

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

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In the International Fusion Materials Irradiation Facility (IFMIF), a 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 considered as the beam target. A key technology is liquid Li flow technology in an open channel for the design of the stable target system, and for liquid Li fusion blanket.

In the present program, experiments on a liquid lithium flow for the target flow were performed with using the lithium circulation facility in Osaka University. And as the results, many outcomes were obtained, such as successful measurement of free-surface fluctuation and surface-wave velocity, in the joint research of the LHD Project Research Collaboration between Osaka University, University of Tokyo, Tohoku University, JAEA, and NIFS^{1), 2), 3)}.

In the present report, activities conducted between April 2008 and March 2009 are summarized. In FY 2008, main activities are focused on presentations and publications of our achievements since budget was only planned for traveling expenses.

Table.1 summarizes presentations and publications including domestic meetings and conference, workshops, international conferences, proceedings and papers in FY 2008. Contents of the presentation and papers mainly focused on the measurement of the surface fluctuations and the surface-wave velocity.

Owing to various fruitful discussions at the conferences and to the peer-review processes, positive comments for improvement of the diagnostics were addressed. The authors were greatly appreciate for them, and would like to reflect them to future works of diagnostic system design, for the IFMIF-EVEDA Li loop.

Future works which remain to be solved other than those above are to develop diagnostics applicable to the actual target flow in the IFMIF. Under the IFMIF condition, diagnostics must be radiation-resistant and non-contact methods from a standpoint of continuous monitoring of the dynamic behavior of the lithium target. Thus, development of diagnostics available in the IFMIF is a crucial task.

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Table.1 Presentation and Publication List in FY 2008.

Domestic Meeting and Conference
H. Sugiura, H. Kondo, T. Kanemura, Y. Niwa, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Measurement of surface-wave velocity of a liquid lithium flow for IFMIF," The 7th Joint Conference for Fusion Energy, June 19-21, 2008, Aomori, Japan
H. Kondo, T. Kanemura, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Measurement and analysis of surface waves on liquid lithium free-surface flow for IFMIF," The 7th Joint Conference for Fusion Energy, June 19-21, 2008, Aomori, Japan
H. Sugiura, H. Kondo, T. Kanemura, Y. Niwa, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Measurement of surface-wave velocity of liquid lithium flow with pattern-tracking method (2)," 2008 Fall Meeting of the Atomic Energy Society of Japan, September 4-6, 2008, Kochi, Japan
International Workshop
H. Kondo, T. Kanemura, H. Sugiura, N. Yamaoka, H. Horiike, "Evaluation of nozzle lifetime related with Target Assembly lifetime," IFMIF/EVEDA Workshop n° 1, September 10-12, 2008, Karlsruhe, Germany
H. Kondo, T. Kanemura, H. Sugiura, N. Yamaoka, H. Horiike, "Status mid 2008 Diagnostics Task in Osaka Univ.," IFMIF/EVEDA Workshop n°1, September 10-12, 2008, Karlsruhe, Germany
H. Kondo, T. Kanemura, H. Sugiura, N. Yamaoka, H. Horiike, "Conceptual Design of Changeable Nozzle for Osaka Test Loop," IFMIF/EVEDA Workshop n°1, September 10-12, 2008, Karlsruhe, Germany
International Conference
T. Kanemura, H. Kondo, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Liquid Metal Lithium Jet Experiment for IFMIF Target," 16th International Conference on Nuclear Engineering, May 11-15, 2008, Orlando, Florida, USA
H. Sugiura, H. Kondo, T. Kanemura, Y. Niwa, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Measurement of surface-wave velocity of a liquid lithium flow for IFMIF," 25th Symposium on Fusion Technology, September 15-19, 2008, Rostock, Germany
H. Kondo, T. Kanemura, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Thickness distribution of high-speed free-surface lithium flow simulating IFMIF target," 25th Symposium on Fusion Technology, September 15-19, 2008, Rostock, Germany
H. Horiike, H. Kondo, T. Kanemura, T. Sugiura, N. Yamaoka, K. Ara, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, E. Yoshida, "R&D Status on IFMIF/EVEDA Lithium Target System," 18th Topical Meeting on the Technology of Fusion Energy, September 28 - October 2, 2008, San Francisco, USA
Proceedings of International Conference
T. Kanemura, H. Kondo, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Liquid Metal Lithium Jet Experiment for IFMIF Target," Proceedings of 16th International Conference on Nuclear Engineering, May 11-15, 2008, Orlando, Florida, USA
Paper with Peer Review
H. Horiike, S. Konishi, H. Kondo, A. Yamaguchi, "Liquid metal cooling issues for fusion and fission," <i>Fusion Engineering and Design</i> , 83 (2008), 943-947
T. Kanemura, H. Kondo, H. Sugiura, Y. Niwa, K. Ko, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Measurement of free-surface velocity of liquid lithium flow for IFMIF," <i>Fusion Engineering and Design</i> , 83 (2008), 1529-1535
Hiroo KONDO, Takuji KANEMURA, Hirokazu SUGIURA, Nobuo YAMAOKA, Mizuho IDA, Hiroo NAKAMURA, Izuru MATSUSHITA, Takeo MUROGA and Hiroshi HORIIKE, "Liquid Metal Lithium Jet Experiment for IFMIF Target", <i>Journal of Power and Energy Systems</i> , Vol. 3, No. 1 (2009), pp.114-125.
Review Paper with Peer Review (Japanese)
H. Kondo, T. Kanemura, K. Ko, N. Yamaoka, S. Miyamoto, M. Ida, H. Nakamura, I. Matsushita, T. Muroga, H. Horiike, "Experimental study on liquid lithium target flow for IFMIF," <i>Journal of Plasma and Fusion Research</i> , Vol.84, No.9 (2008), 600-605

- 1) Horiike, H. et al. : Ann. Rep. NIFS (2005-2006) 240.
- 2) Horiike, H. et al. : Ann. Rep. NIFS (2006-2007) 233.
- 3) Horiike, H. et al. : Ann. Rep. NIFS (2007-2008) 231.