DUST PARTICLE CHARGE DETERMINATION IN CONSIDERATION OF NON-LOCAL EFFECTS IN A STRATIFIED GLOW DISCHARGE

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A new theoretical method of dust particle charge determination is provided. This method is based on the calculation of the ion and electron fluxes on the dust particle surface in a spatially periodic strata field. The electron flux is calculated through the non-local electron distribution function (EDF), which is formed by inhomogeneous strata potential. The comparison between proposed theoretical method and the traditional method of using Maxwell EDF for dust particle charge calculation is done.

Dust particle charging in a low-pressure glow discharge was investigated theoretically. The numerical calculation is based on the equality of ion and electron fluxes on the dust particle surface. The theory of the motion of electrons and ions in stratified glow discharge in a vertical cylindrical discharge tube is considered.

The electron flux is derived by integrating over distribution function of electrons, which were passed through the absorption cross-section. The calculation were performed with the help of non-local electron distribution function (EDF), which is not formed by the local field, but the whole potential profile of the striation. The computations were made in the steady electric field, which is correlated with the field profile, experimentally obtained under the conditions of the P-striations formed in the discharge tube with a radius R=1 sm, at low pressure p=0.2 torr of neon. In this case the coefficients of the kinetic equation can be averaged over the radial transits due to the feasibility of the diffusion approximation [1]. EDF is compressed into narrow peaks, which move along the resonance trajectories.

The usual way to calculate the dust particle charge is to use Maxwell distribution function. The electron flux on the dust particle surface was calculated for two types of EDF. The essential differences between two fluxes, related with the absolute values, the modulation depth and the phase are shown. So, the dust particle charge, obtained using the equality of electron and ion fluxes, also depends on the type of EDF. It is shown that the potential and the charge number of dust particles calculated for two types of EDF are not equal.

REFERENCES

1. Golubovskii, Y.B., Rabadanov, K.M. & Nekuchaev, V.O. Russ. J. Phys. Chem. B (2017) 11: 106