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OBSERVATION OF THE SURFACE REGRESSION BEHAVIOR OF HYBRID ROCKET FUEL USING A SLAB MOTOR

Abstract

Hybrid rocket system is one of the most prospective next-generation space propulsion systems having low cost, high safety ability and green characteristics. However, conventional hybrid rocket system has a difficulty in the delivery of a large thrust motor due to the low fuel regression rate. Therefore, studies about high regression rate of hybrid rocket fuel have been necessary for the large motor design. The high regression rate of low melting point fuels such as a paraffin wax was confirmed at static firing tests by several researchers and, small droplets of the liquefied fuel popping out from the burning surface were observed directly using a slab motor at the atmosphere condition. However, the detail mechanism of small droplets generation from the fuel surface is not known well. The observation of small droplets behavior under the high pressure is needed for the understanding of more detail combustion mechanism. In this study, the slab motor with observation windows for high pressure experiment was prepared. Two types of fuel, PMMA and low melting point thermoplastics fuel (LT fuel), were selected in this study as inert and low melting point fuel. Katazen Corporation has LTs which have excellent mechanical properties and they developed special LTs for this use lowering the melting point down to hot water temperature range. In the observation using a slab motor, visible light was cut in order to easily observe a surface behavior, and an infrared filter was employed as the cut filter in which only the wavelength of 760nm or more penetrates. No droplets were observed at the PMMA combustion. At the LT fuel, the small droplets were observed during combustion between 0.1MPa to 2MPa of chamber pressure. The particle size and the amount hardly change in this pressure range. However, under the high oxidizer mass flux, the amount of droplet increased and the particle speed was enhanced. This paper presents the observational comparison of PMMA and LT fuel, and reports the detailed discussion of experimental results.