§59. Recovery of Metal Impurities in Pb-17Li Natural Convection Loop

Kondo, M., Ishii, M. (Tokai Univ.),
Norimatsu, T. (Osaka Univ.),
Muroga, T.

Lead lithium alloy (Pb-17Li) is a candidate tritium breeder of the inertial fusion reactor KOYO-FAST. The compatibility of Pb-17Li with the structural materials is the one of critical issues, and has been studied for the development of the blanket system. A reduced activation ferritic martensitic (RAFM) steel is the candidate structural material of the blanket. The corrosion of the RAFM steels was based on the dissolution of the steel elements (i.e Fe and Cr) into the Pb-17Li. The solubility of metals in Pb and Pb-17Li was summarized in Fig. 1. The solubility of Cr in Pb-17Li must be low as the solubility in pure Pb is low. However, it was known that the dissolution ratio of Cr from the steel surface into the Pb-17Li was large[1]. These facts indicate the precipitation of Cr at the low temperature region of the blanket system can be large, and can cause the loop plugging accident[2]. The recovery method of the metal impurities from flowing Pb-17Li was not made clear so far. In the present study, preliminary study on the recovery of Cr metal from liquid Pb-17Li at a static condition was performed. The purpose is to investigate the Cr removal in Pb-17Li by Mo hot trap due to the alloying procedure.

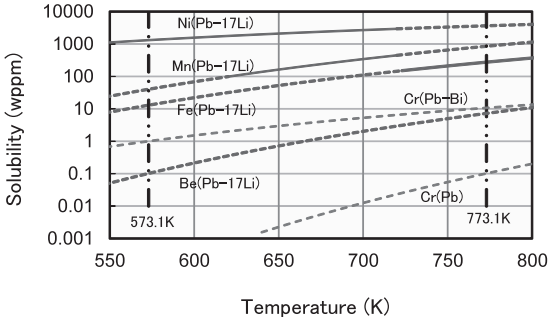

Fig. 1 Solubility of metals in Pb and Pb-17Li

Figure 2 shows the experimental set up. The test conditions were summarized in Table 1. The crucible was filled with Pb-17Li (3cc). Then, the rectangular plate type specimen was immersed in the Pb-17Li. The Mo foil was placed along the crucible inner wall in the Pb-17Li. The specimen assembly was placed in the vessel filled with Ar gas (purity: 99.999%). The test temperature was 873K and the test duration was 250 hours. After the experiment, metallurgical analysis on the surface cross section of Mo foil and the crucible was performed. The result of the metallurgical analysis in Test A was shown in Fig.3, and indicated the removal of Cr by trapping on the Mo foil in Pb-17Li. Some part of trapped Cr diffused into the inside of the foil. However, some part of Cr was precipitated near the crucible inner wall due to the cold trap effect during the cooling procedure of the specimen assembly after the experiment. Carbon (C) dissolved in Pb-17Li was also trapped near the surface of Mo foil and Nb crucible.

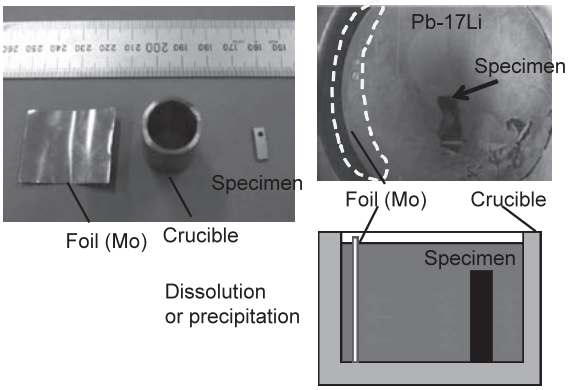

Fig. 2 Specimen assembly

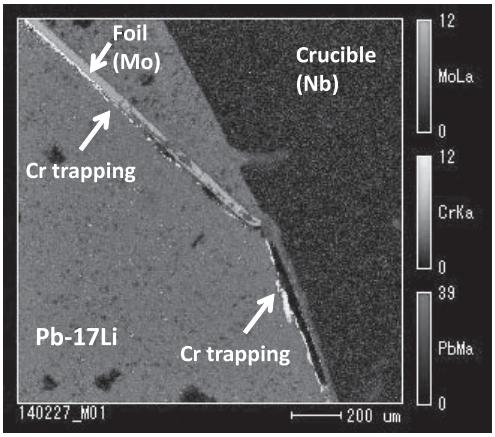

Fig. 3 Result of EPMA analysis of Cr mapping on the cross section of Mo foil in Test A

1) Kondo, M. et al., Fusion. Eng. Des. **87**, 1777 (2012).
2) Kondo, M. and Takahashi, M. Prog. Nucl. Energy, 47: 639 (2005).

Table 1 Test conditions

	Specimen A (Rectangular plate)	Specimen B (Foil)	Crucible	Time (hour)	Temperature (K)
Test A	Cr	Mo	Pure Nb	250	873
Test B	Fe	Mo	SUS316 (Fe-18Cr-12Ni-2Mo)	250	873
Test C	Cr	Mo	SUS316 (Fe-18Cr-12Ni-2Mo)	250	873
Test D	Nb	Mo	SUS316 (Fe-18Cr-12Ni-2Mo)	250	873