

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

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HYPERVELOCITY IMPACT EXPERIMENT ON PERFORMANCE OF STUFFED WHIPPLE SHIELD
WITH AL-MESH AND BASALT FIBER WOVEN**Abstract**

The textile materials in the field of aerospace have become more and more important. Basalt fiber woven as one of it is a new type of material for shield of spacecrafts because of its light-weight and high specific strength. Three different Stuffed Whipple shields based on basalt fiber woven and Al-mesh were presented for 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/cm^2 . The mesh count of the Al-mesh was 20×20 and the mesh had an areal density of 0.0325g/cm^2 . The total shield space was 100mm for all three 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. The total bumper areal density of each shield, rear wall excluded, was about 0.54g/cm^2 . The projectile launched was 2017 aluminum sphere with the diameter of 3.97mm at velocity of 2km/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.