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IFMIF/EVEDAリチウム試験ループにおける実証試験の進捗 2）リチウムターゲットの厚み変動計測

Progress of Activities in the IFMIF/EVEDA Lithium Test Loop 2) Thickness measurement of Li target

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1. Introduction

In the framework of the Engineering Validation and Engineering Design Activities (EVEDA) of the International Fusion Materials Irradiation Facility (IFMIF), the EVEDA lithium (Li) test loop (ELTL), which is the prototype of the IFMIF Li loop, was constructed and has been operated to validate the stability of the Li target flow and a Li purification system. In the current IFMIF design, the Li target flows along a concave back plate with a thickness of 25 mm and a width of 260 mm at a velocity of 15 m/s under a vacuum condition of 10^{-3} Pa. The current design requires the Li target thickness should be maintained within 25 ± 1 mm. This presentation focuses on the measurement results of Li target thickness and fluctuation with a laser-based distance meter under a pressurized condition.

2. Experiment

The measurement was performed in ELTL. The main Li loop of ELTL produces the Li target in the Target Assembly (TA). TA of ELTL can produce a Li jet of 25 mm in thickness and 100 mm in width at a velocity of up to 20 m/s along a concave flow channel with gradually-changing curvature radius [1].

The measurement device used is a laser distance meter named Optical Comb Absolute Distance Meter, a product of Optical Comb, Inc. Measurement precision was experimentally estimated to be 0.02 mm for measuring the Li target thickness.

The experiments were performed at a Li temperature of 300 °C and at Li speeds of 10, 15, and 20 m/s, which cover the operational range foreseen in IFMIF. The Ar pressure was set to be 0.12 MPa (abs). The data recording time and sampling frequency were 60 s and 500 kHz, respectively. Measurement was done in the region of -50 <= y <= 50 and -50 <= x <= 50, where the origin (x, y) = (0, 0) is defined as the beam center and the x and y directions denote streamwise and spanwise direction, respectively. The region corresponding to the beam footprint of IFMIF is -20 <= y <= 20 and -25 <= x <= 25 in the present case.

3. Result

Fig.1 shows the three-dimensional plot of the average Li target thickness at 15 m/s. The z direction denotes the depth direction (z=0 means the location of the flow channel). As shown in the figure, the target was very smooth on average. Average thickness was 25.80, 26.06 and 26.09 mm for 10, 15 and 20 m/s respectively at the origin. The target slightly increased along the streamwise direction toward the beam center, and after passing the center, decreased toward the downstream region. It can be considered that this phenomenon can be attributed to the gradually-changing channel curvature, in other words, static pressure change along the x direction. In the vicinity of the side wall, the thickness rose toward the side wall. This means Li well wetted to the side wall.

The average and maximum wave amplitude was approx. 0.3 and 1.5 mm at all the velocities, which almost satisfies the design requirement value of 1 mm.

4. Summary

It was found that the Li target was very smooth on average at the velocity of 10, 15, and 20 m/s. The average thickness at the beam center was approx. 26 mm. Average and maximum wave amplitudes were approx. 0.3 and 1.5 mm, respectively. Therefore, we confirmed that the Li target of the current design almost satisfies the design requirement of the target thickness variation of 25 ±1 mm under Ar pressure of 0.12 MPa. The next step is to measure the Li target under a vacuum condition of 10^{-3} Pa.

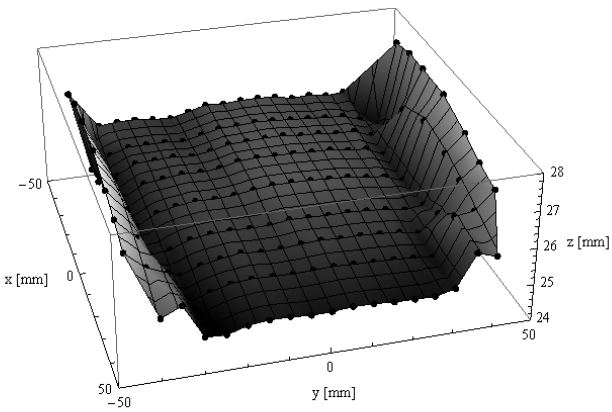

Fig.1 Three-dimensional plot of the average thickness of the Li target at the velocity of 15 m/s
(Black symbols denote measurement data)

References

[1] H. Kondo, et al, Nucl. Fusion **51** (2011) 123008.