



Adaptive Nanocomposites and Autonomic Gels

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Continual innovation at the forefront of soft-matter and nano-materials, in areas such as directed meso-assemblies, liquid crystal networks, nano-composites and bio-molecules, is providing exciting opportunities to create smart materials systems that not only exhibit controlled, reproducible and reversible modulation of physical properties, but also self-report their status and exhibit robustness with regard to a broad range of stimuli. These material systems evoke the adaptivity of natural organisms, and inspire radical aerospace notions. Current efforts focus on understanding the mechanisms underlying mechanical responsivity, and thus establish the ultimate performance limit and design options, of four emerging adaptive material concepts: shape memory nanocomposites, light-triggered azo-liquid crystal networks, thermo-electric nanocomposite actuators, and autonomic BZ hydrogels. The talk will highlight recent developments in the design of polymers for these mechanically adaptive applications based on an understanding of the correlation between network structure, local chain dynamics near the glass transition temperature and storage of mechanical energy.

Dr. Richard A. Vaia is the Technology Advisor of the Nanostructured and Biological Materials Branch at the U.S. Air Force Research Laboratory (AFRL). The diverse 90 person team focuses on accelerating the maturation of high-risk material-based solutions for unique Air Force energy and sensor requirements. His research group focuses on polymer nanocomposites, complex nanoparticle architectures and their impact on developing adaptive soft matter. He received his BS, MS, and PhD degree in Materials Science and Engineering at Cornell (1991, 1993, 1995) and was a distinguished graduate from Cornell's AFROTC. His honors and awards include the Doolittle Award (American Chemical Society PMSE, 2009), Air Force Outstanding Scientist (2002), Air Force Office of Scientific Research Star Team (2001-2013), and Fellow of the APS (2011), ACS, PMSE Division (2011), and the Air Force Research Laboratory (2010).

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