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THERMAL DECOMPOSITION OF HAN GREEN PROPELLANT

Abstract

Since 2000, the research and development (RD) of hydroxylammonium nitrate (HAN)-based liquid monopropellant, SHP163 which is composed of HAN, ammonium nitrate (AN), methanol and water have been studied. The thruster employed in the tests is vertical 20 N type which is optimized after several failures. The historical evolution of the thruster development was due to couple of problems that were resolved: i.e. lack of control of the catalyst-bed temperature, heat soak back effect, vertical test thruster setting and lack of knowledge about the chemical reaction of HAN/AN. In this paper, promising SHP163 as green space propellant is synthesized and successively considered as candidate for small satellite missions. In-depth system studies in relation to the aforementioned propulsion, the design for advanced green propulsion systems of the future is appreciated. The obtained results on thruster 20 N type demonstrate that SHP163 is selected to be used as hydrazine alternative monopropellant for innovative satellite technology project. In general, HAN based monopropellant consists of HAN, fuel, solvent and some additives. We chose a mixture of HAN, AN, and water as a basic oxidizer, and employed methanol as fuel. The mass ratio of HAN, AN, and water mixture are fixed at 95/5/8, and only methanol content varied. Control sample does not include methanol and is originally developed as a liquid oxidizer of which the freezing point is below -10 C. SHP163 delivers the highest performance within these compositions because the methanol content of SHP163 is equivalent to stoichiometric ratio against the oxidizer, HAN and AN. On the other hand, The direct insertion probe-mass spectrometry (DIP–MS) L–250G–IA (Canon Anelva Co., Ltd) has been applied for the thermal analysis of HAN–based samples. The technique is based on the introduction of the samples into the ionization chamber, followed by their vaporization and eventual ionization by electronic impact. Collected data by mass spectrometer showed that the real time decomposition species of SHP163 decomposition in the absence of catalyst. For both heating rates, the species detected are mostly H2O steam, NO, N2, NH3, O2, N2O and NO2 fragments as previously reported and corresponded to mass fragments of m/z = 18; 30; 28; 17; 32; 44 and 46; respectively. Recently, HAN 20 N-thruster chamber and corresponding advanced monolith catalysts were developed and considered as the most promising technology to replace the conventional hydrazine.