Effect of Electrode Material to Gerdien Condenser Current-Voltage Characteristics

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A Gerdien condenser diagnostic instrument is being developed as a new characterization method for laboratory-produced atmospheric pressure plasma. The Gerdien condenser is capable of determining ion density and ion species through the calculated ion mobility. In this study, the effect due to electrode materials used to construct the condenser upon the current-voltage (*I-V*) characteristics is investigated.

The Gerdien condenser has a 1.0 cm diameter, 6 cm long cylindrical collector electrode mounted in a bias electrode of 1.7 cm inner diameter. The entire condenser is mounted in an electrically grounded aluminum-made rectangular shield box. A 2.5 cm by 2.5 cm fan is attached to the end to ventilate the tube and drag in ions into the region to measure ion mobilities. The Gerdien condenser is positioned apart from a nozzle of an atmospheric plasma source with the nozzle exit to the condenser distance of 2.0 cm. The atmospheric pressure plasma source is operated with 2 ℓ/min Ar gas flow rate and 30 W discharge power using a 13.56 MHz RF power supply. A voltage sweep from -40 to +40 V is applied to the outer electrode to collect ions while current is measured at the inner electrode. Copper and aluminum electrodes are initially polished using 600 and 1200 grade abrasive papers and cleaned with ethanol. *I-V* characteristics are recorded right after polishing and 24 to 72 hours after exposing to ambient air allowing native oxide layer to form on the surface of the electrodes.

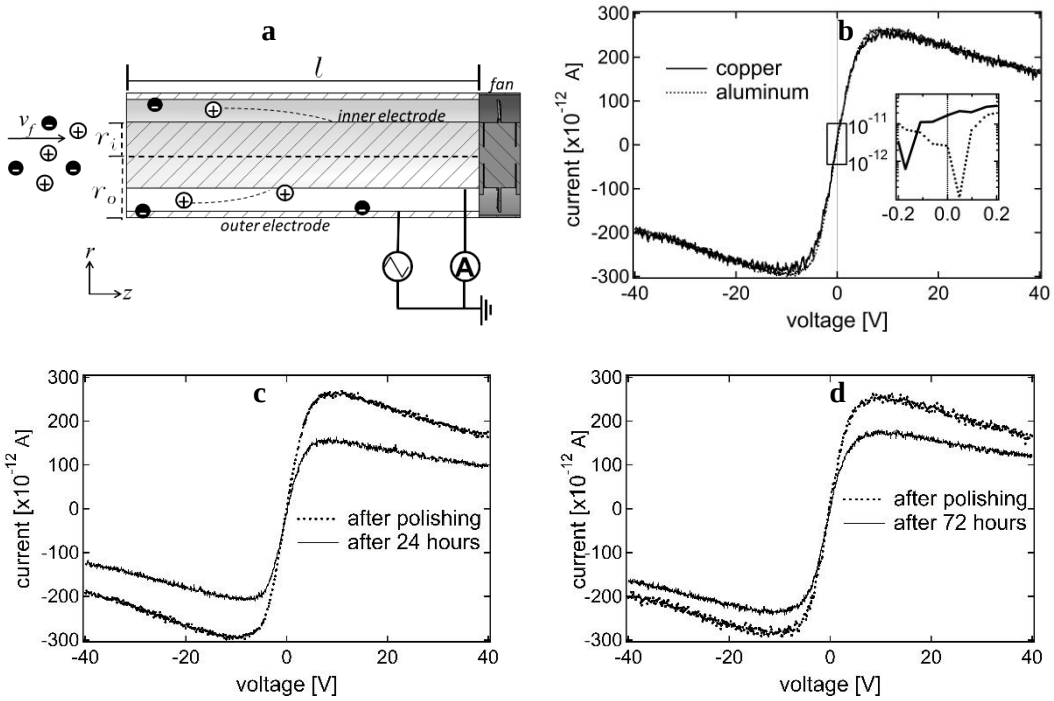

Fig. 1 a) Operation principle of Gerdien condenser; and the obtained *I-V* characteristics b) after polishing, then c) 24 hours after for the aluminum electrode while d) 72 hours after for the copper electrode.

Results show that although the *I-V* characteristics are not dependent on the material after the electrodes are polished, higher current offset of 1.7 x 10^{-11} A at *V*=0 is observed for copper as compared to aluminum with the offset of -0.3 x 10^{-11} A. Measurements for electrodes after forming native oxide layer show that copper yields higher current than aluminum resulting in a higher value of calculated total ion density.