SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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THE STUDY OF HYPERVELOCITY IMPACT CHARACTER FOR HONEYCOMB SANDWICH WITH MULTI-LAYER INSULATION

Abstract

Honeycomb sandwich with multi-layer insulation (MLI) is a kind of structure material on spacecraft. Experiment research and numerical simulation was carried on in this paper. The classic damage model of MLI is that MLI is holed by projection, the rear diameter of hole is bigger than front's and there is radial avulsion and ablation around it. The classic damage model of honeycomb sandwich is that front plate is holed, rear plate is domed and some is holed, the damage area of honeycomb cores is far bigger than front plate hole. The damage model of honeycomb cores are creases (no hole in cores shell), break (there are holes in cores shell), burst (large area of cores is broken). The quantitative relationship of the diameter of MLI front plate hole and impact kinetic energy is dentr=1.64+0.011Ek, where dentr is the diameter of MLI front plate hole, Ek is impact kinetic energy. The quantitative relationship of the dome diameter of honeycomb sandwich rear plates and impact kinetic energy is ddome=-20.8EXP-Ek/120+26.4, where ddome is dome diameter of honeycomb sandwich rear plates, Ekis impact kinetic energy. Based on the analysis of test results, the ballistic limited equation in 1mm ballistic limited criteria is obtained, which is similar to the ballistic limited equation of Whipple structure, and the MLI equivalent thickness for 2A12 is 0.55mm calculated by the equation. A SPH-FE coupled method is introduced to simulate the process of hypervelocity impact on honeycomb sandwich. The simulation result shows that radial expanding of debris cloud is restricted by honeycomb cores, and the honeycomb cores make a considerable channeling and distributing effects to debris cloud in the axis path. The existence of honeycomb cores could reduce the damaged area of honeycomb rear plate to some degree, but make the local area of rear plate more damaged.
Key words: Honeycomb sandwichMulti-Layer insulationHypervelocity impact Numerical simulation