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SPACECRAFT DEBRIS GENERATION DUE TO MATERIALS DEGRADATION FOR LEO ORBIT CONDITIONS

Abstract

The space that extends beyond the earths atmosphere contains several threats responsible for the degradation of spacecraft coverage, and eventually for the generation of debris. Usually spacecraft materials are selected considering mission time, so that material degradation does not affect satellite integrity. However, satellite may remain in orbit much beyond its expected life time. If this is the case, space radiation, atomic oxygen (for LEO) and temperatures cycles may induce generation of space debris (e.g. paints flaking, MLI fissures in stress areas, MLI fixations points degradation).

The present article describes the observed effects (including debris generation) on a set of space material samples subjected to space evaluation test (thermal vacuum cycles, VUV radiation and atomic oxygen), that simulates LEO space conditions. The samples were exposed to high ATOX fluence (average 9.2E20 atoms/cm^2), 500 TVC (+140^{o}C to -120^{o}C); VUV exposure of 5145 ESH. This conditions are equivalent to 9.7 years in LEO at orbit 800 km, declination 75^o. The samples (3 paints and three MLI blankets), were selected from renown manufactures and are representative of material most used in spacecraft's. The materials were characterized at start of test, after ATOX, and at the end (ATOX+ TVC + VUV). The results show a degradation of samples, flaking of same paints and microdebris generation.

This study was performed in the framework of an investigation on spacecraft debris generation due to materials degradation for the European Space Agency (ESA).