

3D-SPATIALLY RESOLVED INVESTIGATION OF THE COPLANAR BARRIER DISCHARGE IN SYNTHETIC AIR BY CROSS-CORRELATION SPECTROSCOPY

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Abstract. The evolution of the luminosity of the coplanar barrier discharge in the single-filament mode was studied by the technique of cross-correlation spectroscopy. For the first time 3D-spatially and temporally resolved measurements of the radiation intensity of the second positive (at 337.1 nm) and first negative (at 391.5 nm) system of molecular nitrogen in this discharge type were realized. From these experimental data, the propagation of the cathode-directed ionizing wave (CDIW) is clearly seen. Surprisingly, a second ionizing wave (SW) has been detected, too. The results for the coplanar barrier discharge (CD) are compared with corresponding experimental results obtained for the volume barrier discharge (VD).

1. INTRODUCTION

The determination of spectrally and spatio-temporally resolved luminosity from statistically generated volume barrier discharges (VDs) succeeded by the technique of cross-correlation spectroscopy (CCS), sometimes also referred to ‘time-correlated single photon counting’. The extremely high sensitivity of the CCS combined with the temporal resolution in a sub-nanosecond range is the main advantage, as compared to other methods of emission spectroscopy. The CCS-measurements in VDs allowed a deeper understanding of the process of the electrical breakdown as well as the determination of basic plasma parameters [1-5]. In comparison with the VDs, the level of the experimental investigation of coplanar barrier discharge arrangements (CDs) up to now was not so advanced [6]. Despite the fact that several experimental investigations and numerical simulations of CDs have been made, e.g. [7-10], the systematic spatio-temporally and spectrally resolved study of the ignition, propagation and extinction phases is still missing. In this contribution recent experimental activities on the investigation of CDs by the technique of CCS are summarized.

2. EXPERIMENTAL SET-UP

The measurements were performed in a pin-to-pin coplanar electrode configuration which is shown in figure 1. The curvature radius of the tips of both electrodes was $r = 0.25$ mm and the distance between them 1 mm. To insulate the electrodes, circulating transformer oil was applied. The electrodes were situated on the one side of the 0.7 mm thick alumina ceramic (96% pure Al_2O_3 , $\epsilon_{\text{rel}}=10$), the discharge plasma appearing on the opposite surface. The discharge cell was situated inside a stainless steel chamber. The discharge has been driven typically by the voltage of 24 kV_{p-p} at 10.2 kHz in flowing synthetic air (flow rate 500 sccm) at atmospheric pressure. The voltage was slightly above the on-set value. Under these experimental conditions, only one microdischarge (MD) appeared during every half-period. The applied CCS set-up is shown schematically in figure 2. Here only a brief description is given, because it was already described in several publications, e.g. in [1-3]. The main signal

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