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ADVANCED MICRO-PROPULSION BASED ON THE MICRO-CATHODE ARC THRUSTER

Abstract

The George Washington University developed the Micro-Cathode Arc Thruster (μCAT) in 2008. The μCAT is an electric propulsion system that is based on the well-researched ablative vacuum arc or 'cathodic arc' process. Due to the physical nature of the arc discharge, any conductive material can be used as a propellant, as long as it is solid. This allows the thruster to operate with different metals, each with different physical properties, giving the mission designer flexibility when it comes to the mission's design. To exemplify this: if a nickel cathode is used, the thrusters will produce a higher thrust compared to titanium, but the latter would offer a higher specific impulse under similar conditions. The system caters to small satellites and is designed mostly for attitude control tasks where small impulse bits are required. The μCAT system has been flown on BRICSat-P, which is a 1.5 U CubeSat mission led by the United States Naval Academy (USNA). Preliminary reports show that the propulsion system was capable of detumbling the satellite to a rate of less than 1 degree per second on all axes within 48 hours of deployment. The system is scheduled to fly on two more missions within the next 12 months. The first mission is Canyval-X, which is a joint project between NASA Goddard Space Flight Center, the Korean space agency KARI, GWU, and the Yonsei University in Korea. The second mission is another partnership with the United States Naval Academy, who will be launching BRICSat-2, a follow-up mission to their previous joint project with GWU, BRICSat-P.

Most recently, the Laboratory began work in an advanced version of the system, that will be designed to provide CubeSats with a main propulsion system based on the μCAT system. The new thruster works as a two-stage propulsion system that is designed to accelerate the plasma further, providing higher thrusts and higher specific impulses of over 3000 seconds. The first version of the propulsion system uses an acceleration grid to produce an electrostatic field that accelerates the metallic ions produced by the first stage, which is a modified μCAT system. The system is designed to enable interplanetary CubeSat missions at a low cost. We will report the current development of the system, which includes thrust measurements and plasma diagnostics within the acceleration chamber and ion beam diagnostics.