§17. Production of the Fast Scanning Langmuir Probe Array System for the Simulated Gas Divertor Experiment in TPD-II

Kawamura, K., Takayama, K. (Res. Inst. Sci. Tech., Tokai Univ.), Shibuya, T. (Dept. Elect. Photo. Opt., Tokai Univ.), Matsubara, A. Tonegawa, A. (Dept. Phys. Sci., Tokai Univ.), Sato, K.

i) Introduction

The prevention of the reversed flow of cooling gas in the closed divertor toward the main plasma is crucially important subject to achieve both a low thermal load on a divertor plate and high magnetic confinement in the main plasma. The effect of high vacuum (HV) region installed before an inlet of gas divertor on the reversed flow has been investigated in simulated gas divertor experiments by using TPD-II at NIFS and SPD at Tokai Univ. [1] Various physical forces, such as pressure gradient, electric force, and thermal force play an important role in a model of the prevention of reverse flow. In order to measure detailed axial- and radial- profiles of the plasma density, electron temperature, and plasma space potential, we have produced the Fast Scanning Probe Array (FSPA) semi-aliening along the magnetic field line (see Fig.1). In this report, we will explain briefly the FSPA system and the preliminary experimental results by using it.

ii) Fast Scanning Probe Array

Figure 2 shows the schematic diagram of FSPA. At the present time, thirteen cylindrical Langmuir probes are set on the rectangular stage (made of stainless steel: 30×300mm). For minimizing the shadow effect of the probe, the probes are aligned along the diagonal-line of the stage, in such a way that the probe does not become immersed in the shadow due to the probe at the upper stream.

In the measurement, we sweep the stage in the radial direction, under the applied sinusoidal voltage, V_p. The scanning speed of the stage is set 50-100 mm/s for the heat loading from the plasma. The signal of the current drawn by the probe, I_p, was detected as the potential drop due to the load resister (10Ω).

iii) Preliminary Experimental Results

Typical waveforms for both V_p and the signal for one of probes are shown in Fig.3. The measurement was performed under following conditions: the discharge current is 20A (He gas), the magnetic field strength is ~0.2T. The negative value of the signal shown in Fig.3 means the electron current drawn by the probe. At t≃0.17s or ≃0.18s, the negative current takes a minimum, indicating the probe goes across the center of the plasma at that moment.

Figure 4 shows the radial profiles of the electron plasma density n_e at the low neutral pressures (~0.01Pa) and sufficiently high-pressure (~1Pa) in HV region. It can be seen that n_e for the low pressure is 2.5 times larger than that for the high pressure. This can imply that the detached plasma is formed as the pressure is increased. The detailed observation is going on.

[1] Matsubara, A., et al. : J. Nucl. Sci. Technol., 37, No.6 (2000) in printing.

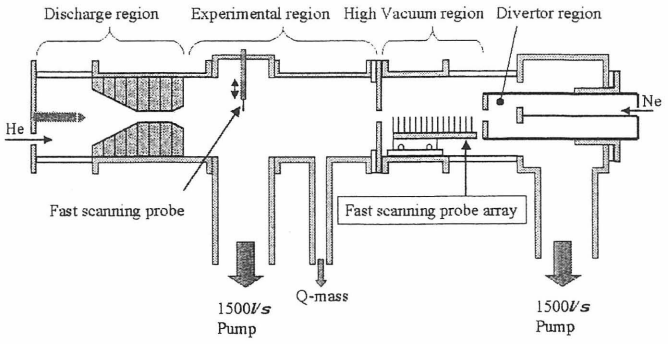

Fig. 1. TP-D type machine with FSPA for the simulated gas diverter experiment.

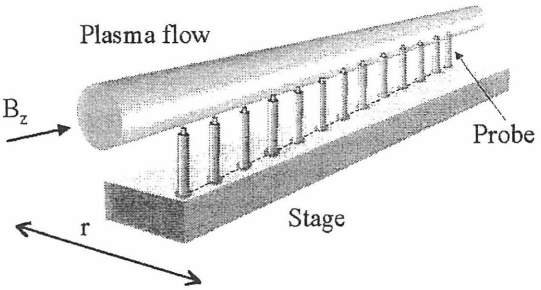

Fig. 2. Schematic diagram of Fast Scanning Probe Array.

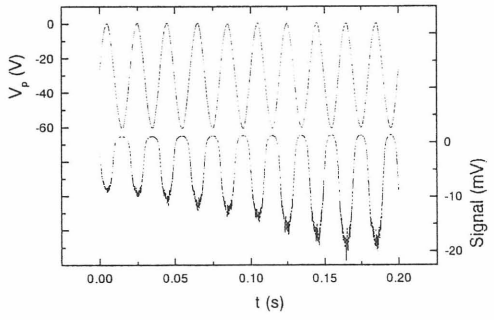

Fig. 3. Typical waveforms for both V_p and the signal of current drawn by a probe.

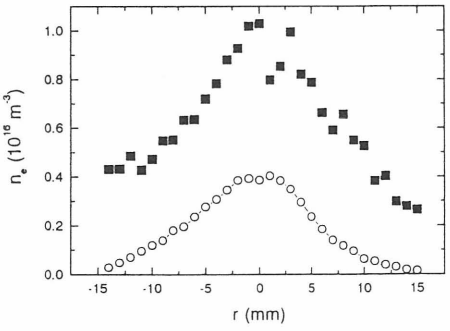

Fig. 4. Radial profile of the electron plasma density for two cases of the neutral pressure in the HV region: the low neutral pressure (~0.01Pa) [solid squares] and for the high neutral pressure (~1Pa) [open circles].