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

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INTERPRETATION OF IMPACT FEATURES ON THE SURFACE OF THE WFPC-2 RADIATOR

Abstract

An examination of the Hubble Space Telescope (HST) Wide Field Planetary Camera 2 (WFPC-2) radiator assembly was conducted at NASA Goddard Space Flight Center (GSFC) during the summer of 2009. Immediately apparent was the predominance of impact features resident only in the thermal paint layer; similar phenomenology was observed during a prior survey of the WFPC-1 radiator. As well, larger impact features displayed spallation zones, darkened areas, and other features not encountered in impacts onto bare surfaces. Whereas the characterization of impact features by depth and diameter on unpainted surfaces has been long established, the mitigation provided by the painted layer presented a challenge to further analysis of the WFPC-2 features; a literature search revealed no systematic characterization of the ballistic limit equations of painted or coated surfaces. In order to characterize the impactors responsible for the observed damage, an understanding of the cratering and spallation phenomenology of the painted surface was required.

To address that challenge, NASA sponsored a series of hypervelocity calibration shots at the White Sands Test Facility (WSTF). This effort required the following activities: the production, painting, and artificial ageing of test coupons in a manner similar to the actual radiator; the determination of the test matrix parameters projectile diameter and material (mass density), impact velocity, and impact angle, so as to enable both an adequate characterization of the impact by projectile and impact geometry and support hydrocode modeling to fill in and extend the applicability of the calibration shots; the selection of suitable projectiles; logistics; and an analysis of feature characteristics upon return of the coupons. This paper reports the results of the test campaign and presents ballistic limit equations for painted surfaces. We also present initial results of our interpretation methodologies.