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PERFORMANCE DEPENDENCE OF AN INDUCTIVE RADIO-FREQUENCY PLASMA THRUSTER WITH A RADIAL MAGNETIC FIELD ON ACCELERATION FREQUENCY

Abstract

In a 2 kW-class inductive radiofrequency plasma thruster, an applied 100 kHz time-varying magnetic field induces a perpendicular Hall electric field capable of cross-field ion acceleration. However, the orientation of the Hall electric field was predominantly radial and needed to be redirected axially. Consequently, for effective axial acceleration of ions, the thruster was redesigned with a dominant static radial magnetic field using permanent magnets. Preliminary steady-state thrust measurements yielded minimal propulsive performance improvement, suggesting possible ion magnetization. As a result, two follow-up studies were conducted to verify the formation of the Hall electric field and to assess ion magnetization at different static magnetic field strengths by replacing the permanent magnet with an electromagnet. In contrast, this paper presents recent experiments aiming to elucidate the performance dependence of the thruster on the acceleration frequency. The amplitude of the acceleration current, which induces the alternating magnetic field, is kept constant while varying its frequency. The effect of the acceleration frequency is examined at different radiofrequency plasma generation powers, different static radial magnetic field strengths and 60 sccm of Argon propellant. The ion energy distribution function, ion velocity, and thrust are evaluated using a retarding potential analyzer, a mach probe, and a pendulum-type thrust target, respectively.