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

Sakamoto, M., Terakado, A., Nojiri, K., Ezumi, N., Nakashima, Y., Ichimura, M., Imai, T. (Univ. Tsukuba)

In GAMMA 10/PDX, 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 interaction. 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 of 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 plasma-surface interaction is equivalent to that of the torus plasma from a viewpoint of hydrogen recycling.

Figure 1 shows a schematic view of the D-module, which consists of a rectangular box (0.5 m square and 0.7 m in length) with an inlet aperture 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. In this experiment, the open angle was 45 degrees. The 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 time evolution of the neutral pressure inside the D-module, which was measured with an ASDEX gauge. The pressure of the gas tank for the gas supply (i.e. plenum pressure) was changed up to 1000 mbar shot by shot. The plasma was produced from t = 50 ms to t = 240 ms and the hydrogen gas was supplied from ~ 300 ms before the plasma production to the end of the plasma. The neutral pressure is kept constant before the plasma production but it increases after the plasma flows into the D-module. The pressure increase seems to be attributed to reduction in outflow of neutral particles to outside of the D-module.

As shown in Fig.3, the electron temperature near the inlet (~0.23 m upstream from the front edge of the V-shaped target) decreased from ~30 eV to ~8 eV with increase in the neutral pressure and that near the corner of the V-shaped target decreased from ~23 eV to ~1eV. The electron density near the corner of the target increased with increase in the neutral pressure and then it decreased although the density near the corner was kept almost constant over ~2 Pa. It means the detachment occurred near the corner of the V-shaped target. Moreover, the dependence of the H_α and H_β line intensities on the neutral pressure indicates that molecular activated recombination (MAR) occurred near the corner of the V-shaped target.

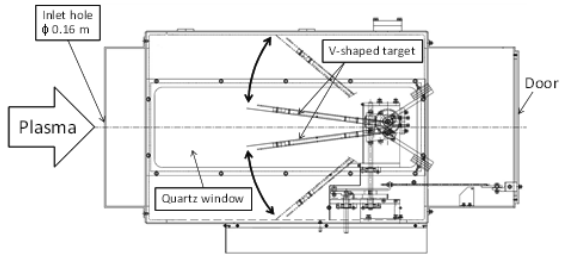

Fig. 1 Schematic view of the D-module.

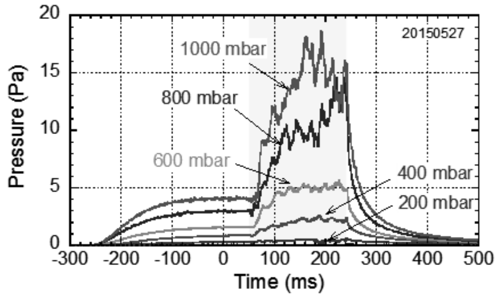

Fig. 2 Time evolution of the neutral pressure inside the D-module. The number in the figure shows the plenum pressure for the hydrogen gas supply.

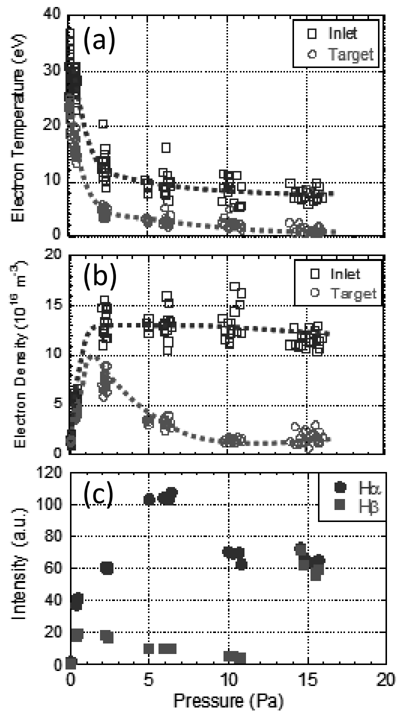

Fig. 3 (a) Electron temperature, (b) electron density near the inlet and on the target and (c) H_α and H_β line intensities as a function of neutral pressure in the D-module.