

SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

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FEEP THRUSTER CHARACTERIZATION IN FUNCTION OF EMITTER HYDRAULIC
RESISTANCE

Abstract

The FEEP (Field Emission Electric Propulsion) is a technology for extremely fine positioning and attitude control applications and is currently baselined for the Lisa Pathfinder micro-propulsion subsystem. The thrust is provided by caesium ions extracted from liquid metal reservoir and accelerated by an applied electric field. Of great interest is the hydraulic resistance the liquid caesium finds while flowing in the emitter slit before the ionization mechanism take place. This characteristic affects the capability of the emitter to sustain caesium back pressure in the feeding duct during both test and flight operations and therefore the emitter performance.

An intensive test campaign at emitter level was performed using a dedicate set-up able to change the hydrostatic pressure of the propellant during the firing. The ion beam diagnostic system and the photo-camera located in front of the slit allowed to characterize the emission and correlate it with the electrical parameters and the presence of caesium on the emitter tip. The data collected in the five tests performed (namely, EVT-9, EVT-10, EVT-11, EVT-12, and EVT-12B) were reviewed and analyzed to characterize the FEEP emitter behaviour in terms of the meniscus hydraulic resistance and electrical parameters. The main outcome of the test series (each unit had different hydraulic resistance) was the demonstration of the possibility to considerably improve the capability of the emitter to sustain back pressure, tested up to 20 mbar, and to reduce the thruster beam divergence.

The results of the test campaign were used to update the technical specifications of the design to be manufactured and assembled for the LISA Pathfinder mission. The experimental results of the test campaign activities are presented and discussed in the paper.