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SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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HIGH EFFICIENCY IONIC LIQUID ELECTROSPRAY PROPULSION FOR NANOSATELLITES

Abstract

The Space Propulsion Laboratory at the Massachusetts Institute of Technology has developed highly miniaturized electrospray thrusters with thrust densities comparable to large electric propulsion devices. To circumvent physical difficulties in miniaturizing ionization chambers, an electrostatic propulsion device using ionic liquids as propellants was developed, obviating the need for propellant ionization. These electrospray devices consist of arrays of 480 ion emitter tips per square centimeter. Propellant distribution within the emitter, ion extraction and acceleration are accomplished on a length scale of 2.5mm only, not counting the propellant tank. Each emitter, featuring a cross section of $1cm^2$ achieves a specific impulse of 1150s and $12\mu N$ of thrust. The high degree of miniaturization of the presented thrusters allows using multiple thrusters in parallel in a modular way. Different propulsion modules featuring 8 thrusters, complying with Cubesats as small as 1.5U, have been developed and tested. In addition, the thrusters allow easy up-scaling of the propulsion unit. A propulsion module featuring 28 emitters per Cubesat panel is presented in this work. This propulsion module fits in an envelope of less than 0.5U and is capable of thrust vectoring, 2-axes attitude control and single axis propulsion with a projected total Δv in the order of several hundreds of meters per second for 3U Cubesats.