

## From Nanoparticles to Nanocomposites: Processing, Performance and Toxicity

University of Massachusetts Lowell (UML), One University Avenue, Lowell, MA 01854

Monday Morning, June 15, 2009 to Thursday Afternoon, June 18, 2009

### Lecturers:

**Derk Brouwer** is a senior exposure assessment scientist with many years experience in occupational hygiene, both in practice and in research. He was trained as a chemical engineer and hygienist, and received his PhD from the University of Utrecht (NL). His research related to occupational health and safety covers exposure to pesticides, dermal exposure methodology, personal protection, dust hazards, etc. and has resulted in numerous publications. He is the organizer of a working group within the European standardization organization (CEN) dedicated to dermal exposure issues and participates in a similar ISO working group. In recent years, the focus of his research has been occupational exposure to ultrafine and (engineered) nanoparticles. He is principal investigator for TNO in (EU-sponsored) projects on occupational exposure (and health risks) related to such engineered nanoparticles, i.e. NANOSH and NANODEVICE.



**Alan Lesser** is a Full Professor in Polymer Science & Engineering at U. Mass. Amherst. His research activities include structure-property relations in polymers and composites, nonlinear and fracture behavior of polymeric materials and polymer processing in supercritical CO<sub>2</sub>. He is Editor of *Polymer Composites*, Assoc. Editor of *Polymer Engineering and Science*, and a member of the *Journal of Applied Polymer Science* advisory board. He is a Fellow of the Society of Plastics Engineers, former chair for the Gordon Composites conference and the Polymer Analysis Division and Failure Analysis and Prevention SIG for the Society of Plastics Engineers. He has more than 80 refereed journal publications and more than 90 conference proceedings. Dr. Lesser received his Ph.D. in Civil Engineering from Case Western in 1988 and joined the faculty in the PSE Department in 1995 after 6 years as a Research Scientist for Shell Development Company.



**Michael Rubner** is the TDK Professor of Polymer Materials Science & Engineering and Director of the Center for Materials Science and Engineering (NSF MRSEC) at MIT. He received his B.S. in Chemistry from U. Lowell (summa cum laude, 1982) and his Ph.D. in Materials Science & Engineering from MIT (1986) while a staff member in GTE Laboratories, accruing over twelve years industrial experience before accepting a faculty position at MIT in 1986. Rubner has given more than 190 invited lectures and published more than 200 technical papers, including five book chapters, and is holder of nine U.S. patents. From 1995-1999, he was U. S. Editor of *Supramolecular Science* (Elsevier), and serves on the Board of Directors for the Materials Research Society. His current interests include molecularly assembled PEM thin films as multifunctional coatings providing new capabilities in thin film optics, extreme surface wetting and biomaterial interface design.



**Dale W. Schaefer** is Professor of Chemical and Materials Engineering and former Dean of Engineering at the University of Cincinnati. He earned his Ph.D. in Physical Chemistry and performed post-doctoral studies in Physics at MIT. Dr. Schaefer was a technical manager at Sandia National Labs and a Senior Technical Advisor at the DoE. He is a Fellow of the American Physical Society and the American Institute of Chemists. He was the 2004 John Wheatley Scholar and is a member of the Materials Program Advisory Committee and the User Group Executive Committee of the Lujan Neutron Scattering Center at Los Alamos National Labs. Prof. Schaefer is a specialist in structure-property relations, light, x-ray and neutron scattering. Recent projects include water-barrier properties of silane films, non-chromate corrosion inhibitors, morphology of reinforcing fillers for rubbers, antifouling polymers for desalination membranes and carbon and clay nanocomposites.



**Sanford Sternstein** is Professor Emeritus in Materials Science & Engineering at Rensselaer Polytechnic Institute. He earned his Ph.D. in Chemical Engineering at RPI and joined the faculty in 1961, was the William Weightman Walker Professor of Polymer Engineering from 1976 to retirement (2006) and Director of the Center for Composite Materials and Structures (1987-2000). His research included swelling and elasticity in elastomers, viscoelasticity and creep in plastics, and shear yielding and crazing criteria (design tools for 30+ years). Recent studies cover creep and dynamic moduli in ceramic fibers and reinforcement mechanisms in filled polymer melts and elastomers. He served on the Executive Boards of the Society of Rheology and the High Polymers Division of the American Physical Society (Fellow since 1977) and on several NMAB Panels on composites and elastomers. He is a founder and past chair of the Gordon Conference on Composites.



