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交流駆動熱陰極による生成プラズマの振動測定
Measurement of plasma oscillation generated by an AC driven hot cathode

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1. Introduction

The ion source plasma operated with hot cathode has advantages of production efficiency and stability over other production method of plasma. However, hot cathodes have finite lifetimes due to the evaporation and sputtering. Moreover, the erosion is accelerated because of inhomogeneous heating of hot cathode in the case of DC heating [1].

In the previous test, AC heating current was induced to separate one spot of largest erosion for DC heating current into two, and the lifetime could be prolonged by about 1.4 times [2]. However, fluctuation presumably due to the change of electron emission point was observed in the discharge current.

To produce a stable plasma with AC operation, the effect of the magnetic field intensity is being investigated.

2. Experimental setup

The Bernas type ion source developed for a medium current ion implanter [3] has been modified to operate with AC heating current. The dimensions of the arc chamber are 90 mm height, 36 mm width, and 29 mm depth. An external magnetic field in the direction parallel to the hot cathode is produced by a pair of electromagnets set on both sides of the vacuum chamber.

3. Result

To investigate the effect of the external magnetic field on plasma oscillation, we observed waveform of the discharge current with high speed data recorder. A typical waveform of discharge current excited by 50 Hz AC heating current and 6 mT external magnetic field is shown in Fig. 1. The fluctuation amplitude was as large as 8 % for the average value of the discharge current.

Figure 2 shows the ratio of oscillation amplitude of discharge current for various external magnetic field. By increasing the external magnetic field, fluctuation level decreased and the frequency which the ratio of oscillation amplitude taking the minimum increased. The details of mechanism for plasma fluctuation will be presented at the conference.

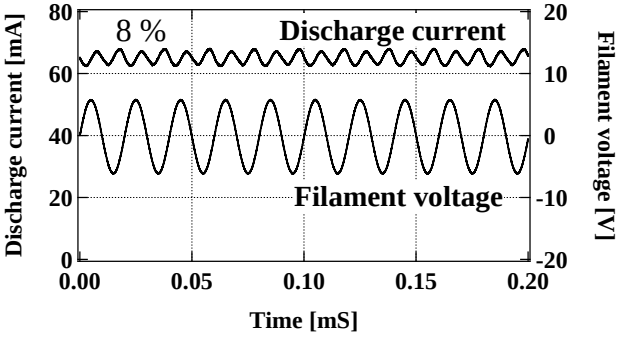

Fig. 1. Waveforms of discharge current and filament voltage. Filament diameter : 0.4 mm, Filament heating current : 14 A Discharge voltage: 60 V, Ar gas pressure : 7 x 10^{-2} Pa

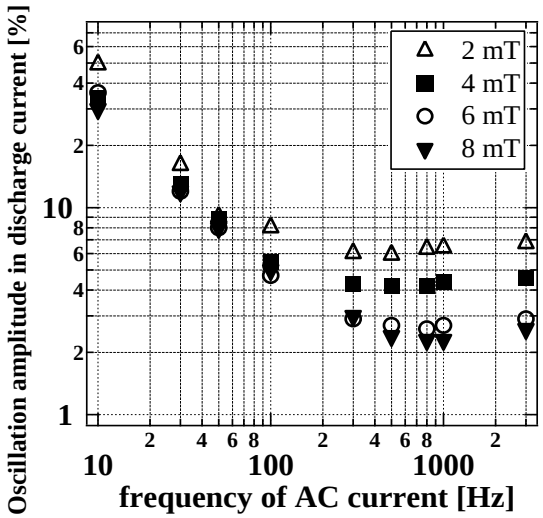

Fig. 2. Oscillation amplitude in discharge current. Filament diameter : 0.4 mm, Filament heating current : 14 A Discharge voltage: 60 V, Ar gas pressure : 7 x 10^{-2} Pa

Reference

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