Control of microparticle oscillations by the thermal field in a plasma of a glow discharge

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Thermal fields can be applied for change the shape and separate into parts the structures of microparticle. In the present work, we research the dynamics of polydisperse charged microparticles in plasma of a DC discharge upon changes in the radial thermal-field gradient. It is demonstrated that the thermal field can be used for effective control of a cloud of microparticles formed in an electrostatic trap of stratum the positive-column stratum of discharge. The discharge was ignited in air with polydisperse (3—10 micron) particles in a vertical tube with the inner diameter of 5 cm. The air pressure varied in the range of 0.1—0.5 Torr, while the discharge current varied in the range of 0.25—1 mA. Radial temperature gradient in plasma was varied by changing the tube wall temperature. The required wall temperature was achieved by means of two chillers mounted coaxially on the wall opposite to the cloud of microparticles. Variation in the tube wall temperature is found to cause changes in the cloud location in plasma volume, its shape and size, along with suppression of oscillations of microparticles in the directions transverse with respect to this gradient. Microparticles of larger size experience stronger thermal action. Changes in location of the cloud of microparticles were accompanied by redistribution of the stratum glow intensity caused by considerable plasma losses upon interaction with microparticles and additional ionization. Damping of oscillations of microparticles with increase in the thermal-field gradient was discovered, and its efficiency was estimated. By analogy with free damped oscillations, the obtained damping of large microparticle oscillations would be characterized by a very large damping decrement of 3.