§9. Study of Divertor Simulation Using End-region of a Tandem Mirror – Mechanisms of Radiation Cooling Divertor and Plasma Detachment –

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As a future research plan of Plasma Research Center, University of Tsukuba, making use of the advantage of open magnetic field configuration, we have started a study of divertor simulation under the closely resemble to actual fusion plasma circumstances and we directly contribute the solution for realizing the divertor in toroidal devices.

Figure 1 shows the schematic view of the vacuum vessel in the west end-mirror region of GAMMA 10/PDX tandem mirror and the divertor simulation experimental module (D-module) recently installed in the west end-mirror exit. The experimental module (D-module) was installed at the exit of west end-mirror and plasma irradiation experiments onto a new V-shaped target in D-module were started. This experimental module consists of rectangular chamber (cross-section of 500×500 mm, 700 mm in length) with an inlet aperture of ϕ200 mm and two tungsten plates (350×300 mm) are mounted in V-shaped with their variable open angle from 15 degree to 80 degree.

The first experiment for realizing detached plasma state from the high-temperature plasmas has been performed using H_2 and noble gas injection in D-module. Here, the plasma with $n_e \sim 2\times10^{18}$ m^{-3} and $T_{i//} \sim 150$ eV was produced at the upstream region (central-cell) using two ICRF waves (RF1 and RF2). Figure 2 shows the dependence of the particle flux Γ_i and the heat flux on Ar plenum pressure in the case with H_2 and Ar injection. The calorimeters CM#1 ~ CM#5 and Langmuir probes (LP) are located along the upstream direction on the target plate as shown in Fig.1(b). As increasing the amount of injection gas, both particle and heat fluxes continuously decrease. Note that the heat flux measured behind the gap of the V-shaped corner (CMcorner) shows the strong reduction to less than 20 %. In Fig. 3, the electron density and temperature measured on the target plate are also plotted against the Ar plenum pressure. It is observed that the T_e is drastically reduced from few tens eV to ~3 eV due to the Ar injection.

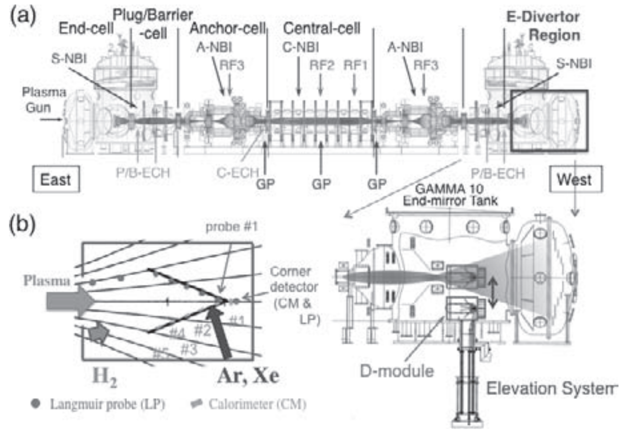

Fig. 1 Schematic view of west end-mirror vacuum vessel GAMMA 10/PDX (a) and the divertor simulation experimental module (D-module) (b).

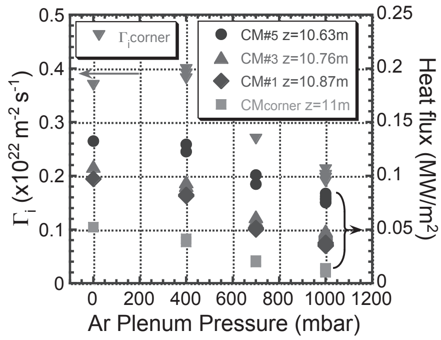

Fig. 2 Dependence of the Γ_i and heat flux on Ar plenum pressure measured with calorimeter and probe on the target plate and behind the V-shaped corner.

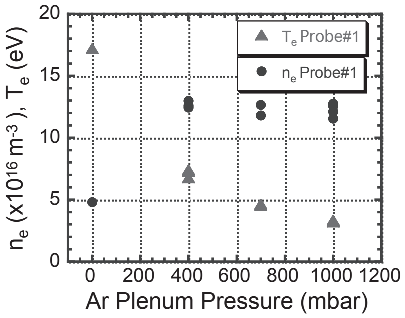

Fig. 3 Dependence of n_e and T_e on Ar plenum pressure measured with Langmuir probe on the target plate.

The presentations and publications from this collaborative research are listed below:

1. Y. Nakashima, et al., 4th Int. Workshop on Plasma Material Interaction Facilities for Fusion Research (PMIF2013) (9-11 September 2013, Oak Ridge National Laboratory, USA).
2. K. Ichimura, et al., *ibid*.
3. H. Takeda, et al., 14th Int. Workshop on Plasma Edge Theory in Fusion Devices (PET-14) (23-25 September 2013, Cracow, Poland).