CHARACTERISTICS OF THE SIMILAR DBDS IN NE/XE MIXTURE

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

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

Abstract. In this paper two similar DBDs with similarity coefficient of 10 in 95% neon- 5% xenon mixture are studied within the one-dimensional drift-diffusion model. Realization of similarity laws and reasons for deviations from the laws in these DBDs are analyzed.

1. INTRODUCTION

Barrier discharges (DBD) in mixtures of inert gases now are widely used as sources of vacuum ultra-violet (VUV) radiations in excimer lamps and plasma display panels (PDP) [1, 2]. PDPs are now the ideal candidate for large area wall hanging televisions but improvements are still needed to increase the luminous efficiency and the contrast ratio of these displays. In the barrier discharges the alternating voltage is applied to the electrodes covered by dielectric layers, as a rule, with a frequency ~10-100 kHz. The discharge glows in microdischarges which are initiated each half-cycle when the potential drop on a gap exceeds the breakdown voltage. Experimental studies of the spatio-temporal characteristics of the DBDs are complicated, that is connected with the small gap length and small duration of the microdischarges. Because of this, in a number of papers similar discharges in macroscopical cells of PDPs of the same geometry which dimensions on 1-2 orders exceed the dimensions of the real PDP cells [3] are experimentally studied.

It is known, that the low-current glow discharges having the same $p \times d$, have similar properties at the same $p \times t$ if the same voltage is applied to the electrodes. When p or d are changed keeping the same $p \times d$ and the same applied voltage, the following quantities are conserved: J/p^2, E/p and $n_{e,i}/p^2$ (here J is a current density, E is an electric field intensity , $n_{e,i}$ are densities of electrons and ions) [4]. In PDP cells the current density and charged particle densities are low enough, therefore it is supposed, that physics of the DBD in PDP macrocells is the same, as in real cells.

In this paper realization of similarity laws and conservation of properties and physics of the DBDs in the mixture of Ne/Xe are studied numerically.

2. MODEL

Within the one-dimensional drift-diffusion model simulations of steady-state dynamics of characteristics of two similar DBDs between the parallel flat electrodes covered by dielectric barriers with permittivity ε=5, in 95%Ne/5%Xe mixture are carried out. Parameters of the discharges are following: thickness of dielectric barriers is 0.2 and 2 mm, a discharge gap length is 0.4 and 4 mm, the pressure is 350 and 35 Torr and a source voltage is a harmonious signal with the amplitude of 400 V and the frequency of 100 and 10 kHz. The one-dimensional drift-diffusion model is based on fluid description of ions and electrons, using drift-diffusion approach for particle fluxes [5]. For electrons along with the continuity equation, the equation of electron energy balance is solved. The calculated mean electron energies ε_e are used to find electron transport coefficients and rate constants of electron interactions with heavy particles in lookup table, produced previously after solution of the local stationary Boltzmann equation for a given range of the electric fields. The Poisson equation is used for

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