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OVERVIEW OF NASA'S GREEN PROPELLANT INFUSION MISSION AND NASA GLENN RESEARCH CENTER'S THRUSTER TESTING AND PLUME DIAGNOSTICS

Abstract

The Green Propellant Infusion Mission (GPIM) is sponsored by NASA's Space Technology Mission Directorate (STMD) Technology Demonstration Mission (TDM) office. The goal of GPIM is to advance the technology readiness level of a green propulsion system, specifically, one using the monopropellant, AF-M315E, by demonstrating ground handling, spacecraft processing, and on-orbit operations. AF-M315E, an ionic salt monopropellant, is referred to as "green" because it has reduced toxicity hazards compared to hydrazine (the current state-of-art monopropellant), potentially resulting in lower ground handling and transportation costs. This green monopropellant is formulated to provide higher density and specific impulse than hydrazine. The GPIM project intends to fly an operational AF-M315E propulsion system on a Ball Aerospace-built BCP-100 spacecraft in 2016. One of the risks identified for GPIM is potential contamination of sensitive spacecraft surfaces from the effluents in the plumes of AF-M315E thrusters. NASA Glenn Research Center (GRC) has conducted activities to characterize the effects of AF-M315E plume impingement and deposition. GRC has established individual plume models of the 22-N and 1-N thrusters that will be used on the GPIM spacecraft. The models describe the pressure, temperature, density, Mach number, and species concentration of the AF-M315E thruster exhaust plumes. The models are being used to assess the impingement effects of the AF-M315E thrusters on the GPIM spacecraft. These simulations are correlated with plume measurement data from a Laboratory Model 22-N AF-M315E thruster. This thruster was tested in a small rocket, altitude facility at NASA GRC. A suite of diagnostics, including Raman spectroscopy and Schlieren imaging, were used to acquire plume, thermal, and pressure measurements of the AF-M315E thruster. Plume data includes temperature, velocity, relative density, and species concentration. The plume measurement data is compared to the corresponding simulations of the plume model. This GRC effort establishes a data set of AF-M315E plume measurements and a plume model that can be used for future AF-M315E applications