SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (3)

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A NOVEL KIND OF GREEN HIGH ENERGY SOLID PROPELLANT CONTAINING HYDROGEN PEROXIDE

Abstract

A novel kind of green high energy solid propellant containing hydrogen peroxide, which can be prepared, stored and applied at ambient temperature easily, is developed in our study. The main ingredients of this propellant are H2O2(98wt%), adsorbent, metal or metal hydride fuel, hydrocarbon fuel, stabilizer, adhesive system, etc. Consequently, the major combustion products of this propellant are nontoxic water, hydrogen, carbon oxide and metal oxide without the corrosive hydrochloride which generates in the combustion process of conventional HTPB/AP/Al solid propellant. Therefore, this propellant is environment-friendly. On the other hand, the total oxygen content and effective oxygen content in hydrogen peroxide are up to 94.1% and 47.05% respectively. As a result, this propellant possesses a potential high energy property. When powdered aluminum and polyethylene are used as the fuel ingredient, the standard theoretic specific impulse and the experimental explosion heat of this propellant exceed 2744N•s/kg and 8300kJ/kg respectively under the conditions of T0=298.15K, Pc=6.86MPa and Pe=Pa=0.101MPa, both of which are much higher than those of the conventional solid propellant. Furthermore, the standard theoretic specific impulse of this propellant even exceeds 2842N•s/kg at the same conditions when powdered aluminum hydride is added in formula. A two-step method was adopted to prepare this propellant. Firstly, the 98wt% H2O2 was absorbed by absorbent according to a special ratio of absorbent and oxidant and turned into semisolid scattered particles. Secondly, the scattered particles, metal or metal hydride fuel, hydrocarbon fuel, stabilizer, adhesive system, etc. were weighed in proportion, mixed uniformly and solidified at room temperature, then the cured block of this propellant was gained. After being stored for 60 days at room temperature, the weight loss of the propellant block is only 0.2%, and the profile of this block is compact and imperforate, which indicates that this propellant can be stored stably. In addition, the combustion characteristics of this propellant were investigated. It can be found that the combustion efficiency of Al in this propellant is up to 99.74%, and the experimental explosion heat achieves 98.0% of the theoretic explosion heat, which proves that this propellant can combust adequately. From 2MPa to 9MPa, the combustion process of this propellant is relatively stable. The combustion behavior of this propellant is in keeping with Vieille's law, and the static burning rate pressure expression and dynamic burning rate pressure expression are $r = 9.109P^{0.56}$ and $r = 9.948P^{0.57}$respectively.