MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialised Technologies, Including Nanotechnology (8)

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STUDY OF THE ADDITION OF DIFFERENT CARBON NANOSTRUCTURES IN CONDUCTIVE EPOXY MATRIXES FOR STRUCTURAL HEALTH MONITORING PURPOSES

Abstract

The addition of carbon nanostructures to traditional composites has led to the creation of new multi-scale reinforced composites with multifunctional applications. The aim of these materials is creating new functionalities or modifying the ones of the traditional composites without decreasing their mechanical properties allowing them acting as structural elements.

Conductive networks of CNT and CNF could be used as sensors when they are added in a concentration enough to allow the formation of conductive paths in the composite materials. Several research works have been done in order to study this possibility of structural health monitoring by using carbon nanostructures networks. These studies have already proved the possibility of sensing electrical conductivity variations when the materials are subjected to deformation and mechanical damage such as delamination or crack initiation/growing. Most of these studies are now focused on the location of the damage, that is, not only detecting the failure but also the position in the composite panel.

There is an important scientific effort to evaluate the concentration of nanoreinforcement needed to reach enough electrical conductivity in the composite material to sense the conductivity variations caused by the deformation and damage with enough resolution. Moreover, the distribution of the nanoreinforcement must be homogeneous enough to ensure homogeneous electrical conductivity through the whole panel.

Several techniques and different nanoreinforcements are currently used in laboratory scale, but further investigation is still required to determine which nanoreinforcements are more efficient when improving the electrical properties of the composite materials. Also the dispersion techniques used should ensure not only good dispersion and homogenization of the nanoreinforcement but also the possibility of scaling the method to industrial manufacturing size.

Three different types of nanoreinforcements: carbon nanofibers (CNF) and multiwall carbon nanotubes (MWCNT) both amino functionalized (MWCNT-NH2) and without functionalization were studied in a wide range of concentrations added to an epoxy resin with aeronautical grade used for manufacturing of carbon fiber composites by infusion techniques. Mechanical route of dispersion was used in order to use a method suitable to be scaled up to industrial size, and avoiding the use of organic solvents. The percolation thresholds and maximum electrical conductivity were studied in order to choose an appropriate content and type of nanoreinforcement to be used for structural health monitoring purposes.