Study of different kind of Magnetic Field and Density Profiles of a Hall Thruster

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Hall thrusters have emerged as an integral part of propulsion technology. Unlike chemicals and electric rockets, in a Hall thruster, the propulsion thrust is achieved by a propellant (usually Xenon). This gas is ionized and then accelerated by electrostatic forces. In Hall thruster, the electric field $\vec{E}$ is perpendicular to the magnetic field $\vec{B}$ and the electrons are constrained to move in the azimuthal direction of the closed $\vec{E}\times\vec{B}$ drift [1-9]. As it's clear, the magnetic field is required to trap the electrons for larger duration in order to enhance the ionization. The magnetic field profile controls the discharge voltage and the discharge current, which affect the performance of the thruster. The performance is also related to the divergence of exhaust-beam/plasma plume, which may cause electrostatic charging and communication interference of satellites. Therefore, we have studied the effect of different profiles of magnetic field, density and velocity on the potential of the plasma plume. Plasma plume is found to acquire larger potential if the magnetic field of higher strength is used. Potential of the plasma plume attains a peak value outside the acceleration channel [9-10]. The peak of the plume potential gets shifted more outside in the case of Gaussian density profile, when the position of the magnetic field is shifted towards the cathode. No shifting of the peak of the plume potential is observed for the super-Gaussian profile of density. Plume potential gets enhanced if the ions have larger initial axial velocity. Reduced potential of the plasma plume is realized for the higher frequency of the collisions of ions and electrons. The effect of electron temperature is to enhance the potential of the plasma plume.

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