SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

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NUMERICAL SIMULATION OF THE INFLUENCES OF CEX IONS ON ION THRUSTER OPTICS

Abstract

Ion thruster, which belongs to the electrostatic electric propulsion, usually accomplishes a space propulsion mission with a long lifetime. Charge exchange (CEX) ions can do great damages to the ion thruster optics. Based on particle-in-cell (PIC) method plus Monte Carlo collision (MCC) method, a two-dimensional axis-symmetric code in C++ language was developed to investigate the trajectories of the ions and the characteristics and influences of CEX ions on the ion optics. In our code, Xenon propellant is used. At start of each time step, new particles are injected into the calculation domain from upstream boundary where the axis velocity of particles satisfies the Bohm criterion and the radial velocity of particles satisfies Maxwellian distribution. The initial positions and the velocity components of the new particles are achieved from a generator of random number uniformly distributed between 0 and 1. A single linked list was adopted to store the information of the charged particles and only the singly charged ions were considered. The simulation results show that although CEX ions may be produced in the entire beamlet region near the ion optics, the ones produced downstream of the accelerator grid should be paid more attentions to. The trajectories of the CEX ions are essentially affected by the local electric fields and many CEX ions will be accelerated toward the ion optics causing the erosion of the grids. The screen grid current have been increased a little when the CEX ions were considered. On the other hand, the accelerator grid current increased from zero to about 1.5 percent of the beamlet current. It is indicated from the simulation results that the CEX ions originated in the region far downstream of the accelerator grid are the main reason for the accelerator grid current and the erosion on the downstream face of the accelerator grid.