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Simulation of effective parameters on the anomalous electrons drifts in the Hall Effect thruster by PIC method

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Abstract

In this paper, we used the Particle in Cell (PIC) method to study a plasma in the Hall Effect thruster in order to optimize the effective parameters on the electron mobility and anomalous electrons drift. In the Hall Effect thrusters magnetic and electrical fields which are perpendicular to each other are used to confine the plasma and create propulsive force on the satellites and spacecrafts. The presence of a magnetic field perpendicular to the electric field causes the electrons to move in an azimuthal direction and in ideal situation it is expected that there is a net electron azimuthal current but we realize in the experimental tests that the electrons have anomalous drift. This anomalous drift causes a weak confinement of elections near the outlet of the thruster and increases the losses of electrons that it is a consequence of corrosion of the wall of the thruster which is made up of the dielectric, and it decreases the efficiency. Two major mechanisms have been proposed to control this electron current, the first is involving electron-wall collisions and the second one is involving plasma oscillations such as E×B drift instability. In this paper, these two subjects are investigated and the effective parameters on electron mobility are optimized. The simulation shows that the ideal value for a magnetic field to confine electrons is about 250 to 300 Gauss, and the reasonable value for accelerating electrons is more than 300 Volts. It is also shown that the optimal density of plasma and neutral gas is 2×10^{17} m^{-3} and 1×10^{20} m^{-3} respectively.

Keywords: Hall thruster, anomalous electron transport, PIC simulation, E×B drift instability

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