IAF SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (9)

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DEVELOPMENT AND QUALIFICATION OF THE FEEP TECHNOLOGY FOR THE UPCOMING ESA'S EARTH OBSERVATION MISSION NGGM

Abstract

In 2015, FOTEC developed the IFM Nano Thruster which is based on proprietary LMIS (Liquid Metal Ion Source) and FEEP (Field Emission Electric Propulsion) technology. The successful in-orbit demonstration took place in 2018. With a volume of less than 1U of a CubeSat, the propulsion system can provide up to 350 N thrust with Isp ranging from 2,000 to 7,000 seconds. The 250 g propellant reservoir is filled with Indium and allows operation of up to 5 kNs total impulse. With the aid of the IFM Nano Thruster, the orbit of nano- or micro-satellites can be modified significantly: station keeping in constellations, drag compensation in LEO (Low Earth Orbit) or controlled de-orbiting at the end of a mission.

The unprecedented controllability in terms of thrust and specific impulse make the thruster ideal for the large upcoming ESA mission NGGM (Next Generation Gravity Mission). Other ESA missions that require precise pointing and controllability, such as the Science mission LISA, could also benefit from such thruster technology. The objective of NGGM is long-term monitoring of the temporal variations of Earth's gravity field at high resolution in time and space. The total impulse, thrust stability, misalignment and plume divergence put strong requirements on potential fine-pointing propulsion systems. System studies have shown that propulsion systems with Isp ¡ 3,000 seconds, such as cold gas thrusters, are not practical for a mission duration of up to 7 years due to the high propellant demand. The FEEP propulsion technology is one of the most promising candidates that is able to fulfill these requirements. In the frame of an ongoing endurance test being conducted at FOTEC, a porous tungsten crown emitter has been tested for more than 36,000 hours accumulated operation time. No other competitive propulsion technology underwent such a successful endurance test so far.

FOTEC's FEEP technology already fulfills the majority of the NGGM fine control thruster requirements. In the next years, therefore the focus is laid on the improvement of the technology to demonstrate full compliancy. In parallel, FOTEC is developing and improving their diagnostics systems to be able to verify these requirements. This includes a low-noise and fast-sampling plasma diagnostics system, a novel mass efficiency test stand and an ultra-precise thrust balance for direct thrust measurements. This paper gives an overview on the current status of the technology, the research efforts planned for the next years and the features of FOTEC's in-house diagnostics systems.