Determination of Anisotropic Ion Velocity Distribution Function in Intrinsic Gas Plasma. Probe Method

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The ion velocity distribution function (IVDF) is of interest in cases associated with the study of plasmachemical reactions occurring with the participation of ions, the determination of ion mobility in the plasma object, processes of heating of the neutral plasma component, etc. Among technical applications, we remark modern plasma nanotechnologies, fine ion purification of the surfaces, and the technology of creating reliefs on the surface owing to selective etching during bombardment by ion fluxes.

This work is devoted to the experimental and theoretical determination of the ion velocity distribution function in intrinsic gas for a glow discharge in a constant field with allowance for the appearance of slow ions with atomic temperature as a result of charge exchange, which was considered the dominating process. It was assumed that the ion velocity before the collision considerably exceeds the velocity of atoms.

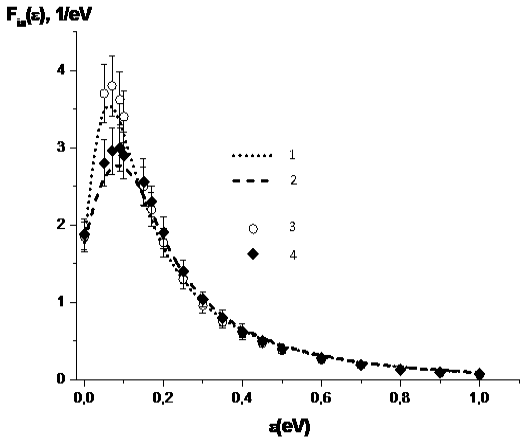

Figure. Comparison of IDF He^+ in He in the strong field approximation [1] with experimental data: T_a=600K, E/P_0=20 V/cm·Torr, P=0,2 Torr

For the first time, the ion distribution functions over energy and direction of motion for He^+ in He (see Figure) and Ar^+ in Ar have been measured by the method of the plane one-sided probe [2]. Here IVDF was determined in the glow discharge of intrinsic gas in a constant electric field of an arbitrary value. The obtained results make it possible to conclude that, in independent gas discharge plasma, even at moderate fields, the ion distribution function can have noticeable anisotropy and can strongly differ from Maxwell distribution.

References

[1] A. Mustafaev, V. Sukhomlinov and M. Ainov. 2015. Tech. Phys. Vol. 60 P. 1778.

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