Abstracts

Microwave Electrothermal Propulsion for Space

J.L. Power. "Microwave Electrothermal Propulsion for Space." 1992 Transactions on Microwave Theory and Techniques 40.6 (Jun. 1992 [T-MTT] (Special Issue on Microwaves in Space)): 1179-1191.

The microwave electrothermal thruster (MET) is an attractive concept for medium or high power spacecraft propulsion. The heart of the concept lies in heating a propellant gas by passing it through a microwave plasma discharge. As described in the paper, the plasma is created in a resonant cavity by tuning either the TM(011) or the TM(012) mode for impedance-matched operation, using two internal tuning mechanisms. The MET concept is electrodeless, synergistically combines high pressure and high power capability, provides external control over the energy-conversion discharge, and operates on hydrogen propellant. Upwards of 95% efficiency has been reported in absorbing the applied microwave power in the plasma discharge. By employing a magnetic nozzle with the MET, substantial performance and life gains are expected due to reduced wall heating and losses, improwed recovery of propellant internal energy, and discharge stabilization. Calculations of potential MET performance predict that 2000 sec. specific impulse at 6000 K average discharge chamber temperature and 1.0 MPa (10 atm.) pressure are reasonable goals with hydrogen propellant. Apparatus is described for testing the resonant-cavity MET to power levels of 30 kW at 915 MHz on nitrogen, helium, and hydrogen. It includes a superconducting magnet, providing field strengths to 5.7 T, to implement a magnetic nozzle. The low-ripple operation of the microwave generator has been verified, as has a procedure for starting the microwave discharge and raising the powler applied to the cavity via a phase shifter-tuner. Impedance-matched resonant operation of the microwave cavity has been achieved.

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