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Particle-in-Cell Simulation of a Micro ECR Plasma Thruster KEISUKE UENO, DAISUKE MORI, YOSHINORI TAKAO, KOJI ERIGUCHI, KOUICHI ONO, Department of Aeronautics and Astronautics, Graduate School of Engineering, Kyoto University — Downsizing spacecrafts has recently been focused on to decrease mission costs and to increase launch rates, and missions with small satellites would bring a great advantage of reducing their risks. Such a concept supports a new approach to developing precise, reliable, and low-cost micropropulsion systems. We have developed a new type of electromagnetic micro plasma thruster using electron cyclotron resonance (ECR) discharges. The microthruster consists of a microwave antenna and a quartz microplasma chamber 4.15 mm in inner diameter surrounded by two permanent magnet rings. The plasma is generated by 4-GHz microwaves of < 10 W with a propellant gas of Xe, where the ions are accelerated through divergent magnetic fields and the resulting ambipolar electric fields generated. To investigate plasma characteristics of the thruster, we simulated the plasma density, electrostatic potential, and ion velocity in the exhaust area by the particle-in-cell (PIC) method with a Monte Carlo calculation for particle collisions, where the electrostatic field and the ion velocity were obtained by solving the Poisson equation and the equation of motion, respectively. The numerical results showed that the ions generated in the plasma are well confined by the applied magnetic fields and diffuse out of the discharge tube, then being accelerated by a potential drop of $\sim$7 V through divergent magnetic fields from < 1000 to > 3000 m/s (< 0.7 to > 6 eV) in the axial direction.

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