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Distributed strain measurement and damage detection by carbon nanotube sensor thread for composite materials

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Polymeric composite materials have been widely used in many applications. However, the fundamental weakness of the composite materials is its low capability to resist delamination, which could initiate inside the laminate structure. It is important to detect delamination of composite materials in early stage in order to avoid misfortunate consequence. This research demonstrates the use of carbon nanotube thread, spun from carbon nanotube forest, as a sensor to measure strain and monitor delamination of the composite materials on real time basis. Carbon nanotube sensor thread was bonded on the surface of IM7 laminated composite specimen to measure strain in a quasi-static tensile test. The carbon nanotube sensor thread measures the average strain of the material it covered. Tensile test shows a good match of measured strain by sensor thread and traditional strain gage. A carbon nanotube sensor grid consists of multiple carbon nanotube sensor threads was built and bonded on the surface of IM7 laminated composite panel to detect, locate and partially characterize damage caused by impact loads applied to the panel. Impact test shows that the carbon nanotube sensor grid can effectively detect the location and size of the damage occurred in the composite panel. This sensor system does not add significant weight to composite material and its detection of damage is reliable. A data acquisition system including data algorithm has also been developed.

Biography

Yi Song is a Postdoctoral fellow in the Nanoworld Laboratory of the Department of Mechanical Engineering at the University of Cincinnati. He earned his PhD degree in Mechanical Engineering at the University of Cincinnati. His main expertise is the design, fabrication, and mechanical, thermal, and electrical characterization of polymeric composites and nanocomposites. His current research interests include the development of high volume fraction composites reinforced by carbon nanotube materials with superior mechanical properties and the study of self-sensing concepts on composite materials that can detect their own strain and integrity.

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