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RESEARCH AND DEVELOPMENT OF HYBRID THRUSTER FOR ELS-R100: MISSION CONCEPT & FIRING TEST RESULTS

Abstract

We have been developing the "ELS-R100" spacecraft, which is approximately 200 kg and aims to demonstrate re-entry technology from low Earth orbit. To achieve re-entry, the ELS-R100 needs to be equipped with an orbit transfer thruster. Hybrid thrusters use solid fuels such as plastic and oxidizers separately. This makes them safer than typical chemical thrusters. Therefore, a hybrid thruster was selected in the ELS-R100 mission and has been developed in collaboration between *ElevationSpace Inc.*, Japan Aerospace Exploration Agency (JAXA), and Tohoku University. This hybrid thruster uses multi-port solid fuel and gaseous oxidizer as propellant, and the solid fuel is regressed by boundary-layer combustion. It is ignited by a proprietary ignition system. This system uses low-toxicity fuel with a catalytic reaction. Specific design values for thrust, chamber pressure, and firing duration were determined in terms of initial orbit altitude ($\sim \Delta V$), combustion stability, and attitude stability. Vacuum and ground firing tests were conducted using an engineering model equivalent combustion chamber. In the vacuum firing tests, the thrust was measured, and the required system performance was obtained, although the firing duration was set shorter than the actual mission as it was limited on the facility side. The ground firing tests were conducted at the long firing duration required for re-entry, obtaining an extremely stable chamber pressure history. Additionally, the forms of the fuel and insulation could be maintained even during the long firing duration, confirming the validity of the heat-resistant design. This presentation will provide an overview of the hybrid thruster of the ELS-R100 spacecraft and describe research and development achievements including the results of these firing tests.