§30. Experimental Study on Liquid Lithium Flow for IFMIF Target

Horiike, H., Kondo, H. (Osaka U.), Ida, M. (JAEA), Iida, T., Inoue, S. (Osaka U.), Kukita, Y. (Nagoya U.), Matsui, H. (Tohoku U.), Miyamoto, S. (Osaka U.), Nakamura, Hideo, Nakamura, Hiroo (JAEA), Suzuki, A. (Tokyo U.), Yamanaka, S., Yamaoka, N. (Osaka U.),
Tanaka, T., Muroga, T.

In the current design of IFMIF (International Fusion Materials Irradiation Facility), liquid Li plane jet of 25 mm in depth and 260 mm in width with a flow velocity of 10 to 20 m/s is designed as the deuteron beam target. The target flows along a concave wall with curvature radius of 0.250m, in the vacuum of 10^{-3} Pa. In the present study, Li jet stability is experimentally examined. Free surface waves and wakes generated on the Li jet surface were measured by an electro-contact probe and a pattern projection method.

Test section of the Li loop at Osaka University has a two-stage contraction nozzle that is 1/2.5 scaled model of IFMIF nozzle. The nozzle creates the Li jet of 10mm deep and 70mm wide. The test channel is placed horizontally.

Figure 1 shows picture of the free surface waves on Li jet taken by a CCD camera and strobe. The picture was taken from a viewing port set vertically to the test channel. The port is set at 175 mm downstream from the nozzle on which D beam axis are placed in design. As shown in the figure, waves were generated on the surface, and amplitude of the waves was measured by an electro-contact probe for the velocities of 1 to 15 m/s.

Figure 2 shows experimental results of wave amplitude. The amplitude increases with the velocity and lead to 2.5 mm at the velocity of 15 m/s (center of the flow).

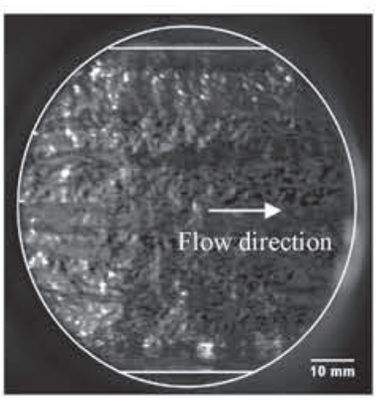

Fig.1. Free surface waves on Li target at the flow velocity of 15m/s

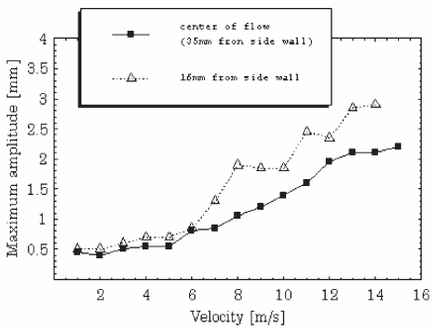

Fig.2. Wave amplitude vs flow velocity at 175 mm from the nozzle. Circles indicate those at the center, and triangles those at 16 mm from the side wall of the channel.

Figure 3 shows surface wakes that are stationary wave pattern caused by a deficit on the nozzle edge. Visual observation showed a small dent in the center of the nozzle edge, which may be produced by erosion or corrosion by Li.

The surface wakes were measured by a image measurement method called as the pattern projection[1]. One result is shown in Fig.4, clearly shows a dent at 1.5mm in Y. The two diagnostics were found to be effective to measure the surface waves on Li flow and would be instrumented in IFMIF.

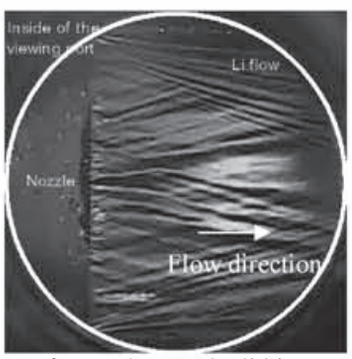

Fig.3 surface wakes on the lithium surface

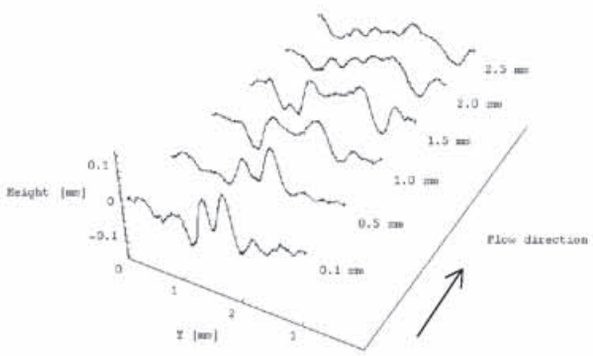

Fig.4 surface wake measured by pattern projection method

Reference
[1] M.Takeda and K.Mutoh, “Fourier transform profilometry for the automatic measurement of 3-D object shapes”, Appl. Opt. 22, 24 pp.3977~3982 (1982)