On the Preparation of Polonium Sources

Erbacher[1] has described a technique for preparing polonium sources, wherein polonium deposits on platinum from a 0.1 *N* HCl solution saturated with hydrogen. However, some difficulty has been experienced in this laboratory in getting sources as strong as his by his method. Being guided by the assumption that the hydrogen adsorbed on the surface of the backing is involved in the process, palladium was substituted for the platinum with gratifying results. Whenever polonium was deposited first on platinum and then on palladium from the same solution, the palladium took up many times more radioactive material than did the platinum. Sources may be prepared on palladium as easily as on silver,[2] are about of the same strength, yet have far more uniform range distributions.

Since Ra E is also deposited by this method, it must be removed by repeated depositings of the polonium on silver. The palladium foil needs no preparation other than heating in a flame to clean the surface. It is attached to a glass rod with Picein and is immersed in the radioactive solution, through which hydrogen is bubbled and which is rotated at 100 to 200 r.p.m.

The strengths and range distributions of these sources have been tested by counting the emitted particles with a linear amplifier. Sources of 3 or 4 mC per sq. cm showed no evidence of tarnish whatsoever, and the variation in range, which was between one and two millimeters, was possibly inherent in the counting system. Stronger sources, up to 17 mC per sq. cm, have been prepared, but these become covered with a thin layer of black material. In the case of the strongest source, 82 percent of the particles had ranges greater than 3.5 cm, and 60 percent of the particles came to the ends of their ranges within a region of 2 mm. On platinum, Erbacher has obtained 10 mC per sq. cm on sources of similar area.

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[1] Erbacher, Zeits. f. physik. Chemie **A156**, 142 (1931); **A163**, 196 (1932).
[2] I. Curie, J. chim. phys. **22**, 471 (1925); L. R. Hafstad, J. Frank. Inst. **221**, 191 (1936).
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Positron-Electron Emitting Isomer in Radiosilver

When silver is bombarded with very high energy neutrons, ranging up to 20 Mev, a 25.5-min.[1] and an 8-day radioactive period are produced, the former emits positrons and the latter electrons. For slow neutron bombardment only the well-known 20-sec. and 2-min. periods are obtained, both emitting electrons. Table I shows the positions of the two stable isotopes of silver, Ag^{107} and Ag^{109}, in relation to other neighboring known stable nuclei. The assignment of the two long radioactive periods is also shown, and is based upon the following observations.

Neutron bombardment: When Be is bombarded by deuterons of 6 Mev, neutrons of about 8 Mev are emitted; however, these neutrons, when used to bombard silver, do not seem to have sufficient energy to produce the two long periods. Neutrons of nearly 20 Mev, obtained from deuteron bombardment of boron or lithium, do produce these periods. Neutrons of about 11 Mev from a Ra-Be source produce the 25.5-min. period.[2] High energy neutron bombardment of cadmium produces in the silver separation both the positron and electron emitting periods.

TABLE I. *Positions of the two stable isotopes of silver in relation to other known isotopes. The assignment of the two long radioactive periods is also shown.*

	103	104	105	106	107	108	109	110
$_{45}$Rh	99.9%							
$_{46}$Pd		9.3%	23%	27%		27%		14%
$_{47}$Ag				25.5 m ↑ 8 d ↓	52%	2 m ↓	48%	20 s ↓
$_{48}$Cd				1.5%		1%		15%

Deuteron bombardment: Palladium, when bombarded by 6.3 Mev deuterons gives in the silver separation both the 25.5-min. and 8-day periods.[3]

Helium bombardment: Helium was admitted into the cyclotron so that rhodium could be bombarded by about 12 Mev alpha-particles. A weak activity was observed which had about the correct periods. The signs of the particles were not observed. A chemical check was made on only the 25.5-min. period which initially is much the stronger of the two.

These observations can be made consistent among themselves if Ag^{106} is assigned the double duty of emitting positrons with a period of 25.5 min. and electrons with a period of 8 days. The positron period cannot be assigned to Ag^{105} because this period could then not be obtained from cadmium by high energy neutron bombardment. Also confirmatory evidence by alpha-bombardment of rhodium would be lacking. If the 8-day and 25.5-min. periods were assigned to Ag^{108} or Ag^{110}, they should be obtained by slow neutron bombardment of silver, which however is not observed.

The reaction equations which give the radioactive isomeric Ag^{106} may be written as follows:

$$n' + Ag^{107} \rightarrow Ag^{106} + 2n'$$
$$n' + Cd^{106} \rightarrow Ag^{106} + p'$$
$$D^2 + Pd^{105} \rightarrow Ag^{106} + n'$$
$$He^4 + Rh^{103} \rightarrow Ag^{106} + n'$$
$$_{47}Ag^{106} \rightarrow {}_{46}Pd^{106} + {}_{+1}e^{\circ}$$
$$_{47}Ag^{106} \rightarrow {}_{48}Cd^{106} + {}_{-1}e^{\circ}$$

So far only one other artificial radioactive isomeric nucleus has been reported, namely Br^{80} with an 18-min. and a 4.2-hour period.[4] However, in this case both members of the isomer emit electrons. This work was made possible by a grant from the Horace H. Rackham fund.

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