IAF SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (1) (5)

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RESULTS OF THE SUCCESSFUL 48000 H ENDURANCE TEST OF A FEEP MULTI-EMITTER

Abstract

The FEEP thrusters developed at FOTEC have been extensively optimized and tested in the recent years. The core element of this advanced propulsion technology is the so-called crown emitter featuring 28 porous tungsten needles. This emitter is impregnated with propellant and, when raised at highly positive potential together with the surrounding extractor electrode at highly negative potential, ions are extracted from its tips and accelerated to generate thrust in the order of several hundreds of micronewtons. Following the successful in-orbit demonstration in 2018, the same crown emitters are utilized both in FOTEC's thrusters and in the hundreds of commercial thrusters sold by the spin-off company ENPULSION. The main goal of the developed propulsion system is to enable very accurate positioning and precise orientation control of CubeSats and small satellites.

Among extensive performance testing activities, endurance tests lasting several thousand hours have been performed on crown emitters at the Aerospace Laboratory of FOTEC. The test campaign described in this paper gives an overview of the longest endurance test carried out on a FEEP thruster so far, with a cumulative firing time of 48000 hours. The most relevant performance parameters and their evolution over time are described. The gradual change of the tip morphology induced by nominal operation, which was suspected to be a possible lifetime limiting factor, slowed down over time and did not lead to the functional loss of any needle. However, as expected, the repeated exposure to ambient air due to inspection of the emitter in between test runs has been correlated with a decreasing number of firing needles over time which results in an increased overall impedance of the emitter during the test campaign. These artificial degradation effects are only present due to facility limitations during ground testing with repeated venting and inspections, and would not be experienced in the vacuum of space. Therefore, it is likely that these emitters can be operated successfully in space for an even longer timespan than proven by this endurance test over 48000 hours.

This endurance test has helped identifying lifetime limiting factors and demonstrating the high potential that the FEEP technology can offer for future Earth observation and science missions such as NGGM or LISA respectively.