ON THE EFFECT OF GAS TEMPERATURE ON THE DRIFT AND DIFFUSION OF IONS

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As a rule, measurements and calculationsare performed for room temperatures: 293, 298, and 300 K. There are also some experimental data onthe drift characteristics atcryogenic temperatures close to 77 K and 4.2 K [1, 2]. It is well known that the properties of a cryogenicdischarge change substantially upon a decrease in the gas temperature [3]. Low gas temperatures are typical of the ionosphere, as well as of interplanetary and interstellar space. In the experiments on studying the properties of ultracold plasma in Pauli traps, ions also drift in a very cold gas (with a temperature much lower than 1 K). Furthermore, even in the laboratory plasma, the gas temperature can differ from the room temperature. Modern plasma technologies often use the discharge modes in which the gas temperature is substantially higher than the room temperature. Therefore, studies of the effect of the gas temperature on the characteristics of ion driftare also very important from the standpoint of plasma technologies [4 -6].

Another important characteristic of the ion flux is the angular distributionof ions intersecting the surface as the ionangular distribution determines, for example, the etching profile in the manufacturing of semiconductor structures. It is also important to study the energy distribution of ions crossing any selected surface. If it is a real surface, such as a substrate surface,and electrode in the plasmachemical etchingreactor ora dielectric in the barrier discharge, then the energy distribution of ions bombarding the surface determines the rate of spraying of the electrode material, the secondary emission of electrons, the profile of etching of the substrate material [7].

The drift velocities of ions in a constant homogeneous electric field are calculated using Monte Carlo simulations for noble-gas and some metal vapor. The ion mobility is analyzed as a function of the field strength and gas temperature. A general approximate formula for the dependence of the drift velocity on the reduced field and gas temperature is derived. The results of calculations of kinetic characteristics ofions crossing the surface of the targetare presented. The authorsfocus on the angular and energy distributions of ions and differences between the distributions of the average volume and the averageflow on the surface.

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