Title

NOVEL STRUCTURAL HEALTH MONITORING FOR COMPOSITE STRUCTURES BY USING SMART PAINT SENSOR BASED ON CARBON NANO HYBRID COMPOSITES

Abstract text

To address the need of structural health monitoring (SHM) for composite structures, this paper presents a novel sensing technique based nano smart paint which can monitor impact and structural deterioration. The smart nano paint simultaneously uses both the piezoresistive and electrical impedance properties of carbon nano hybrid smart materials made of multi-wall carbon nanotubes (MWCNT) and grapheme oxide (GO).

We applied the nano smart paint to a composite structure and tested its strain, impact and fracture cases. The smart nano paint can be easily installed on the composite structure using a spray-on technique, making the sensor low cost and practical. The SHM sensor system made of smart nano paint can monitor the composite structure continuously with electrical impedance and piezoresistive signals indicating structural deterioration and impact that may be sufficient to cause damage in real time.

Static and dynamic responses of the composite structure were measured by using the paint sensors with the data acquisition system consisting of voltage divider, and signal processor. Being made of carbon nano smart materials, the electrical properties of nano smart paint varies under structural deterioration conditions. The impact or strain of the structure changes piezoresistivity of the paint and that converts into voltage output consequently by means of simple signal processing system. The paint sensors have the enough sensitivity to detect impact energy over 0.5 ~ 3 J and showed linear voltage output responses. The impact makes deformation of the structure and it brings change of piezoresistivity of the paint sensor and those are converted into voltage output consequently by means of simple signal processing system.

The smart nano paint can effectively detect strain, shock and low frequency vibration based on its electrical impedance properties and that may prevent structural deteriorations in early stage. The nano smart paint is lightweight and easily applied to the structural surface, and there is no stress concentration, no piezoelectrics, no amplifier, and no storage of high frequency waveforms. Most current nondestructive testing methods are not sensitive enough for composite structural applications. But nano smart paint is expected to be a cost effective and sensitive multi-functional sensor for composites and other damage monitoring applications in the field of SHM and diverse engineering applications as well.

Keywords

CARBON NANOTUBES, GRAPHENE OXIDE, SMART MATERIAL, NANO COMPOSITE, HYBRID COMPOSITE, SMART PAINT, STRAIN SENSOR, , IMPACT SENSOR, STRUCTURAL

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