Paper ID: 31127

66th International Astronautical Congress 2015

SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

Author: Ms. Brittani Searcy
University of Alabama in Huntsville, United States, brs0004@uah.edu

Mr. Roberto Dextre
United States, robertdextre@gmail.com

MICROTHRUSTER DEVELOPMENT AND MEASUREMENT USING A MICROWAVE MICROPLASMA SOURCE

Abstract

The ultimate goal of this project is to develop an in-space micropropulsion unit for small satellites. This is achieved by using a microwave microplasma resonator microstrip in a 3D printed thruster body. As technology advances, smaller satellites are being used to perform experiments in microgravity. These satellites require a highly efficient microprolusion unit. Direct application of this technology primarily focuses on a more efficient and affordable alternative to spacecraft propulsion, whether that is long distance travel or attitude control systems. Plasma thrusters have a higher specific impulse which allows for longer space missions without the cost of extra fuel. The microwave resonator used in this work is a split-ring resonator operating at 900 MHz. The microwave signal creates a surface wave on the ring. A small gap (around 500 microns) in the ring allows a large amplitude electric field to be created that ionizes the working gas. Argon is used as the propellant gas in this work. The thruster body will be 3D printing from PFA (perfluoroalkoxy) plastic and is comprised of a back shell with propellant and electrical connections, and a front shell with a micronozzle. The initial throat diameter of the nozzle's is 0.5mm. The nozzle shape and throat size are varied based on results of plasma behavior to optimize nozzle performance. Plasma density and temperature are measured with a Langmuir Probe inside the reservoir and at the nozzle exit. Pressure taps are used to measure the reservoir and exit pressure. The results will be compared to the isotropic flow equations which are used to simulate the theoretical nozzle performance. The reservoir measurements will also be compared to previous work that measured the plasma properties as a function of power, pressure, and resonator geometry in open vacuum. This paper will present the design of the 3D printed thruster body, measurements of the plasma properties and pressure inside the reservoir and outside the nozzle, and the comparison to the theoretical performance.