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EFFECT OF RESIDUAL STRAIN ON STRUCTURAL INTEGRITY OF SRM GRAIN DURING IGNITION

Abstract

During the curing and cooling process of solid rocket motor, the shrinkage deformation of the propellant grain is restricted due to the mismatch of the thermal expansion coefficient of the propellant, insulation layer and case, which consequently leads to the residual strain in the propellant grain. The residual strain persists throughout the storage period, which will affect the mechanical properties of propellant and the structural integrity of the propellant grain during ignition. Therefore, the effect of residual strain on structural integrity of propellant grain was researched in this paper. Firstly, the mechanical properties of solid propellant aged under constant strain were studied. Then the viscoelastic constitutive model of the propellant was established, in which the damage effect of residual strain was considered. Finally, the structural response of the propellant grain during ignition was analyzed, and the structural integrity of the propellant grain with and without residual strain damage effect was compared. The results show that not only the mechanical properties of the propellant will be affected by the residual strain, but also the mechanical response characteristics of the propellant. When considering the damage effect of the residual strain, the maximum equivalent strain of the propellant grain increases, and the structural safety margin decreases accordingly. Therefore, the influence of residual strain should be taken into account to improve the accuracy of structural integrity assessment of SRM grain.