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PRODUCTION OF RADIOISOTOPE ^{28}Mg BY
(n, alpha) - (t,p) REACTION AT NUCLEAR REACTOR

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INTRODUCTION.-

Magnesium is very important ions in biological and medical fields. Radioactive magnesium as a tracer, if a high specific activity is available, would have a wide range of application in biological and medical fields of research.

Magnesium-28 is practically the only radioactive isotope of magnesium which is suitable as a tracer since the half-lives of the other known isotopes are too short. It decays, with a half-life of 21,3 h. to aluminium-28, which then in turn decays, with a half-life of 2,3 m. to silicon-28. (1)

Magnesium-28 was first obtained by the reaction $^{26}\text{Mg}(\alpha, 2p)^{28}\text{Mg}$ on an accelerator. (2,3) Carrier-free ^{28}Mg could be isolated from aluminium irradiated with α particles. (4,5) However, because of the low yield the reaction $^{27}\text{Al}(\alpha, 3p)^{28}\text{Mg}$ has not found use for the production of Magnesium-28.

The most convenient reaction which can be used for production is the $^{26}\text{Mg}(t, p)^{28}\text{Mg}$ reaction. (6,7) Making use of this reaction, magnesium-28 has been produced, using tritons from the $^6\text{Li}(n, \alpha)^3\text{H}$ reaction, by the irradiation of the Li-Mg alloy with thermal neutrons at reactor.

EXPERIMENTAL.-

Preparation of targets :

The Li-Mg alloy targets required for the production of magnesium-28 were prepared. They were obtained by fusing equal parts by weight of lithium and magnesium in an iron crucible while passing a protective argon gas over it. After allowing the alloy to cool also in an argon gas atmosphere, they were removed from the crucible and kept under petroleum ether until irradiation time.

Irradiation :

0,6 gr. Li-Mg alloy samples were irradiated in a standard ($3/4 \times 4$ inc. diameter) aluminium isotope can, for 2 hours in the fast transfer system (large rabbit) of the UTR-300 reactor at Scottish Universities Research and Reactor Centre, East Kilbride, Scotland in a neutron flux approximately $3,2 \times 10^{12}$ n/cm².sec.

In order to prevent air oxidation and since the high temperatures developed during irradiation may bring about a reaction between the Li-Mg alloy and the aluminium can, a thin iron foil was placed between the alloy and the aluminium can.

Chemical isolation and purification of magnesium-28 from target :

After completion of the irradiation, the aluminium can was pulled out of the flux and allowed to cool for

approximately 30 minutes. At the end of the cooling time the aluminium can was removed and taken to a hot chemistry laboratory where the can was opened.

The problem of isolating the magnesium-28 from the target and purifying it is very difficult.

Strong fluorine-18 activity was produced by the oxygen in the target. To remove this fluorine-18, irradiated Li-Mg alloy was dissolved in 50 ml. water and a few drops concentrated HCl in a 250 ml. beaker kept cool by ice. To this solution was added 2 ml. concentrated NH_4OH and 2,5 gr. NH_4Cl and 1 ml. 6% w/v H_2O_2 .

The iron taken up in the target as an impurity during the production was precipitated as $\text{Fe}(\text{OH})_3$ and removed by filtration.

Approximately 4gr. of sodium hydroxide in solid form was added to the solution. The magnesium was precipitated as magnesium hydroxide and was centrifuged off.

In order, to ensure elimination of the sodium activity produced by the $^{25}\text{Mg}(\text{t},\alpha)^{24}\text{Na}$ reaction, the magnesium hydroxide was several times dissolved and reprecipitated. The inactive Na ions still present can be removed by washing 3 times with 40 ml. water.

The magnesium hydroxide dissolved with the 20 ml. concentrated HCl, and the final solution was filtered by using 0,45 μ millipore filter. The solution was transferred to a serum bottle.

Measurements of activities :

