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EXPERIMENTAL STUDY ON PERFORMANCES FOR THE DIFFERENT GRADED-IMPEDANCE DISTRIBUTION MATERIALS

Abstract

Seeking new shields with excellent performance against the impact of the space debris is one of the key technologies and hot issues to ensure the success of the spacecraft mission. Our group has proposed and proved that Graded-impedance bumper has a very good performance against hypervelocity impact. In order to understand its protective mechanism and to obtain the optimized Graded-Impedance distribution law with the better protective performance, it is necessary to study the hypervelocity impact characteristics for different Graded-Impedance distribution materials. In this paperhypervelocity impacting (HVI) experiments have been performed on two difference graded-impedance bumper Whipple shield with opposite distribution of wave impedance, titanium-aluminum-magnesium alloy, magnesium-aluminum-titanium alloy, by using two-stage light gas gun at velocity at 4.8 km/s with the 5.24 mm diameter of the aluminum spheres, combining with experimental measures of high speed photography, optical pyrometer and laser shadow photography. The perforation characteristics in the front bumper, debris clouds patterns and damage characteristics on the rear wall were studied. Also, as the comparison, the same HVI experiment was conducted on the same areal density aluminum alloy bumper Whipple shield. The results showed that titanium-aluminum-magnesium alloy shield was not failed, but the other two shields were both failed with perforation on the rear wall, and the protective capacity of aluminum alloy bumper shield is better than magnesium-aluminum-titanium alloy bumper shield. This means that the graded-impedance bumper with wave impedance distribution from high to low has better protective performance against hypervelocity impact. The study of the reason and the protective mechanism are being carried out.