EFFECT OF THE AC VOLTAGE AMPLITUDE AND FREQUENCY ON THE XE DBD CHARACTERISTICS

Avtaeva S.V.[1] and Kulumbaev E.B.

Kyrgyz-Russian Slavic University, Kievskaya st. 44, Bishkek, 720021, Kyrgyz Republi,

Abstract. Self-consistent one-dimensional simulations of characteristics of dielectric barrier discharges (DBDs) in xenon have been performed. Effect of the harmonic voltage frequency and amplitude on formation of spatio-temporal characteristics of the xenon DBD is investigated. It is shown that increase in overvoltage and decrease in voltage frequency lead to jump from a one-peak mode of the DBD to a two-peak mode and at great overvoltage to a multy-peak mode.

1. INTRODUCTION

Dielectric barrier discharges provide simple technologies for production of nonequilibrium plasma in gases at atmospheric pressure. This has led to a number of industrial applications of barrier discharges, including ozone generation, surfaces modification of polymers, pollution control, sterilization and disinfection, excitation of CO_2 lasers, excimer lamps and plasma display panels. Depending on a variety of gas properties, operating conditions and the nature of dielectric surface properties, these discharges can exist in the form of series of microdischarges, the self-organized regular pattern or to have completely diffuse character [1]. Several factors, including the voltage frequency and amplitude, gap distance, electrode configuration, material and barrier thickness, influence on a discharge existence form.

DBDs in mixtures of inert gases now is widely used as sources of VUV in excimer lamps and plasma display panels (PDPs) [1, 2]. They are objects for intensive investigations, that is caused by necessity of increasing their power efficiency. Efficiency of DBDs as VUV sources is defined by complex of physico-chemical processes which understanding is promoted by developing DBD theoretical models. In this paper, effect of the harmonic voltage frequency and amplitude on the xenon DBD characteristics is investigated using self-consistent one-dimensional model.

2. ONE-DIMENSIONAL DRIFT-DIFFUSION MODEL

The barrier discharge model [3] is based on a fluid description of ions using drift-diffusion approximation for the particle flux. The description of electrons is based on a "hybrid" approach. In this approach, a local Boltzmann equation for a given range of the electric fields E and electron densities is solved previously, and two-dimensional lookup tables for electron transport coefficients and reaction rates are produced. Then the electron-energy balance equation for the average electron energy is solved. This allows to account approximately for the nonlocality of electron kinetics. The obtained average electron energy and electron density are used to find the electron parameters from the lookup tables. After that, the continuity equation for electrons with also drift-diffusion approximation for the electron flux is solved. An electric field is found from the Poisson's equation. In addition, a set of kinetic equations is used to characterize the evolution of the populations of atom and excimer excited states leading to VUV emission in xenon. The discretization scheme is based on the

[1] Electronic address: s_avtaeva@krsu.edu.kg