Preparation of Bismuth and Antimony Sources for Beta Spectroscopy

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With 2 figures. (Received May 3, 1968)

For beta spectroscopy with a double focusing magnetic spectrometer, operated at a 0.1% momentum resolution, the required sources need a light backing, a uniform distribution over a well defined area and a minimum weight of deposit. The present methods describe the preparation of such sources for ^{207}Bi and ^{124}Sb. A standard electroplating cell made of perspex was used in both cases. 5 sources of ^{207}Bi and 10 of ^{124}Sb have been prepared with these procedures, obtaining good yields and uniformity in all cases.

1. Carrier-Free ^{207}Bi Sources

Methods which have been reported previously [1, 2], were not successful in obtaining sources of uniform quality. An alternative electroplating method was developed in which each 15 ml of the solution contain:

0.9 ml nitric acid (density 1.42)
60 mg hydrazine sulfate
2.25 mg acid saccharine
1.35 mg sodium lauryl sulfate.

The rest of the volume was made up with distilled water. Analytical grade reagents were used in all cases. The solution was heated to 70 °C and stirred for about 2 min. The final p_H is 0.4–0.5 and it was found that the uniformity of the deposits depends strongly on the p_H. The hydrazine avoids the formation of bismuth pentoxide on the anode while the wetting agent and the saccharine improve the uniformity and adherence of the deposit.

To the required volume of this solution to fill the cell, an aliquot of a carrier-free 100 μCi ^{207}Bi solution as $Bi(NO_3)_3$ in 0.5 N HNO_3 (New England Nuclear Corp., Boston) was added. The cathode of the cell was a 0.44 mg/cm^2 copper foil covered by a perspex mask with a 1 mm $\times$ 40 mm slit. A platinum wire was used as anode. The plating was carried out under strong stirring with a current of 30–40 mA and a potential of 3 V. Fig. 1 shows the progress of the plating as taken with a Geiger monitor. At the end of the operation the solution was removed from the cell and the deposit washed with distilled water and ethyl alcohol. Fig. 2 shows the K-Line of the 568.9 keV transition taken with a double focusing magnetic beta-ray spectrometer.

2. ^{124}Sb Sources

The radioactive solution used in this case was ^{124}Sb as $SbCl_3$ in 5 N HCl as obtained from the Radiochemical Centre, Amersham. This solution contains a small amount of carrier.

It proved convenient to deposit the antimony from the dissolved sulfide. First the dark-gray Sb_2S_3 was precipitated from the original solution by keeping the bottle in boiling water and bubbling hydrogen sulfide through it. After decanting, the residue was taken up in 6 ml of a 13.6% Na_2S solution (p_H 12.8–12.9) and 500 mg of KCN were added to avoid polysulfide formation. 8 ml distilled water were then added and the KCN was dissolved at 80 °C, with shaking of the solution.

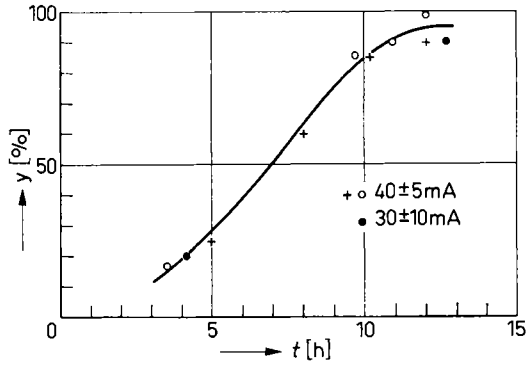

Fig. 1. Yield of bismuth deposit vs. electrodeposition time. Data for two independent runs are plotted for 40 mA plating current

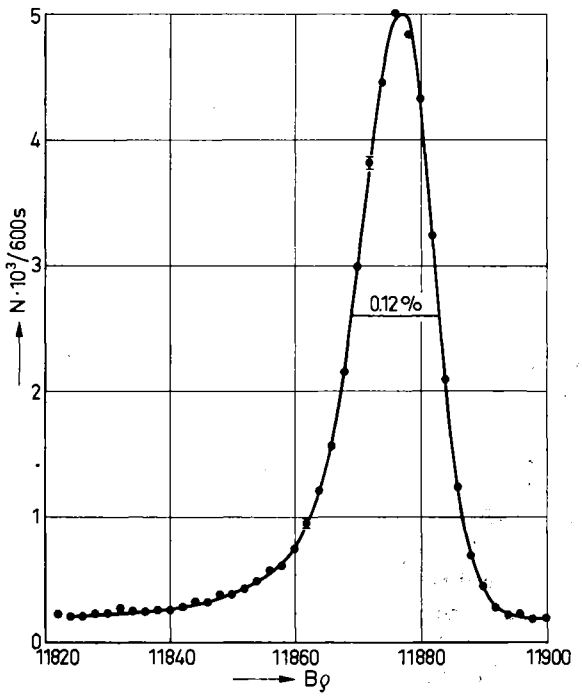

Fig. 2. K-line of the 568.9 keV transition in ^{207}Pb taken with a magnetic beta-ray spectrometer

The same electrodeposition procedure as for bismuth was followed with this solution under moderate stirring with a current of 50 mA and a potential of 4–4.5 V. After 20 h the yield was 90±5%. Sources of up to 10 mCi have been prepared in this way.

1. D. E. ALBURGER and G. FRIEDLANDER, Physic. Rev. **81**, 523 (1951).
2. W. PARKER, Thesis, Göteborg 1965.