Optical emission spectroscopy of surface dielectric barrier discharge generated by liquid electrodes in different gases

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1. Introduction

In one of the basic configurations of dielectric barrier discharges (DBDs), the surface barrier discharge (SD) arrangement, the discharge develops along the dielectric surface between the electrodes. On this surface a set of microdischarges appears at critical field strength. The discharged area depends on many parameters such as applied voltage, working gas, configuration of electrode, etc. Nowadays, discharges generated in and in contact with water or other liquids draw attention for big potential in applications [1–2].

For example, a permanent hydrophilization of outer and inner surfaces of PTFE tubes using ambient air plasma generated by surface dielectric barrier discharges [3]. For their innovative properties the discharge generated has been intensively studied. In this contribution results of optical emission spectroscopy (OES) will be discussed in detail.

2. Experimental set-up

The setup consists of discharge cell, power supply unit and the diagnostic instruments (Fig. 1). The chamber was made of polypropylene (volume 1 L). As an inner chamber a glass cuvette (50 ml, 12 cm long) was used. During the discharge plasma was ignited on the whole perimeter of the cuvette.

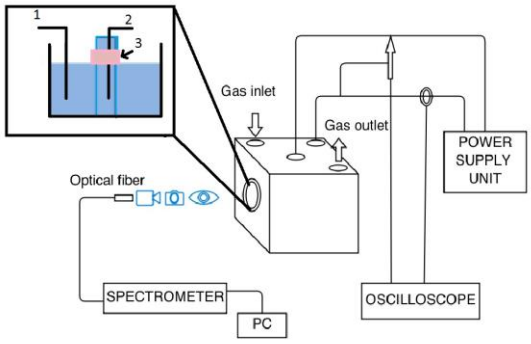

Fig. 1: A schematic drawing of the experimental set-up: the zoom of electrode configuration is shown.

The discharge was generated on the boundary of air, dielectric and the 5% solution of oxalic acid in distilled water. The conductivity of the solution was 50mS/cm. The oxalic acid was used in order to increase the conductivity of water and to prevent its overheating.

3. Results

The optical emission spectra were recorded in the range of 250–750 nm for different working gas compositions: air, pure Ar, pure N_2 and pure O_2. In addition, it was found that only in case of argon electron number density can be estimated from hydrogen line profiles [4]. It was found that for input powers from 20 W to 80 W the relevant full widths vary from 0.086 to 0.13 nm in case of H_α line. In case that the main broadening mechanisms is the broadening by electrons the electron number density covers the interval (2.1 – 5.8) x 10^{15} cm^{-3} while the temperature Te seems to be extremely low (slightly above 1x10^3 K).

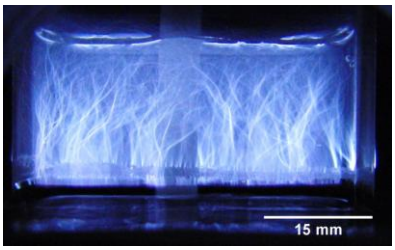

Fig. 2: *An image of the discharge in argon atmosphere for 40 W of applied power.*

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