§ 19. A New Facility for Proof-of-Principle Experiments on Innovative PFC Concepts and the First Experiments on Liquid Ga and Li

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Over the past several years, much has been discussed about the need for the development of innovative plasma-facing component (PFC) concepts for steady state fusion power reactors to come after ITER. These innovative concepts are intended to resolve technical issues, including (1) materials erosion lifetime; (2) tritium build-up along with codeposition of eroded materials; (3) high heat flux removal; and (4) fuel and impurity particles control.

Among these PFC concepts, the most promising is the Moving-Surface Plasma Facing Component (MS-PFC) concept: the plasma-facing surface, either made of solid or liquid, will be circulated. In this concept, one expects that erosion will no longer limit the lifetime of PFCs. Also, tritium recovery can be done ex-situ. Heat removal can also be done without complex heat sink structures. Finally, this concept will regenerate the surface particle trapping capabilities automatically. In theory, the MS-PFC can resolve all the existing PFC issues.

Out of these outstanding issues we have first chosen to demonstrate the particle control capability of the MS-PFC concept. In most of the existing confinement experiments, particle control has been done, using wall conditioning techniques, e.g., boronization. However, it is well known that these techniques are not quite suitable for steady state reactors because the wall surface will be saturated with trapped particles, which then require re-conditioning.

In our recent experiments, it has been successfully demonstrated that reduced (5~10%) hydrogen recycling can be maintained even at steady state, using a laboratory scale experimental setup that employs a rotating drum bombarded with steady state plasmas in the NAGDIS-I facility at Nagoya Univ. [1,2].

As the next step, innovated PFC concepts using liquid metals and molten salts should be evaluated. However, it is of tremendous difficulty to build a liquid metal circulating system in a small laboratory scale. Also, the temperature control, i.e. vapor pressure control, is the key to these experiments. Therefore, we have chosen to construct a new facility to enable to expose standing liquid metals in a crucible to vertically incoming plasmas as the first-phase experiment. However, in the second phase, one needs to simulate a "liquid waterfall" bombarded with horizontally incoming plasmas.

In order to conduct these two phases of experiments in one single test stand. A new facility, shown in Fig. 1, has been constructed as a joint project by NIFS and Osaka Univ. The first liquid Ga and Li experiments have been conducted and the results have been presented at the recent US-Japan workshop held in Seattle for the period of Jul. 28-30th, 2003.

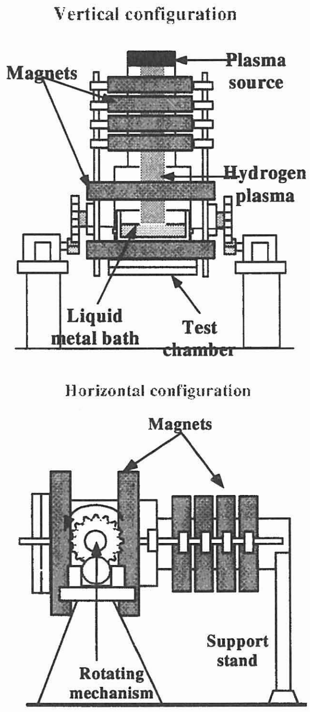

Fig.1 A schematic diagram of the innovative PFC concept test facility [2].

References

[1] Y. Hirooka et al., Fusion Eng. & Des. **65**(2003)413-421.
[2] Y. Hirooka, et al., presented at ANS-TOFE, Washington DC, 2002.