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Author: Mr. shixiong song
College of Astronautics, Northwestern Polytechnical University, China, songshx1015@163.com

Dr. SHI Hongbin
Xi'an institute of aerospace propulsion technology, China, peterlon@126.com
Dr. min TANG
Xi'an institute of aerospace propulsion technology, China, peterlon@126.com
Mr. YAO Dong
The 41st Institute of the Fourth Academy, China Aerospace Science and Technology Corporation (CASC), China, hbyaodong@126.com
Ms. Ying Wang
The 41st Institute of the Fourth Academy, China Aerospace Science and Technology Corporation (CASC), China, funnyface@vip.qq.com

STRUCTURAL INTEGRITY ANALYSIS OF SRM GRAIN AT LOW TEMPERATURE IGNITION

Abstract

Solid rocket motor is a power device for launch vehicle and weapon equipment. Its structural integrity is closely related to the safety and reliability of power system, and it will also have a great impact on the overall safety of launch vehicle and weapon equipment. The propellant grain is one of the important components of the solid rocket motor. The structural integrity of the propellant grain is the key factor for the integrity of the solid rocket motor. With load characteristics and mechanical properties of the propellant are more complex, the structural integrity of propellant grain is easily destroyed. Therefore, it is necessary to analyze the structural integrity of propellant grain at low temperature ignition. The main work of this article is as follows: In this paper, the relaxation test and tensile test of propellant are carried out, and the corresponding test data are processed and analyzed. Based on the time-temperature equivalence principle, the data obtained from the relaxation test were processed and fitted, and the principal curves of relaxation modulus of propellant in the form of 8 order prony series were obtained. In the same way, the time-temperature equivalence principle was used to deal with the experimental data obtained from the tensile test, and the main curve of the elongation at low temperature was obtained. The failure criterion method of structural integrity of propellant grain is analyzed. Two different safety evaluation methods of grain structure safety are compared, which are strain superposition and cumulative damage. The experiment was carried out by simulated motor at low temperature ignition. Based on the related material parameters of propellant obtained in this paper, simulation calculation is carried out for a solid rocket motor, and its structural response at low temperature ignition is analyzed. Three characteristic lines were set up to study the influence of the stress concentration part on the structural response of a propellant grain . The safety factor of the grain structure was calculated by using the strain superposition method and it was verified by experiments. To sum up, the results show that the mechanical properties of propellant used in this paper can meet the requirements of the structural integrity analysis of the propellant grain based on the linear viscoelastic model. The selected failure criterion of the structural integrity of the grain is reasonable and experimentally , it can be applied to the analysis of the grain structure.