angle by the sample. This plastic disc served also to guard the window against mechanical injury.

A typical absorption curve (Figure 3) used to calibrate the instrument with standard aluminum absorbers indicates that the instrument is most sensitive for films up to 6 mg/cm<sup>2</sup>. In this range it is possible to discover thickness variations from point to point of less than 1/10 mg/cm<sup>2</sup>.

Employing more energetic beta-ray emitters as source materials will permit the gage to shift its most sensitive range to greater

thickness, with some loss of resolution. Narrower collimating holes and more intense sources would allow greater definition of the gaged point on the film, but competition with cosmic ray and bremsstrahlung background precludes such improvement in this direction.

The primary advantage of the gage is that it allows the measurement of film-thickness at a predetermined point with relatively great accuracy and without destruction of the sample. The gage is equally applicable in the laboratory for measurements of any thin film material.

This work was supported in part by the U. S. Atomic Energy Commission. The assistance of Mr. John Mannlein in the construction of this instrument is gratefully acknowledged.

List of References:

1. O. U. Anders, *Nucleonics* 13, No. 7, 46 (1955).
2. The promethium-147 used in this work was obtained from the Isotopes Division of the U. S. Atomic Energy Commission.
3. L. Mandel, *Brit. J. Appl. Phys.*, 5, 287 (1954).

List of Figures

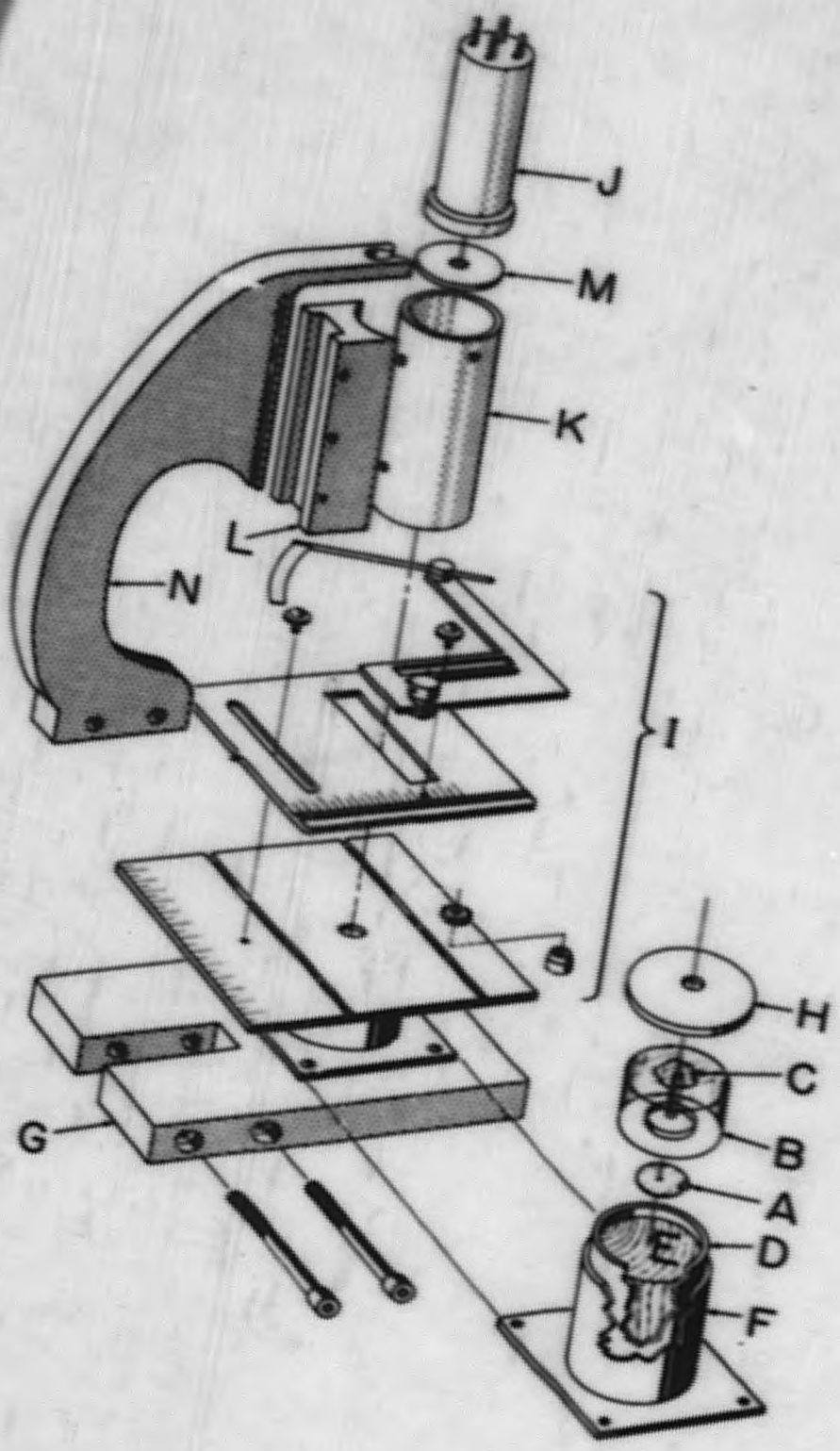
Figure 1. Beta gage.

