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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
1）運転性能に関する各種実証試験
Progress of Activities in the IFMIF/EVEDA Lithium Test Loop
1) EVEDA Li Test Loop Operational Test

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1. Introduction

Engineering Validation and Engineering Design Activities (EVEDA) for the International Fusion Materials Irradiation Facility (IFMIF) have been carried out under the "Broader Approach" (BA) agreement. As a major activity by the Japanese for the Li target facility, the EVEDA Li test loop (ELTL) was constructed at the Japan Atomic Energy Agency's Oarai site to validate the hydraulic conditions of the IFMIF Li target. This paper presents the first operational results of the Li target in the ELTL. A series of tests were performed to check the operational performance of the Li target.

Validations of the performance of the ELTL, the Li target, and the purification system are specified in the first phase of the validation (the phase 1 validation) from the beginning. Finally in this phase, we have established a significant achievement that was observation of the Li target at the design nominal velocity (15 m/s) under a vacuum condition. In this presentation, we focus on tests on observation of the Li target using a normal camera up to the maximum velocity.

2. Experimental facility and condition

The ELTL, whose Li inventory is 5.0 m^3 and platform size is roughly 20 × 20 × 20 m (See our previous report [1] for more details), can produce the Li target at a maximum velocity of 20 m/s under a vacuum condition of around 10^{-3} Pa. The Li target is formed in a component called as the target assembly which consists of a flow straightener, a double reducer nozzle, and a back plate. Li flows into the double reducer nozzle, and is formed as the Li target whose velocity, thickness, and width are 20 m/s (maximum), 25 mm, and 100 mm, respectively along the concave back plate. The Li target is to be observed and measured in detail through a viewing port.

In this study, the flow rate is measured by an electro-magnetic flow meter (EMF). The pressure is measured by a pressure gauge for tests under pressurized conditions and by a vacuum gauge under vacuum conditions. The appearance of the Li target was monitored and recorded by a digital camera (D800 with AS Nikkor 28-300 mm, Nikkon).

The pressure conditions were two cases—pressurized (117, 120 kPa) and vacuum conditions (373, 550 Pa)—and the temperature was set at 300 °C.

3. Results and discussion

Fig. 1 shows photographs of the Li target under the vacuum (373 Pa) condition. The exposure time in all photographs was 2 s to characterize the time-averaged shape of the Li target.

The center of the beam footprint planned in the IFMIF is located 196.97 mm downstream from the nozzle outlet in the current configuration. The area within 30 mm from each side wall is the margin within which the side wall effect should be avoided. The surface wake originated from the corner of the nozzle was initially pointed out as a major factor to disturb the thickness uniformity. Through observation, the side wall margin of 30 mm was sufficient to avoid the surface wake from each side wall. Therefore, the thickness of the Li target was almost flat except for the small surface wakes caused from the center of the nozzle. The contribution of these surfaces wakes to the thickness uniformity was confirmed by a laser distance meter, and therefore, the non-uniformity was confirmed to be within 1 mm. This result will be reported in the near future.

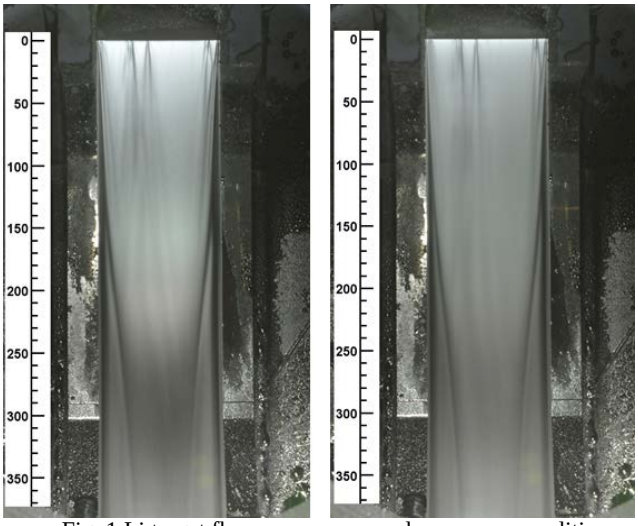

Fig. 1 Li target flow appearance under vacuum condition
Pressure: 373 Pa, Velocity: 15 m/s (left) and 20 m/s (right)

4. Conclusion

In the phase 1 validation of the ELTL, a series of tests on the Li target were initially performed. The tests aimed at establishing the Li target start-up process and preliminary observation of the Li target flow up to the maximum design velocity (20 m/s). As a result, we have successfully established the stable Li target, and the thickness and surface fluctuation of the Li target can be clarified by diagnostics such as a laser thickness meter and a high-speed video camera in the later phase.

References

[1] H. Kondo et al., "IFMIF/EVEDA Lithium Test Loop: Design and Fabrication Technology of Target Assembly as a Key Component", Nucl. Fusion 51 (2011) 123008