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EXPERIMENTAL CHARACTERIZATION OF A HYDROGEN PEROXIDE-BASED THRUSTER FOR SMALL SATELLITES

Abstract

The growing interest of the space market in the use of small satellites (e.g. cubesats) requires the research of proper miniaturized propulsive systems for attitude, trajectory and orbit control. Chemical propulsion can be suitable for this kind of applications, when the required ΔV is too low for electric propulsion systems. In particular, monopropellant and hybrid rockets can provide good I_{sp} performance, re-ignition and throttling capability with relative system simplicity, due to the single flow feed line. Being the research oriented towards green solutions, chemical thrusters based on hydrogen peroxide are studied as candidates for these applications. Their performance is strictly related to the catalytic chamber: the catalysts task is to decrease the activation energy leading to the decomposition reaction acceleration. The heat released by decomposition can be then converted directly into propulsive energy for monopropellants, while can provide the necessary power for mixture ignition in case of hybrids. In this scenario, University of Naples “Federico II” (UNINA) is involved in several projects in which hydrogen peroxide finds its application as monopropellant or oxidizer in the case of hybrid system, in combination with polymeric fuel grains. A laboratory is available at the Grazzanise (CE) military base where, in collaboration with the Air Force Academy, a test bench has been set up to carry out tests on various rocket engines. Small thrusters (1N class) have been designed with the purpose of providing nanosatellites with formation flying and orbital maneuver capability, and ground breadboards were tested. A load cell was used to measure the thrust, while pressure transducers and thermocouples have been positioned in different points in the chamber and upstream the nozzle. Results are discussed in order to study the effects of several parameters including chamber pressure and catalyst material on decomposition efficiency and thruster performance. For example, it was assessed the higher the pressure, the longer the residence time, that translates in a greater efficiency. Further activities are ongoing for the complete characterization of this kind of architecture in both propulsive modes, in order to optimize the design for a flight application.