SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

Author: Mr. Luca Paita
Sitael Spa, Italy

Mr. Ugo Cesari
Sitael Spa, Italy
Mr. Leonardo Priami
Sitael Spa, Italy
Dr. Nicola Giusti
Sitael Spa, Italy
Dr. Angela Rossodivita
Sitael Spa, Italy
Mr. Francesco Nania
Sitael Spa, Italy
Prof. Mariano Andrenucci
Sitael Spa, Italy

ALTA FT-150 FEEP: OVERVIEW AND DEVELOPMENT STATUS

Abstract

The FT-150 FEEP microthruster is designed for extremely fine position and attitude control applications. It generates thrust by ejecting of Cesium ions at about 100 km/s of speed with a very low noise level. The ions are extracted from the emitter tip and accelerated by the strong electric field created by a high voltage electrode placed in front of the emitting slit. The total voltage applied to the electrodes is between 7 kV and 13 kV. The propellant is fed from the reservoir to the emitter by capillarity alone. The specific impulse of the FT-150 FEEP microthruster is in the typical range of ion thrusters, varying between 4500 s and 5500 s depending on operating conditions. The design of the FT-150 FEEP microthruster was demonstrated to be capable to meet the more stringent mission requirements (e.g. LISA Pathfinder). Nevertheless, since the first endurance test completed successfully on late 2009 with the achievement of about 1000 Ns of total impulse and more then 3200 hours of firing, the development of the design was further carried on in order to increase the robustness of the thruster in terms of repeatibility and stability. To achieve this, it was necessary to analyze and manage the following critical issues:

- The cesium propellant is highly reactive in air and to prevent contamination, it must be stored in a sealed reservoir which is opened in space. Therefore the thruster priming and activation is performed in flight and shall be very reliable.

- The high voltage insulation is provided between the electrodes by ceramic insulator. The progressive insulation reduction is the major life-limiting factor. The main source of this leakage current is identified to be the progressive contamination of the insulator.

- The flow control of the propellant is driven by capillarity alone. If excessive residual pressure is present in the propellant reservoir, it can result in the cesium seepage on the emitter blades altering the performance and thus reducing lifetime. In the worst case, propellant seepage can occur within the thruster, possibly inducing early thruster failure.

A comprehensive development plan was defined and the correlated activities performed. This article provides the overview of the plan, the main outcomes of the activities performed, and the status of the FEEP technology at the completion of the development.