

SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations (IP)

Author: Mr. Rajesh Natarajan
Bellatrix Aerospace Private Limited, India

Mr. Rohan M Ganapathy
Bellatrix Aerospace Private Limited, India

STUDY OF EFFECT OF NEUTRAL FLOW AND ELECTRON TRANSPORT IN WALL LESS HALL
THRUSTER CONCEPT**Abstract**

Hall Effect Thruster or Stationary Plasma Thruster is a type of advanced electrostatic ion propulsion system. They work by trapping electrons in a magnetic field and use the electrons to ionize the propellant, efficiently accelerate the ions to produce thrust. HET's have been successfully used as means of in-space propulsion system for EOR, attitude control and station keeping since 1972. As technology advances, more complex missions are born, where the use of HET's are required. Major drawback of HET's is its life of around 4000-7000 hours due to the erosion of discharge channel. This paper concentrates on an unconventional design of an HET known as wall less HET concept, with an aim to increase the life span to >10,000 hours. In wall less concept, ionization is at the exit plane and acceleration zone is shifted outside. Understanding of physical process of neutral flow, behaviour of electrons and its effect in hall thruster performance is a difficult problem to solve. Accurate prediction of the flow properties within the anode region is challenging due to variation in pressure and continuum flow at the inlet. In the discharge channel, few electrons do not create sufficient ions, some electrons lose their energy during their excitation through elastic collision with neutral species, and some electrons get deposited in anode due to low anode temperature and other electron loss (Secondary Electron Emission). In wall less concept, due to the change in topography of magnetic field and position of anode, the transport and trajectory of electrons in the ionization and acceleration region play a major role in the overall performance of the thruster in terms of rate of erosion and performance. This paper discusses, through analytical approach, the role of neutral flow dynamics, collisions of electrons and its transportation in wall less hall thruster concept. A Particle in Cell (kinetic and full PIC code) simulation of neutral flow within the discharge channel is carried out, with an aim to increase propellant flow uniformity across the channel and study the residence time to improve the overall thruster performance in terms of life and efficiency. Also, Bohm diffusion function, an empirically derived expression for electron transport was used to model anomalous transport mechanisms in the wall less configuration.