SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

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FEEP CHARACTERIZATION IN TERMS OF MASS EFFICIENCY AND SPECIFIC IMPULSE VERSUS EMITTER GEOMETRY

Abstract

One of the main characteristics of the FEEP (Field Emission Electric Propulsion) technology is the very high specific impulse and mass efficiency with respect to the other electric propulsion technologies. The ideal theoretic specific impulse of the FEEP thruster is 12200 seconds assuming the applied average emitter voltage of 10 kV. The specific impulse and correlated mass efficiency are also an indirect measurement of the composition of the beam exhausted from the emitter tip in terms of ions and neutrals. High specific impulse indicates that the beam is mainly composed by ions. This parameter is strictly correlated with the main life-limited factor of the FEEP micro-thruster.

An intensive test campaign was performed at Alta to correlate the specific impulse and mass efficiency of specific emitter geometries. A dedicated test set-up was designed and assembled in a vacuum chamber to allow an accurate measurement of the consumed mass of cesium during the performed tests.

Emitters having different characteristics in terms of fluid-dynamic impedance and tip geometry were tested recording the electrical parameters and the consumed mass.

The data were then used to calculate the specific impulse and the mass efficiency for each tested emitter. A comparison of the calculated specific impulse was finally performed in order to identify the geometric parameters of the emitter that are strictly correlated to the specific impulse.

A conclusive test was performed using an emitter having the design parameters defined in order to achieve a very high specific impulse and mass efficiency. The thruster achieved more than 90 Ns of total impulse and 400 hours of firing; the measured specific impulse was 9400 seconds and the mass efficiency 71