

§5. Development of Multi Layer Wall Channel to Reduce MHD Pressure Drop

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In order to employ liquid lithium as coolant material in fusion blanket system, it becomes critical to reduce MHD pressure drop and develop coating technique for insulating the inside wall of metal channel. In these concepts, however, cracking in the insulator layer might become fatal to increase the MHD pressure drop drastically[1]. To avoid this fatal failure, three layer wall was proposed where inner thin metal layer protect permeation of lithium into the crack of coated layer as shown in fig.1. In this concept, structural integrity of the inner thin layer becomes important because shear stress from the liquid metal flow is relatively large. In the previous study, the coating method using HVOF system was applied to form the thin coating layer of Al_2O_3 [2]. In this study, therefore, the MHD pressure drop is measured experimentally. Figure 2 shows the cross section of channel simulating the three-layer channel, which is composed from SUS front and inner wall, insulating tape and aluminum plate corresponding to outer thick wall in fig.1. Working fluid is KOH and 1.22T is applied transverse to the flow direction and normal to the front wall. In fig.4, the MHD pressure drop is plotted for 6 cases. The concentration of KOH is 15%, 30% or 48%. By increasing the concentration, the pressure drop increases. This change is, however, not due to the MHD effect caused by changing the electrical conductivity, but due to the change of viscosity. Even though the magnetic field is applied, the pressure drop does not change. The reason of this result is that the threshold electrical voltage for KOH electrolysis is about 2 V while the induced voltage in this experiment is 5 mV. In order to verify the three-layers coating system, it is necessary to perform the experiment using liquid metal such as Ga or wood metal in future research.

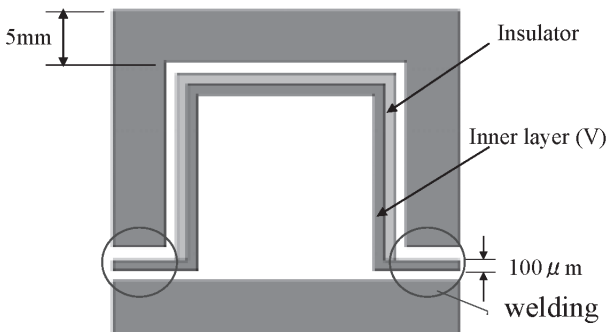


Fig.1 Three layer channel for Lithium

The method for coating should also be improved since the thin metal wall of 100μm thickness was deformed after the HVOF coating, for example, by introducing the initial deformation to make the final shape be flat after the coating.

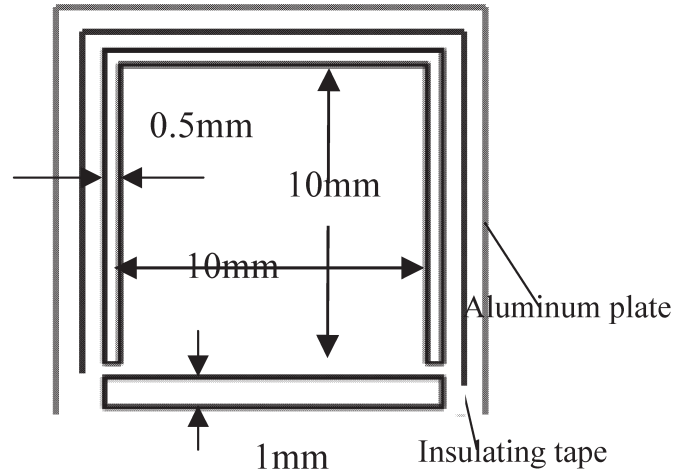


Fig.2 Cross section of channel used in experiment

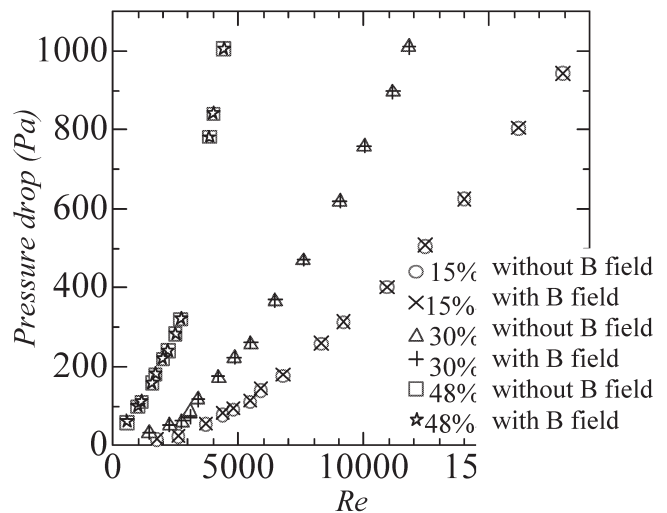


Fig.3 Experimental result for pressure drop

Reference

- [1] H. Hashizume, Fusion Eng. and Design, 81, 1421-1438(2006)
- [2] H. Hashizume, NIFS Annual report (2006)