Paper ID: 60321
oral
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

Author: Mr. Sanjay A
R V College of Engineering, Bengaluru, India, sanjuroy.1007@gmail.com

Mr. Kunal Bavikar
R V College of Engineering, Bengaluru, India, bavikarkunal@gmail.com
Mr. Maneesh M
R V College of Engineering, Bengaluru, India, maneeshm.ae17@rvce.edu.in
Mr. Chathura G R
R V College of Engineering, Bengaluru, India, chathuraguddemane@gmail.com

PROTECTION AGAINST MICROMETEOROID IMPACTS IN GEO SATELLITES USING ALUMINIUM-BASED SELF-HEALING MATERIAL AIDED BY ACCESSIBLE THERMAL ENERGY

Abstract

With increasing bounds of space exploration, emerge new challenges; micrometeoroid impacts being one among them, becomes a liability to the overall mission criticality by inducing microcracks. Prolonged exposure to these impacts results in the coalescence of induced microcracks, ultimately leading to catastrophic failure before mission accomplishment. Space vessels being very much susceptible to these impacts require counter measures.

This paper focusses on protecting Geosynchronous satellites against hypervelocity micrometeoroid impacts using self-healing material. The self-healing material is aluminium matrix composite reinforced with microcapsules containing healing agent. The healing agent is an aluminium-based liquid polymer engineered to harden as it fills the microcracks by using available thermal energy, mainly solar radiation. It is also designed to be stable at operating temperatures of the satellite structure. The structural properties of the self-healing material are studied before and after healing using which the healing efficiency is determined. Also, a comparison is made between the properties of the self-healing material and conventional materials (Aluminium Alloys).

Further, the behaviour of self-healed material subjected to micrometeoroid impact is simulated using Finite Element Method (FEM) solver and the flow of healing agent into cracks is simulated using Computational Fluid Dynamics (CFD) analysis. Ultimately, this material can be used to replace the conventional materials that protect the satellite structure against micrometeoroid impacts as it self-heals without additional energy requirements with enhanced resistance to impacts.