§2. Corrosion Study on Natural Convection Loop for Liquid Li Blanket System of Fusion Reactor

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The lithium exposure experiments were carried out in flowing condition for low activation ferritic steels and ceramic materials using rectangular plate type specimens.

Figure 1 shows the schematic of a natural convection Li loop. The loop was set up and operated in Tokyo Univ. The size of the channel is 15cm in height and 35cm in width. The Li inventory was 180cc. The loop was made of SS316 (18Cr-12Ni), and equipped with an upper tank and a drain tank. The temperature of the loop was controlled by the thermocouples and winded heaters. The thermocouples were set on outer wall and the five heaters were winded on upper tank, cooling region, low temperature region, heating region and high temperature region.

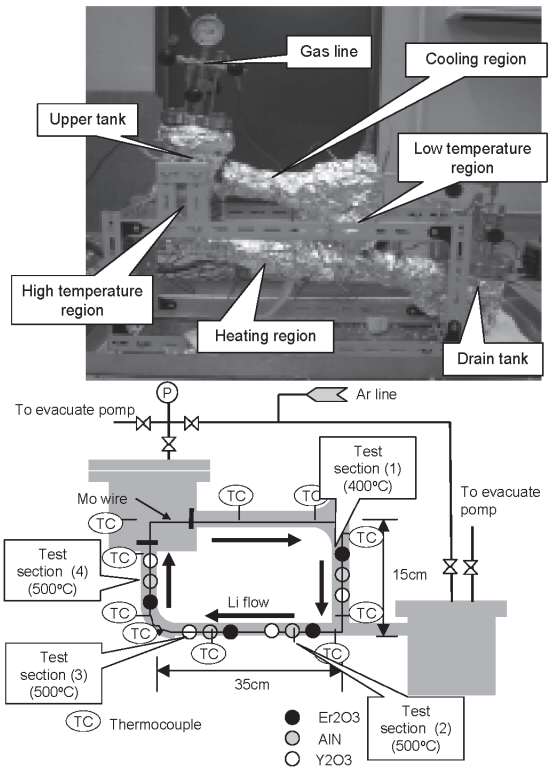


Fig. 1 Li natural convection loop system

The JLF-1 steel (9Cr-2W), Er_2O_3, Y_2O_3 and AlN specimens were placed in the loop. These specimens were connected with each other using Mo wire, and placed in the four parts in the loop. After the exposure, adhered Li on the specimen surfaces were removed by water and the corrosion characteristics were investigated by means of weight loss measurement and SEM/EDX analysis.

Figure 2 shows the specimens after exposure. The weight losses of specimens in the heating region were larger than the other part. The specimens placed in the low temperature region gained slightly the weights. These were due to the phenomenon of mass transfer, and this caused the dissolution corrosion in the high temperature region and deposition of dissolved material in the low temperature of the loop. The corrosion characteristics of ceramic materials in detail were reported in ref.[1].

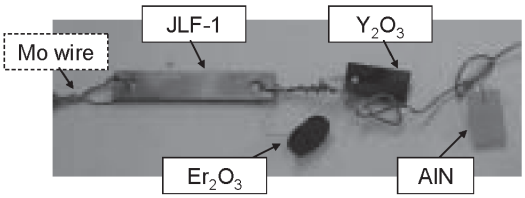


Fig. 2 Specimens after exposure

Figure 3 shows the cross section of JLF-1 specimen placed in the heating region. 10μm of phase transformation was found on JLF-1. In the ferrite layer, weight ratio of Cr was decreased. This corrosion characteristics was compared with those obtained in static tests, and it was found that mass transfer accelerated the corrosion.

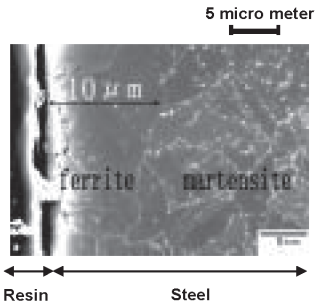
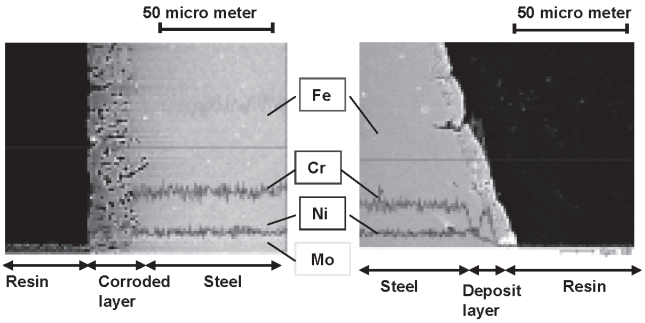


Fig. 3 Cross section of JLF-1 specimen in heating region

After the operation, the loop tube was disassembled into some parts and the tube interior wall was analyzed by SEM/EDX in order to investigate the mass transfer phenomenon. Figure 4 (a) shows the cross section of SS316 specimen placed in the heating region. So-called liquid metal corrosion was observed in 10μm depth. In the corroded layer Cr and Ni was dissolved due to their high solubility in Li. The dissolved Ni in Li was deposited in the low temperature region of the loop.



(a) (b)

Fig. 4 Cross section of SS316 loop tube placed in (a) heating region and (b) low temperature region

Reference

[1] Nagura, M., Kondo, M., et al. Proceeding of Int. Conf. of 17th TOFE (2007) *accepted.*