

MODELING AND SIMULATION OF A MEMS-BASED PSEUDOSPARK MICROTHRUSTER*

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The requirements for satellite station-keeping include low levels of thrust applied intermittently over the lifetime of the satellite and high specific impulse to optimize payload efficiency and high reliability. Advances in MicroElectroMechanical Systems (MEMS) technology have enabled the design and fabrication of microthrusters that can meet these requirements¹. The first step is to model and simulate a microthruster, with the eventual goal of building and testing arrays of thrusters.

This research presents the modeling and simulation of a MEMS-based microthruster that generates a pseudospark discharge in a hollow cathode configuration². The ion microthruster operation uses a 5-nanosecond (ns) pulse of 500 V in argon gas at 10 Torr. Simulation runs are executed using XOOPIE PIC-MCC code (developed by the Plasma Theory & Simulation Group of UC-Berkeley) for a microthruster with accelerator/extractor stages.

Simulation results have been obtained for the microscale thrusters with one- and three-extractor stages. The average kinetic energy and number of particles (for both argon ions and electrons) have been plotted over the 5-ns pulse. The microthruster potential profiles and particle number densities have been recorded at times $t = 2$ ns and $t = 5$ ns. Estimates of the thrust and specific impulse have been determined from the flux and angular distribution data of the exiting ions.

1. J. Mueller, "Thruster Options for Microspacecraft: A Review and Evaluation of State-of-the-Art and Emerging Technologies", Micropropulsion for Small Spacecraft, Progress in Astronautics and Aeronautics, AIAA, Vol. 87, 2000, pp. 45-137.
2. J.P. Verboncoeur, H.P. Chen, A. Minnich, "Modeling of a MEMS Pseudospark Microthruster", Bulletin of the American Physical Society (APS), Vol. 49, No. 8, 2004.

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