

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

Author: Dr. Bin Jia
Harbin Institute of Technology, China, jiabin@hit.edu.cn

HYPERVELOCITY IMPACT CHARACTERISTICS OF BASALT FIBER WOVEN/AL-MESH
COMBINATION BUMPER STUFFED IN WHIPPLE SHIELD**Abstract**

The latest research direction of shield structure is composed of new material with better protective properties against hypervelocity impact of space debris. Four different Stuffed Whipple shields based on basalt fiber woven and Al-mesh were presented under the concept of light-weight shield structure and more effective protection of spacecrafts, and their shield performances were compared with each other through hypervelocity impact experiments using two-stage light gas gun. The basalt fiber woven used had an areal density of 0.022g/cm². The mesh count of the Al-mesh was 20*20 and the mesh had an areal density of 0.0325g/cm². The total shield space was 100mm for all four shields and the rear wall was an Al 5A06 plate of 3mm in thickness for each. In Shield A, the front bumper was an Al 2A12 plate of 1mm in thickness as the first bumper. At the distance of one third of the total shield space from the first bumper, there were 3 layers of AL-mesh closely tied to 1 layer of basalt fiber woven without any spacing between each adjacent layer as the second bumper. And at the next one third of the total shield space there were 2 layer of basalt fiber woven next to 3 layers of AL-mesh without any spacing between each adjacent layer as the third and final bumper. The second and the third hybrid bumper in Shield A were exchanged in space to form Shield B. In Shield C, the second bumper was 6 layers of AL-mesh closely linked together with the same position in that of Shield A and B. And the third bumper was 3 layers of basalt fiber woven tied closely without any spacing between each, also at the same position as Shield A and B. In Shield D, the second and third bumpers were the same materials and locations as in Shield C, but the numbers of layers were changed to be 2 and 9 in sequence. The total bumper areal density of each shield, rear wall excluded, was about 0.54g/cm². The projectile launched was 2017 aluminum sphere with the diameter of 4.76mm at velocity of 1km/s to 6km/s, and the impact angle was 0 degree. The damage of the bumpers included and the rear wall were examined thoroughly after impact and compared to each other to evaluate the shield performance of different structures.