Paper ID: 69947
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IAF SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM (IPB)

Author: Dr. Chuang Zhou
School of Astronautics, Beihang University, China, zhouchuang@buaa.edu.cn

Dr. Nanjia Yu
School of Astronautics, Beihang University, China, ynj@buaa.edu.cn
Prof. Jue Wang
China Academy of Launch Vehicle Technology (CALT), China, wangjuetougao@163.com
Mr. Zeng Zhao
School of Astronautics, Beihang University, China, zhaozeng@buaa.edu.cn
Mr. Haojie Gong
Beihang University (BUAA), China, sqrtseven@buaa.edu.cn

EXPERIMENT AND SIMULATION FOR DYNAMIC CHARACTERISTICS OF DUAL-MODE SPACE PROPULSION SYSTEM PRESSURIZED BY ELECTRIC PUMP

Abstract

With the development of motor and battery, the electric pump is gradually used to pressurize the propellant in the propulsion system. At the same time, more than 90% hydrogen peroxide can be decomposed by catalysis or burned with fuel. In this study, a dual-mode propulsion system pressurized by electric pump using hydrogen peroxide and kerosene is proposed. The system includes an electric pump for hydrogen peroxide, an electric pump for kerosene, orbit-control engine and its catalytic bed, attitude control engine and its catalytic bed, etc. The thrust of orbit-control engine is 2.5 kN and that of attitude control engine is 25 N. The ignition experiment of whole system shows that the combustion chamber pressure of orbit-control engine is 5.88 MPa. There is approximately 15% start-up pressure peak in the catalytic stage, however, there is basically no start-up pressure peak in the combustion stage with kerosene. Under the expansion ratio of 110, the vacuum specific impulse can reach 313.4 s. The establishment time of combustion chamber pressure is less than 0.5 s. The attitude control engine can complete pulse work continuously, and the work is reliable. The speed of electric pump for kerosene is 33500 r/min and that of electric pump for hydrogen peroxide is 36000 r/min, and the starting process of the two pump is steady. The simulation results show that the thrust and flow regulation process of the orbit-control engine can be completed in 0.5 s. The pulse width of attitude control engine mainly depends on the response time of the valve before the injector. The success of ignition proves the reliability of hydrogen peroxide as propellant for both orbit-control engine and attitude control engine. In addition, it is also helpful to analyze the start-up dynamic characteristics of dual-mode space propulsion system pressurized by electric pump, so as to guide the application of electric pump system in space propulsion.