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Artificial Radioactivity of Chromium

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Artificial Radioactivity of Chromium.

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Summary.

Induced radioactivities of chromium have been investigated by bombarding chromium with slow neutrons, fast neutrons, and fast deuterons. Two radioactive isotopes of chromium were established; Cr^{55} (1·7 hours) Cr^{51} (about 14 days).

We have investigated the induced radioactivities of chromium by bombarding chromium with slow neutrons, fast neutrons, and fast deuterons. The decay curves of the radioactive products were measured with a Lauritsen electroscope.

1). Deuteron bombardment.

Chromium metal was exposed to about 100 microampere hours of 3 Mev. deuterons in our cyclotron. The chemical procedure used for chromium metal which had been bombarded with deuterons was as follows;

The surface of chromium metal was dissolved out by immersing it in hot concentrated hydrochloric acid. The chloride solution was alkalized with sodium hydoxide, and oxidized by bromine water. The excess of bromine was boiled off and the clear chromate solution was slightly acidified with sulphuric acid. Small amount of ferric sulphate, manganese sulphate and sodium vanadate were added as carriers. Iron and manganese were precipitated with sodium carbonate. Taking out the half of the filtrate, vanadium was precipitated with cupferron after being weakly acidified by sulphuric acid. No activity was detected in this precipitate. The residual part of the filtrate was acidified with acetic acid and barium chloride was added. Chromium was precipitated as barium chromate together with barium vandate and barium sulphate. The separation of chromium from this precipitate was not carried out.

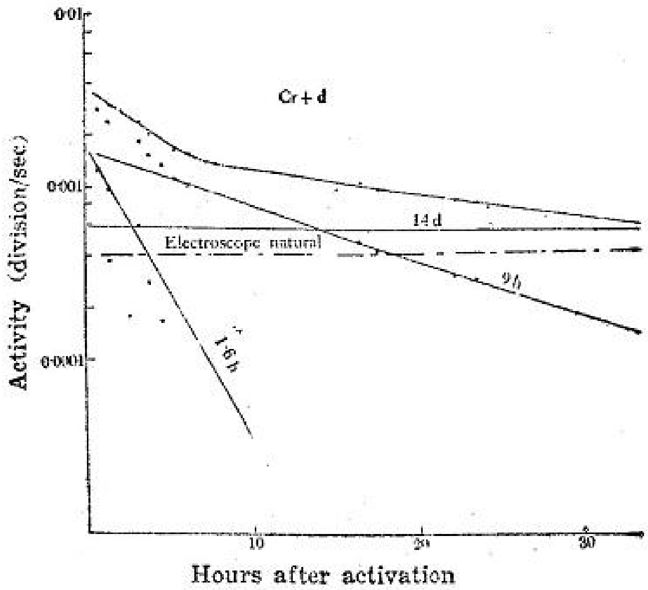

Fig. 1.

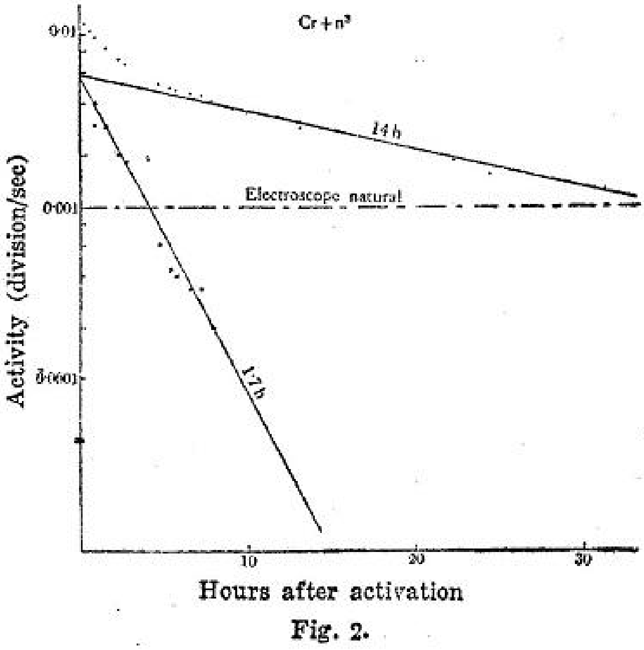

Fig. 2.

The rate of decay of the active chromium precipitate is shown in Fig. 1. From the analysis of the decay curve two periods were established namely 1·6 hours and about 14 days.

2). Slow neutron bombardment.

