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

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PLASTIC CUBESAT FOR MICROPROPULSION AND ACTIVE DEBRIS REMOVAL TEST

Abstract

This paper describes the design and the manufacturing of a 3U Cubesat designed in collaboration between the II Faculty of Engineering of Bologna University and the Sapienza aerospace research center (CRAS). The cubesat is developed in the framework of the QB50 project and will host the Von Karman Institute sensor set for atmosphere parameters analysis . Despite its small size this cubesat is a complete platform for space experiments, with a system for active attitude control, a redundant telecommunication system and a high efficiency power control system. This allow to perform complex experiments as the test of a micropropulsion system, in order to verify the effectiveness and the efficiency of a MEMS cold gas micro-thruster. This system operated with nitrogen employs COTS components and a non-commercial MEMS valve-nozzle system. The MEMS control system is based upon a proportional valve using a solenoid-like system, where the moving part is composed by a polymeric material charged with nanoparticles of iron-nikel-oxide (NiFeO4). Applying a magnetic field, the nanoparticles compress the hyperelastic polymer and open the valve. The nozzle has a peculiar axis-symmetric shape, it is realized by a wet etching of two symmetrical halves which are then bonded together ensuring leak tightness. The test of the proper actuation of the micropropulsion system is performed taking advantage of the attitude control system on board. In particular it is based on active magnetic system with magnetotorquers for the detumbling phase and three reaction wheels for fine control. To allow this system to be used in a cubesat satellite it is developed with the dimension of about 52x52x52mm and it is completely realized by the Space Robotics Laboratory. Moreover another experiment is hosted, related to the space debris research field. A Bi-component foam will be used at the end of the operational life time of the Cubesat to accelerate its decay time by increasing its area to mass ratio. This foam has been developed specifically

to be used in space. The cubesat structure is itself a technological experiment. It will be realized not with conventional materials, but using a polymeric material with the technique of "rapid prototyping" thanks to the equipment provided by the V-Lab of the II Faculty of Engineering of University of Bologna. The structure has been qualified to withstand the launch vibrational and static loads. The paper shows the detailed design of the subsystems with the analysis of the solution to critical points.