Production of purified ^{85}Sr solution

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Since 2007, we have distributed purified radioisotopes such as ^{65}Zn, ^{88}Y, and ^{109}Cd to the general public.[1] After the Fukushima Dai-ichi Nuclear Power Plant accident in 2011, the demand for ^{85}Sr solutions having a high specific radioactivity has been growing. In this work, we investigated the production of ^{85}Sr in the ^{85}Rb(d,2n)^{85}Sr reaction using a 24-MeV deuteron beam from the RIKEN AVF cyclotron. We also studied a chemical procedure to obtain a purified ^{85}Sr solution.

^{85}Sr ($T_{1/2}$ = 64.853 d) was produced by irradiating an RbCl disk (Sigma-Aldrich; chemical purity: > 99.99%; thickness: 500 mg cm^{-2}) of natural isotopic abundance with 24-MeV deuterons. The average beam intensity was 159 nA. The irradiation time was 17 min. ^{85}Sr was chemically separated in accordance with the scheme shown in Fig. 1. The irradiated RbCl target was dissolved in 2 mL of H_2O and 2 mL of 8 M HNO_3. After evaporating the solution almost to dryness, the residue was again dissolved in 2 mL of 8 M HNO_3. The resulting solution was evaporated to dryness to remove chloride ions, and the residue was dissolved in 4 mL of 8 M HNO_3 and loaded onto a reversed-phase extraction chromatography column (ϕ5 mm×50 mm height) packed with Sr Resin (Eichrom; 100–150 mesh). The column was then washed with 12 mL of 8 M HNO_3. In this process, ^{85}Sr was absorbed on the Sr Resin, and the target material of Rb was completely eluted, as traced with byproducts of ^{84}Rb and ^{86}Rb. ^{85}Sr was then eluted with 8 mL of 0.05 M HNO_3. The eluent was evaporated to dryness, and the residue was dissolved in 1 mL of concentrated HCl (c. HCl). After evaporating the solution almost to dryness, the residue was dissolved in 2 mL of 0.1 M HCl and loaded onto a column (ϕ5 mm×40 mm height) packed with a cation-exchange resin (Dowex 50W×8; 200–400 mesh). The column was then washed with 3 M HCl. ^{85}Sr was eluted with 6 M HCl. The activity of ^{85}Sr was determined through γ-ray spectrometry using a calibrated Ge detector.

The γ-ray spectra of the produced ^{85}Sr are shown in Fig. 2. The produced activity of ^{85}Sr was 145 kBq, and the radionuclidic purity was > 99.9%. The production yield of ^{85}Sr under the present experimental condition was about 3 MBq μA^{-1} h^{-1}. The chemical yield was 89%.

The chemical impurity in the purified solution will be evaluated by using ICP MS for a control sample, which was treated using the same procedure as that used for the irradiated sample, in further studies.

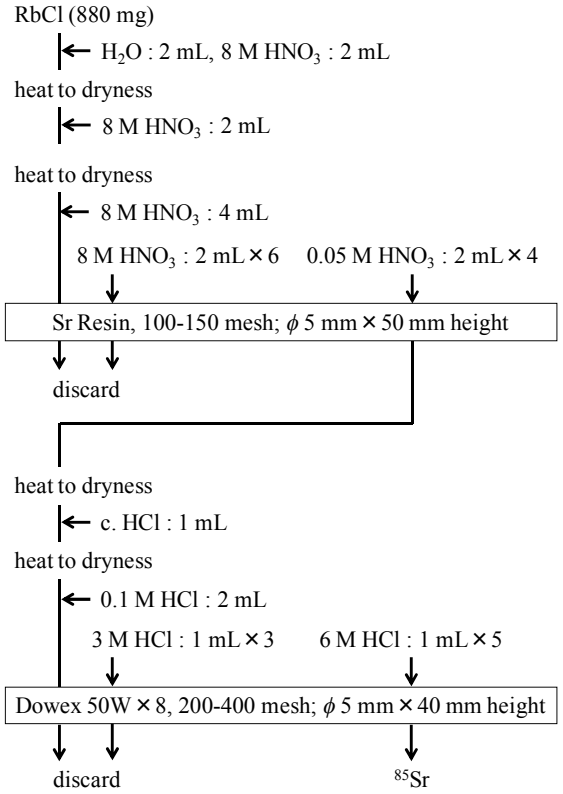

Fig. 1. The chemical separation procedure of ^{85}Sr from the irradiated RbCl target employed in the present study.

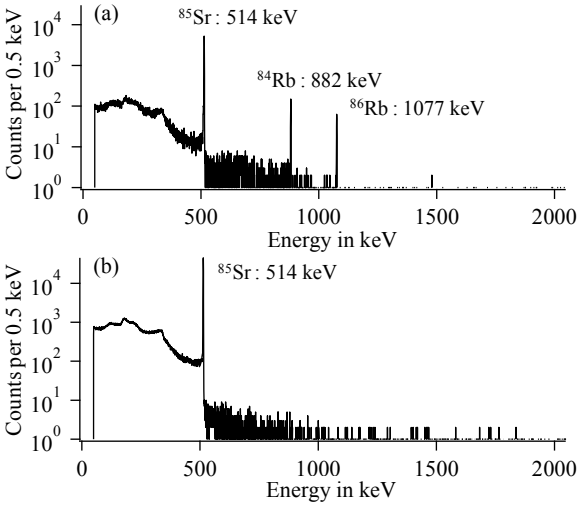

Fig. 2. The measured γ-ray spectra of the produced ^{85}Sr. (a) and (b) were obtained before and after the chemical separation, respectively.

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References

1) T. Kambara et al.: a separate paper in this issue.