MODELING OF THE ION AND FAST ATOM ENERGY SPECTRA IN AN ARGON TOWNSEND DISCHARGE

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Simulation of argon ion motion in the low-current discharge is fulfilled by the Monte Carlo method, taking into account the charge exchange and elastic scattering on argon atoms. The energy spectra of ions and fast neutrals generated under ion elastic scattering are calculated and their contributions to the cathode sputtering are found.

A mixture of argon with mercury vapor, in which the density of saturated mercury vapor decreases exponentially with temperature, is used in different types of gas discharge illuminating lamps as a background gas [1,2]. When the electric current flows in the mixture, the mercury ion flow density depends significantly on temperature and at its negative values it is by several orders lower than the argon ion flow density [3,4]. Hence, sputtering of the cathode, which reduces the lamp lifetime, is a result of its surface bombardment by argon ions and fast atoms generated in ion-atomic collisions. Therefore, only argon ions and fast neutrals, which move into the parent gas, can be taken into consideration under simulation of this process at low mixture temperatures.

The effective (averaged over particle energies) coefficient of the cathode sputtering by argon ions as a function of the reduced electric field in the Townsend discharge was calculated in [5] under taking into consideration their resonant charge exchange on argon atoms, whereas the ion elastic scattering on argon atoms was neglected. In this work, motion of the argon ions in the discharge volume is simulated by the Monte Carlo method with due account of their charge exchanges and elastic scattering on argon atoms. The energy spectra of ions and fast neutrals generated in elastic collisions are calculated at different discharge conditions. The contributions of both types of particles to the cathode sputtering, as well as the flow densities of atoms sputtered by them from the cathode surface, are found.

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