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INITIAL STUDY FOR THE RESPONSE OF TI-6AL-4V PLATE USED IN TANK MATERIAL

Abstract

We have been conducting hypervelocity impact tests and numerical simulations to develop a Japanese spacecraft design guideline for the protection of satellites from a certain degree of M/OD impacts. A working group was formed by members of JAXA, spacecraft manufacturers, experts, and researchers in the field of hypervelocity impacts to investigate the effects of M/OD impacts on satellite critical parts and bumpers by hypervelocity impact (HVI) tests and analysis. The knowledge acquired is now being reflected in the spacecraft design guidelines. We investigated the effect of hypervelocity impacts of micrometeoroids and small-scale orbital space debris (M/OD) on space structures by comparing numerical simulation results obtained using the AUTODYN-2D hydrocode with the results of experiments using a two-stage light gas gun since 2005. The hyper velocity impact of space debris on a spacecraft result in a catastrophic event that not only destroys the structure but also create space debris. The design of any spacecraft requires understanding the potential damage that can be inflicted by such an event. We will consider the case of a satellite hydrazine fuel tank and the consequences of a hypervelocity impact from space debris. The final purpose of this study is to better understand the mechanisms of detonation of hydrazine vapor during a hypervelocity impact on a low-pressure reservoir. As part of this effort and an initial study, the response of an Ti-6Al-4V plate which is used tank material to 6 km/s high-velocity impacts is shown and discussed. AUTODYN-2D, which is used for impact analysis of complex physical systems including fluid and solid materials. Material models used in the simulation to allow investigation of phenomena over a wide range of impact velocities, including shock-induced vaporization, are also presented, and discussed.