

**MATERIALS SCIENCE AND ENGINEERING SEMINAR
544 BALDWIN HALL
THURSDAY MARCH 8 2PM**

**Focusing on the Interface: New Opportunities
for Functional Polymer Nanocomposites**

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Ever since the Wright Brothers defied the skeptics of powered flight over a hundred years ago, scientists and engineers have been searching for innovative ways to build better aerospace systems. Continual innovation at the forefront of soft-matter and nano-materials, in areas such as directed meso-assemblies, nano-composites and bio-molecules, is providing exciting opportunities to create materials systems that exhibit a controlled, reproducible and reversible modulation of physical properties in response to an external stimulus. These new material systems evoke the adaptivity of natural organisms, and inspire radical aerospace notions. This talk will consider polymer nanocomposite concepts and their opportunities to enhance the performance of functional applications, as well as impart responsive characteristics. These possibilities arise from 1) the extensive polymer-nanoparticle interfacial area ($>500 \text{ m}^2/\text{g}$), 2) the responsiveness of the percolative network of the nanoparticles to external fields, and 3) the impact of nanoscale compositional fluctuations on the local driving field (strain, electric, etc.). Recent development of single component polymer nanocomposites for lubricants for RF MEMs, ultrahigh density capacitors, and plasmonic-based switchable filters will be discussed to highlight the current understanding, and to underscore the challenges to establishing a reasonable expectation of performance.

Richard A. Vaia Biography

Richard A. Vaia is the Technology Advisor of the Nanostructured and Biological Materials Branch at the U. S. Air Force Research Laboratory (AFRL). 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 University (1991, 1993, 1995). 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 American Physical Society (2011), American Chemical Society, PMSE Division (2011), and Air Force Research Laboratory (2010). Vaia has served on numerous editorial boards, Board of Directors, and external review panels, and has authored over 160 peer-reviewed papers and patents.