Paper ID: 17005
poster
student

SPACE PROPULSION SYMPOSIUM (C4)
Poster Session (P)

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INTERDEPENDENCE BETWEEN INTEGRAL CHARACTERISTICS OF HALL THRUSTERS

Abstract

Interdependences between integral characteristics of Hall thrusters play important role at its engineering. A simple method of evaluation of interdependences between integral characteristics of Hall thrusters with anode layer is suggested. The equation of balance of the forces acting on a region with a Hall current and the relation between current of the accelerated ions and the flow rate of working gas are taken into consideration. Given that the geometrical parameters of the specific Hall thruster are fixed this model allows to relate to each other the basic integral characteristics of the thruster, such as accelerating voltage, magnetic field strength, the flow rate of working gas and the current of the accelerated ions. The numerical estimations are presented for one of the most commonly used Hall thrusters with anode layer - TAL-WSF. The region of discharge existence in the channel of the Hall thruster is considered. It is shown, that a rather small demagnetization is typical for Hall thrusters with anode layer, that is the ratio of the strength of magnetic field near anode boundary of Hall current layer to the strength of magnetic field on its cathode boundary is close to 1. It is shown, that taking into account the kinetic effects at free-molecule flow of neutral particles (a preferential depletion of tangentially flying particles and slowly flying particles) leads to decrease of a current of the accelerated ions and thrust of the thruster. The initial heating of working gas also leads to decrease of thrust. The suggested method can be used in engineering of new Hall thrusters for estimation of their parameters. Application of suggested method to stationary plasma thrusters also gives acceptable results.