§3. Lithium Isotope Fractionation on Ion Exchange Reaction and its Application to Isotope Separation

Suzuki, T., Tachibana, Y. (Nagaoka Univ. Tech.),
Sugiyama, T. (Nagoya Univ.),
Tanaka, M.

Tritium is used as fusion fuel, but natural abundance among hydrogen isotopes is too low. Thus, the tritium must be produced artificially. The $^{6}Li(n,\alpha)T$ reaction is a most well-known tritium breeding method. For the effective breeding the tritium, the enrichment of lithium-6 is necessary, since the natural ratio of lithium-6 is about 7.5%. We are proposing the lithium-6 enrichment method by using the ion exchange.

In this report, the lithium isotope separation by the cation exchange chromatography and the cross-linkage effect on the isotope fractionation are described. And the synthesis of new cation exchange resin is also reported.

We used some cation exchange resins with different cross-linking degrees. Each cation exchange resin was filed in a glass column, 1 cm ID and 1 m of length. The cation resin in the column was conditioned to H^{+} type resin. The lithium ion was adsorbed on the conditioned column by flowing the 0.5 M lithium acetate solution. The lithium was eluted by flowing the 0.5 M potassium acetated solution. Three examples of the chromatogram and the lithium isotope fractionation are shown in Fig. 1. The chromatograms and the isotope fractionation curves are similar form, and the adsorption amounts are different. From the isotope fraction curves, we confirmed that the lithium-6 is enriched in the resin phase. The separation coefficient, ε, was calculated from the chromatogram and isotope fractionation curve. The relationship between the calculated separation coefficient and the cross-linking degree of the used resin is shown in Fig. 2. We can see that the separation coefficient have a linear relationship to the degree of cross-linkage. This result shows that the separation coefficient can be raised by increasing the degree of cross-linkage of resin.

By the way, many researchers are exploring the cation exchanger with the higher separation factor. Lithium isotope separation factors in many system are summarized in Tables of Ref. 1 very well. The higher separation factors were generally obtained in the case of using inorganic cation exchanger than in the case of using organic cation exchange resin. From our result of cross-linkage effect, we have an intense interest in how close the separation factor obtained by cation exchange resin with higher cross-liking degree can approach one by inorganic exchanger. Thus, we tried the synthesis of cation exchange resin with higher cross-linking degree. In this fiscal year, we synthesized the sulfo-type strongly acidic cation exchange resin with 50% degree of cross-linkage. We have plan of lithium isotope separation experiment using this synthesized resin in next fiscal year.

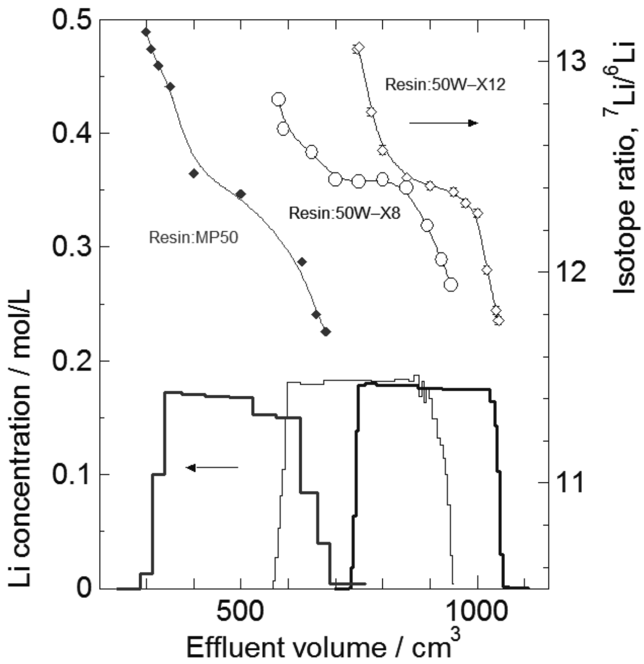

Fig. 1. Example of the chromatograms and the lithium isotope fractionation curves by the lithium cation exchange chromatography.

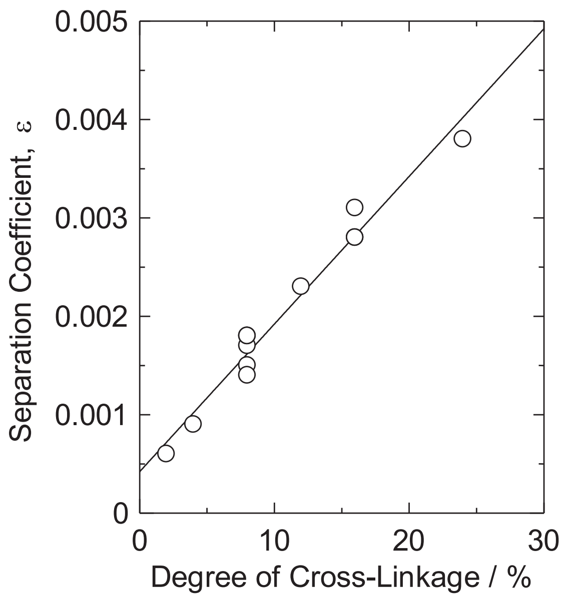

Fig. 2. Cross-linkage effect of cation exchange resin on isotope fractionation.

1) Gu, Z., Li, Z., and Yang, J. :Prog. Chem. 23(2011)1892 (in Chinease).