

## §77. Concept Design of Li-enclosed Capsule in Pile

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A vanadium alloy is expected as a candidate material of blanket system with liquid Li coolant for fusion reactor application. Since there is not yet enough knowledge about radiation effect and compatibility between liquid Li coolant and structural materials, its engineering design cannot be determined. In order to resolve this problem, it is necessary to exam the compatibility experiment in liquid Li with Li-enclosed capsule in pile, so that it is required to develop the Li-enclosed capsule as an irradiation vehicle in pile.

In this study, we discuss the compatibility experiment in liquid Li with Li-enclosed capsule in the domestic reactor such as JMTR and Joyo, and aim at acquiring the data in order to design the capsule.

Task items in this plan are shown in the following;

- Analyses of the tritium production and leakage amount from Li-capsule in irradiation
- Evaluation of thermal expansion difference (TED) in Li-fulfilled capsule
- Analysis of corrosion resistance of material against Li coolant
- Design of Li-enclosed capsule

A cylindrical vessel made by V-5Ti alloy was manufactured in order to design an irradiation capsule enclosed with liquid lithium. A series of rolling work and deep drawing of the V-5Ti alloying were performed in Taiyo Koko Co. Ltd. The cylindrical vessel composed of a pipe with 105mm in length x 22mm OD x wall thickness of 0.5mm. In order to reduce the number of welded joint in the vessel, the deep drawing of pipe products made in V-5Ti was attempted and the vessel manufacture was succeeded. By means of the vessel, specimens of V-4Cr-4Ti alloys designated as NIFS-Heat-2 were enclosed in liquid lithium in the vessel by electron beam welding in vacuum. In order to perform the electron beam welding, a handy-type container was fabricated. The container was prepared for transporting the vanadium specimens and liquid lithium no to touch the air and moisture. Figure 1 shows a photo that the vanadium alloy

specimens were fulfilled with liquid lithium in the vessel. Figure 2 shows a view of the handy-type container for electron beam welding. The manufacturing process of electron beam welding was performed in the SFC Co. Ltd. After the weldment, a visual inspection on the weld point was examined and no crack and leakage could be found. Consequently, it is concluded that the manufacturing process of lithium bonding irradiation capsule and enclosed process of liquid lithium in the vessel can be established. A lithium compatibility test for vanadium alloys at the elevated temperature of 700C will be performed with this capsule in 2013.

A microball with 1.2mm diameter necessary for encapsulation of thermal expansion difference monitor (TED) was made on an experimental basis. It was found that the processing technique was not enough in the real manufacture of microball, and a design of the enclosure plug geometry to take place of microball for endcap encapsulation has been examined. It is expected that component design implementation of TED will be over in 2013 and the settlement of encapsulation approach are aimed in future. A TED performance test in the liquid lithium and the corrosion test are going to be performed soon after the manufacture of TED is succeeded.



Figure 1 : Cylindrical vessels made by V-5Ti alloys with vanadium specimens fulfilled in lithium.

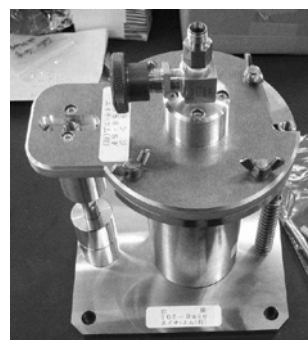


Figure 2 : The handy-type container for electron beam welding.