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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
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MULTIFUNCTIONAL SENSORS FOR UV AND MECHANICAL DAMAGE DETECTION OF AEROSPACE STRUCTURES

Abstract

During space missions, on-board structural and electronic components are continuously exposed to radiations, which can degrade their performance or permanently damage them. The design of space-stable structures needs to take into account the combined effect of all the local environmental factors. Indeed, polymer-based materials in space exhibit larger degradation effects due to the combination of energetic UV radiations, vacuum, atomic oxygen, as well as large temperature gradients, which generate thermal stresses inside the structures. The health monitoring of composite structures in the aerospace and astronautic fields is a concept of great interest in view of the potential re-usability of such structures. Main applications include earth-deck panels and lateral panels of spacecrafts, in particular addressing shape and stress monitoring during ground testing and orbit operation. An open question in structural health monitoring (SHM) for composites remains the integration of sensors into the components, and the characterization of their micromechanical behavior. In this work, we investigate a novel approach to integrate both UV-sensing and piezoresistive capabilities into composite structures. Nanostructured films made of graphene and DNA strands were used to confer UV-sensitivity and piezoresistive response to the composites. These films were deposited on two types of composite laminates (carbon fiber/epoxy and glass fiber/epoxy) using spraying or spin coating processes. UV damage was assessed through changes of the sensor dielectric properties, while mechanical damage was investigated through analysis of the piezoresistive behavior of the film sensor under flexion. Scanning electron microscopy (SEM) was used to identify damage modes in the host structures.