Vol.3 No.3　　NUCLEAR SCIENCE AND TECHNIQUES　　Aug. 1992

IMPROVEMENT IN SEPARATION OF ^{68}Ge FROM Ga_2O_3 TARGET

Bao Borong (包伯荣) and Wang Yinsong (王荫淞)

(Shanghai Institute of Nuclear Research, Academia Sinica, Shanghai 201800, China)

(Received August 1991)

ABSTRACT

Two new systems have been presented for the extraction separation of ^{68}Ga from irradiated Ga_2O_3 target after proton bombardment. It could avoid the loss of $^{68}GeCl_4$ during the processing and storage, resulting a stable ^{68}Ge source.

Keywords: ^{68}Ge　Ga target　Solvent extraction

1 INTRODUCTION

^{68}Ge decays *via* EC process with a halflife of 287 d. Its daughter ^{68}Ga emits β^+ and γ-ray of 1.077 MeV with a halflife of 68.3 min.[1] Because of its nuclear properties ^{68}Ge could be used in many cases. For instance, ^{68}Ge was used as a positron source in positron annihilation study in nuclear physics and metal radiography in industry[2-3] and as a tracer in many fields (for example, in chemical study of organogemanium compounds). However, ^{68}Ge is mainly used as a ^{68}Ge— ^{68}Ga generator for positron emission tomography (PET) in nuclear medicine[4].

^{68}Ge could be produced through either ^{69}Ga (p,2n) ^{68}Ge or ^{66}Zn(α, 2n)^{68}Ge. The advantage of ^{69}Ga(p, 2n)^{68}Ge reaction used in this paper is highly productive (about 7.4×10^5 Bq per μA · h at proton energy of 25 MeV), but relatively high proton energy is needed.[5,6]

The target was about one gram of natural Ga_2O_3 (natural abundance of ^{69}Ga is ~ 60%). It was pressed into a disk tablet of 15 mm in diameter and wrapped by aluminium foil. Target was bombarded by 25 MeV proton for 1— 2 d. After irradiation, target was cooled for a few months to allow radioactive impurities (mainly ^{69}Ge and ^{71}Ge with halflives of 39 h and 11.2 d, respectively) to decay.

The most convenient method for the separation of ^{68}Ge from large amount of Ga_2O_3 is solvent extraction[7]. For instance, Ge could be extracted by CCl_4 from 9— 10 mol/l HCl and Ga remained in aqueous solution[8]. However, the problem is that $GeCl_4$ formed from concentrated HCl is easy to vaporise (boiling point of $GeCl_4$ is only 83 °C), and thus, a loss of $GeCl_4$ might happen during the processing and storage[9]. At present, we have tried some new systems for Ge-Ga extraction separation.

2 EXPERIMENTAL

a. H_2SO_4-HCl system: Ga_2O_3 was dissolved in concentrated H_2SO_4 by gentle heating, and then a little HCl was added. Solvent extraction was carried out under the given conditions shown in Table 1. In "cold test", Ge and Ga in aqueous phase before and after extraction were analyzed by phenylfluorone and rhodamine B spectrophotometry respectively[10-11]. Table 1 shows that Ge was quantitatively extracted by benzene from 9 mol/l H_2SO_4— 0.1mol/l HCl or 9 mol/l H_2SO_4— 0.3 mol/l HCl, whereas Ga remained in aqueous solution.

Table 1

Extraction of Ge and Ga by benzene from H_2SO_4— HCl system

No.	Aqueous phase	Organic phase	Ratio	Extraction (%)	
				Ge	Ga
1	6 mol/l H_2SO_4— 0.1 mol/l HCl	Benzene	1:1	12	-
2	6 mol/l H_2SO_4— 0.3 mol/l HCl	Benzene	1:1	45	-
3	9 mol/l H_2SO_4— 0.1 mol/l HCl	Benzene	1:1	99	0
4	9 mol/l H_2SO_4— 0.3 mol/l HCl	Benzene	1:1	100	0

Table 2

Extraction of Ge and Ga by benzene from H_2SO_4— KI system

No.	Aqueous phase	Organic phase	Ratio	Extraction (%)	
				Ge	Ga
1	9 mol/l H_2SO_4— 1 mol/l KI	Benzene	1:1	100	0
2	9 mol/l H_2SO_4— 0.5 mol/l KI	Benzene	1:1	100	0
3	4.5 mol/l H_2SO_4— 1 mol/l KI	Benzene	1:1	0	-
4	4.5 mol/l H_2SO_4— 0.5 mol/l KI	Benzene	1:1	0	-

b. H_2SO_4-KI system: The experimental procedure was as same as above and the results are shown in Table 2. It is seen that Ge could be extracted quantitatively by benzene from 9 mol/l H_2SO_4— 0.5 mol/l KI or 9 mol/l H_2SO_4— 1 mol/l KI and Ga remained in aqueous solution.

We have separated Ge from Ga_2O_3 by above procedures. The separation method was proved to be successful and efficient. After Ga_2O_3 was dissolved in H_2SO_4 and Ge separated from Ga by two systems mentioned above, Ge could be obtained by vaporization of benzene solvent.

3 CONCLUSION

An improved method for separation of ^{68}Ge from irradiated Ga_2O_3 was given. The method is simple and efficient in avoiding the loss of ^{68}Ge during its chemical processing and storage.

REFERENCES

[1] Choppin G R, Rydberg J. Nuclear chemistry, Theory and applications. New York: Pergaman Press. 1985.
[2] Hughes A E. *Material in Engineering,* 1980, 2:34.
[3] Hughes A E, Coleman C E. R-10377, Harwell:AERE, 1981.
[4] TID-7673. 1962, 371.
[5] Yaggc U Z. *Radiochemistry* (in Russian), 1970, 12(5):796.
[6] Chang Hongjun. Annual Report, Shanghai Institute of Nuclear Research, Academia Sinica, 1983, 192.
[7] Gleason G I. *Int J Appl Radia Isotop,* 1960, 8:90.
[8] Dmitliev P P. *Atomic Energy* (in Russian), 1972, 33(3):774.
[9] Remy H. Treatise on inorganic chemistry. Amsterdam: Elsevier Publishing Company, 1956: Vol.1, 520.
[10] Charlot G. Colorimetric determination of elements. Amsterdam: Elsevier Publishing Company, 1964: 254.
[11] O'Nishi, Sandell. *Analytical chimica Acta,* 1955, 13:159.