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EFFECT OF MAGNETIC FIELD CONFIGURATION AND ANODE CONFIGURATION ON 5 KW CLASS ANODE LAYER TYPE HALL THRUSTER

Abstract

Anode layer type Hall thrusters are promising thrusters for spacecraft's main propulsion, since it have the potential of high thrust efficiency, long lifetime and larger thrust density than those of magnetic layer type Hall thrusters and ion thrusters. We have been developing high power anode layer type Hall thrusters for a Cargo for manned mission to Mars as well as that for the construction of heavy space structures like the space solar power system. For the development of high power anode layer type Hall thruster, a 5 kW class anode layer type Hall thruster (named RAIJIN94) has been developing and it showed unsatisfactory performance, that is, the thrust was 160 mN at 3 kW at xenon mass flow rate of 9.8 mg/s and discharge voltage of 300 V. In order to improve the thrust efficiency, optimization of anode shape and magnetic field configuration are essential. The effects of anode shape and magnetic field configuration on thrust performance, that is, thrust, thrust efficiency, oscillational condition map, ion beam divergence were investigated. Thrusts for two types anode shape, normal shape, and boss shape, were measured using the pendulum type thrust stand. The thrusts with normal anode and boss anode are 111 mN and 103 mN, respectively at discharge voltage of 400 V and anode mass flow rate of 4.9 mg/s and cathode mass flow rate of 0.5 mg/s. The beam with normal anode is less divergent than that with boss anode, though the difference between the two is little. The stable operational range with normal anode is larger than that with boss anode. Thrusts for various magnetic field configurations were also investigated by changing the inner/outer/trim coil currents and the results shows that the optimum ratio of inner coil current to outer coil current is 5:3. The effect of trim coil was small compared to the effect of changing the ratio of inner to outer coils. For evaluation of the thrust performance, we have not yet investigated the effect of anode configurations and magnetic field configurations on the lifetime and we have planned to do it.