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EXPERIMENTAL CHARACTERIZATION AND PERFORMANCE ANALYSIS OF LOW POWER
ARCJET THRUSTERS OPERATED ON ARGON, NITROGEN AND AMMONIA

Abstract

To realize the practical operating characterization and performance of low power Arcjet Thrusters in detail, comprehensive multi-start experiments are carried out on the thrusters with various constructions operated on argon, nitrogen and ammonia. Integrated ground experimental facilities including propellant-feeding facilities, vacuum-simulating facilities, power-processing unit, small-thrust-measuring device and experimental data acquisition system are developed and set up to simulate the actual space environments and operating conditions. Structure design and material selection of the thrusters are accomplished, and three low power radiation cooled laboratory type thrusters structured by BHRAT-I, BHRAT-II, and BHRAT-III are developed by using a modular design and assembly technique. Twenty-one assembled configurations of the three thrusters are tested with argon, nitrogen and ammonia as propellants under various mass flows rates and electric currents. Experimental phenomena are observed, and experimental data are attained by accommodating operation electric current and mass flow rate, measuring voltage and thrust, and calculating the corresponding power input, specific power, specific impulse, thrust efficiency and thrust to power ratio. Effects of propellant property, operation condition, structure design, and material selection on the start characteristic, operation characteristic, thermal load and overall performance of low power Arcjet Thrusters are demonstrated expressly through experimental analysis.