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Electric Propulsion (1) (5)

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PERFORMANCE CHARACTERIZATION OF THE FIRST ECLIPSE THRUSTER PROTOTYPE

Abstract

FOTEC's electric propulsion systems are based on Field Emission Electric Propulsion (FEEP) where liquefied metal is ionized and accelerated from the tips of porous tungsten needles under the application of a strong electric field. This not only assures a high specific impulse but also allows unprecedented accuracy and controllability. The thrusters underwent successful endurance tests, reaching over 52,000 hours of accumulated operation time. In preparation for long duration scientific and Earth observation missions, FOTEC is developing the ECLIPSE thruster, a novel electrostatic propulsion system based on its proprietary FEEP technology. The development of the thruster module is an evolution of the heritage IFM NANO thruster design, originally developed at FOTEC and commercialized by FOTEC's spinout ENPULSION. The development strategy involves the creation a flexible thruster module that can adapt to various mission requirements. The modular design is configured to facilitate straightforward clustering, catering to missions that necessitate a broader thrust range and/or higher total impulse. The primary modifications with respect to the heritage FEEP thruster design include (1) an enlargement of the reservoir, allowing up to 500 g of propellant, (2) the incorporation of a focusing electrode to restrict the beam divergence and optimize the alignment with the thruster's central axis, and (3) enhancements in thermal design to minimize thermal losses. Since the key component, the crown emitter, remains unchanged from the heritage design, the maximum nominal thrust achievable is 500 μN. This paper presents the results of the first performance characterization of the first prototype of the ECLIPSE thruster. This characterization has been done for several operation points in the large vacuum facility in FOTEC's Aerospace Laboratory. The measurements have been acquired on one hand with the plasma diagnostics system featuring 23 Digital Faraday Cups, and on the other hand with the μN thrust balance. Although the thruster that has been tested is a first prototype and design changes are still possible, the successful test shows promising results that will help finalize the design of this novel thruster module in the near future.