

Carrier-free ⁷⁴As Production from Ge by Proton Irradiation

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III. 7. Carrier-Free ^{74}As Production from Ge by Proton Irradiation

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Arsenic (As) is well known as a toxic element. In olden times, it was used as a poison by assassins. Today, on the other hand, the biological behavior of As interests many researchers, who have published investigations using As radioisotopes (^{74}As). The present experiment was conducted to obtain the carrier-free ^{74}As , which is used as a spiker in ultramicro As determination and tracer studies on animal behavior, especially young animals.

Metal Ge was irradiated with a proton beam ($^{74}\text{Ge}(p,n)^{74}\text{As}$). Then ^{74}As was separated out by the solvent extraction of ion association systems.

Experiment

Ge: high-grade pure metal (Ge; 99.9₆ %, Nacalai Tesque Inc., Kyoto, Japan).

Irradiation by cyclotron: proton-beam current 2 μA ; time: 2 h; energy; 13 MeV, by the Cyclotron and Radioisotope Center, Tohoku University.

Chemical separation : Cooling for 20 to 30 days took place after irradiation. Ge was dissolved with the aqua regia reagent, then chemical separation was conducted (Table 1). The separation procedure was mainly carried out by eliminating Ge from the solution using benzene for ion association systems.^{1,2)} Radioactivities for each fraction (I~V) that underwent the extraction process was measured by the well type γ -ray counter set up in the range of 550~650 keV limited. The main photopeak of ^{74}As is 596 keV.

Results

The γ -ray spectrum of Ge irradiated with a proton beam is presented in Fig. 1. it clearly shows the photopeaks (551, 596 keV) for ^{74}As and many other peaks but a search for others was not done. The radioactivity for each fraction separated chemically is shown in Table 1. The I, II and IV fractions showed very low activity (almost background levels)

and III or V showed very high levels. Most of the radioactivity concentrated on these two fractions.

Discussion and Conclusion

It is known that the nuclear reaction of ^{74}Ge (p,n) ^{74}As is generated by proton irradiation in a cyclotron and the production of As is the result. Our present experiment also confirmed this fact. The irradiated Ge metal (Fig. 1) produced ^{74}As and concurrently many radionuclides were also produced.

To obtain the pure carrier free ^{74}As , the irradiated Ge solution was extracted after being dissolved in an aqua regia reagent. Five fractions were separated by extraction (I-V). For each fraction, very specific radioactivity characteristics were observed, namely, I, II and V fractions had extremely low levels, almost background levels. By contrast, III and V were very high. Fraction V should have contained pure ^{74}As as its radioactivity had the highest value (550~650 keV). But III was another highly active fraction. It might be assumed that the contamination of ^{74}As in this fraction was due to insufficient extraction. The benzene extraction for fraction III should be done until the radioactivity levels fall to the level of the other fractions(I, II, and IV).

An ultra-pure 99.96 % grade level Ge metal was used for irradiation. Therefore, in the separated ^{74}As fraction V, no As carrier should exist.

Acknowledgement

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References

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Table 1. Carrier-free separation of ^{74}As from Ge by proton irradiation.

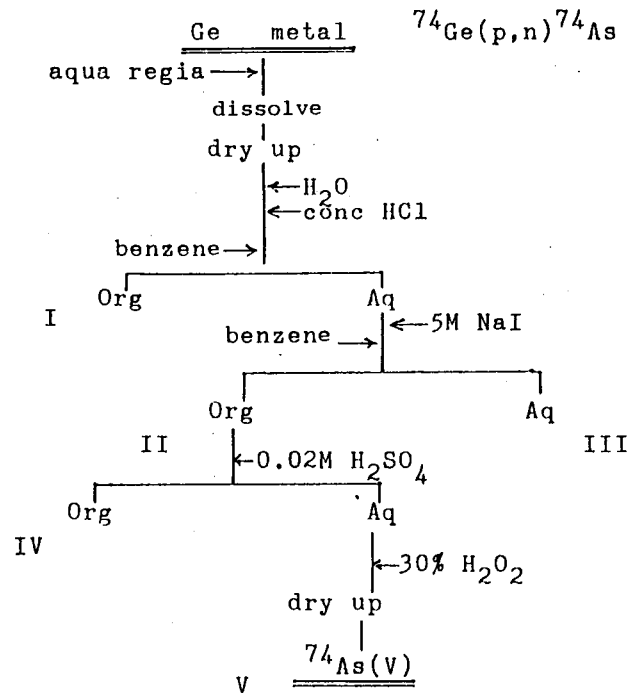
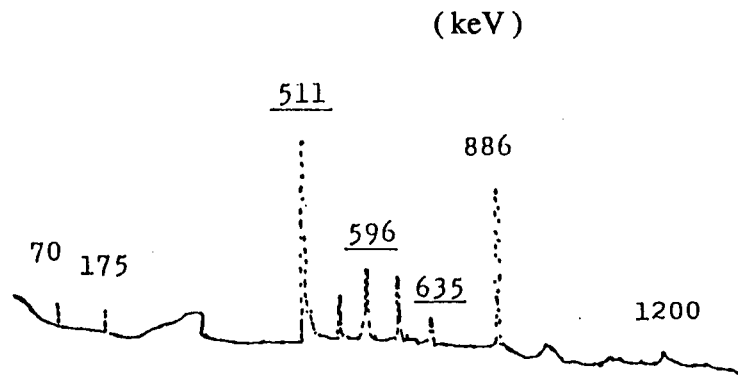


Table 2. γ -ray Measurements in the 550-650 keV Range in Separated Fractions

Fraction No.	cpm		
	1*	2*	3*
I	22	24	41
II	66	13	65
III	33,214	8,346	96,917
IV	39	25	1,642
V	146,297	37,946	452,562

Radioactivity of irradiated Ge was ca. $1 \pm 0.1 \mu\text{Ci}$

*Experiments were performed three times



Photopeaks of 596 keV show ^{74}As

Fig. 1. γ -ray spectrum of Ge irradiated with a proton beam.