

DEPARTMENT OF MECHANICAL ENGINEERING SEMINAR SERIES

Autonomous Materials Systems: From Self-Healing to Regeneration

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Abstract: Inspired by living systems, self-healing polymers and composites are designed to autonomously repair damage whenever and wherever it occurs, thus providing a means to significantly extend the service life and reliability of structural materials. Since the inception of the field in 2001, there have been three conceptual approaches demonstrated in the literature including capsule-based, vascular, and intrinsic systems. The particular approach used is dictated by a number of factors including the type of damage to be healed, the damage volume, material architecture, etc. Of these, damage volume is perhaps the most explicit design requirement for a self-healing system. For example, intrinsic systems require intimate contact of damage surfaces in order for healing to proceed at high efficiency. As a result they are most suited to micro- (or nano-) scopic damage modes such as interfacial debonding. Capsule-based systems can deliver a moderate volume of healing agent to the site of damage and are therefore more capable of healing fatigue damage, transverse or shear cracks, etc. However, for large damage volumes (e.g. impact damage) only vascular approaches are capable of supplying the necessary volume of healing agent for appreciable healing. Beyond simple healing strategies we have recently embarked on a research program to explore full scale regeneration of materials when the damage is too severe or too extensive to heal adequately.



Figure 1. Self-healing polymers have been demonstrated using three conceptual approaches including (a) capsule-based, (b) vascular, and (c) intrinsic mechanisms.

[Blaiszik et al. *Ann. Rev. Mater. Res.* 2010]

Biography: **Scott R. White** is the Donald Biggar Willett Professor of Engineering at the University of Illinois. In 2000, he joined the faculty of the Beckman Institute for Advanced Science and Technology where he leads the Autonomous Materials Systems Group bringing together students and faculty from a broad cross-section of scientific and engineering disciplines. He received a Ph.D. in engineering mechanics from The Pennsylvania State University in 1990 before joining the Department of Aerospace Engineering at the University of Illinois. An internationally recognized materials engineer, Professor White has played a leading role in the development of self-healing materials and multifunctional materials systems. In recognition of his creative and fundamental research contributions Professor White and his team were honored as a finalist for the 2001 Tech Award recognizing outstanding contributions in technology from the Tech Museum of Innovation (San Jose, CA) and Popular Science acknowledged his work on self-healing materials as one of the Top Ten Scientific Innovations for 2001. Scientific American also recognized his work in microvascular systems with the SciAm 50 prize in 2007. His most recent work on mechanochemistry was recently cited by Popular Science as one of the Top Ten Concepts to Know for 2011. He received the Humboldt Research Award in 2012 in recognition of his contributions to science and engineering. Professor White holds 38 patents and applications in the materials field and is a founding partner in two start-up companies seeking to transition university technologies to industry.

DATE: Friday, February 21, 2014

TIME: 3:00—4:00 p.m.

LOCATION: Macdonald Engineering Bldg., RM 267