**Richard A. Vaia** is Technology Advisor of the Nanostructured and Biological Materials Branch at the U.S. Air Force Research Lab (AFRL, Wright-Patterson AFB, OH) and Nanomaterials Lead for the Materials and Manufacturing Directorate. His group focuses on polymer nanocomposites, complex nanoparticle architectures and adaptive soft matter. He received his Ph.D. degree in Materials Science & Engineering at Cornell University in 1995 and was a distinguished graduate from Cornell's AFROTC. His honors and awards include Air Force Outstanding Scientist (2002), MRL Visiting Professor at U. C. Santa Barbara (2006), and Air Force Office of Scientific Research Star Team (2003-2005; 2005-2007; 2007-2009). Rich serves on the editorial boards of *Macromolecules* and *Materials Today*, as well as the Board of Directors for the Material Research Society. He has authored over 120 peer-reviewed papers and patents.



## Course Organization

While nanofillers like carbon black and fumed silica have been used for decades, the field of polymer nanocomposites came into its own when Toyota engineers demonstrated nanoclay hybrids in the early 1990s. Thanks to the interest their work generated, many products now incorporate nanoparticles, nanotubes, nanorods, or nanolayers into polymers, demonstrating the commercial viability of nanocomposites. Subsequent generations of nanocomposites promise additional functionality or multifunctionality – flexibility, toughness, and electrical properties, transparency, abrasion, and ballistic impact resistance, structural stiffness and vibration damping, fire retardance and environmental acceptability, etc. In order to meet the technical challenges to realize this promise, the fundamentals that serve as the basis of such efforts must be addressed: How nanoparticles and polymers interact; how such interfacial interactions may be controlled; what is necessary to achieve dispersion using practical processing methods; what properties may be obtained by tailoring the nanoparticle, matrix, and interface; effective approaches, common mistakes, and novel techniques relevant to measuring structure and properties; and hazard assessment and best practices when handling nanoparticles.

The short course will be co-hosted by the UML Nanomanufacturing Center of Excellence and the NSF-funded Center for High-rate Nanomanufacturing (an equal partnership with Northeastern and the University of New Hampshire). With strong core expertise in plastics, composites, and nanomaterials and an integrated cadre of EH&S researchers in the School of Health and Environment, UML provides a unique setting for this course. Along with invited lecturers, our expert faculty will provide state-of-the-art research briefs and hands-on demonstrations of processing, characterization, and EH&S equipment and techniques.

## Course Outline

- Monday, June 15, Morning: Novel Properties and Applications (Vaia)
- Monday, June 15, Afternoon: Nanoparticle Engineering and Nanocomposite Formation (Rubner)
- Tuesday, June 16, Morning: Micromechanics and Physics of (Visco)Elastic Reinforcement (Sternstein)
- Tuesday, June 16, Afternoon: Nanocomposite Mechanics Beyond the Elastic Limit (Lesser)
- Wednesday, June 17, Morning: Characterization of Nanoparticles and Nanocomposites (Schaefer)
- Wednesday, June 17, Afternoon: Assessing and Controlling Nanoparticle Exposure (Brouwer)
- Thursday, June 18: Hands-on demonstrations and facilities tours

## Fees

Status	Registration Fee	Deadline
Fellowship application	Covered by NSF	<b>EXTENDED – March 20, 2009</b>
Early Registration	\$1600 (20% discount)	<b>April 1, 2009</b>
Registration	\$2000	May 1, 2009
Late Registration	\$2200	After June 1, 2009

Includes daily coffee breaks & lunches, Monday reception, Wednesday banquet, presentation materials, lecture notes & reviews.

## Location

The course will be held at the University of Massachusetts Lowell (thirty five miles northwest of Boston Logan Airport and thirty miles south of Manchester Boston Regional Airport).

## Accommodations

A block of rooms has been reserved at the Doubletree Hotel in Lowell; reservations may be made through the Course website. A special rate of \$84/night has been arranged for attendees; reservations may be made at this rate until May 1, 2009.

## Registration

A registration form can be downloaded from the Course website.

## Fellowships

U.S. professors, post-doctoral researchers and graduate students can download fellowship application forms from the Course website. Fellowship applications are due March 20, 2009. Fellowships also cover accommodations based upon double occupancy. Please check the Course website for more information.

**New England Nanomanufacturing Workshop – June 18 and 19.** The NSF-funded Center for High-rate Nanomanufacturing is also hosting the New England Nanomanufacturing Workshop on June 18 and 19. For more information, see <http://www.nano.neu.edu/>

## For additional information on this short course:

Visit [http://www.uml.edu/nano/events/summer\\_institute](http://www.uml.edu/nano/events/summer_institute), or e-mail [NSF\\_SummerInstitute@uml.edu](mailto:NSF_SummerInstitute@uml.edu)

*Co-Organizers from the University of Massachusetts Lowell for this event are  
Assistant Professor Daniel Schmidt (Plastics Engineering) and Professor Julie Chen (Mechanical Engineering)*