SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (2) (2)

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THEORETICAL AND EXPERIMENTAL INVESTIGATION OF MULTIPLE CATALYST IGNITION OF HYDROGEN PEROXIDE HYBRID ROCKET MOTOR

Abstract

Hydrogen Peroxide is one of the most commonly used oxidizers in hybrid rocket motors and can be catalytically decomposed to ignite solid fuels and achieve multiple starts. As a promising way of ignition, catalyst ignition simplifies the structure and schedule of ignition process, which further highlights the simplicity and safety of hybrid rocket motors. However, compared with other devices of ignition, the delay time of catalyst ignition is often long with large uncertainties in hybrid motors. This paper aims to investigate the characteristics of catalyst ignition of 90% hydrogen peroxide hybrid motors. A theoretical model was developed and experiments with different fuels were conducted in order to estimate and decrease the delay time of ignition. In the model, the ignition process was subdivided into five parts: the response of valve, the filling of feed-line before catalyst bed, the start-up of catalyst bed, the build-up of pressure in combustion chamber and the inert heating of solid fuel. Effects of mass flux of hydrogen peroxide, temperature of catalyst bed, scale of fuel grain were taken into account. Subsequently, multiple catalyst ignition tests of PE, PMMA, HTPB and metallized HTPB (28%Al,10%Mg) with 90% hydrogen peroxide were carried out on Φ45mm and Φ100mm fuels. The theoretical model was confirmed by ignition test results. The results indicate that ignition delay time of multiple starts decreases with the increase of mass flux of hydrogen peroxide and temperature of catalyst bed, as well as the decrease of scale of grain. The delay of ignition significantly decreases in short-time restarts. The ignition delay of PE and HTPB is short, while that of metallized HTPB (28%Al, 10%Mg) is longer, and PMMA is the most difficult to be catalytically ignited.