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# RADIATION SHIELDING OF COMPOSITE SPACE ENCLOSURES

## Abstract

Space electronic systems employ enclosures to shield sensitive components from space radiation. The purpose of shielding is to attenuate the energy and the flux of ionizing radiation as they pass through the shield material, such that the energy per unit mass (or dose) absorbed in silicon is sufficiently below the maximum dose ratings of electronic components. The received radiation amount varies significantly depending on several variables that include mission parameters (orbit, altitude, inclination and duration), spacecraft design (spacecraft wall thickness and panel-enclosure location). To achieve the optimum shielding with the minimum weight, all these variables have to be considered in the design. Energetic particles, mainly electrons and protons, can destroy or cause malfunctions in spacecraft electronics. The standard practice in space hardware is the use of aluminium as both a radiation shield and structural enclosure. Composite structures show potential for significant mass savings. However, conventional graphite epoxy composites are not as efficient shielding materials as aluminium because of their lower density, that is, for the same mass, composites provide 30 to 40A solution is to embed high density (atomic weight) material into the laminate. This material, typically metallic material, can be dispersed in the composite or used as layers in the laminate (foils). The main objective of SIDER project is the development of the technologies and tools required to obtain lightweight, safe, robust and reliable composite structures. In SIDER project a technology based on nanomaterials is proposed as an alternative for radiation shielding. Two different strategies have been followed with nanomaterials:

- Bulk doping strategy Dispersion techniques have been studied in order to obtain the best dispersion of nanofillers into the resin and good interfacial bonding. With the doped resin, laminates have been manufactured by hand lay-up and autoclave curing.

- Buckypaper strategy The method for production of buckypapers has been based on a multiple-step process that includes dispersion of CNTs/tugsten nanofillers in a solvent and filtration processes; ultrasonication, mechanical stirring and the use of surfactants to obtain a stable nanofiller suspension before filtering. The buckypaper has been integrated into prepreg lay-up for later curing in autoclave. A second strategy based in the incorporation of a high density material foil is also being considered.

This paper will present and analyze the radiation shielding obtained by the incorporation of nanomaterials in composite structures.