

Modular FEEP propulsion systems for smallsatellite missions

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Abstract

Liquid metal Field Emission Electric Propulsion (FEEP) is a propulsion technology that allows high specific and total impulse densities due to the metal propellant. While inert during integration, ground handling and launch, the technology allows for very high specific impulse operation on orbit. Building on a decade long development heritage of Liquid Metal Ion Sources (LMIS) for scientific missions including Rosetta and NASA MMS at Fotec/Austrian Institute of Technology, the technology was then used as basis for electric propulsion systems for small spacecraft by introducing the NANO thruster. This 40 W propulsion unit has been developed by FOTEC and commercialized by ENPULSION, with over 160 flight units delivered to date, with 63 thrusters launched in multiple missions. The electrostatic emission principle of ions from Taylor cones allows, together with independently controlled acceleration and extraction electrodes for variable specific impulse operation, and therefore controlled operation within an independent range of thrust and specific impulse operational points.

Based on the substantial heritage both from inorbit and manufacturing point of view, ENPULSION has introduced new FEEP propulsion systems, namely the ENPULSION NANO R3/AR3, and MICRO R3. Based on the heritage porous ion emitter technology of the NANO thruster, the NANO R3 and AR3 thruster incorporate design lessons learnt to increase resilience and allow for added features such as beam steering capability without moving parts for the NANO AR3. The MICRO R3 is a 3.9 kg thruster including up to 1.7kg of propellant and power processing unit, which can be operated at thrusts up to 1.35 mN and up to 120W. This thruster recently gained flight heritage by passing onorbit commissioning and being successfully used in first orbit change operations.

The presentation summarizes the heritage both in ground testing and selected onorbit data for the heritage NANO thruster, and provides an overview of the R3 FEEP propulsion systems.

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