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EXPERIMENTAL CHARACTERIZATION OF AN IMPULSIVE HYDROGEN PEROXIDE-BASED ROCKET FOR FINE ORBIT CONTROL

Abstract

The space market is strongly moving towards small satellite applications and miniaturized propulsive systems for attitude, trajectory and orbit control are required. For such maneuvers, when a low ΔV (in the order of cm/s) is required, monopropellants in pulsed mode can have their mission application. Furthermore, storability, easy handling, and interest in green solutions, are some of the elements that drive the researchers in the choice of hydrogen peroxide as one of the best candidates for these applications. Catalysts are used to decrease the activation energy leading to the decomposition reaction acceleration. Nevertheless, the main criticalities of such operation mode consist in the fact that it is impossible to reach the steady state during such short pulses, so that the acquired data for each injection need an opportune treatment to have a faithful estimation of propulsive performance. In this scenario, University of Naples "Federico II" (UNINA) is strongly interested in this research field and in the propulsion laboratory at the Grazzanise (CE) military base, hydrogen peroxide is one of the propellants used for experiments on monopropellants. Thanks to the use of a solenoid valve, a monopropellant breadboard was tested in an impulsive functioning and more than 200 tests were performed. For a fixed upstream pressure, several opening and closing valve intervals were chosen to change the mass injected at each pulse and to wait for the emptying time between two shots. Firstly, the propulsive performance of an impulsive thruster for small ΔV required and secondary the temperature growth in the catalytic chamber via several impulse sequences (varying open to close valve interval ratio), with the aim of preheat the system for a continuous functioning, have been analyzed. As for the latter problem, other tests are ongoing to be performed using a geometrical different catalytic bed to better understand the effect of its size on the thermal exchange during the transient operation. Preliminary results are showing good performance in terms of decomposition efficiency (characteristic velocity) and in a few of pulses the gas temperature upstream the nozzle can reach temperatures approaching the adiabatic one.