Analysis on Moisture Absorption and Ignition Failure of Fuel-rich Propellant Containing Magnesium-Aluminum

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Abstract: To analyze the failure mechanism of an aerospace type of magnesium-aluminum fuel-rich propellant, the component, thermal decomposition rule and ignition performance at atmospheric pressure of the fuel-rich propellant were tested by micro morphology analysis, X-ray diffraction(XRD), thermal analysis and high-speed photography and other detection means. The results show that ammonium perchlorate(AP) in the propellant after moisture absorption is agglomerated and $Mg(OH)_2$ is formed by the reaction of product after Mg oxidizing with water after moisture absorption. Before moisture absorption, only crystal transition and thermal decomposition with mass loss of AP happen before 420 ℃. Thermostability decreases after moisture absorption, and mass loss begins at 90 ℃. There are four decomposition steps before 420 ℃: evaporation of water, thermal decomposition of $Mg(ClO_4)_2$ and decomposition AP and $Mg(OH)_2$ propellant before moisture absorption is able to burn stably after ignition by electric igniter under atmospheric pressure, while propellant after moisture absorption cannot be ignited. Analyses believe that the cause of the failure of the propellant ignition is the AP agglomeration and reducing of active magnesium content, therefore, the priority attention and regular sampling monitoring for magnesium-aluminum fuel-rich propellant stored in humid environment should be applied.

Key words: fuel-rich propellant; moisture absorption; thermal property; ignition failure

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