Performance Characterization of the Vaporizing Liquid Micro Thruster (VLM)

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Future small and microspacecraft, potentially having wet masses as little as 1 kg, as well as high-precision interferometry missions will have needs for micro-Newton level thrusts and impulse bit capabilities of micro-Newton-seconds or less. In the case of applications to microspacecraft, small size and weight, as well as low power usage of thrusters and propulsion systems will also be of critical importance. Such spacecraft are currently being explored by DARPA (Defense Advanced Research Project Agency) and NASA in the US, with the involvement of several universities.

A novel approach in the fabrication of propulsion systems may be needed to address these newly emerging propulsion needs. One technique that has recently gained increased attention is the fabrication of propulsion systems using MEMS (Microelectromechanical Systems) technologies. Several different institutions around the world are currently working on MEMS propulsion projects. The Jet Propulsion Laboratory (JPL) is involved with the development of a so called Vaporizing Liquid Thruster (VLM). Here, a liquid propellant is fed into a microfabricated thruster that features two opposite thin-film deposited heater elements. The propellant is pressure-fed between these heaters, and is vaporized through heat transfer from the electrically powered heaters. The resulting vapor is ejected out of a microfabricated nozzle. Using liquid, rather than gaseous propellants, will ultimately reduce propulsion system mass and volume in a complete system due to the use of more compact and lighter liquid propulsion tanks.

This paper presents the latest design iterations of the VLM chip and the first thrust stand tests of this device. Thrust reported so far range around 30 micro-Newton at power levels of 0.8 W. Additional data will be collected to determine the impact of thruster chip design changes on thruster performance.