IMPROVED MEASUREMENT OF ABSOLUTE RATE OF β-DISINTEGRATION USING THE 4π-COUNTER TECHNIQUE

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ABSTRACT

The construction of the 4π-counter and the measuring technique of the active-drop-weight have been improved over our previous work resulting in a higher accuracy of measurement of the absolute rate of β-disintegration, $(8{\cdot}31 \pm 0{\cdot}29)10^6$ disint./min./gm., from a P^{32}-source, (3·74 ± 3 per cent) micro-Curie, prepared in the laboratory.

In a previous publication (Saha and Nath, 1956) we reported the determination of absolute rate of β-disintegration of radiophosphorus (P^{32}) by the 4π-counter technique. The P^{32}-source was prepared by electrochemical concentration of active phosphorus produced as reported earlier. The superiority of this method over the orthodox methods of β-ray counting was also discussed. It was, however, pointed out that improvements are possible in several directions in the present technique by which the probable error of counting could be considerably reduced. It is the purpose of this note to present results of such an improved determination carried out by us.

First of all the brass partition between the two semi-cylindrical counters was replaced by one made of stainless-steel which eliminated all irregularities of the cathode surface and also any possibility of oxide formation. The length of the new 4π-counter cylinder was made double of its diameter. (For each semi-cylindrical counter the length was four times the breadth.) The vacuum sealing through the rubber gasket was also eliminated by introducing a closely fitting metal cap at

TABLE I

Weight of the active salt ($Mg.NH_3(PO_4)_2$) *with carrier* = 0·59 ± 0·02 *mgm.*

Set No.	Time after removal of the neutron source.	N_1 cpm.	N_2 cpm.	N_{12} cpm.	N_{11} cpm.	$N = N_1 + N_2 - N_{12}$ cpm.	Mean of last two columns $\bar{N}$ cpm.	N_0 Absolute activity after correcting for decay cpm.
I	44715 mins.	575 ± 9	610 ± 9	84 ± 3	1100 ± 14	1101 ± 21	1101 ± 13	4960 ± 60
II	45080 ,,	568 ± 9	586 ± 9	81 ± 3	1086 ± 14	1073 ± 21	1080 ± 13	4920 ± 60
III	46110 ,,	555 ± 9	588 ± 9	83 ± 3	1047 ± 14	1060 ± 21	1053 ± 13	4970 ± 60
IV	47550 ,,	535 ± 9	547 ± 9	71 ± 3	991 ± 13	1011 ± 21	1001 ± 12	4960 ± 60
V	47850 ,,	519 ± 9	536 ± 9	71 ± 3	971 ± 13	984 ± 21	978 ± 12	4850 ± 60
VI	48975 ,,	500 ± 8	514 ± 9	68 ± 3	937 ± 13	946 ± 20	941 ± 12	4890 ± 60
VII	49305 ,,	498 ± 8	523 ± 9	68 ± 3	934 ± 13	953 ± 20	943 ± 12	4960 ± 60
VIII	50315 ,,	473 ± 8	490 ± 8	65 ± 3	886 ± 13	898 ± 19	892 ± 11	4850 ± 60

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the partition inlet side. These and some other minor modifications in the design reduced the end effect and resulted in improved counting characteristics which were practically identical for the two halves. Hardly any correction was needed in the counting rate for change of threshold or the slope of the characteristics.

Another limitation in our previous determination was the inaccuracy in the measurement of the sample-weight. In the present work a semi-microbalance reliable up to $\pm 0{\cdot}01$ mgm. was used for weighing and the evaporation method (Houtermans *et al.*, 1952) involving continuous weighings of the sample-drop with time was employed to obtain a very reliable estimate of the drop-weight extrapolated to zero time. From the known weight of the dissolved active salt in a given weight of the solution the weight of the active sample was accurately obtained.

The parallel and coincidence counting techniques as used before were employed. The table shows a typical series of results.

In the table N_1 and N_2 denote the single counting rates per minute from the two halves, N_{12}, the coincidence rate and N_{11}, the counting rate with two halves connected in parallel. The mean value of 'N_0' in the last column comes out to be 4900 ± 50 c./min. for $0{\cdot}59 \pm 0{\cdot}02$ mgm. of the active salt of P^{32}. The absolute β-activity of the source then becomes $(8{\cdot}31 \pm 0{\cdot}29) \times 10^6$ disintegrations/min./gm. This corresponds to a specific activity of the source $\approx 3{\cdot}74$ μ Curie with a probable error of ± 3 per cent. Comparing this with the figure of ± 12 per cent obtained in our earlier measurement (Saha and Nath, 1956), the present measurement seems to be a positive advance over the earlier.

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