The activity of the magnesium-28 in the preparation

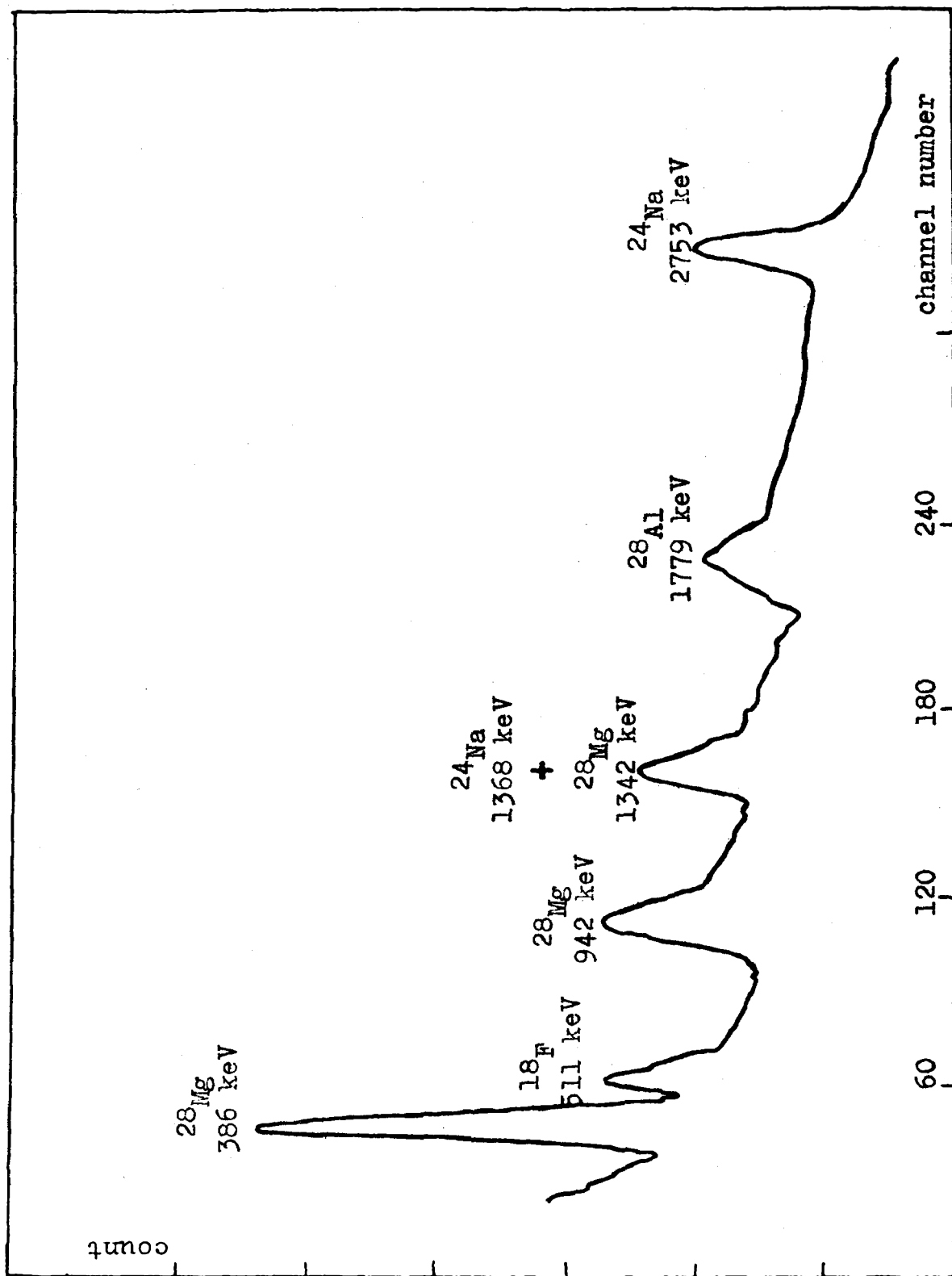


Figure . 1 Gamma spectrum of Magnesium-28 after the irradiation. A peak of the 511 keV annihilation gamma rays from Fluorine-18 with a 1,87 h. half-life , which came from the oxygen contamination in the target, was observed.

