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液体金属と塩化物溶融塩間におけるリチウム６同位体の平衡分配
Lithium isotope distribution between liquid metal and chloride molten salt

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1. Introduction

Tritium is necessary as fuel for fusion reactors. It is mainly produced by the nuclear reaction between lithium-6 (^{6}Li) and neutrons in the blanket. However, lithium (Li) contains only 7.6% ^{6}Li in nature and needs to be enriched to 90% for fusion reactors[1]. The mercury amalgamation method[2] is a two-liquid-phase chemical exchange system (liquid/liquid system) and the only practical way to enrich ^{6}Li though there are concerns about the environmental impact of mercury. This study focuses on the new liquid/liquid system with liquid metal and chloride molten salt. ^{6}Li isotope separation factor (α) was obtained, where α>1 shows that ^{6}Li is distributed more in liquid metal than in chloride molten salt. Also, their temperature dependencies were investigated.

2. Method

Li or Li–Pb eutectic alloy (Li–Pb) was sealed with LiCl–KCl in capsules. The capsules were rotated at 4 rpm at a constant temperature (370 °C, 410 °C, and 450 °C) for 12 hours in an electric furnace. The liquid metal and chloride molten salt were stirred upside down inside the capsules (Fig. 1). They were cooled to room temperature and taken out. Li was dissolved in water. Li–Pb, and LiCl–KCl were dissolved in acid solutions. Each solution was diluted with dilute nitric acid. Inductively coupled plasma spectrometry (ICP–MS) measurements were performed to quantify the ratio of ^{6}Li to ^{7}Li.

3. Result and Discussion

α is defined by the following equation,

$$\alpha = \frac{([\,^6\mathrm{Li}]/[\,^7\mathrm{Li}])_{metal}}{([\,^6\mathrm{Li}]/[\,^7\mathrm{Li}])_{salt}} \qquad (1.1)$$

The obtained α are shown in Fig. 2. Each data has an error that shows the 68% confidence interval. In the system with Li and LiCl–KCl at 370 °C, and the system with Li–Pb and LiCl–KCl at 370 °C and 410 °C, α were greater than 1. ^{6}Li was probably distributed more in liquid metal. On the other hand, the temperature dependencies were not obvious in both systems, considering the error bars. The more accurate analysis results will be shown at the conference.

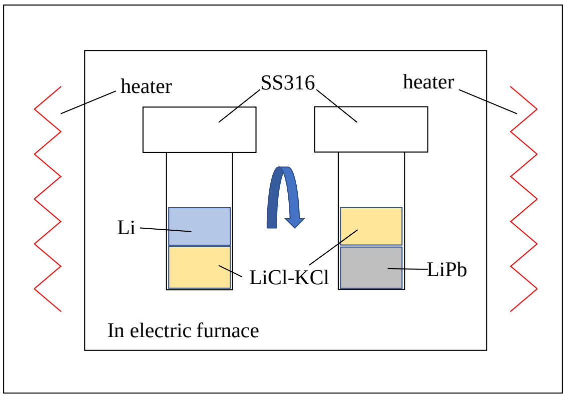

Fig. 1 Schematic diagram of the experimental set–up

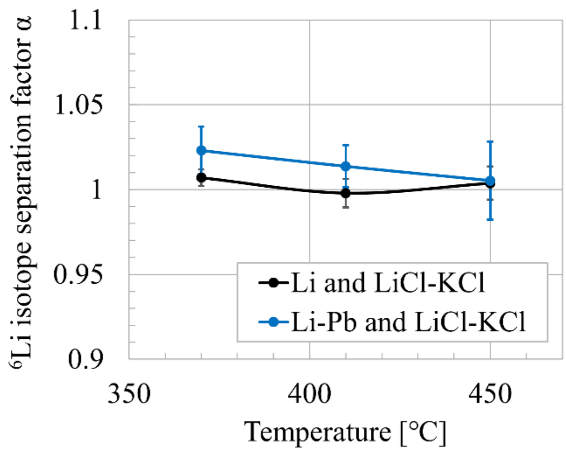

Fig. 2 ^{6}Li isotope separation factor between liquid metal and chloride molten salt at 370 °C, 410 °C, and 450 °C

<Reference>
[1] K. Tobita, et al., Fusion Sci. Technol 75, 372-383, 2019
[2] A. A. Palko, et al., J. Chem. Phys 64, 1828-1837, 1976