INDUCTIVE CURRENT MONITOR FOR LOW CURRENT ATMOSPHERIC DISCHARGE PLASMA DEVICE

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1. Introduction

In atmospheric pressure discharge the AC voltage and current measurement are used to monitor and control the discharge [1]. Voltage is usually measured by voltage divider and current by the drop of voltage on resistances. One alternative method to measure the current is the inductive method using an independent winding around part of the circuit that acts as a secondary of a transformer. A typical waveform is a sequence of spikes modulated to a low frequency sinusoidal signal with amplitude in order of tenths of milliamperes. Parameters such as self integration region, boundary frequency and sensitivity need to be carefully designed for each application.

2. Experimental

The experimental set up is shown in figure 1. The discharge occurs between a needle with outer diameter 0.70 mm and a brass ring. A borosilicate capillary is the dielectric between the electrodes. The applied voltage has a sinusoidal waveform with peak voltage in the range of 1-3 kV and 37 kHz frequency. The plasma plume is generated downstream the gas flow from the tip of the needle. The current measured with current monitor coil (Ion Physics CM-500-L 5V/A) shows a waveform of a sequence of spikes modulated to the displacement current. Alternative coils were winded using toroidal ferrite core with various dimensions and number of turns.

3. Results and Discussions

The parameters investigated on the monitor coils were sensitivity, boundary frequency and maximum matching frequency. The primary circuit is a resistance connected to a function generator in sinusoidal. The monitor coil was measured with different resistance terminations. A typical sensitivity for a non-integrating winding is shown in figure 2 for a coil made with 400 turns of AWG 30 winded in a torus with major radius 2.5 cm and section 0.5 cm × 0.5 cm. The sensitivity has almost constant value for low resistance termination which is adequate to reduce the ringing on the waveform of the current.

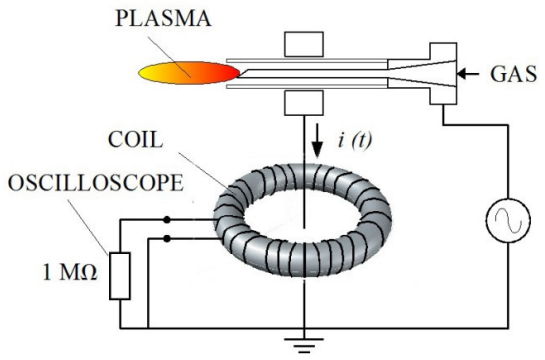

Fig. 1. *Experimental arrangement of self integrating coil*

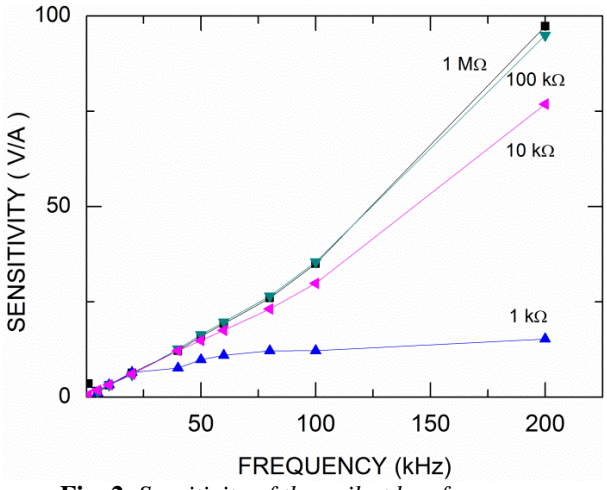

Fig. 2. *Sensitivity of the coil at low frequency*

4. References

[1]- Kriegseis J., Grundmann S. and Tropea C., *"Power consumption, discharge capacitance and light emission as measures for thrust production of dielectric barrier discharge plasma actuators"*, Journal of Applied Physics, 110, 013305 (2011); doi: 10.1063/1.3603030.

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