MICROVASCULAR NETWORKS FOR SELF-HEALING POLYMER COATINGS

K.S. Toohey[1], S.R. White[2], N.R. Sottos[1]

[1]Department of Theoretical and Applied Mechanics &
The Beckman Institute of Advanced Science and Technology
University of Illinois at Urbana-Champaign, Urbana IL 61801
n-sottos@uiuc.edu

[2]Depatment of Aerospace Engineering
The Beckman Institute of Advanced Science and Technology
University of Illinois at Urbana-Champaign, Urbana IL 61801

Inspired by biological systems in which damage triggers an autonomic healing response, structural polymeric materials have been developed that possess the ability to self-heal. First generation self-healing composites incorporate healing agent filled microcapsules and catalyst particles in an epoxy matrix. Although high healing efficiencies have been achieved using this concept, only a limited supply of healing agent is available. If the same crack were to open again, a second healing would in general not be possible. In this presentation, we report on a second generation of self-healing composites that utilize an interconnected microvascular network to flow healing agent throughout the matrix. This concept is applied to heal a coating on a substrate containing a microchannel network. A new protocol is developed for coated networks, which entails testing virgin samples in four-point bending until cracks initiate in the coating. The onset of cracking leads to a distinct load drop and corresponding decrease in the bending stiffness. The sample is then allowed to heal (healing agent from the channels permeates the cracks and interacts with a catalyst suspended in the coating) and is retested. The results from this microvascular system are compared with appropriate controls as well as healing efficiencies of a microcapsule coating system.

Keywords: self-healing, polymer, microvascular