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SPACE PROPULSION SYMPOSIUM (C4)
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COMBUSTION EFFICIENCY BEHAVIOR OF HYBRID ROCKET WITH H2O2 CATALYTIC DECOMPOSITION

Abstract

A hybrid rocket which is a design where a liquid oxidizer is passed over a solid propellant has higher specific impulse compared to bi-propellant system. A hybrid rocket has an attractive advantage like safety due to the separation of propellant and oxidizer, combustion stability. In addition, hybrid rocket can be throttled flow rate of oxidizer to control thrust as necessary like liquid propellant rockets. For the reasons of these advantages, hybrid rocket has been developed for long decades. A hybrid rocket has an ignition process to start combustion similar to bi-propellant and solid propellant rocket. A general hybrid rocket is needed an additional device as an igniter like small bi-propellant igniting system using spark to butane-oxygen mixed gas and solid propellant igniting system using joule heating. In small bi-propellant igniting system, a regular process which required supplying mixed gas using spark plug with complex system successively can be difficult to immediate burn. The igniting system using solid propellant has fast response time but it is not easy to re-start due to the concept of dispose. In this present research, the auto-ignitable system using catalytic decomposition is developed for improving the limitations like response time and shutdown recovery. The processes are following. First, the oxidizer passes through the catalytic reactor before supplying the solid propellant. In this process the oxidizer is decomposed of high temperature gas. Second the high temperature gas which was exhausted from catalytic reactor is injected to solid propellant of combustor. Third, the high temperature gas of oxidizer makes the solid fuel gasify. Finally if the temperature of combustor is up to ignition temperature, auto-ignition is occurred. There are several advantages like simple structure, instantaneous ignition, re-startability, low combustion instability and high storability using hydrogen peroxide as an oxidizer. In this research, hydrogen peroxide which is non-toxic and environmental friendly reactant is chosen as a liquid oxidizer. In front of the solid fuel, we chose the mixing zone for low combustion instability using step design with vortex flow. To find out the combustion efficiency, we changed the characteristics length of combustion chamber and solid fuel. For stable combustion, a higher characteristics length was required for the paraffin combustion compared with polyethylene. On the other hand, much faster response time was demonstrated in case of paraffin having the low melting point and ignition temperature.