§7. Behavior of Neutral Particles in the Boundary of Microwave Discharge HYPER-I Plasma

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Stationary visible patters associated with vortices have been observed in a large volume (diameter: 30 cm; length: 200 cm) of plasma produced by 2.45 GHz microwave discharge with the power of several kW.[1)] In relation to such the patters, extensive plasma flow measurements have been made using directional Langmuir probes.[2)] The results of the measurement indicate that plasma flow or rotation can be explained by the ExB drift in some cases, but not in other cases. Then, the measurement of laser induced fluorescence (LIF) Doppler spectroscopy has been made and the importance of neutral gas particles has been found, since the LIF measurement can be applied to either plasma ions or neutral gas particles by tuning the laser wavelength.[3)]

As for the easy measurement of neutral gas particles, a piezoelectric transducer is one of the possibilities and, in fact, piezoelectric transducers were used to excite and detect pressure modulation due to sound wave or pseudo-wave (> 10 kHz) under the gas pressure of > 10^{-4} Torr.[4)] In order to investigate its availability to measure gas pressure modulation due to plasma behavior, a piezoelectric transducer (FUS-300A) was set at the top of a cylindrical support with the outer diameter of 10 mm as shown in Fig. 1. The sensibility of the induced voltage of the piezoelectric transducer was considered to be independent of a frequency of < 10 kHz, since its resonant frequency was about 300 kHz. Then, the head of the piezoelectric transducer was situated at a place slightly retracted from the surface of the inner vacuum vessel in the radial direction and at 117.5 cm apart from the end of microwave injection in the axial direction. Figure 2 shows the waveform of the induced voltage of the piezoelectric transducer for a microwave discharge under the condition that the helium gas pressure was 1 x 10^{-2} Torr, the microwave power was 6 kW, and the ambient magnetic field intensity was about 1.15 kG. It is seen that abrupt pressure change was observed at the microwave breakdown and following pressure modulation of ~ 100 Hz with spiky signals. On the other hand, any pressure modulation was not observed for a quiet plasma condition with higher helium gas pressures in HYPER-1. The modulation of neutral pressure in the microwave discharge plasma is now investigated in relation to plasma density perturbations.

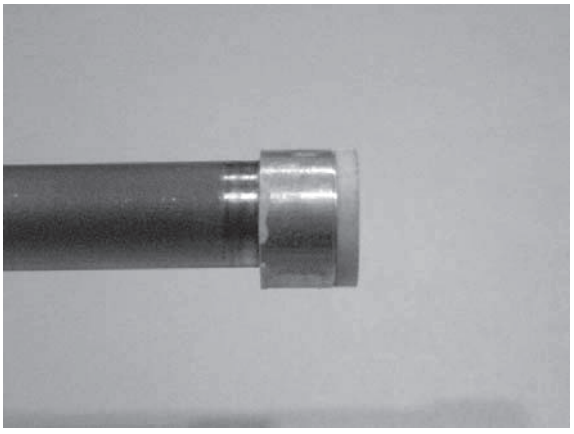

Fig. 1. Piezoelectric transducer with a cylindrical support.

1) Tanaka, M. Y. et al.: J. Phys. Soc. Jpn. **60** (1991) 1600
2) Nagaoka, K. et al.: J. Phys. Soc. Jpn. **70** (2001) 131
3) Okamotoown , A. et al.: Plasma Fusion Res. **80** (2004) 1003
4) Tsushima, A. and Tanaka, T. K.: Jpn. J. Appl. Phys. **71** (2002) 1805; Tsushima, A.: J. Phys. Soc. Jpn. **45** (2006) 8141

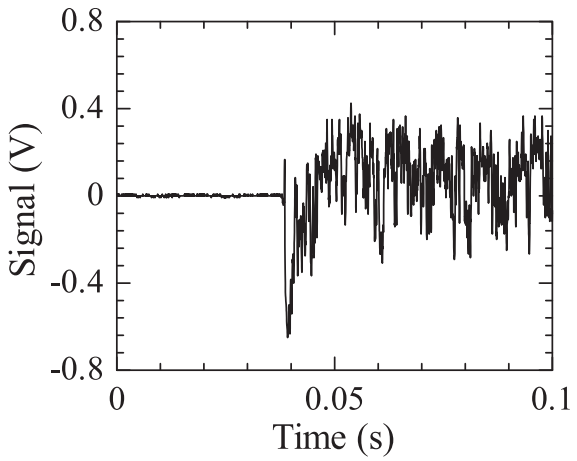

Fig. 2. Waveform of induced voltage of piezoelectric transducer as a function of time.