§9. Potential Structure Deformation around Biased Obstacles

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The face-to-face double probe (FDP) is a probe for Mach number measurement proposed by two of authors (Saitou and Tsushima)[1, 2]. The probe has a pair of face-to-face electrodes and the electrodes have to be placed in a line along the direction of the plasma flow in order to secure the one-dimensionality. This restriction brings a difficulty when the probe method is applied, for example, to plasmas whose external magnetic field diverges. One of solutions to dissolve this difficulty is to adopt an electrode-arrangement similar to the Gundestrup-type probe[3, 4]. Such an arrangement makes a shadow region surrounded by the face-to-face electrodes. It is expected that a potential structure is formed in the shadow region responding to the electrodes' bias. A purpose of the present work is an investigation on such a potential profile in the shadow region. In the following part, the probe used in the investigation is tentatively named "reversed Gundestrup-type" probe.

The experiments were performed using the HYPER-I device at NIFS. Argon gas was fed at a pressure of 10^{-4} Torr. Plasma is generated by ECR using a microwave of 6 kW. The reversed Gundestrup-type probe was located at z = 155.5 [cm] from the microwave injection point along the chamber axis and r = 0 [cm] along the radial direction. The magnetic field line diverged around this position. The plasma parameters using the Langmuir probe and the optical measurements in this case were as follows: $n_e \approx 10^{11}$ [cm^{-3}], $T_e \approx 8$ [eV], $T_i \approx 1.2$ [eV]. In addition, it is known that there exists a plasma flow whose Mach number is 0.7～0.8 from the previous investigations.

A structure of the reversed Gundestrup-type probe used in the experiments is shown in Fig. 1. There are 3 pairs of face-to-face electrodes. The size of each electrode is 4 mm in length and 0.7 mm in width. A combination of any two electrodes is used as a double probe. The electrode, which is numbered 1, is located at the upper stream (z is minimum) and the electrode, which is numbered 4, is located at lower stream (z is maximum).

Typical examples of obtained V-I characteristic curves, using a pair of Nos. 1 and 4 electrodes, are shown in Fig. 2. In this figure, a polarity of the bias applied between the electrodes is reversed. It is found that the floating potential shifts from negative value to positive value by changing the polarity. This fact suggests that a structure of the potential is formed due to the plasma flow because the floating potential reflects the flow direction[1, 2].

It is expected that the potential structure around the probe tip is clarified. Detailed analyses on the potential structure are now in progress. At the same time, it is also expected that a new method to measure a direction of the flow will be constructed.

1) Y. Saitou *et al*. J. Phys. Soc. Jpn. **70** (2001) 3201.
2) Y. Saitou *et al*. Jpn. J. Appl. Phys. **40** (2001) L1387.
3) C. S. MacLatchy *et al*. Rev. Sci. Instrum. **63** (1992) 3923.
4) A. Litnovsky *et al*. Chech. J. Phys. **53** (2003) 903.

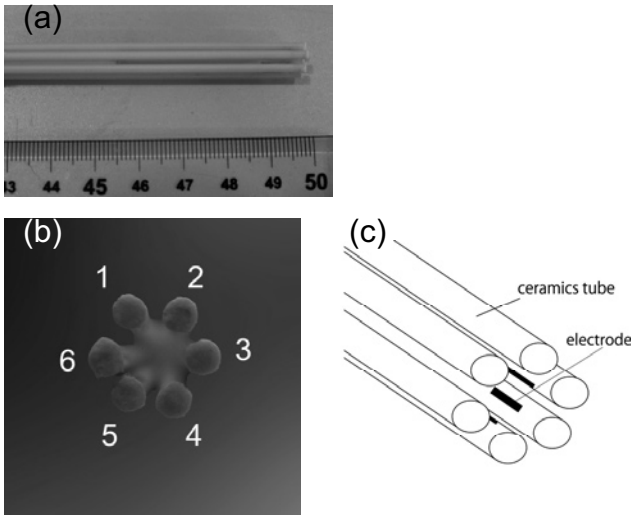

Fig. 1. Side view (a) and top view (b) of constructed reversed Gundestrup-type probe. The numbers in (b) are the number of each electrode. The direction of the electrode is shown in (c).

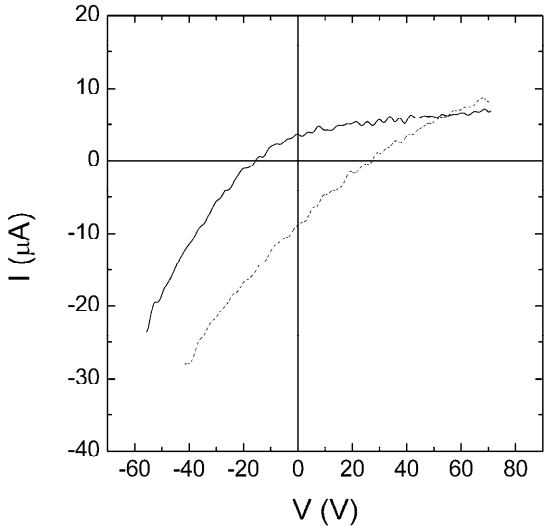

Fig. 2. Example of the obtained V-I curves using the two electrodes, Nos. 1 and 4, as a double probe (solid line) and the curve obtained with reversed polarity (dotted line).