Manufacturing and Characterization of Carbon Fiber and Carbon Nanotube Hybrid Composites

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Abstract

Carbon fiber reinforced polymer is vastly used within many industries due to its superior specific strength and stiffness. A material that is being developed to be used in conjunction with or as a replacement of carbon fiber is carbon nanotubes (CNTs). CNTs are a multifunctional material which exhibit excellent mechanical, thermal, and electrical conductive properties. However, these properties are exemplified at the nanoscale level, and the properties begin to decrease as the CNT network increases in scale. The goal is to minimize surface cracks that may occur. Therefore, these two materials are tested together and separately to evaluate their performance and validate improvement. Functionalization techniques were employed on the CNT network as well as varying the curing parameters to improve the properties. Mechanical testing as well as microscopy characterization were performed on the resulting composite samples. Results were then analyzed by using statistical tools. After thorough research it was found that, by creating a hybrid composite of carbon nanotubes and carbon fiber, the mechanical properties varied from an improvement upon the control composite to a decrease in properties depending on the test performed. The goal of using this approach is to later be used in larger samples and ultimately in spacecraft and other applications.

Keywords
Carbon fiber, Carbon nanotubes, Characterization

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Biographies

Samantha Bell is a 5th year Industrial Engineering Student at Florida State University. Currently works as an Undergraduate Research Assistant at the FSU High-Performance Materials Institute and as a Water Resource Assistant at the FSU Utilities and Engineering Services. She is involved in the Society of Women's Engineers (SWE) as part of the fundraising committee and also as the treasurer for the Institute of Industrial and Systems Engineers (IISE).

Claire Jolowsky is a 4th year PhD candidate in the Industrial and Manufacturing Engineering department at Florida State University. She has a B.S. in Composite Materials Engineering from Winona State University. Her research focuses on carbon nanotube composites manufacturing, mechanical testing, and microscopy characterization. She is supported by the Solvay Fellowship for Composite Materials Engineering. She is a member of SAMPE and ASC.

Dr. Ayou Hao serves as research faculty in the FSU High-Performance Materials Institute (HPMI). She received her B.E. in Textile Engineering from Donghua University and her Ph.D. in Materials Science and Engineering from the University of Texas at Austin. Her research areas include advanced composite materials, multifunctional composites and carbon nanotube nanocomposites.

Dr. Richard Liang is a professor in the Department of Industrial and Manufacturing at Florida State University. Additionally, he serves as the Director of the FSU High-Performance Materials Institute (HPMI). He has a Ph.D. in Materials Science and Engineering from the Beijing University of Aeronautics and Astronautics. His research experience includes the areas of advance composites, multifunctional nanomaterials and CNT buckypaper materials.