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DEVELOPMENT OF A CYRINDRICAL HALL THRUSTER

Abstract

Recent development trend of satellites is miniaturizing, since downsizing satellite can drastically reduce the cost and time of development. Thus, miniaturized propulsion system corresponding to small satellites is becoming more and more important.

A Hall Thruster is one of the most promising electric propulsion systems. It performs high thrust efficiency at specific impulse range of 1,000 3,000. Since Hall thruster has relatively high thrust density, and simple thruster and power supply system, it is one of the best propulsion systems for small satellite's station keeping missions.

The major problem of miniaturizing a Hall thruster is wall loss. According to scaling law, downsizing a Hall thruster without decrease of thrust efficiency requires increase of magnetic flux density inside the acceleration channel. However, down scaling the magnetic circuit makes it very difficult to optimize the magnetic field configuration. This effect increases electron energy loss to the channel wall, and results in decreased thrust efficiency. Moreover, ion flux impinges the channel wall will increase, so the lifetime performance of the thruster will get worse.

Cylindrical Hall thruster is an approach to solve this problem, which was first proposed by PPPL. The retarded channel wall and magnetic circuit reduces the wall area exposed to plasma greatly, compared with a conventional Hall thruster.

In this study, a 300 W class Cylindrical Hall thruster was developed. The outer diameter of the thruster is 30 mm, and inner diameter is 22 mm. The thrust performance was measured and discussed, in order to improve the development of down scaled Hall thruster.