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DEVELOPMENT OF A MICROSCALE HEATING MECHANISM FOR A SMALL SATELLITE RESISTOJET THRUSTER

Abstract

As the small satellite industry begins to expand beyond Low Earth Orbit, there is an increasing need for in-space mobility solutions at the scales demanded by CubeSats. Some of these more complex missions would require advanced propulsion systems to provide attitude control, orbital maneuvers, and planetary intercepts while still meeting the Size, Weight and Power (SWaP) requirements driven by the miniaturization of satellite components and subsystems. A resistojet thruster is one possible solution capable of satisfying these requirements. Resistojet thrusters electrically heat propellant upstream of the nozzle resulting in improved efficiency when compared to a cold gas system.

In this study, a benchtop model of a resistojet thruster developed for use on small satellites is described. The system expands upon an existing chemical micropropulsion system that leverages a powder based exothermic solid gas generator or warm gas generator. By investigating multiple electro-resistive heating methods, thruster performance, measured by specific impulse, is analyzed as a function of heat input. This paper will also discuss some of the challenges associated with component selection and packaging of a propulsion system designed to interface with CubeSats in the range of 3U-6U.

The initial benchtop development model has shown specific impulse improvements of over 25% and numerical simulations indicate promising results for additional design iterations. Through this research, the most effective heating method will be identified, and the corresponding specific impulse will be presented.