Crack-Induced Resistivity Changes in Carbon Nanotube Reinforced Composite

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Abstract: The unique intrinsic physical properties, particularly rigidity and strength-to-weight ratio, of carbon nanotubes (CNTs) suggest that they are ideal fillers for high performance composites. However, most recent advances have allowed not only their rigidity and strength capacity, but also additional self-sensing capabilities. Such multifunctional capabilities of CNT reinforced composites open a vast range of possibilities in the field of Structural Health Monitoring. In particular, this work analyzes-from a numerical perspective-two possible effective implementations of CNTs reinforcements for crack and damage detection in structures or mechanical systems. The first strategy considers a reinforced epoxy strip-like sensor on a structure that assists in detecting a crack or a local failure in the structure. In the second strategy, the CNTs constitute a matrix aggregate in a fiber-reinforced composite structure resulting in a smart composite structure. Both strategies are based on the changes recorded on the electrical resistance (of the sensing strip or the sensing smart composite structure) induced by the variations of the strains produced by the presence of a crack or a local damage in the structure.

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