§12. Control of Nitrogen Concentration in Liquid Lithium by Fe-Ti Alloy

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Efficiency of tritium recovery from liquid lithium is depressed by the formation of nitride film on tritium gettering materials such as yttrium. Hence, reduction of nitrogen concentration is an important subject to apply the liquid lithium to breeding blanket. Immersion of a nitrogen gettering material in liquid lithium, namely the hot trap method is one of the promising techniques to cut down the nitrogen concentration. Materials, which are easy to make nitride and have a high compatibility with lithium, are used as the nitrogen getter. In the present work, the capability of Fe-Ti alloy was investigated. High diffusion constant of nitrogen in iron and large affinity of nitrogen with titanium are expected to result in the excellent getter performance.

Alloys of Fe-10at.%Ti and Fe-5at.%Ti with surface area of 2400 mm^2 were used as a sample. The sample was introduced into liquid lithium whose initial nitrogen concentration was controlled at 100, 250 and 350 ppm by Sieverts' method, and the immersion test was conducted at 873 K. The nitrogen concentration of the liquid lithium was measured by the ammonia method once a day until the reduction in the concentration was stopped. Fig. 1 shows the experiment system for immersion and N concentration measurement. After a series of immersion test, sample was analyzed using SEMS, XRD and EPMA in order to verify distribution and existence nature of nitrogen.

Fig, 2 shows nitrogen concentration change after the start of immersion. In the case of the initial nitrogen concentration of 300 ppm, rapid decrease to around 100 ppm was observed in the first two days without dependence on the alloy composition. The absorption rate in initial two days was estimated to be 1-2 g m^{-2} $day^{0.5}$. Additional absorption was not observed after that. It was appeared that the getter performance of the Fe-Ti alloy was similar or higher than that of the V-Ti alloy reported by Sakurai. When we started from 100 ppm, the nitrogen concentration continuously decreased to 30 ppm in 7 days. The absorption seems to be parabolic and the rate was estimated to be 0.3g m^{-2} $day^{0.5}$. Hence Fe-Ti alloy is considered to be effective after the nitrogen concentration becomes relatively low. Fig. 3 shows the XRD analysis for Fe-5%Ti. TiN was considered to be formed from Fe_2Ti in this alloy. From these experimental results, mechanism of nitrogen gettering was discussed.

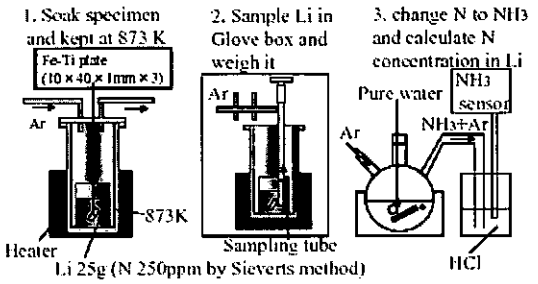

Fig.1 Experiments of gettering and N concentration measurement

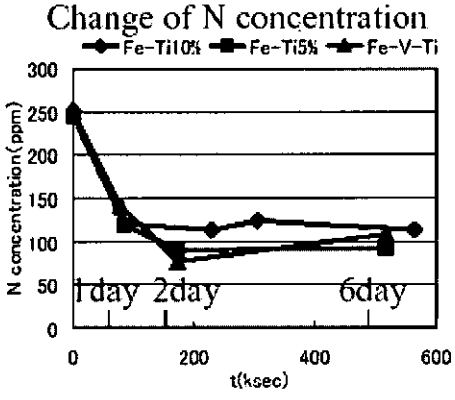

Fig. 2 Nitrogen concentration change by gettering (Fe-10%Ti, Fe-5%Ti, Fe-V-Ti, 873K)

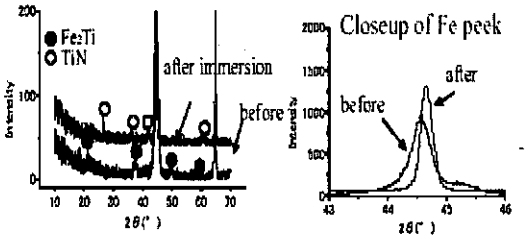

Fig. 3 XRD analysis for Fe-10%Ti (before and after immersion)