The temperature of electrons of complex plasma in the mixture of He/Ar in radio frequency discharge

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1. Introduction

Dusty (complex) plasma is the usual low-temperature plasma which contains small solid particles, with sizes from tens of nanometers to several hundreds of micrometers [1,2]. Dust particles in the plasma acquire charge equals to few tens of thousands of elementary charges and can be ordered create plasma dust structures. Diagnostics of low-temperature dusty plasmas using traditional methods is of great interest and the results show that the presence of dust particles significantly affect the basic properties of the background plasma. As well, the addition of the impurity gas in the main gas leads to significant changes in the structural and dynamic properties of plasma-dust formations [3,4]. This work presents the results of measurements of the electron temperature of the complex plasma in a mixture of noble gases He + Ar using an RF compensated Langmuir probe.

2. Experimental setup

The experiments were carried out in the plasma of radiofrequency capacitive discharge. The main part of the experimental setup is the electrodes system, between of them a high-frequency gas discharge is formed. The electrodes are located parallel to each other in a horizontal position. The distance between the electrodes is 30 mm. The RF compensated single electric probe is inserted into the plasma and connected to the measuring circuit through the multicontact connector in the vacuum chamber. The probe has a compensating aluminum electrode and LC resonance filters for the first and second harmonics of the RF field. The contacting part of the probe has a diameter of D = 0.12 mm and length L = 3.3 mm. Argon, helium gases and their mixtures were used as a working medium. As dust particles we used polydisperse Al_2O_3 particles and monodisperse particles of melamine formaldehyde with size of 10 mkm.

3. Experimental results

The electrons temperature distributions in the axial direction in the buffer plasma of pure He and He + Ar mixture were determined using the Langmuir probe. The electron temperatures were measured in the range from 6 mm to 26 mm from the lower RF electrode with increment of 2 mm. Ut was shown an increase in the temperature of the electrons in the sheath of the discharge, due to stochastic heating and acceleration of electrons in the RF field. Addition of argon (3%) to helium (97%) reduces the electron temperature (fig. 1), which in turn significantly affect the properties of plasma-dust formations: structure, the dust charge and the average interparticle distance between dust particles.

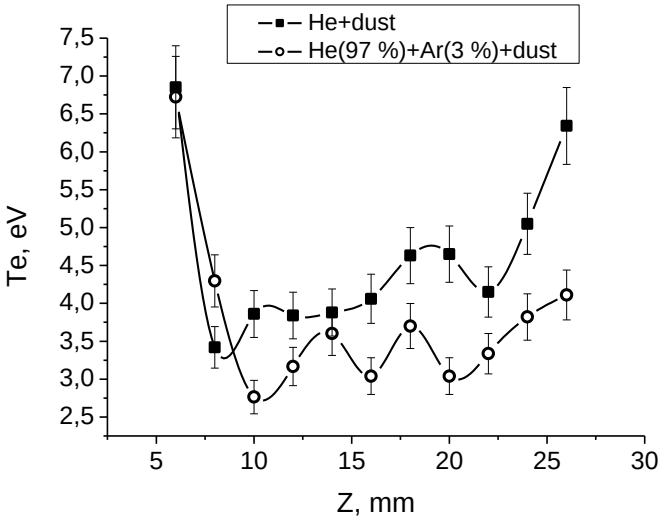

Fig. 1: *The axial distribution of the temperature of electrons in the interelectrode volume in pure He and He + Ar mixture with dust particles. The pressure in the discharge chamber is 0.3 Torr, power is 20 watts.*

References

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