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DEGRADATION OF MLI AND PAINTING INDUCED GENERATION OF DEBRIS

Abstract

Space environment is a harsh environment for exposed materials. Amongst all environmental constraints, ionizing radiation in GEO (particles, UV), atomic oxygen in LEO and temperature variation through synergy mechanisms may lead to serious damage and loss of performance of surface materials (thermo-optical or mechanical properties). Optical and radar observations from the ground as well as analysis of retrieved hardware have shown an abundance of space debris objects that seem to result from the degradation of outer spacecraft surfaces. Recent surveys of the GEO and GTO region have found many objects with high area-to-mass ratio (HAMR debris, see T. Childknecht et al. 2003, 2004, 2005) indicating that they must consist of relatively thin material, like foils. 20-year GEO ground simulation along with thermal cycling has been applied to a set of MLI assemblies and painting samples. The material degradation was monitored with the objective to determine conditions for debris generation through self-flaking or delamination process. As paint surfaces became very brittle, reclosable fasteners of MLIs and Mylar inner foils were strongly damaged by synergy of radiation with temperature. Potential scenarios for delamination of MLI foils are proposed. This paper explores the cause, amount and characteristics of space debris objects resulting from spacecraft surface degradation. These data will help at improving space debris population models and supporting the selection of materials in the context of debris mitigation measures.