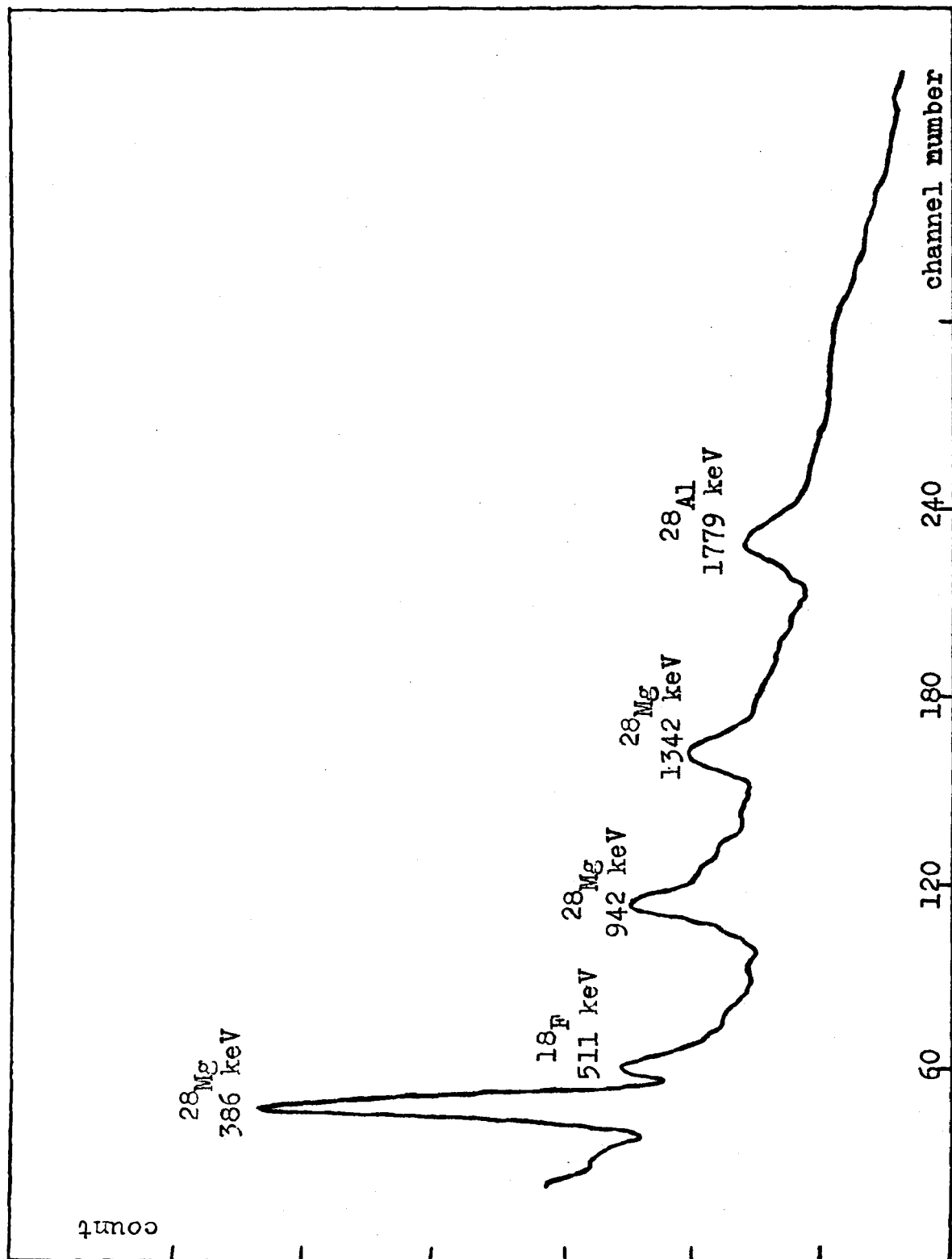


Figure . 2 Gamma spectrum of Magnesium-28 ; after the chemical isolation and purification.

obtained was measured on a scintillation gamma spectrometer with 3" X 3" NaI (Tl) crystal with ^{137}Cs and ^{60}Co used as standard sources.

Typical gamma spectra of the radiation of magnesium-28 is given in Fig. 1.

The activity of ^{59}Fe was measured on a gamma spectrometer with a standard ^{22}Na source. The radioactive impurities ^{18}F , ^{24}Na were also determined with a gamma spectrometer and from the decay curve measured on a β counter.

Fig. 2 illustrates a gamma spectrum of magnesium-28, after the chemical isolation and purification. The final solution contained the following radioisotope impurities: $^{18}\text{F} < 1\%$, $^{24}\text{Na} < 2,5\%$. The impurities given are relative to the activity of the Magnesium-28.

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REFERENCES.-

1. LEDERER, C.M., HOLLANDER, J.M., PERLMAN, I., Table of Isotopes , John Wiley , New York , 1967.
2. WAPSTRA, A.H., VEENENDAAL, A.L., Phys. Rev. 91 , No. 2 , 426 , 1953.
3. SHELINE, R.K., JOHNSON, H.R., Phys. Rev. 89 , No. 2 520 , 1953.
4. HUDIS, J., J.Inorg. Nucl. Chem. 4 , No. 5/6 , 237, 1957.
5. LINDSAY, R.H., CARR, R.J., Phys. Rev. 118 , No. 5 , 1293 , 1960.
6. STANG, L.G., TUCKER, W.D., DOERING, R.F., WEISS, A.J., GREENE, M.W., and BANKS, H.O., Development of Methods for the Production of Short-Lived Radioisotopes, Intern. Conf. on Radioisotopes in Scientific Research, Paris , 1957 , p.190.
7. KOZYREVA, L.S., LEVIN, V.I., MESHCHEROVA, I.V., Methods of Producing Radioactive Preparations, Gosatomizdat , 1962 , p.103.