SEONG SU KIM

INVITED TALK 14

Sensors for Structural Health Monitoring of Lightweight Medical Equipment

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Abstract

A coaxial structured fiber sensor was developed to overcome the limitations of existing sensors and apply it to the manufacturing and structural health monitoring of composite materials. Four perspectives were used to design the fiber sensor, including load-bearing capacity, improvement of measurement characteristics such as linearity, repeatability, and noise reduction, minimization of measurement errors through improved creep resistance, and the ability to measure both temperature and strain. To achieve this, a coaxial structure was adopted to provide load-bearing capacity and measurement characteristics simultaneously, and a core fiber based on ultra-high molecular weight polyethylene with high stiffness and strength was selected, and the mechanical properties of the fiber were greatly improved through optimization of its manufacturing and post-processing conditions. In addition, a microwave-assisted cross-linking method was developed to suppress creep deformation, which causes significant measurement errors in polymer-based sensors, and greatly improved the load-bearing capacity and creep resistance of the core fiber. A dip-coating method was applied to give the manufactured core fiber the ability to measure temperature and strain. A multilayer structure with conductive layers of different concentrations and a polyurethane layer was designed to improve the noise level and linearity of the measurement results from the perspective of strain measurement. The structure of the strain measurement layer was designed to significantly improve the linearity of the measurement results while maintaining a low level of noise.

Keywords: Fiber sensor, Load carrying capacity, Creep resistance, Cure monitoring, Structural health monitoring

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Professional Background

2020-present Editor of Materials Today Communications

Selected Awards and Honors

1. 2023 Experimental Mechanics Academic Award
   (The Korea Society of Mechanical Engineers)

Selected Publications

1. Mohamad A. Raja,Su Hyun Lim, Doyun Jeon, Sangyoon Bae, Woong Oh, Inyeong Yang, Dajeong Kang, Jawon Ha, Ha Eun Lee, Il-Kwon Oh, Sanha Kim, Seong Su Kim*, “Thin, Uniform, and Highly-Packed Multifunctional Structural Carbon-Fiber Composite Battery Lamina Informed by Solid Polymer Electrolyte Cure Kinetics”, ACS Applied Materials & Interfaces, Volume 16.43 (2024), 59128–59142.