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IN-HOUSE DEVELOPMENT OF GRID OPTICS FOR MINIATURIZED MICRO ION THRUSTER

Abstract

The demand for small-scale propulsion systems with high efficiency and precise control has been growing rapidly, driven by advancements in miniaturized satellite technology and deep-space exploration. Micro ion thrusters have emerged as a promising solution, offering high specific impulse and low power consumption. However, achieving optimal performance in these thrusters requires precise control of ion beam divergence and uniformity, which is heavily influenced by the design and fabrication of the grid optics.

This paper presents the development of grid optics tailored for miniaturized micro ion thrusters at Sharjah Academy of Astronomy, Space Science, and Technology (SAASST). Traditional approaches rely on commercial off-the-shelf components, limiting customization and optimization for specific thruster designs. By developing our grid optics internally, we gain unprecedented control over the manufacturing process, enabling fine-tuning of parameters such as aperture size, grid spacing, and material properties to meet the exact requirements of our micro ion thruster.

The design process begins with computational modeling using advanced simulation techniques to optimize the geometry of the grid optics for efficient ion extraction and beam focusing. We employ finite element analysis (FEA) and computational fluid dynamics (CFD) simulations to predict ion trajectories and grid performance under various operating conditions. These simulations guide the iterative refinement of the grid design, ensuring optimal performance across a range of thrust levels and operating environments.

This paper highlights the importance and benefits of in-house designing and development of grid optics for miniaturized micro ion thrusters, facilitating advancements in small-scale propulsion technology and unlocking new opportunities for space exploration and satellite missions.