§11. Study of Optimum Conditions and Atomic and Molecular Reactions on LHD Closed Divertor

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The closed Helical Divertor (HD) in LHD is planned to accomplish an active detached plasma and neutral control to improve plasma confinement and to sustain high performance long pulse operation. The critical issue for realizing long pulse operation is reduction of heat load on the divertor plates with efficient particle control in the divertor plasma. In the closed HD, the neutral pressure has to be enhanced by more than one order of magnitude compared to that under the present open divertor condition. Also, the closed HD configuration can contribute to sustaining the super dense core plasma by active pumping of neutral particles in the plasma periphery.

On the other hand, in high gas pressure, the vibrationally excited hydrogen molecules, $H_2(v'')$, in their electronic ground state play a significant role in the detached plasma because of the increase in ionization and dissociation rate coefficients[1-3]. Therefore, the atomic and molecular processes in the periphery plasma are important for understanding the role of closed HD.

In this paper, we have been demonstrated the observation in the detached plasma by changing the geometry of the target plate, such as, the oblique target and the V-shaped target, on the linear plasma divertor simulator TPD-SheetIV. Basic plasma parameters (electron density n_e, electron temperature T_e) in the plasma were investigated with the dependence of the gas pressure for two target geometry.

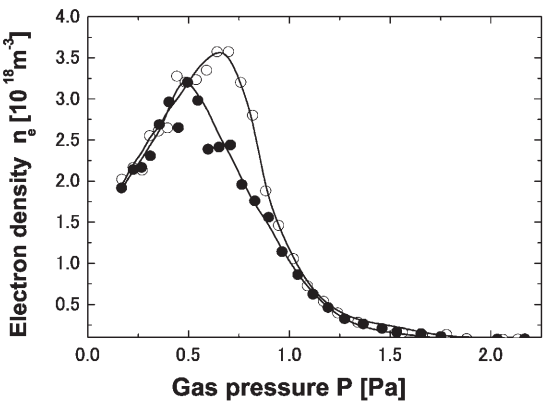

Fig. 1 Dependence of hydrogen gas pressure P on the electron density n_e at a discharge current of 50A. The geometry of the target plates are the oblique target (○) and the V-shaped target (●).

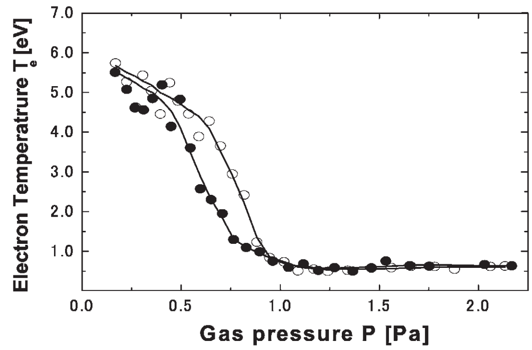

Fig. 2 Dependence of hydrogen gas pressure P on the electron temperature T_e at a discharge current of 50A. The geometry of the target plates are the oblique target (○) and the V-shaped target (●).

The experiment was performed in the linear plasma device TPD-SheetIV. Ten rectangular magnetic coils formed a uniform magnetic field of 1.0 kG in the experimental region. The hydrogen plasma was generated at a hydrogen gas flow of 75 sccm, with a discharge current of 30-100 A. The neutral pressure P in the experimental region was controlled between 0.01 and 2.0 Pa with a secondary gas feed. The sheet plasma flowed from the plasma source along the magnetic field to a floating endplate located about 1.0 m downstream. Electron density and electron temperature were measured using a planar Langmuir probe in front of the endplate.

Figures 1 and 2 shows the dependence of hydrogen gas pressure P on the electron density n_e and the electron temperature T_e at discharge current of 50 A. The geometry of the target plates are the oblique target (○) and the V-shaped target (●). With increasing in P, the value of T_e decreases gradually from 6 to 0.5 eV. On the other hand, n_e has the maximum value and decreases with increasing P. At the same time, the line intensities of Balmer series influenced by EIR were observed in front of the target. For the V-shaped target, both n_e and T_e decrease at the lower pressure in comparison with oblique target. Divertor detachment is formed under low gas pressure. It is though that this characteristics results from the increase of neutral particles in front of the V-shaped target.

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