Metallic chromium was bombarded with slow neutrons. Slow neutrons were produced by slowing down the neutrons from beryllium bombarded with deutrons in our cyclotron.

In this case the activity induced in chromium was very weak and no chemical separation was done. From the analysis of the decay curves the following periods were established; 1·7 hours, 14 hours (Fig. 2).

The 14 hour activity seems to be due to Na^{24} (15 hours) produced in aluminium impurity by the reaction Al^{27}–n–α–Na^{24}, since considerable number of fast neutrons were always contained in slow neutrons. The period 1·7 hours is very near to the period 1·6 hours observed in the case of deuteron bombardment, therefore can probably be ascribed to an isotope of chromium, but unfortunately no chemical identification was done owing to its very weak intensity.

3). Fast neutron bombardment.

Chromiumoxide was bombarded with fast neutrons. Fast neu-

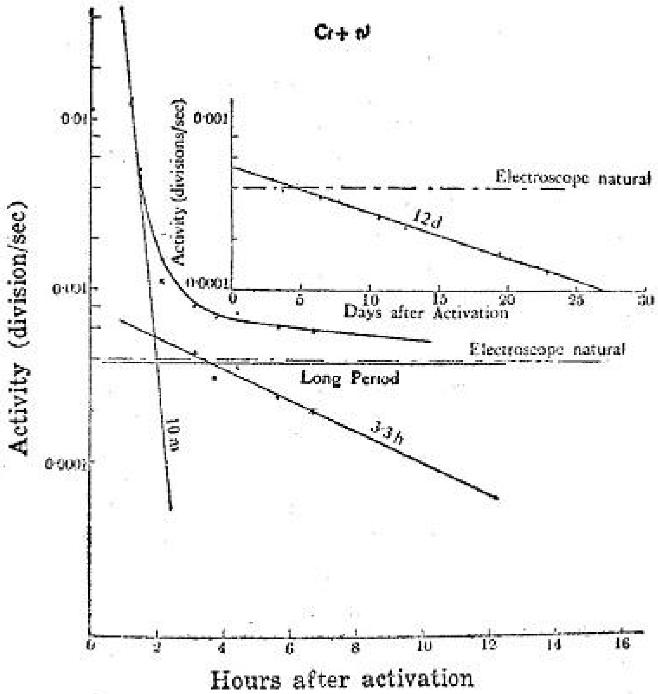

Fig. 3.

trons were produced from lithium bombarded with deuterons of 3 Mev. The following periods were observed; 10 minutes 3~4 hours, about 12 days (Fig. 3). Also in this case the activities were very weak except the 10 minute activity (N^{13}) which was produced from nitrogen occluded in the chromiumoxide. The 3~4 hour activity is very likely due to V^{50} (3·7 hours) according to the reaction Cr^{50}–n–p. The period 12 days is probably due to the same activity 14 days as observed in the case of deuteron bombardment. But no chemical identification was done.

Now chromium has four stable isotopes Cr^{50}, Cr^{52}, Cr^{53}, Cr^{54}. As 1·6 hour activity was observed both in the case of deuteron bombardment and slow neutron bombardment and not in the case of fast neutron bombardment, we can attribute the 1·6 hour activity to Cr^{55}, and the longer one (about 14 days) to Cr^{51}.

Recently H. Walk, F. G. Thompson, and J. Holt(1) have investigated the induced radioactivity of chromium and shown that Cr^{51} can be produced by bombarding titanium with high speed alpha-particles or chromium with deuterons, its half-life being 26·5 days. Moreover they also observed this period by bombarding chromium with slow neutrons.

Unfortunately the activities of chromium in our case were very weak and the value of longer period (about 14 days) is somewhat inaccurate. It may therefore be possible that the 26·5 day activity observed by Walke and others is the same as the longer period activity observed by us. They have never observed the 1·7 hour activity which has been observed in our case. M. L. Pool, J. M. Cork, and R. L. Thornton(2) have observed a 1·7 hour activity in Cr by bombardment it with very high energy neutrons, but no chemical identification was done. This activity should be attributed to Cr^{55} produced in Cr by capture of slow neutrons which were mixed with fast neutrons.

In conclusion we wish to express our best thanks to Dr. Y. Nishina for his kind interest throughout this work.

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(1) W. WALK, F. C. THOMPSON, and J. HOLT: *Phys. Rev.*, 57 (1940), 171.

(2) M. L. POOL, J. M. CORK, and R. L. THORNTON: *Phys. Rev.*, 52 (L 1937), 239.