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EFFECT OF PRESTRAIN ON UNIAXIAL TENSILE BEHAVIOR OF HTPB COMPOSITE PROPELLANT

Abstract

Aiming at the effect of prestrain on uniaxial tensile properties of composite propellant, the accelerated aging tests for HTPB composite propellant were carried out under thermal-mechanical coupled condition. The uniaxial tensile tests were conducted, and the mesoscopic characteristics were observed by using scanning electron microscopy. The tensile stress-strain diagrams of HTPB propellants aged under different prestrain conditions were obtained. The results show that the uniaxial tensile behavior of HTPB propellants under different prestrain conditions shows a great difference, and the shape of stress-strain curves also vary obviously. In general, with the increase of prestrain, the mechanical properties of the propellant are degraded, which is reflected in the decrease of maximum tensile strength and the maximum elongation. Without prestrain, the stress-strain curve of the HTPB propellant shows a two-stage viscoelastic tensile response. During the stretching process, the tensile curve exhibits stress softening due to the dewetting of the interface between the filled particles and binder matrix, and then the tensile curve exhibits a stress plateau region. With the increase of prestrain, the stress strain curve is concave in the plateau region, and shows bimodal characteristics slightly. The transgranular cracking of AP particles can be observed obviously in the fracture surface. With the further increase of prestrain, the stress response is no longer linear with strain in the beginning of the tensile test, and the characteristics of dewetting are no longer obvious in the stress-strain curves. The SEM images show that the accumulated damage occurs in the binder matrix and the interface between the AP and matrix during the storage process.