SPACE PROPULSION SYMPOSIUM (C4)
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MEMS COLD GAS MICROTHRUSTER ON URSA MAIOR CUBESAT

Abstract

The Sapienza aerospace research center (CRAS) is involved in the design and manufacturing of a cold gas micropropulsion system for attitude control to be tested on board the Ursa Maior CubeSat in the frame of the QB50 project. The main goal is to design and test a new integrated MEMS (Micro Electro Mechanical System) valvenozzle system. The whole system is designed to fit in a 1/2 U of the CubeSat. The cold gas propellant is nitrogen at ambient temperature. The feeding system upstream of the MEMS integrated system is composed by commercial offtheshelf (COTS) components chosen to fulfill the valvenozzle system constraints. The MEMS nozzle and valve are manufactured by means of innovative techniques. Generally, MEMS nozzle geometry is characterized by a conical divergent profile and a rectangular section. The present MEMS nozzle has an axissymmetric geometry obtained etching two halves of the nozzle and then bonding them together. The nozzle feed system is controlled by a MEMS valve which works mainly like an electromagnetic valve. The sealing part is a polymer which is moved by the action of two permanent magnets immersed in a magnetic field generated by two planar spires. When current flows inside the spires, the magnets are repulsed from the spires and the polymer sealing moves away allowing the gas flow to reach the exit nozzle. The microthruster is designed to give a 1 mN nominal thrust which is a typical thrust level for micropropulsion attitude control systems. The effective thrust in orbit is evaluated by measuring the effects of the microthruster activation on the angular velocity components measured using a miniaturized IMU. The test consists in an attitude control manoeuvre in which the microthruster is maintained constantly on for a prefixed amount of time (30s). The spacecraft angular velocity variation due to the microthruster torque is proportional to the thrust, therefore the thruster performance can be evaluated by measuring the angular velocity components. To verify the repeatability and the reliability of the system, a sequence of 10 runs will be performed taking advantage of a constant feeding pressure provided by the pressure regulator upstream of the MEMS integrated section.