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SPACE PROPULSION SYMPOSIUM (C4)
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FEASIBILITY STUDY ON NON-TOXIC HYPERGOLIC BIPROPELLANT THRUSTER USING HYDROGEN PEROXIDE AS AN OXIDIZER

Abstract

Liquid-fueled propulsions have been improved over the past 100 years. Especially for a bipropellant chemical propulsion system, it is suitable for a variety of civilian and military applications. As an attempt to increase the performance of the liquid propellant rocket, diverse systems and numerable propellant combinations have been developed and tested since the Robert Goddard's first rocket. Above all, a hypergolic ignition system has been extensively used in many applications up to now thanks to the simplicity and reliability on ignition. A hypergolic bipropellant thruster as a spacecraft engine is necessary for successful execution of Korea's moon exploration project. The spacecraft engine imparts required impulse for the spacecraft to transfer orbit or soft-land on the moon. The maximum required thrust of the spacecraft engine for this mission ranges from 100 to 500 N assuming the space mission from the low earth orbit to the moon. The key technology of hypergolic rocket is strictly controlled by national and international regulations, because it can be adapted to weapons of mass destruction. Indigenous development of hypergolic rocket, therefore, is essential for Korea's success in moon exploration. Investigation of hypergolic rocket, however, has never been attempted in Korea. In the existing hypergolic propulsion systems, however, hydrazine or its derivatives as a fuel are indispensable, although they are highly toxic and potent carcinogenic. Convenient oxidizers, nitrogen tetroxide or nitric acids, are also extremely toxic, corrosive and therefore difficult to treat. Utmost danger involved in the toxicity of the propellants causes enormous cost in the process of development and launch a rocket. The cost penalties are made up of diverse parts such as propellant itself, fueling, health surveillance, decontamination and disposal of residuals. In addition, a curtailment in the budget for space missions of national space agencies and stricter regulations on safety and environment are provoked in urgent need of non-toxic hypergolic propellants. From the point of view, multifarious studies on non-toxic hypergolic bipropellant combinations to remedy the drawbacks have been reported but follow-up research to implement was relatively rare. This paper assesses the feasibility of the non-toxic hypergolic bipropellant thruster. We were focused on high test hydrogen peroxide (HTP) as a green oxidizer considering its environmentally benign nature and sought to find a comparable non-toxic hypergolic fuel with the toxic fuels currently used.