MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialized Technologies, including Nanotechnology (8)

Author: Dr. M. Gabriella Santonicola
MESA+ Institute for Nanotechnology, University of Twente, Italy

Dr. Susanna Laurenzi
C.S.M. Centro Sviluppo Materiali of Rome, Italy
Prof. Mario Marchetti
Associazione Italiana di Aeronautica e Astronautica (AIDAA), Italy

DNA-BASED SENSORS INTEGRATED IN COMPOSITE POLYMERIC MATERIALS FOR MONITORING RADIATION DAMAGE IN SPACE ENVIRONMENT

Abstract

Specifically for space environment, characterized by high damaging levels of radiations, there is a great need to develop rapid, sensitive and small assays that can be used to assess the potential for exposure and can be related to a biological target. Bio-based sensors offer unique advantages to solve this problem, by integrating the high selectivity, robustness and packaging efficiency that biological systems exhibit with traditional engineered materials. Miniaturization using biological components allows achieving high performance and high complexity within a very small volume. In this sense, biosensors can find useful applications in space environment due to volume and mass savings they bring to the spacecraft compared to conventional systems, which translates into significant cost savings. Our research efforts are focused on the design and fabrication of bio-based sensor that are integrated in high-performing composite materials developed specifically for aerospace applications. In particular, we exploit the unique structural and electrical properties of composite materials made of carbon nanotubes (CNTs) and polymeric resins, by embedding UV-sensitive DNA strands into the composite structure. Modification of the electrical properties of the DNA-functionalized carbon nanotubes as a consequence of the radiation damage provides a natural sensing functionality to the bio-based composite material. The sensitivity of DNA charge transport to perturbations in base-pair stacking, as may arise with base lesions and mismatches, is used to detect and quantify the UV-induced damage. The high surface area of CNTs is of particular interest to achieve high densities of immobilized DNA molecules, therefore allowing for a high degree of device miniaturization with in-situ and real-time analysis capabilities.