§13. An Experimental Study to Recover Tritium by Y Metal from IFMIF Li Loop

Fukada, S. (Kyushu University)
Muroga, T.

Liquid lithium is proposed as IFMIF target to produce fast neutron for the material irradiation test of ITER. In the target Li loop, around 7 g tritium per year is estimated to be generated and be dissolved in Li. Tritium is present in Li with N and O impurities as well as other hydrogen isotopes of H and D. Yttrium bed is a promising way to recover tritium from the flowing Li flow. Previously, the Y bed was proposed by an ORNL group in US, and the possibility of tritium recovery from Li was made sure. However, the dependence of the recovery rate on temperature was not experimented. In the present study, the hydrogen isotope diffusivity in Li and the recovery of hydrogen from Li by Y were investigated experimentally.

Two experimental programs were conducted this year as follows; (1) to test the recovery of hydrogen through Li to Y metal and (2) to determine the hydrogen diffusivity in liquid Li. In the first experiment, only Li or Y immersed in Li was put in a Mo crucible in a quartz-glass tube in an Ar glove box. The system was evacuated by a turbo-molecular pump before gas introduction, and a mixture of Ar and H_2 (100 ppm) was introduced into the quartz-glass tube. Variations of the outlet hydrogen concentration detected by gas chromatography with time are shown in **Fig. 1**.

As seen in Fig. 1, hydrogen was dissolved in Li and also in Y immersed in Li at 500 °C. The total hydrogen absorption amount was 0.03 in H/Li atomic ratio and 1.6 in H/Y. Thus, Li was in the α phase and Y was in the β phase. In other words, hydrogen in Li can be recovered by Y at 500 °C. The difference between the two data corresponds to the amount of hydrogen recovered from Li to Y. The absorption rate of Y was almost unchanged between Y immersed in Li and Y in Ar. Thus high hydrogen absorption capacity can be expected in Y immersed in Li.

Diffusivity of hydrogen isotopes in Li is a key factor to design a trap to recover tritium from flowing Li. Previously two experiments were present. However, there was large discrepancy between the two experiments. Therefore, hydrogen diffusivity was here determined by a capillary method. Each side of a stagnant liquid Li layer with 3 cm in length was disposed to Ar+H_2 or Ar flow. The permeation rate of hydrogen through Li was detected by gas chromatography. Variations of the hydrogen concentration with time were fitted by numerical simulation, and diffusivity and solubility of H in Li were simultaneously determined. **Fig. 2** shows comparison of the hydrogen diffusivity in Li between experiment and previous data. Our data were present in extrapolation from Alire's correlation. Moriyama's correlation was consistent with the Li self-diffusivity but was inconsistent with our data. Since diffusivity may be affected by the hydrogen concentration in Li, further work is necessary to make clear the diffusion behavior.

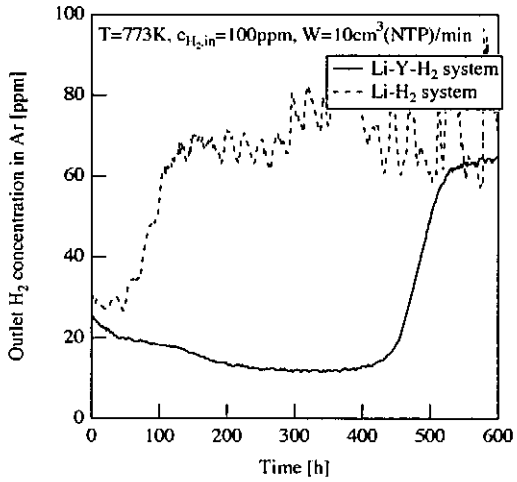

Fig. 1 Absorption of hydrogen in Li-H_2 and Li-Y-H_2 system

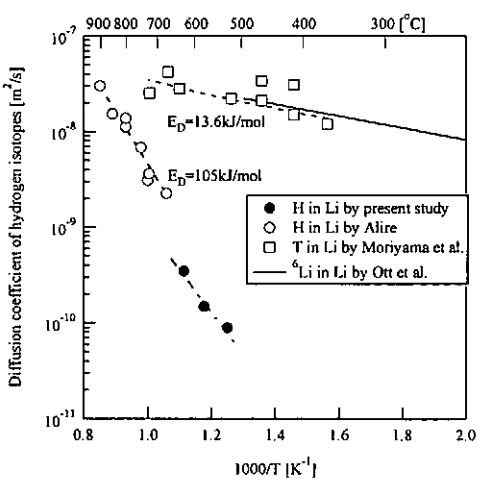

Fig. 2 Diffusivity of hydrogen in liquid Li

Reference

(1) S. Fukada et al., Proc. of 2004 spring meeting of Japan Atomic Energy Society, (2004).