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EVALUATION OF THE IMPACT RESISTANCE OF GLARE UNDER HYPERVELOCITY IMPACT LOADING

Abstract

Orbital debris is an ever-growing threat for spacecraft longevity. Current trends of structural solutions for protecting spacecraft systems take advantage of composite materials, because of their high specific strength. Fiber metal laminates (FMLs), such as GLAss fiber REinforced aluminum (GLARE), combine the high strength-to-weight ratio of composites with the durability and impact resistance of aluminum, and have already shown superior shielding capacity under low velocity impact. The shielding performance of GLARE due to a hypervelocity impact is evaluated by numerical simulation using ANSYS/LS-DYNA. The numerical simulation models the impact between a stationary GLARE target plate and an aluminum particle with a relative velocity of 5.5 km/s. A smoothed particle hydrodynamic (SPH) method is defined as a subroutine in order to avoid large mesh distortions. The numerical simulation results show debonding between the aluminum sheets and individual composite layers at each time increment. The model also indicates good agreement with the damage of the target plates, in the form of the breakage of fibers and the petalling of the aluminum sheet in the vicinity of the penetration on both the front and back sides, when compared with the experimentally tested plates. A sensitivity study is done to evaluate the influence of mechanical properties of the GLARE panels on their impact resistance performance.