

§5. Influence of Non-metal Impurity on Corrosion in Liquid Lithium

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Liquid metals lithium (Li) is considered as a coolant and a tritium breeder for the blanket systems of fusion reactors. The important issue is the compatibility of structural materials with the liquid lithium. Purpose of the present study is to investigate the influence of the non-metal impurity in Li on the corrosion of reduced activation ferritic martensitic (RAFM) steel.

The RAFM steel, JLF-1 (JOYO-HEAT), was used as a test material for corrosion tests. The chemical composition in weight percent is 9Cr–1.98W–0.49Mn–0.2V–0.09C–0.015N and balance Fe. The corrosion tests were performed at a static condition. The influence of the non-metal impurities (C, N or O) was individually investigated. The concentration of the non-metal impurity in Li was adjusted by the addition of powders of Li_2O , Li_3N or carbon into the melts. After the dissolution of the powder in the melts, the specimen was immersed into the melts. The concentration of oxygen, nitrogen and carbon in Li was 0.8wt%, 0.5wt% and 3.7wt%, respectively. The test temperature was 600°C. The exposure time was 250, 287 and 750 hours for the test in pure Li, carbon doped Li, oxygen doped Li and nitrogen doped Li, respectively. After the tests, specimen was cleaned in ethanol to remove an adhered Li.

Fig. 1 shows the weight loss of the specimens after the exposure. Fig. 2 shows the SEM image of the specimen surface after the exposure. The corrosion in Li was small when the Li was high purity (Fig.1 and Fig. 2 (b)). However, nitrogen dissolved as a non-metal impurity in the Li could increase the corrosion. In the corrosion reaction, unstable ternary nitrides were formed and dissolved in the Li (Fig. 1 and Fig.2 (e)). The carbon in the steel was depleted in Li when the carbon potential was low in the Li. On the contrary, the high concentration of carbon in the Li could suppress the

carbon depletion from the steels and the phase transformation (Fig.2 (c)). It was newly found that the corrosion can be larger when the concentration of oxygen in the Li was higher (Fig.2 (d)).

It was found that the corrosion of structural materials can be suppressed by the control of non-metal impurity (C, N and O) in the Li.

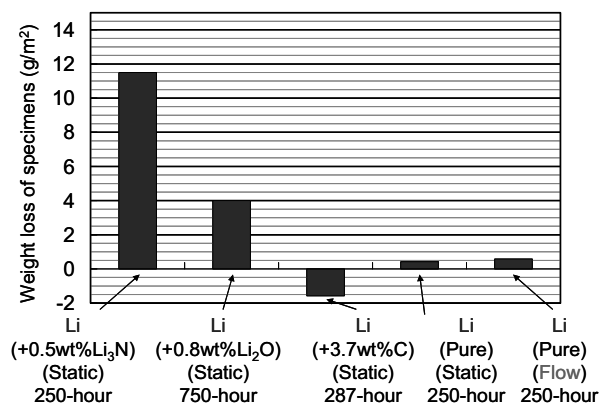


Fig. 1 Weight loss of specimens by corrosion test in Li

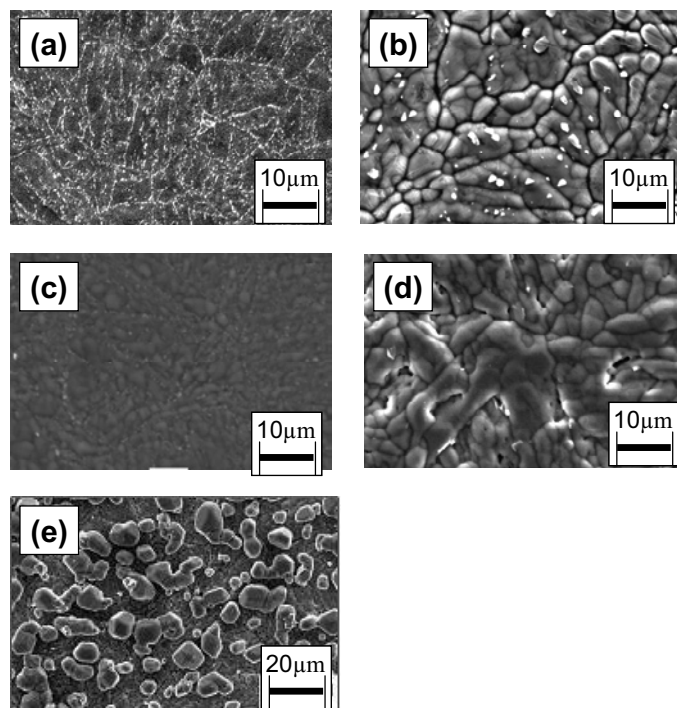


Fig. 2 SEM image of specimen (a) initial, (b) after immersion in pure Li, (c) after immersion in carbon doped Li, (d) after immersion in oxygen doped Li and (e) after immersion in nitrogen doped Li