§5. Effect of Neutrals on Decrease in Heat and Particle Loads on the V-shaped Target in GAMMA10

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In a future magnetic fusion device, plasma detachment is necessary to reduce the heat and particle loads onto the divertor plates. It is believed that neutrals play important roles to form the plasma detachment. This study aims at elucidation of effects of neutrals on decrease in the electron temperature and density and the heat flux to a V-shaped target are studied with divertor simulation experimental module (D-module) in GAMMA 10. In this fiscal year, an ASDEX-type first ionization gauge[1)] was installed in D-module to measure neutral pressure and preliminary measurements were started.

Figure 1 shows the gauge installed in the upper part of D-module. The gauge consists of a filament, control grid, acceleration grid and ion collector. The typical current applied to the filament was ~10 A and the bias potential of the filament was 70 V. DC potential of 250 V was applied to the acceleration grid. An emission current (I_e) and ion current (I_i) were measured with the acceleration grid and ion collector, respectively. Since plasmas were not irradiated to the gauge, DC potential of 105 V was applied to the control grid.

Without a plasma, H_2 gas was injected into D-module and temporal evolution of the I_e and I_i were measured (Fig .2). The I_e was set to be 0.5 mA by changing the filament current. Hydrogen gas was accumulated in a reservoir (490 cm^3) with a pressure of 500 mbar and injected into D-module with a pulse length of 300 ms. In this experiment, the injection time of the H_2 gas was not monitored. The I_i increased rapidly and the duration of ~300 ms was similar to the pulse length. It is noted that the I_e also increased since the filament current was not controlled if H_2 gas pressure changed. Since the sensitivity of the gauge changes with I_e, control of the filament current is required to keep the sensitivity constant.

Neutral pressure P can be estimated with the following equation using the I_e and I_i

$$P = I_i / (S \cdot I_e), \qquad (1)$$

where S is the sensitivity of the gauge. Without a magnetic field, the sensitivity for H_2 gas had been measured to be ~515 at the I_e of 0.5 mA in JAEA. The H_2 gas pressure in D-module was estimated to increase to ~0.53 Pa. In GAMMA 10, a magnetic field is applied in the plasma experiment and the sensitivity of the gauge changes with the strength and direction of the magnetic field. Therefore, we plan to measure the sensitivity of the gauge in D-module in the magnetic field.

Temporal evolution of the I_e and I_i was measured during plasma irradiation to the V-shaped target (Fig. 3). H_2 gas was injected in D-module at -340 ms and the plasma irradiation was started at 0 ms. During the gas injection, the I_e and I_i could be measured. However, the I_e could not be evaluated due to a large noise. To measure the neutral pressure during the plasma irradiation, we have to reduce the noise.

In this study, an ASDEX-type first ionization gauge was installed in D-module and preliminary measurements were started. However, two issues are found. Since the I_e changes with the neutral pressure, control of the filament current is required to keep the sensitivity constant. In addition, the noise of the I_e during plasma irradiation has to be eliminated to evaluate the neutral pressure.

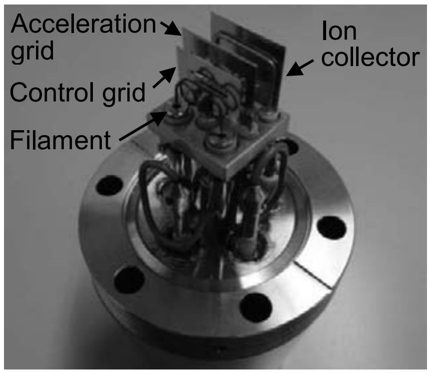

Fig. 1 ASDEX-type ionization gauge installed in D-module in GAMMA 10.

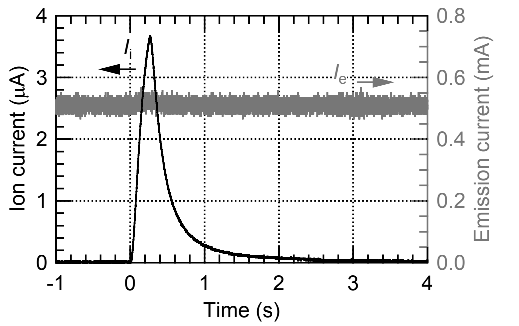

Fig. 2. Temporal evolution of the emission and ion current during H_2 gas injection experiment.

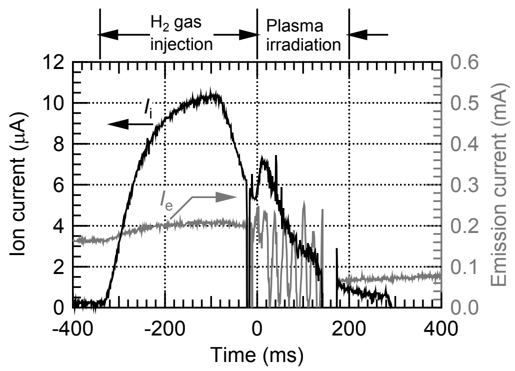

Fig. 3. Temporal evolution of the emission and ion current during plasma irradiation experiment.

1) Haas, G., et al.: J. Nucl. Mater. **121** (1984) 151.