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NUMERICAL SIMULATION OF A SYSTEM OF FORMATION OF AN INTENSE ION BEAM FROM GAS DISCHARGE PLASMA OF AN ION THRUSTER

Abstract

A numerical simulation of axisymmetric cell of two- and three-electrode grid systems of the xenon ion thruster was made by IGUN software. The processes of formation of the primary ion beam and the beam of secondary charge-exchange ions were taken into account at the geometrical parameters of the cell - hole diameter in the electrodes, electrode thickness and inter-electrode gap - corresponding to the screen electrode potential of 4.5 kV. The plasma parameters - plasma density and electron temperature, and their distribution over the surface of the plasma emitter also - were set on the basis of results of experimental works fulfilled at the University of Giessen (Germany), and presented in [1], also. While making calculations for the charge-exchange ion beams, their formation both in the gap between the screen and accelerating electrodes and in the plasma plume (beam neutralization area - the "back flow") was taken into account. The back flow formation is related, in particular, to the kinetics of electrons inside the plasma plume that is considered to determine thermalization conditions for fast electrons emitted by the neutralizer, and to assess electron temperature and plasma potential in area of beam neutralization. Theoretical estimates are in good agreement with the experimental data [2]. The accelerating electrode erosion rate being the determining factor of the ion thruster lifetime constraints was estimated on the basis of the secondary beam calculation results.