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DEVELOPMENT AND PERFORMANCE ANALYSIS OF A MINIATURIZED MICRO ION THRUSTER FOR CUBESAT APPLICATION

Abstract

With the growing utilization of Cube satellites (CubeSats) in space exploration, there arises a pressing need for propulsion systems that can navigate the microgravity conditions of low Earth orbit with precision and efficiency. Traditional chemical propulsion methods, often unwieldy and impractical due to the strict size and mass limitations of CubeSats, have led researchers to explore electric propulsion, notably ion thrusters, as a promising alternative.

This study introduces a thoroughly crafted miniaturized micro ion thruster tailored explicitly for CubeSat missions. Leveraging cutting-edge micro-fabrication techniques, the thruster achieves a compact yet high-performing form factor. The evaluation phase includes a series of analytical tests and simulations to analyze the thruster's effectiveness comprehensively. Parameters such as thrust, specific impulse, and efficiency are measured across various operational scenarios. Crucially, the ionization chamber, conductive grids, and accelerator stages undergo designing iterations to achieve a delicate balance between minimizing mass, size, and power consumption while upholding adequate thrust and specific impulse levels. Consequently, the resulting system demonstrates promising performance attributes, hinting at an elevated thrust-to-weight ratio ideal for CubeSat missions.

The research outcomes substantiate the successful development of a micro ion thruster finely attuned to the distinctive demands of CubeSat missions. It emerges as an efficient propulsion solution, facilitating CubeSats to extend their operational lifecycle, access higher orbits, or participate in satellite decommissioning. A crucial step towards mitigating space debris and fostering sustainable space access. Furthermore, the research domain carved out in this investigation sets the groundwork for subsequent refinements and diverse applications of micro ion thrusters, thereby nurturing innovation within the realm of miniature space propulsion. This trajectory promises to unlock new possibilities for advancing CubeSat technology and propelling broader explorations in space.