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ゲルディエンコンデンサによる大気圧プラズマの診断
Diagnostics of Atmospheric Pressure Plasma by a Gerdien Condenser

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I. Introduction

A low power density atmospheric pressure plasma realizes a chemical reaction field that produces reactive ion species for a specific application. A simple glow discharge in ambient air can produce nitrides for agricultural fertilizer but the confirmation of desired plasma chemical reaction is usually difficult as the produced plasma extinguishes immediately due to high collision frequency in atmospheric pressure condition. A Gerdien condenser used for ion density measurement at stratospheric altitude has the possibility for use in atmospheric environment to measure ion species present in an atmospheric pressure plasma.

The electrostatic potential structure of a Gerdien condenser controls the flow of incoming ions. This principle of guided ion flow can be utilized to separate ions of desired species from others by controlling the electrical potential and flow field structure of the condenser. Thus, a tandem Gerdien condenser structure is being investigated the performance to produce/ diagnose air ion species of laboratory atmospheric pressure plasma.

II. RF Plasma generator

Figure 1 shows the structure of the RF generator. Needle shaped tungsten electrodes excite plasma at the sharpened tips in Ar flow channels. A radial electric field is generated by a bias cylinder to transport flow of ions produced at the region between the bias cylinder and the inner cylindrical electrode. A pair of electrical fans takes in air to generate a flow directed toward the exit, while the ion flow is controlled by the intensity of the electric field determined by the bias voltage to the outer cylinder.

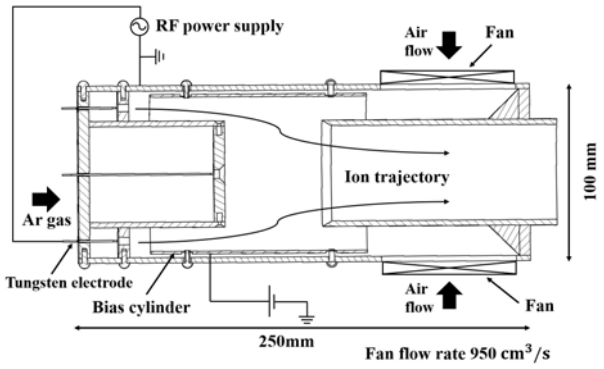

Fig. 1. RF plasma generator with mobility selector.

III. Gerdien condenser

The size and the structure of the Gerdien condenser to measure ion density and mobility is shown in Fig. 2. The condenser has a fan to determine the flow rate in the region where a radial direction electric field is maintained. Depending upon the voltage applied to the outer cylinder electrode, the current collected by the inner cylinder collector changes. Ion species present in the plasma can be estimated from the slope of the *I-V* characteristics obtained by sweeping the voltage applied to the outer cylinder electrode.

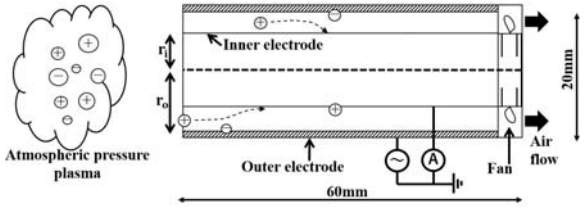

Fig. 2. Working principle of Gerdien condenser.

IV. *I-V* characteristics of tandem operation.

The Gerdien condenser diagnosed the gas effusing out from the exit of the RF plasma generator. The output gas charged positively even without any bias voltage. Positive 20 V bias made the negative current amplitude to a half of the original value, while positive current decreased slightly. The part of the maximum slope in the curve indicating the largest mobility ions diminished above 40 V bias voltage. Thus, the present structure can well exclude light ions from the ion source.

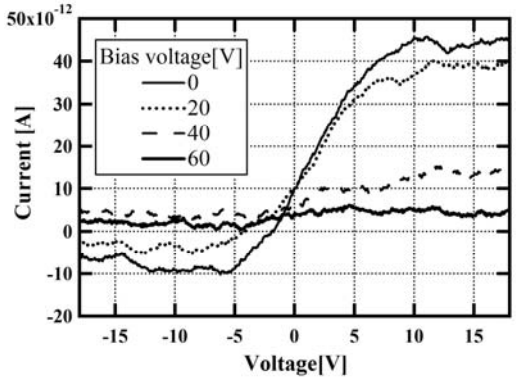

Fig. 3. *I-V* characteristics of Gerdien condenser for different bias voltage applied to the bias cylinder of the mobility selecting RF plasma source.