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COUPLING ANALYSIS OF TEMPERATURE AND STRESS IN THE CURING PROCESS OF SRM'S COMPOSITE CASE

Abstract

Large solid rocket motor is the main power system of space launch vehicle and missile weapon. As the propellant tank and combustion chamber of the motor, its case not only bears high internal pressure (5MPa 20MPa) and high temperature (about 3500K), but also bears and transfers the external load of spacecraft structure. Composite materials have the advantages of low density, high strength, high specific modulus, high temperature resistance and corrosion resistance, which are in line with the development trend of modern large solid rocket motor, and become excellent materials for manufacturing solid rocket motor case. The curing process of composite case is a process of physicochemical interaction. In this process, under the external heating and internal chemical reaction exothermic of composite material, the resin cross-linking reaction occurs, which changes from viscous flow state to glassy state with three-dimensional network structure, which makes the thermal and mechanical properties of the composite change, such as thermal conductivity and elastic modulus. Due to the influence of anisotropic properties of composite materials, thermal expansion and shrinkage effect and mismatch of thermal expansion coefficient between case and mold, thermal strain and shrinkage strain will be generated during the curing process of composite case, resulting in the formation of stress. After the molding, some residual stress will stay in the case, and the deformation after demolding affects the dimensional stability of the case, maybe resulting in the failure of the case. In this study, aiming at the problem of structural deformation in the curing process of composite case, considering the curing exothermic, shrinkage of resin and the anisotropic properties of composite material, the temperature, stress and strain evolution process of composite case during the curing process are numerically studied, so as to clarify the forming process of composite case and provide theoretical support for the process optimization of composite case.