



Doctoral Dissertation Defense Announcement

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PROCESSING AND PERFORMANCE OF COMPOSITES WITH MICRO AND NANOSCALE REINFORCEMENTS

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The dissertation addresses three fundamental issues pertaining to the processing and performance of polymer-matrix composites with micro and nanoscale fibrous reinforcements: active flow control in liquid composite molding processes, characterization of the chemorheology and cure kinetics of carbon nanotube-filled resin systems for application to nanocomposites processing, and studies on the damping behavior of nanocomposites. A particular challenge in liquid molding techniques, in general, is the filling of fibrous-preform-laden mold with catalyzed resin, in that the inevitable permeability variability in the preform causes nonuniformity in the fill patterns and often leads to entrapped voids and dry spots in the product. To address this problem, a novel active control scheme is developed and implemented based on the concept of locally altering the resin viscosity in real time, to enhance flow in areas of poor permeation in the preform. A second focus of the dissertation is on the fabrication of nanocomposites, which requires information on the chemorheology and the cure kinetics of the reactive resins filled with carbon nanotubes. A comprehensive characterization study is conducted, for the first time, to elucidate and empirically model the role of nano-scale reinforcements, their morphology, and geometry on the viscosity and cure reaction rate. The interface between carbon nanotubes and the surrounding resin matrix plays an important role in governing the properties and performance of nanocomposites. While effective load transfer requires a good interface, the generally weak nanotube/resin interface found in nanocomposites is attractive for applications that require damping properties of the structures. To this end, a systematic experimental study of the effects of carbon nanotube morphology, loading, and geometry on the damping characteristics of composites with dual scale micro and nano-level reinforcements will be presented.

Biographical sketch of the candidate: Richard Johnson received the B.S. in Mechanical Engineering from the University of Connecticut in 2000 and started his graduate work in the *Advanced Materials and Technologies Laboratory* in Spring 2001. Apart from his doctoral dissertation, he also conducted research in the *Laboratory* on neural network modeling of life prediction of aircraft engine components and on a novel microfuel cell design. Richard Johnson has authored 6 journal publications and 3 conference publications based on his doctoral dissertation. **Preview his research at <http://www.engr.uconn.edu/amtl/p-johnson.html>**

Advisory Committee:

Professor Ranga Pitchumani (Major Advisor)

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(Associate Advisors)



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