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MECHANICAL PROPERTIES OF AGED HTPB PROPELLANT UNDER A WIDE RANGE OF STRAIN RATES

Abstract

The composite solid propellants are widely used in various solid rocket motors of missiles and rockets boosters due to their excellent properties and high reliability. The propellant grain will experience various loads during its service life, and these different loads are usually under a wide range of strain rates. In this study, the accelerated aging test for HTPB propellant was carried out, and tensile tests were carried out at different strain rates, within the range of 0.0005 s-1 to 30 s-1. The mechanical properties of aged HTPB propellant under different strain rates conditions were analyzed, and the fracture sections of HTPB propellant under different strain rates were analyzed by scanning electron microscopy (SEM). The results show that the mechanical behavior of HTPB propellant has a significant rate related phenomenon. As the strain rate increases, the initial modulus, maximum tensile strength and maximum elongation of the propellant all increase. The maximum elongation shows an approximately linear correlation with the increase of the strain rate, and the maximum tensile strength and the strain rate shows a good quadratic correlation. While, the logarithm of initial modulus changes exponentially with the logarithm of strain rate. The SEM images of the fracture sections show that the dewetting damage evolution of the bonding interface between the AP particles and the HTPB matrix is the main failure mode of HTPB propellant at low strain rate. However, under the conditions of high strain rate, the matrix fracture plays a major role, and the fracture of AP particles is also an important factor affecting the mechanical behavior of the propellant. The research results are helpful to understand the mechanical properties of composite solid propellants under a wide range of strain rates, and are of great significance to the structural integrity evaluation of solid rocket motors.