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DEVELOPMENT OF AN APPLIED FIELD MAGNETO-PLASMA-DYNAMIC (AF-MDP) THRUSTER WITH A HIGH TEMPERATURE SUPERCONDUCTING MAGNET

Abstract

This paper will provide an overview of electric propulsion research at a consortium of universities in New Zealand. The primary goal of this work has been the development and initial operations of an Applied Field Magneto-plasma-dynamic (AF-MPD) thruster using a high temperature superconductor-based magnet (HTS). To enable this research, we have undertaken several critical developments, including the construction of an AF-MPD thruster with a 1 Tesla HTS magnet. Another novel feature of the thruster is a new lanthanum hexa-boride low-current, heater-less, hollow cathode, which we have characterized over a range of operating conditions. Key to the development of the system was an integrated electro-magnetic/thermal model to explore the design of the thermal isolation of the cryogenic magnet with the hot thruster. To validate thruster models we have developed new test facilities including a pendulum thrust stand designed to minimize sensitivity to high magnetic fields and the vibrations from cryocoolers associated with HTS magnet operation. Preliminary results from this facility will be presented. In addition to the AF-MPD work, we have built a Hall-effect thruster which has served as an excellent testbed for power electronics development. These electronics are designed for compatibility with space operations, and prototypes are being used to replace laboratory power supplies required for AF-MPD thruster tests. An experiment to demonstrate key enabling HTS magnet technology at TRL9 is scheduled to launch to the International Space Station in early 2025; data from pre-launch testing will be presented.