SPACE PROPULSION SYMPOSIUM (C4)
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THE DESIGN AND TEST OF 250N THRUSTER WITH HAN-BASED PROPELLANT

Abstract

The attempt of replacing toxic propellant hydrazine by green propellant has attracted the relevant industry worldwide. HAN-based propellants have emerged as good alternatives to replace the hydrazine propellant because of their relatively lower toxicity, higher density, low freezing point and higher specific impulses compared to hydrazine, and a lot of papers have reported the achievements in small thrust class like 1N, 5N by using HAN-based propellants. However, few papers have reported the performances of several hundreds Newton thrust level thrusters and explained the mechanism of reaction of HAN-based propellants. Relevant study has shown that the greater thrust level of the thruster, the more difficult of the research. Shanghai Institute of Space Propulsion (SISP) has been focusing on the novel technology since the late 1990's and developing different thrust level of thrusters using HAN-based propellant named as HB510, which is a blend of HAN, water, fuel and other additives, and the density is 1.3g/cm3, SISP's efforts of these years have yielded substantial progresses in the development of the thruster, and the most important advances have been achieved on 250N thruster recently. It now has achieved an accumulated 450s firing time, 3500 pulses and 50s longest continuous firing time with catalyst bed temperature pre-heated to 150 degree celsius and delivers a specific impulse performance of 220s (with 50:1 expansion ratio nozzle). The highest temperature of the thruster obtained is no more than 1150 degree celsius during thruster operations in vacuum conditions, and the propellant throughput of the 250N thruster is 52kg. The current status implies that the 250N thruster has reached Technology Readiness Level 5 and SISP has found a good opportunity to demonstrate the green propulsion, thus taking a significant step towards its use in future space applications, especially in launch vehicle systems. The achievements of 250N thruster are the results of comprehensive development of propellant formulations, catalyst and thruster design. This paper gives an overview presentation of the research. In addition to the 250N thruster, it lists the performances of the other thrusters developed by using this new propellant and discusses the mechanism of the reaction, which is the key of this new technology.