MATERIALS AND STRUCTURES SYMPOSIUM (C2)
New Materials and Structural Concepts (4)

Author: Dr. Sohaib Akbar
SUPARCO, Pakistan

Mr. Muhammad Muddassir
Pakistan Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan
Mr. Touqeer Rasheed
SUPARCO, Pakistan
Mr. Ahmad Bashir
Pakistan Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan

CARBON NANOTUBES COMPOSITES: MATERIAL FOR NEXT GENERATION SPACE VEHICLE

Abstract

One of the most formidable challenges in the development of next generation space vehicles is weight. The less a space vehicle weighs, the more fuel it can conserve on space voyage. Researchers have already started working on the potential use of carbon nanotubes (CNTs) in the construction of space vehicles intending to reduce weight up to 50Studies are now focused on three major fronts in this regard. First, to achieve efficient and consistent production of high-quality CNTs; second, to develop and standardise characterisation techniques for nanomaterials; and third, to develop techniques for manufacturing nanostructured materials. Our study revolves around the third aspect regarding development of a light weight, high strength/modulus material which is a hybrid of CNTs and carbon tow with epoxy. The combination of polymer matrix with CNTs provides a composite with largely improved modulus and strength. The homogeneous dispersion of CNTs in a polymeric matrix is achieved via chemical surface modification and strong interfacial bonding has been created via covalent linkages. The functionalisation was carried out through the reaction of diamines with alkylcarboxyl groups connected to the CNTs in the course of a dicarboxylic acid acyl peroxide treatment. These nanotubes were dissolved in organic solvent followed by mixing with epoxy resin and curing agent. In this matrix system nanotubes are covalently integrated into the epoxy matrix and become part of the crosslinked structure when carbon tow is impregnated with this suspension which can further be used to manufacture filament wound-structures. Various characterisation techniques are used in order to characterise functionalised nanotubes and the carbon epoxy composite. Results demonstrated a fair enhancement in the mechanical properties of the resulting material (approx 20%) increase in ultimate strength and modulus with the addition of only small amount (i.e. 0.5–4wt%) of functionalised nanotubes. The nanotube-reinforced epoxy composites also exhibited an increased strain to failure, which suggests higher toughness of the resulting material. Apart from standard characterisation a small pressure vessel will also be tested by burst test to examine the actual effect on structure strength and weight. It is strongly believed that the wide range of spin-offs from research in this domain would make their way into everyday use and would have the potential to transform industry and commonly used products.