SPATIALLY AND TEMPORALLY RESOLVED EMISSION SPECTROSCOPY OF LOCALIZED SURFACE DISCHARGE IN DRY AIR

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Abstract. Light emission of surface discharge from an edge of a thin aluminum electrode placed on the surface of a ceramic plate was investigated. A.c. 5 kHz high voltage was used. The aim of the work was to analyze internal structure of surface microdischarges in dry air under normal conditions. The distribution of light emission intensity for second positive (337.1 nm) and first negative (391.5 nm) systems of nitrogen was measured by means of monochomator and photomultiplier. Using a system of vertical and horizontal slits the radiation intensity was measured with a 0.2 mm step across the microdischarge channel and 1 mm step along it. The experiments have shown that microdischarges develop from the electrode tip near the dielectric surface at a distance 0.5 – 1.6 mm from it. Such phenomenon is a result of an influence of electric field of charges that are set on to the dielectric surface during the discharge. Cross-correlation spectroscopy method allowed distinguishing at least two stages of the discharge development. Evolution of the electric field in the discharge region is analyzed.

1. INTRODUCTION

Surface discharge (SD) appears generally in gas at the edge of an electrode placed on the surface of a solid dielectric. In this case the electric field has a tangential component as well as a normal one relative the dielectric surface. Experimental investigations of (SD) in such electrode system [1,2] show that the discharge has a form of discrete microdischarges. Although in different references there is a range of experimental results concerning the SD investigation, many physical processes connected with microdischarges and their characteristics are still not clear and it restrains the modeling of the SD and the possibilities to increase its practical utilization. The aim of the present work was to continue experimental investigation of the SD radiation, first results of which were given in [3], and to obtain new data about distribution of light emission intensity across and along the microdischage channel and its variation in time. The results of such investigation permit to analyze the microdischarge structure, the position of microdischarge channels that develop in gas relative the dielectric plate surface, and analyze distribution in time of the electron density in the discharge channel.

2. EXPERIMENTAL CONDITIONS

The used electrode system consists of a small piece of aluminum foil placed on one side of a dielectric plate of 1 mm of thickness (the discharge electrode), while another piece of metallic foil placed on the back side of the dielectric plate is a high voltage electrode. This electrode system was placed into a discharge cell made of Plexiglas with quartz windows. All measurements were done for a discharge in a weak flow of dry air (the humidity not more than 0.7%). The gas flow rate was about 70 l/hour, the gas temperature 23-25^{o}C and the gas pressure 730-750 mm Hg. Dielectric plates of piroceramics and alumina 40x60 mm in dimensions were used. The electrode system and the position of optical measuring devices are shown in Fig. 1. All electrode edges, excluding a small part 1.5 mm long, are coated with an epoxy compound to prevent appearance of the discharge. Only 3 microdischarge channels are seen from the open edge of the electrode during the discharge. An a.c. high voltage (f = 5 kHz) was applied to one of the electrodes. The other (with the discharge) was grounded. The technique of cross-correlation spectroscopy [4] is applied to measure the light emission of the SD. The light

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