Figure 2. Schematic diagram of gage.

Figure 3. Aluminum absorption curve of promethium-147  
beta rays.

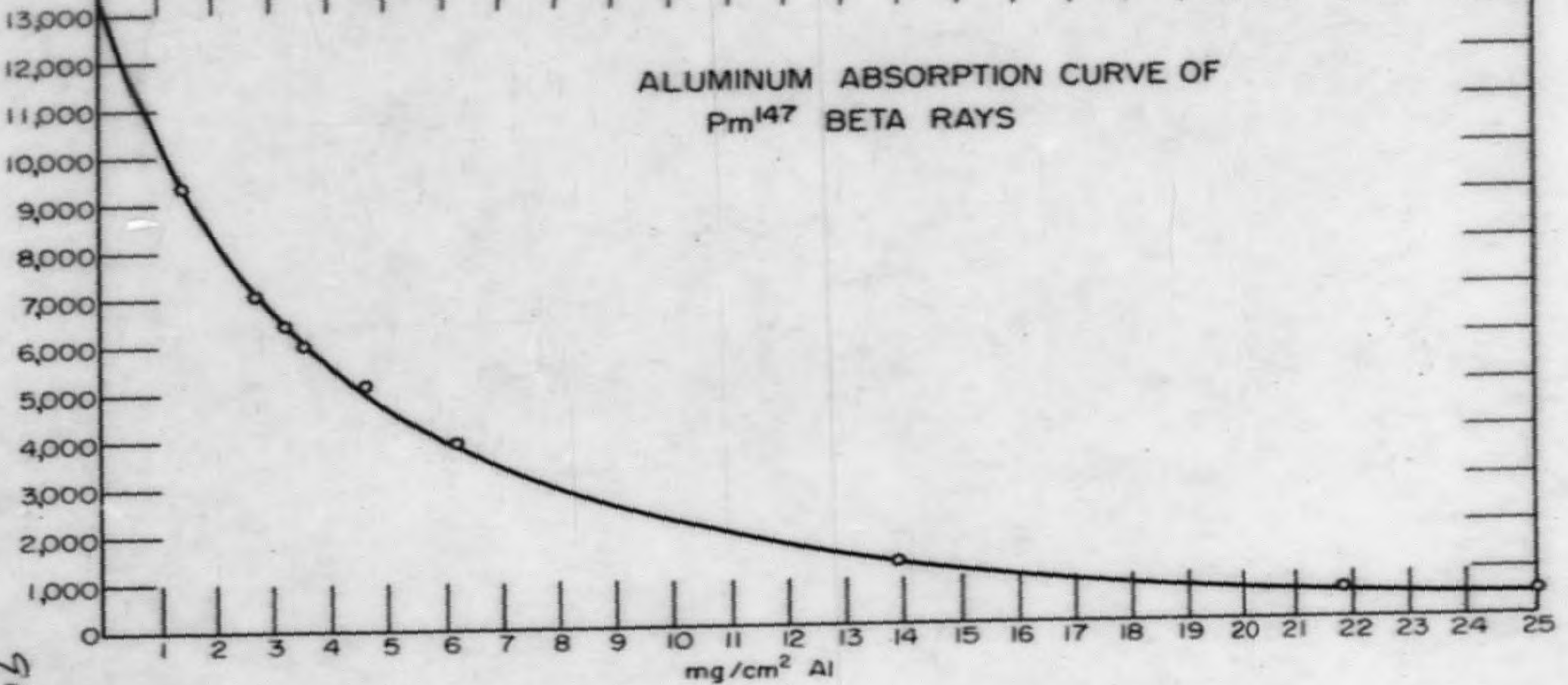


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7-876

c/m



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