

§18. Study on Hydrogen Recycling and Plasma-Wall Interaction in GAMMA 10/PDX

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Hydrogen recycling is one of the most important issues for a stable steady state operation as well as improved confinement. In GAMMA 10/PDX, recently, the divertor simulation experimental module (D-module) has been installed at the west-end region to study the boundary plasma physics, divertor physics and plasma-wall interaction¹⁻⁴. One of the features of GAMMA 10/PDX is high controllability of the plasma exposure since plasma heating systems of ECH, ICH and NBI are equipped. Ion temperature of plasma exposed to D-module is high (i.e. a few hundreds eV) and it is comparable to the SOL ion temperature in ITER. And also ion energy of the plasma is distributed, meaning that condition of PSI is equivalent to that of the torus plasma from a viewpoint of hydrogen recycling.

Figure 1 shows a schematic view of GAMMA 10/PDX and the D-module. The D-module consists of a rectangular box (0.5 m square and 0.7 m in length) with an inlet aperture (0.2 m in diameter) at the front panel and a V-shaped target system inside the box. Tungsten target plates with the thickness of 0.2 mm are attached on a V-shaped base made of Cu. The target size is 0.3 m in width and 0.35 m in length. The length between the front edge of the target and the inlet of the D-module is about 0.3 m. The open-angle of the V-shaped base can remotely be changed from 15 degrees to 80 degrees. The sheath electric heaters are attached on the backside of the Cu base to control the target plate temperature (T_{target}) up to 573 K. Besides, additional hydrogen gas can be supplied near the inlet of the D-module. For the plasma characterization, thirteen Langmuir probes have been installed on the upper target plate and two probes have been installed at the upstream from the front edge of the V-shaped target. Besides, spectroscopy and fast camera measurements have been done.

Figure 2 shows 2D images of $H\alpha$ line intensity which

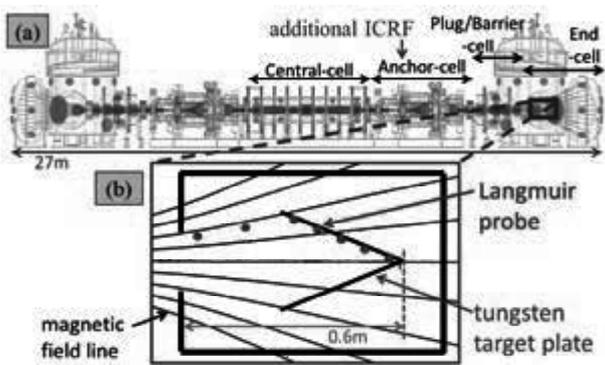


Fig.1 Schematic view of (a) GAMMA 10/PDX and (b) D-module.

was measured using a fast camera with an interference filter for the $H\alpha$ line. It is found that the $H\alpha$ line intensity increase in whole area inside the V-shaped target with increase in the target temperature. These results suggest that the recycling was enhanced due to increase in the target temperature.

When the additional gas puff was supplied inside the D-module, the electron density at ~ 0.23 m upstream from the front edge of the V-shaped target continued to increase from $0.3 \times 10^{17} \text{ m}^{-3}$ to $2.3 \times 10^{17} \text{ m}^{-3}$ and T_e decreased from 33 eV to 11 eV. At that time, n_e inside the V-shaped target increased at once and then it decreased to the original level (i.e. $\sim 0.25 \times 10^{17} \text{ m}^{-3}$ near the corner of the target), and T_e near the corner decreased from 26 eV to 5 eV, suggesting that molecular-activated recombination (MAR) occurred near the corner of the V-shaped target.

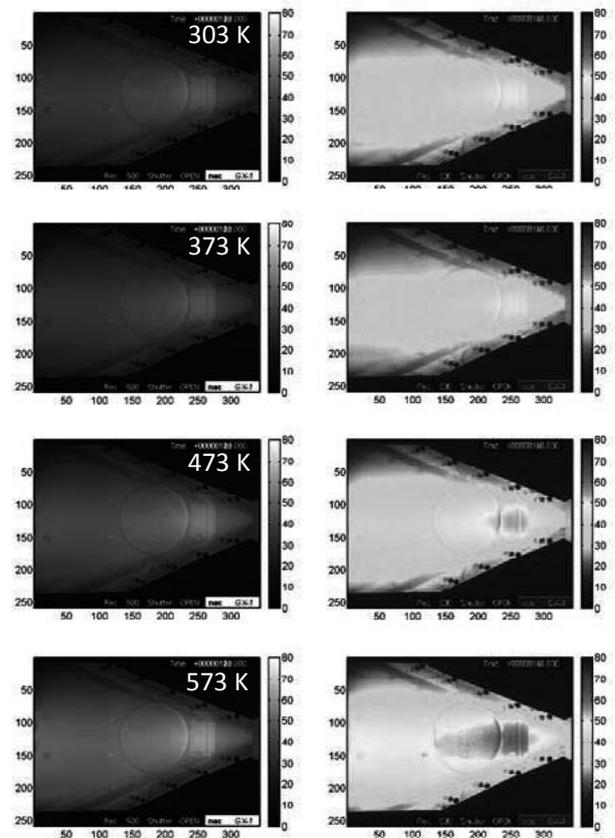


Fig. 2 Evolution of spatial profile of $H\alpha$ line intensity when the target temperature was increased step by step. The target temperatures are indicated in the images. The left column is for raw images and the right column is for false-color images.

- 1) Sakamoto, M. et al.: JPS 2013 annual meeting, Tokushima (2013) 28aKB-3.
- 2) Yoshikawa, M., Sakamoto, M. et al.: 30th JSPF Annual Meeting, Tokyo (2013) 05aE44P.
- 3) Oki, K., Sakamoto, M. et al.: 30th JSPF Annual Meeting, Tokyo (2013) 05pE41P.
- 4) Nohara, R., Sakamoto, M.: 30th JSPF Annual Meeting, Tokyo (2013) 05pE45P.