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MEMS THRUSTER WITH AN ALTERNATIVE ADN BASED MONOPROPELLANT

Abstract

In this research, the ADN salt was mixed with a new ether group fuel. The safety evaluation and hot firing test with a micro thruster were conducted for the developed monopropellant. ADN based monopropellants are currently being investigated to replace the toxic and carcinogenic hydrazine propellant. It has the advantages of high specific impulse and low toxicity compared to hydrazine. However, LMP-103S, which is widely used as an ADN based monopropellant, has lower specific impulse than LP1856, a HAN-based propellant. In this study, to improve the specific impulse, a new type of glyme fuel was mixed with ADN salt instead of methanol fuel. The new type of glyme fuel has a low vapor pressure and therefore is less likely to be inhaled during the production stage. Also, the new fuel has high energy and density, which may enhance the specific impulse and density specific impulse. Since the newly developed propellant is the premixed propellant, the detonation phenomenon may occur. For this reason, a safety assessment was conducted to confirm whether the propellant produced is explosive or not. The blasting cap test was selected for the safety evaluation. It has the advantages of not only using a small amount of sample but also has a simple and inexpensive configuration system. In addition, the pressure sensor was installed in the blasting cap test system to measure the explosive power of the fabricated propellant. By measuring the propellants' explosive power, the explosive power of the fabricated monopropellant was less explosive than ammonium nitrate. Therefore, ADN based monopropellant produced in this study was considered to be safe. With the safety test data, to assess the feasibility of the propellant, a hot firing test using a micro thruster was conducted. The micro thruster has the advantages of using a smaller amount of the propellant than the blasting cap test as well as having a small sized system which means an explosion proof system can be easily made and installed. For the hot firing test, 30 mN micro thruster and La/Pt/γ-Al_2O_3 were used. The combustion test was confirmed with the chamber temperature going up to 872^{o}C. Also, the chamber pressure was measured at 2.7 bar. The test result confirmed that the fabricated propellant can be used in the micro thruster without any detonation phenomenon. In the next study, the exact performance of the propellant will be evaluated by conducting the combustion test in a general thruster.