Corrosion Behavior of Insulator Coatings for Fusion Reactor Lithium Blankets

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A liquid lithium blanket is an attractive system because of its high effectiveness, low irradiation, continuous operation and its compact system. However, there is a serious problem called MHD pressure drop, which is Lorentz force opposite direction to the lithium flow. To solve this problem, it is suggested to construct insulate coatings on inner pipe walls. The coatings must have high resistivity to reduce MHD pressure drop, and also have high chemical stability in liquid lithium, which has high reduction activity, at high temperature. Several ceramic materials were suggested from the point of chemical stability and investigated with bulk materials by sintering in liquid lithium, AlN, Y_2O_3 and Er_2O_3 are thought as good candidate materials. The purpose of the present study is to characterize corrosion behavior of the coatings of the three candidate ceramics fabricated by RF sputtering.

The coatings were sintered in 300-500 ^oC liquid lithium, and after the sintering the specimens were sintered in water to remove lithium remaining on the specimens. In the case of Y_2O_3 and Er_2O_3 coatings, the samples sintered at 300 ^oC were damaged little, while the coatings almost disappeared after sintering at 500 ^oC. Observation by SEM showed that there were little pits on the surfaces of the specimens sintered at 300-400 ^oC, and there were little fragments of the coatings remaining on the specimens sintered at 500 ^oC. This suggests that there were some pits on the coatings, and the coatings were broken and peeled off from the pits. There were already same kinds of pits on the coatings after annealing at 300-500 ^oC. In addition to the sintering in water, vacuum distillation method was applied to remove the remaining lithium, for the samples after sintering in liquid lithium. Although there were many pits on the surface of the coatings, there was almost no destruction or separation. It is considered that the pits were formed by the heating, not by the reaction with liquid lithium, and thus the coatings were stable in liquid lithium. On the other hand, AlN coatings had no pits after annealing; however, the coatings almost disappeared even after sintering at 300 ^oC, with only small fragments remaining. It is considered that destruction and separation of the coatings also happened in the case of AlN coatings.