

§5. Improvement of a Face-to-face Double Probe for General Use in Plasmas with an Azimuth Flow

Saitou, Y. (Utsunomiya Univ.),
 Tsushima, A. (Yokohama National Univ.),
 Yoshimura, S., Tanaka, M.Y. (Kyushu Univ.)

In our previous investigations on establishing Mach number measurement method using Face-to-face double probe (FDP), which has been proposed by Saitou *et al.*,^{1, 2)} it has been confirmed that the FDP method seems to be effective to the Mach number measurement. At the same time, it is found that the electrodes often collect charged particles directly, which have a perpendicular velocity component due to, say, the $E \times B$ drift, and the particles induce a virtual component of the Mach number as long as the FDP tip has a shape shown in Fig. 1, where a sidewall of insulator does not exist to prevent the perpendicular component.

The tip of the FDP used until now (Fig. 1) was designed to be as small as and as simple as possible. Its insulator was made of ceramics whose diameter was 8 mm. There was a clip of 6 mm in depth on top of the tip. Two electrodes, each of which was 4 mm in length and 1.6 mm in diameter, were made of Tungsten.

In this research work, our purposes are to improve the shape of the FDP tip suitable for plasmas with a flow that has the perpendicular component such as the $E \times B$ drift, and to examine its performance in laboratory experiments. As previously described, the sidewall has been required to avoid the virtual image generation by preventing the perpendicular component. The improved shape is shown in Fig. 2. The size is also shown at the top of the figure. Each electrode is made of Tungsten, whose length is 4 mm and diameter is 0.7 mm. The insulator surrounding the electrodes is made of Boron-Nitride (BN). Charged particles cannot enter the area between the electrodes even when the particle has the perpendicular velocity component.

Experiments were performed using the improved FDP tip in the HYPER-I at NIFS. Helium

gas or argon gas was used separately, and a uniform plasma in a radial direction was generated by the electron-cyclotron-resonance with a gradually diverged magnetic field of approximately 0.1 T.

As expected, the virtual image was not detected this time. It is considered that the improved tip is usable in plasmas with perpendicular velocity component. Furthermore, in the present condition, one of qualitative results suggests the plasma may have two different velocity components: one is along the plasma axis and the other flows with an angle of approximately 120 degree from the plasma axis. Further investigation in detail is our future work.

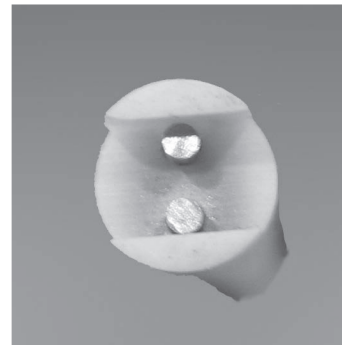


Fig. 1 A photograph of the FDP tip formerly used.

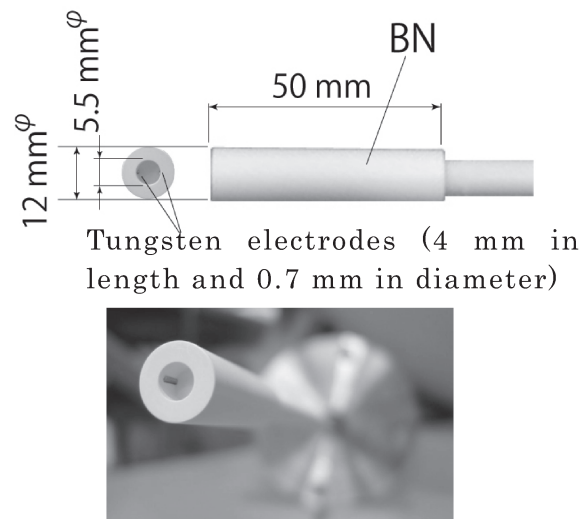


Fig. 2 An improved tip (top) and its photograph (bottom) of FDP.

- 1) Y. Saitou and A. Tsushima, Jpn. J. Appl. Phys., **40** (2001) L1387.
- 2) Y. Saitou and A. Tsushima, J. Phys. Soc. Jpn., **70** (2001) 3201.