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Design and manufacture of lightweight hybrid enclosures of tungsten and CFRP for radiation shielding of satellite electronics

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Radiation shields, namely enclosures or housings, of satellites and other spacecraft have been traditionally made of aluminum alloys. The design criteria of enclosures include tailored heat transfer, mechanical rigidity, low weight and, above all, protection against radiation from the space environment. The radiation content includes proton and electron dose as well as bombardment by alpha and beta particles. The ever more stringent weight minimization in spacecraft projects favors carbon or Graphite-Fiber-Reinforced Plastic (CFRP) as structural material. However, electron attenuation using CFRP is not efficient and hybrid designs exploiting high atomic weight metal e.g. tungsten, foils are necessary. In addition to rolled foils, sintered powder metallurgy-based tungsten alloy foils have been developed by plan see group. The stacking sequence and lay-up can be optimized using commercial codes, e.g. ESA Comp, from the mechanical point of view. Radiation protection characteristics are in a similar fashion numerically pre-designed and experimentally verified. The manufacture of hybrid laminates involves modified surface treatments in order to ensure necessary adhesion between CFRP and tungsten foils. Hence specialized adhesion promoting coatings, such as nano-carbon coatings by DIARC technology increase have been applied on tungsten foils.

Biography

Mikko Kanerva has completed his PhD from Aalto University. He teaches courses such as aircraft structures and aircraft structural design in Aalto University. He has been running several research projects in the lightweight structures group at the department of applied mechanics. He publishes continuously in reputed scientific journals and serves as the Representative of Finland for the International Council of the Aeronautical Sciences.

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