SPACE AND TIME RESOLVED OPTICAL EMISSION SPECTROSCOPY OF DIFFUSE COPLANAR BARRIER DISCHARGE

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Abstract. In this work we have studied the influence of electrode temperature and input power on plasma properties of the surface diffuse coplanar barrier discharge. Properties of the discharge can be affected by outer conditions and discharge configuration and better understanding of these effects can lead to optimization of the discharge parameters for industrial applications. The discharge was operated in nitrogen at atmospheric pressure. The power input and electrode temperatures were changed and plasma parameters were studied by the means of time and space resolved optical emission spectroscopy. These measurements gave us time and space distribution of discharge luminosity (e.g. intensity of second positive system of nitrogen) and spatial profiles of rotational and vibrational temperatures.

1. INTRODUCTION

Atmospheric pressure dielectric barrier discharges (DBD) [1] are used in the industry for in-line plasma treatment of fabrics or large area substrates. The utilization of different types of DBD for these applications has been made with different success. The main problem of processing of movable substrates in DBD stands is the inhomogeneity of DBD at atmospheric pressure (formation of plasma microchannels). This results in inhomogeneous treatment of the substrates and unintentional pin-holing of the substrates at high power densities necessary for rapid treatment. This disadvantage is not presented at atmospheric pressure glow discharge (APGD), but on the other hand the glow regime of this discharge is sensitive to the gas impurities and the discharge power.

In the DSCBD, plasma is generated in thin layer above the surface of dielectric. The plasma microchannels are oriented parallel to dielectric surface. Due to small distance between electrodes the microchannel part of the discharge can be suppressed in order to increase the homogeneity of the treatment and suppress the pin-hole effects. Furthermore, the plasma microchannels of DSCBD move rapidly along the surface, which improves the homogeneity of the treatment [2,3].

For better utilization of the DSCBD for industrial purposes the influence of the outer physical conditions on the discharge parameters has to be studied. In this paper the influence of electrode temperature and total input power is presented. Using spatially resolved spectroscopy spatial profiles of vibrational and rotational temperature calculated from the second positive system of nitrogen was determined and correlated with profile of intensity of the second positive system of nitrogen. Time-space maps of integrated intensities of second positive system of nitrogen (SPS - 377.1 nm) and first negative system of nitrogen (FNS - 391.5 nm) were also estimated.

2. EXPERIMENTAL SETUP

The scheme of experimental setup is shown in Fig.1. It consisted of coplanar discharge cell with discharge chamber and cooling/heating unit, power supply unit and diagnostic instruments.

The discharge cell (see also Fig. 1) was composed of two brass electrodes overlaid by dielectric plate

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