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EXPERIMENTAL INVESTIGATION OF COMBUSTION IN MEMS BASED MICROTHRUSTERS

Abstract

Efforts are going on to reduce cost and increase reliability and efficiency in new MEMS components developed for Space application. Among them, micropropulsion devices is an active field of technological research. Several micropropulsion option are under development in which the thrust is produced either from a electrical source i.e. electrical thruster or a chemical source i.e. chemical thruster. We have selected a chemical thruster option and working on studies of liquid and solid propellant microthruster. The concept of liquid and solid propellant microthruster is based on the high rate of combustion of propellants brought into or stored in a combustion chamber. The main application of the microthruster is the micropropulsion for microsatellites or nanosatellites. Results from the development of a micro-electro-mechanical system based micro-propellant thruster are being reported along with a discussion of their use in a spacecraft. Combustion of liquid and solid propellants in a thruster combustion chamber are experimentally investigated. The combustor under investigation is such that the liquid propellants are injected from the frontend of the combustor and combustion products exited at the other end. Although combustion can be achieved at low pressures, combustion at high pressures is also being investigated as high pressures are required for complete combustion. Combustion at low pressures are investigated by adding small quantities of oxygen to the chamber. Combustion chambers and nozzles are fabricated from easily available ceramics as well as metal alloys to sustain high flame temperatures during combustion. Also the effects of of microthruster downsizing on combustion performance are being investigated. In addition to this experimental investigation, a two-phase numerical flow analysis is being developed to study the combustion of propellants in a small-volume chamber.