28. γ -ray Activity Induced in Cadmium by Slow Neutron Bombardment.

By Shigeo NAKAGAWA and Inosuke SUMOTO.

Institute of Physical and Chemical Research, Tokyo.

(Comm. by S. NISHIKAWA, M.I.A., March 12, 1938.)

Artificial radioactivity produced in cadmium by the bombardment of neutrons and deuterons has been investigated by several authors. Fermi and his collaborators¹⁾ observed by neutron bombardment a weak activity of 70 minute period. With deuteron bombardment, Cork and Thornton²⁾ found 4.3 hour and 58 hour periods in the cadmium chemically separated. Mitchell³⁾ observed weak activities of 5 hours and 52 hours with slow neutron bombardment. Heyn⁴⁾ found, using fast neutrons, two periods of 20 minutes and 200 minutes. Recently Pool⁵⁾ obtained with fast neutron bombardment 6 different periods, all of which could be attributed to silver isotopes.

Most of the periods hitherto found were obtained by β -ray activity, γ -ray activity being observed only in the cases of 3.2 hour and 8.2 day periods by Pool. In the present experiment γ -ray as well as β -ray activities were investigated of cadmium bombarded by neutrons.

The source of neutrons used was Rn-Be (200 mC) for a long exposure and Be+D in a cyclotron for short exposures of 15 minutes to 2 hours. γ -ray activity was measured by a Geiger-Müller counter with brass walls of 1 mm thickness covered with 0.75 mm lead. Two kinds of β -ray counter were used, one with aluminium walls of 0.1 mm thickness and the other with perforated brass walls covered with a thin aluminium foil 0.015 mm thick.

When cadmium was bombarded in a paraffin block, the decay curve for γ -rays shows at least two periods of about 45 minutes and 5 hours, while with a bombardment direct from the source or through a filter of B_2O_3 , the decay curve shows an apparent period of about 70 minutes instead of 45 minutes, assuming the longer period to be 5 hours. From the difference between above two curves, the decay period of about 45 minutes is also obtained and this shows that slow neutrons play a large part in the process of formation of a cadmium isotope of 45 minute period. The energy of the γ -rays was roughly estimated to be about 1 Mev from an absorption measurement.

On the other hand, the decay curve for β -rays showed no such short period, viz. it decreased monotonously with a period of about 5 hours when cadmium was protected from slow neutrons by B_2O_3 and somewhat faster with an apparent initial period of 3 hours when irradiated

1) E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segrè: Proc. Roy. Soc., **146** (1934) 483.

2) J. M. Cork and R. L. Thornton: Phys. Rev., **51** (1937) 608.

3) Allan C. G. Mitchell: Phys. Rev., **51** (1937) 995.

4) F. A. Heyn: Nature, **139** (1937) 842.

5) M. L. Pool: Phys. Rev., **53** (1938) 116.

in the paraffin block. Soft β -rays were tested using the thin-walled counter, but no detectable effects in the form of the decay curve were obtained.

As the back-ground of longer life products is large and uncertain in the period, it is difficult at present to give a definite conclusion, but it seems certain that there is produced by slow neutrons a cadmium isotope of a period of about 45 minutes, which emits fairly strong γ -rays but very weak or no β -rays.

Deflecting β -rays in a magnetic field, residual radiation was tested by absorption measurements with silver and molybdenum absorbers. Any selective absorption which indicates the existence of K-radiation of an element such as silver has not been observed. Also a search for positrons has failed.

Recently Pool¹⁾ has shown in the case of an active silver of 8.2 day period, the existence of a very predominant γ -ray compared to the β -ray activity and attributed it to the process of K electron capture. In the present case any activity due to electron, positron or K-radiation has not been detected and it is questionable whether the γ -ray activity of 45 minute is to be attributed to the same process. If the absence of other radiation than γ -rays could be proved more decisively, it might suggest the existence of a metastable state of nucleus.

We wish to acknowledge our indebtedness to Professor S. Nishikawa for his interest and encouragement in this work. We also wish to express our gratitude to the Japanese Foundation for Cancer Research for the supply of radon and to the members of Nuclear Research Laboratory of the Institute for the privilege of using the cyclotron.

1) loc. cit.