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SPACE PROPULSION SYMPOSIUM (C4)
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SPACE QUALIFICATIONS OF THE MEMS-BASED SOLID PROPELLANT THRUSTER ARRAY FOR ON-ORBIT VERIFICATION USING CUBE SATELLITE

Abstract

A micro-solid propellant thruster array was developed using microelectromechanical system (MEMS) technologies. To date, the MEMS-based solid propellant thruster has not yet been proved in space orbit. In this study, the micro-solid propellant thruster array was applied to Cubesat that was being developed at Chosun University in South Korea. A novel micro igniter on a glass wafer was proposed for a high ignition success rate with the improved repeatability and low performance variation of each thruster unit. The 3 x 3 sized micro-solid propellant thruster array was designed and fabricated applying the igniter that is directly in contact with propellant grains. The measured thruster of each thruster unit was 2.542 N on average, and the calculated standard deviation was 0.369 N. The calculated average total impulse and its standard deviation are 0.182 and 0.04 mNs, respectively. The igniter was also designed to measure the propellant temperature in the operational orbit. Next, the thruster array control system was being developed. When an ignition signal was commanded, the electrical circuit for temperature measurement was isolated from the igniters and the power for ignition was supplied. The information of the propellant temperature and the ignition success or failure was transferred to an onboard computer of the Cubesat. Finally, launch vibration and thermal vacuum environment tests were carried out for the space qualification. Further, ignition tests under thermal vacuum environment were conducted for on-orbit verification. Resistance values from the micro-igniters before, after and during the launch and thermal vacuum environment tests were measured. All functional requirements of MEMS solid thruster have been successfully verified and the performance variation before and after environment test were less than 0.5