# SHORT COMMUNICATIONS

## *Optimum Sample Position in Radioactivation Analysis Using Radium-Beryllium Neutron Source in Paraffin Moderator*

By Fumio Aoki and Minoru Okada

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It is known that in the radioactivation of samples by $(n, \gamma)$ reaction by use of a radium-beryllium neutron source surrounded by a paraffin moderator, the distance between the sample and the neutron source is an important factor affecting the intensity of the radioactivity induced in the sample. However, the optimum distance depends on the size of the sample and the neutron source. In spite of this fact, data for the optimum distance[1-4] have been given without the specification of the size of the sample and the neutron source.

We feel that the size of the sample and the neutron source has some influence on the optimum distance and that, in so far as the problem of the size effect is not solved, it is highly desirable for practical purpose to specify the size of the sample and the neutron source. Therefore, we report in this letter the optimum distance for specified experimental conditions as well as the effect of the orientation of sample surface on induced activity.

The optimum distance was determined on three samples by use of a radium-beryllium neutron source placed in a paraffin moderator. The neutron source had a cylindrical shape (2.2 cm. in diameter and 2.5 cm. in height) and was made of mixture of 1g. of radium and 5 g. of beryllium. The paraffin moderator had a shape of a rectangular parallelepiped, and the minimum distance from the neutron source to the external surface of the moderator was 11 cm. The samples were: a circular plate of silver and flat packages of rhodium and of vanadium powder, their diameter or corresponding size being less than that of the neutron source. The sample position was on the axis of the neutron source cylinder. The nuclides chosen for the measurement of a flux of neutrons which brought about the $(n, \gamma)$ reaction in the sample were 24.2 sec. $^{110}$Ag, 44 sec. $^{104}$Rh, and 3.76 min. $^{52}$V.

As is shown in Fig. 1, each of the three curves, obtained from the counting rates of the product nuclides, shows a maximum at the same distance of $1.7 \pm 0.1$ cm. Meanwhile, if the total cross-section curves given by Hughes and Harvey[5], were referred to, it would be difficult to suppose that the relation between the $(n, \gamma)$ reaction cross-section and the energy of neutrons for one of these elements was quite similar to the relation for the others. Nevertheless, the curves obtained showed very good agreement in the distance. The authors thus feeled that the distance may be valid for many other elements.

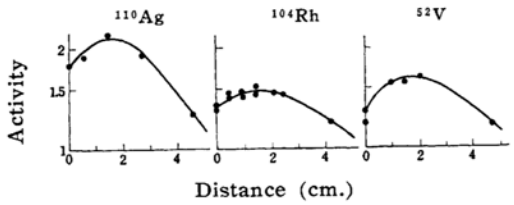


Fig. 1. Activity induced vs. distance from radium-beryllium neutron source.

In the study of the effect of the orientation of sample surface on the induced activity, a strip of silver plate of 0.8 cm. in width was placed at a distance of 2.2 cm. from the same neutron source as above, on the axis of the neutron source cylinder, and irradiated in two orientations: (a) perpendicular to, and (b) parallel to the neutron source axis. The measurements of induced activity for the two cases showed no appreciable difference, the

1) J. E. Hudgens and L. C. Nelson, *Anal. Chem.*, **24**, 1473 (1952).
2) W. W. Meinke and R. E. Anderson, *Anal. Chem.*, **25**, 781 (1953).
3) Y. Kusaka, Report presented at the 10th Annual Meeting of the Chemical Society of Japan, held in Tokyo, April 1957.
4) T. Shiokawa, M. Yagi and N. Yamashiro, Report presented at the 1st Annual Symposium on Radiochemistry, held in Tokyo, Dec. 1957.
5) D. J. Hughes and J. A. Harvey, Neutron Cross Sections (U. S. Atomic Energy Commission) **BNL-325**, 1955.

standard deviation of the observed values of the activity being within ±1% of the absolute values. Thus, it may be said that the orientation of sample surface has no appreciable effect on induced activity, so far as the sample size is less than one-third of the neutron source diameter; although the sample position for this experiment was not at the optimum distance, the same statement will apply to the samples placed at the optimum distance.

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*Government Chemical Industrial Research Institute*
*Shibuya-ku, Tokyo*