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DAMAGE CHARACTERISTICS OF WHIPPLE SHIELD SUBJECTED BY HYPERVELOCITY IMPACT OF SILICATE SIMULACRUM FOR MICRO-METEOROIDS

Abstract

Micro-meteoroids, together with orbital debris, pose significant threat to spacecraft safety in operation and they are often considered as M/OD together. However, the effect of micro-meteoroids is often neglected in risk assessment of spacecraft in space environment, possibly due to their different features from orbital debris such as low density but very high moving speed which can hardly be achieved in laboratories. But it is clear that micro-meteoroids must have different impact damages comparing with orbital debris under the same conditions. To be accurate in risk assessment of spacecraft, particularly avoiding the "over design of shield", the damage characteristics of micro-meteoroids impact on shields should be studied. As silicate compound is a major space material from research of the universe, it was selected as the simulacrum for micro-meteoroids in this paper. The material was made artificially based on the chemical components of high land moon crust considering that the moon is the best known planet to mankind and its chemical elements are similar to the earth. The silicate compound material was synthetized through high-temperature no-pressure sintering method and the temperature was controlled at 1200 degrees Celsius. Finally the density of the material was produced to be 1.72g/cm3. And the projectile was made to be a sphere with the diameter of 7mm which was launched in a two-stage light gas gun at an impact angle of 0 degree. The shield used was the typical Whipple Shield, with an Al 2A12 plate of 1mm in thickness as the bumper and an Al 5A06 plate of 3mm in thickness as the rear wall. And the total shield space was 100mm. The impact velocity was achieved as high as possible by certain technic improvements. And the damages of the shield were examined thoroughly after impact to give the characteristics of impact by the silicate simulacrum for micro-meteoroids.