

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

Author: Dr. Gongshun Guan
Harbin Institute of Technology, China, ggsh@hit.edu.cn

Mr. Heshi Guan
Harbin Institute of Technology, China, hitghsh@163.com

A STUDY OF DAMAGE ON WOVEN MULTI-SHOCK SHIELD BY A HIGH-SPEED IMPACT OF
ALUMINUM SPHERE AT DIFFERENT AMBIENT TEMPERATURE

Abstract

Space environment is a significant component of space resources, while it's also the major cause for the induced fault of spacecraft in orbit, even failure. Space environment is very complex, mainly including vacuum environment, temperature environment, electron irradiation environment, etc., among them, the temperature environment is the main factor influencing the performance of spacecraft surface structure. The space debris shield is usually located in the outermost layer of the spacecraft, and temperature change of the protective material is very intense, which material performance are influenced by ambient temperature. For this study, a two-stage light gas gun is used to launch 2017-T4 Al-sphere projectiles impacting on woven hybrid multi-shock shield in test chamber with different ambient temperature. The effect of ambient temperature on damage and protection characteristic of basalt fiber cloth and kevlar fiber cloth bumpers are studied. The diameter of projectile used to simulate space debris is 3.97mm. Impact velocities of Al-spheres are varied between 1.41km/s and 3.53km/s. The impact angle are 0 for all the tests. Ambient temperatures are approximate 173K, 293K and 473K respectively. The study focus on the influence of ambient temperature on damage and protection characteristic of woven hybrid multi-shock shield. The results indicate that damage and protection characteristic of hybrid multi-shock shield are different in space environment with different temperature for the different impact velocity of aluminum sphere projectiles. High temperature reduces woven material properties, leading protection performance of hybrid multi-shock shield degradation, as well, low temperature results opposite conclusions. At the same time, alternating ambient temperature weakens the protection performance of hybrid multi-shock shield. In addition, damage induced by extreme temperatures and alternating temperature on woven fabrics exists coupling.