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DEVELOPMENT OF HYBRID THRUSTER IGNITION SYSTEM WITH LOW-TOXICITY FUEL AND
CATALYTIC REACTION

Abstract

This study proposes an ignition system for hybrid thrusters using low-toxicity fuel and catalytic reaction. We have been developing the "ELS-R100" mission, a re-entry mission from the orbit, using a hybrid thruster. Since the hybrid thruster uses non-self-igniting solid fuel and gaseous oxidizer, a reliable ignition system is required to ignite the hybrid thruster in space. Therefore, an ignition system has been developed using low-toxicity fuel and catalytic reaction.

This ignition system is based on the low-toxicity HNP series, developed by JAXA (Japan Aerospace Exploration Agency) and IHI AEROSPACE Co., Ltd. Here, HNP consists of HAN (hydroxylammonium nitrate), HN (hydrazine nitrate), methanol, and water. It generates hot gas using a catalytic reaction, which in turn heats the fuel in the pilot burner. Supplying the oxidizer generates the combustion gas from the pilot burner and the exhaust gas from the pilot burner heats the main fuel of the hybrid thruster. By supplying the main oxidizer gas, the hybrid thruster combustion starts.

To validate the ignition system, several firing tests were conducted on the ground and under a vacuum. The results of the ground firing tests showed that the ignition system heated the pilot burner using low-toxicity fuel and catalytic reaction, and exhausted the combustion gases. The ignition system was installed to the hybrid thruster and successfully ignited it under vacuum multiple times. In the main firing tests, the history of the main chamber pressure quickly raised. Therefore, the system can quickly transition to the main combustion of the hybrid thruster without ignition delay. These results show that, we succeeded in developing an ignition system for hybrid thrusters using a highly reliable low-toxicity fuel and catalytic reaction.