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Author: Dr. Andrea Delfini
Sapienza University of Rome, Italy

Dr. Roberto Pastore
Sapienza University of Rome, Italy
Dr. Marta Albano
Agenzia Spaziale Italiana (ASI), Italy
Prof. Fabio Santoni
Sapienza University of Rome, Italy
Prof. Mario Marchetti
Sapienza University of Rome, Italy
Dr. Antonio Vricella
Sapienza University of Rome, Italy

SPACE DEBRIS DAMAGING OF C/C-BASED SPACECRAFT STRUCTURES: THERMO-MECHANICAL ANALYSIS OF IMPACT ENERGY EFFECT IN GROUND SIMULATION BY RAILGUN BALLISTIC TEST

Abstract

The long-standing problem of space debris requires to develop ever more reliable analysis systems, in order to achieve a suitable level of safe operating conditions in space manned activities. In this framework, the study of spacecraft outer surface resistance to hypervelocity impact is mandatory, since the ability of a material or a structure to withstand impacts of micrometeoroids and orbital debris (MMOD) may be crucial to guarantee the mission compliance with the low earth orbit (LEO) space environment. In this work, a thermo-mechanical characterization is carried out on Carbon/Carbon (C/C) plate-shaped structures by means of thermal expansion coefficient (CTE) measurements before and after impact testing, near the crater region and around plate boundary. The ballistic stage is performed by means of a linear electromagnetic accelerator system – developed in the so called 'railgun' configuration – and is discussed and compared to numerical FEM simulation results. The adopted experimental set-up proved to be suitable to perform impact testing of materials in the space debris energy range, allowing to assess the effect of different bump conditions on the impacted materials degradation.