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Author: Prof. Mario Marchetti
Associazione Italiana di Aeronautica e Astronautica (AIDAA), Italy

Dr. Plinio Coluzzi
University of Rome "La Sapienza", Italy
Mr. C. Apollo
Università di Roma "La Sapienza", Italy
Mr. R. Pastore
Università di Roma "La Sapienza", Italy
Dr. Davide Micheli
Sapienza University of Rome, Italy

TEMPERATURE, ATOMIC OXIGEN AND OUTGASSING EFFECTS ON DIELECTRIC PARAMETERS AND ELECTRICAL PROPERTIES OF NANOSTRUCTURED COMPOSITE CARBON-BASED MATERIALS

Abstract

In some current aerospace applications new nanostructured composite carbon-based materials are proposed in order to substitute traditionally metal-based parts. Mainly due to the light weight such composites are ultimately becoming more interesting as electric conductive polymers too. Electric conductive polymers have been receiving great attention upon comparison with conventional metal-based materials, because of their light weight, resistance to corrosion, flexibility and processing advantages. Some electric conductive polymer applications consist in potential discharge for systems, electrical grounding of systems and direct and indirect lightning strike protection. The introduction of carbon nanoparticles into RTM resins for Carbon Fiber Reinforced Polymer components offers some specific composite material improvements by increasing the electrical conductivity and mechanical properties of the composite material. Object of present studies is to analyze the effect of the low orbit space environment on the electromagnetic properties of such nanostructured composite carbon-based materials. In low orbits, i.e. around 350-2000 Km, the space environment is very aggressive since it hardly affects the materiasl properties. In particular temperature gradient between night and day, atomic oxygen, and outgassing phenomena are the main causes responsible of materials degradation. Electric conductive polymer conductivity and microwave absorbing properties are affected by space environment conditions too. In this presentation we conduct our studies trying to determine the dependence of carbon composite material relative permittivity on the space environment. Permittivity is a complex quantity describing the interaction between materials and electromagnetic fields. Accordingly, an increasing imaginary part of permittivity can be ascribed to the enhanced electrical conductivity of the composite, giving rise to electric losses too. In this studies, conductive fillers are first uniformly dispersed in an epoxy resin at different weight percentages (typically from 1 up to 15 Electromagnetic analysis are then performed by first determining the intrinsic microwave impedance of each composite material and the loss factor later on. The knowledge of the latter properties are used to built multilayer absorbing / EMI shielding system for microwave frequencies.

Index Terms — EMI shielding, carbon nanotube, carbon nanofiber, radar absorbing structure, atomic oxygen, outgassing, space environment, electric permittivity.