

§10. Measurement of the Isotope Ratio of Lithium Extracted from Sea Water

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i) Introduction

The resource value of lithium, which is indispensable to fusion blanket, has been rapidly increasing with the demand for production of large capacity rechargeable batteries. Lithium in sea water, 230 billion tons in total, is one of the attractive resources for this purpose. Selective recovery of lithium from sea water with a novel λ -type manganese dioxide adsorbent was demonstrated in a pilot-scale plant.^{1,2)}

Although natural lithium contains only about 7.6 % of ^6Li , isotopic enrichment of ^6Li up to 30-90 % is required for adequate tritium breeding in many fusion reactor concepts. In the case of lithium recovery from sea water, isotopically selective recovery of ^6Li is very preferable from the viewpoint of ^6Li enrichment for the fusion blanket. The purpose of the present study is to measure the isotope ratio of lithium which was extracted from sea water using the novel λ -type manganese dioxide adsorbent.

ii) Measurement of the isotope ratio

Selective recovery of lithium from sea water was performed in the following manner. Sea water of total amount 816 m³ was fed into a column packed with a novel λ -type manganese dioxide adsorbent of 60 kg for 150 days. Dilute hydrochloric acid of 0.4 m³ was subsequently fed into the loaded column to obtain lithium in the eluent. Solid deposit of lithium chloride was obtained from the eluent by an evaporation crystallizer. Composition of the solid deposit in the chloride form is summarized in Table I.

The isotopic ratio of ^6Li to ^7Li was measured in the following manner. The solid deposit of 0.1 g was dissolved with deionization water of 100 cm³. The solution was diluted 200 times so that the content rate of lithium became about 200 ppb. The isotopic ratios of ^6Li to ^7Li for this sample solution and a control solution were measured with a double focusing sector field type ICP-MS instrument (Finnigan MAT ELEMENT, Fig. 1). The control solution was prepared from commercially available lithium chloride reagent (Sigma-Aldrich Japan).

iii) Results and discussion

The isotopic ratios of ^6Li to ^7Li are summarized in Table II. The value of the sample from sea water is smaller than the natural isotopic ratio of ^6Li to ^7Li , which is 0.081. The present result implies that ^7Li adsorbs stronger than ^6Li on the novel λ -type manganese dioxide adsorbent. It is not preferable from the viewpoint of ^6Li enrichment for the fusion blanket. The isotopic ratio of the control solution was also smaller than the natural value. It is said that ^6Li has already been recovered from commercially available lithium in overseas for military purposes.

For further research, it is important to evaluate the enrichment factor and the HETP value of the column packed with the adsorbent, in order to develop a measure to recover and enrich ^6Li efficiently.

iv) Conclusion

The isotopic ratio of ^6Li to ^7Li in the solid deposit, which were recovered from the sea water with the novel λ -type manganese dioxide adsorbent, was measured. The value was obtained as 0.068 ± 0.006 and was smaller than the natural isotopic ratio. The present result implies that ^7Li adsorbs selectively rather than ^6Li on the adsorbent and that it is not preferable from the viewpoint of ^6Li enrichment for the fusion blanket.

Table I Composition of the solid deposit

Element in the chloride form	Ratio [%]
LiCl	24.3
NaCl	24.5
KCl	17.8
MgCl ₂	2.3
CaCl ₂	21.6
MnCl ₂	4.7
SrCl ₂	6.0



Fig. 1 Double focusing sector field type ICP-MS instrument (Finnigan MAT ELEMENT)

Table II Isotopic ratio of ^6Li to ^7Li

Sample obtained from sea water	0.068 ± 0.006
Control solution	0.050 ± 0.007

- 1) K. Yoshizuka, K. Fukui and K. Inoue: *Ars Separatoria Acta*, **1** (2002) 79-86.
- 2) A. Kitajou, Y. Suzuka, S. Nishihama, T. Suzuki and K. Yoshizuka: *J. Ion Exchange*, **17** [1] (2006) 7-13.