Collection of the Potassium-42 from 40Ar(α,pn)42K Reaction

VI. 2. Collection of the Potassium-42 from $^{40}Ar(\alpha,pn)^{42}K$ Reaction

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Radiation sources are great important not only for research in basic science, material science, medical and radiopharmaceutical use but also for education in those area, and even in that in a high school. A ^{42}Ar-^{42}K generator is one of the convenient sources for β- and/or γ-rays as proposed by Morinaga. However, no value for the cross section of the $^{40}Ar(\alpha, 2p)^{42}Ar$ reaction experimentally measured have been reported so far. We have measured the excitation function of $^{40}Ar(\alpha, 2p)^{42}Ar$ reaction for investigating a possibility of the ^{42}Ar-^{42}K generator. The value measured at the incident energy of 41.6 MeV was estimated to be 1.5 ± 0.5 mb, however, which was lesser than that calculated value, 8.3 mb, using ALICE code[1]. In order to investigate another methods by means of chemical treatment, the ^{42}K produced by the $^{40}Ar(\alpha, pn)^{42}K$ reaction was separated chemically and measured, further compared with an amount estimated from the experimental value of the cross section reported by Tanaka *et. al.* [2]

A target of ^{40}Ar-gas sealed by 1 atm in aluminum chamber (165mm in length, 40mm in diameter) was irradiated by α-particles of 41.6 MeV with 1 electric-μA at CYRIC. The irradiation time was about 14 hours. Fig. 1 shows a schematic view of the target chamber and the generator chamber. Two bubbling bottles and a vessel of molecular sieve were installed between the chambers for collection the ^{42}K radionuclides directly produced by the $^{40}Ar(\alpha, pn)^{42}K$ reaction. Pure water was firstly filled to remove the ^{42}K radionuclides, the generator chamber was pumped up to vacuum state, then, the ^{42}Ar-gas was transferred to the generator chamber through the two bubbling chambers being up to equal pressure. The water removed from the two bubbling bottles was dried in a filter paper using a hot plate and an infrared lamp. The generator chamber filled by the irradiated Ar-gas was left for

measuring the cross section of $^{40}Ar(\alpha, 2p)^{42}Ar$ in another run. The inside of the target chamber was washed with pure water. The water was also dried in a filter paper. Finally the filter papers were set on a Ge detector to measure the γ-ray of 1524 keV from ^{42}K radionuclides. Fig.2 shows the γ-ray spectrum of the ^{42}K radionuclides collected from the target chamber. It is clearly seen the peak of 1524 keV in the figure.

An amount of the ^{42}K radionuclides on the filter papers was estimated from yields of the γ-ray of 1524 keV assuming the cross section which is the value reported by Tanaka *et. al.* It was found that only a magnitude of 48% to the total amount of ^{42}K radionuclides produced by the irradiation was collected in the filter paper for the target chamber. Even if the KCl solution was used for washing the inside of the target chamber, a magnitude of 54% to the total amount of ^{42}K radionuclides was collected in the filter paper. In the filter paper for the trap, a magnitude of 5.2% to the total amount of ^{42}K radionuclides was collected. A magnitude of several percentage to the total amount remained in the target chamber and beakers used for the concentration procedure. Therefore, further experimental investigations are needed to determine the exact values of the cross sections of the $^{40}Ar(\alpha, pn)^{42}K$ reactions. We are thinking that TPB (tetraphenylborate) can be useful for washing the inside of the chamber and trapping the ^{42}K radionuclides.

References

1) Blann M., Vonach K.H., Phys. Rev. C **28** (1983) 1475.
2) Tanaka S, Furukawa M., Mikumo T., Iwata S., Yagi M., Amano H., J. Phys. Soc. Jpn **15** (1960) 952

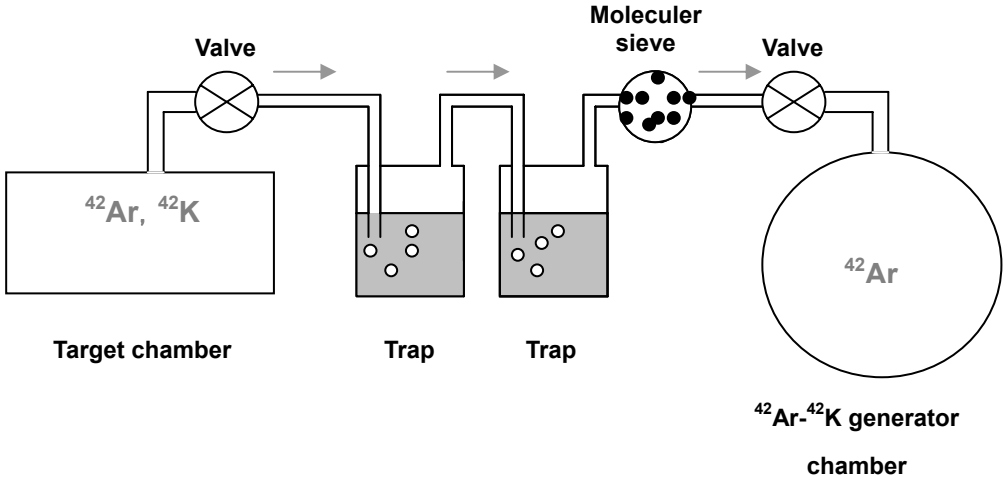

Fig. 1. A schematic view of the target chamber, the bubbling bottles, vessel of molecular sieve and the ^{42}Ar-^{42}K generator chamber.

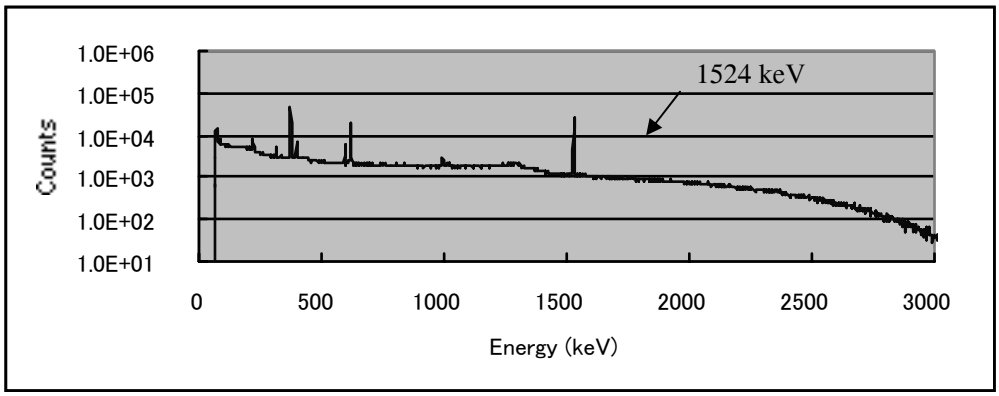

Fig. 2. A typical γ-ray spectrum of ^{42}K radionuclides collecting from the target chamber.