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DEPENDENCE OF THE PLASMA PARAMETERS ON THE OPERATION CONDITION IN A LOW POWER HALL THRUSTER

Abstract

Research on low power plasma thrusters has recently gained lots of interests due to the various applications for small size satellites. In doing so, understanding of the produced thruster plasma characteristics is a prerequisite in optimization of the thruster design and operation. In this work with a 300 W class Hall thruster, plasma parameters including ion current density, plume angle, ion energy distribution, electron temperature, and ion density were experimentally obtained by using a retarding potential analyzer, a Faraday probe, and a Langmuir probe, and change of the parameters were studied depending on the operation conditions such as magnetic field strength, anode bias voltage, and xenon flow rate etc. For measuring electron temperature and density, a double Langmuir probe was employed since it is a suitable diagnostic for plasmas with no well-defined ground such as the Hall thruster plasma since the plasma is ejected from the discharge channel to the large vacuum chamber. Under the typical operation condition of 250 V anode voltage, 0.84 A discharge current, and 8 sccm xenon flow rate, the probe located at 2 cm from the thruster channel exit in the axial direction and 2 cm from the thruster radial center showed the measured electron temperature and ion density of 1.8 eV and 2.3x10$^{11}cm^{-3}$, respectively. As the anode voltage was changed, the electron temperature and ion density followed the tendency of the discharge current. As the applied magnetic field was raised, the ion density decreased. The measured ion densities were 2.3x10$^{11}cm^{-3}$ and 4.9x10$^{11}cm^{-3}$ with the maximum radial magnetic field of 650 G and 280 G inside the discharge channel. At various xenon flow rate and magnetic field profile, the measured ion current density, plume angle, and the ion energy distribution are compared.