**The NSF Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures: 10 years of progress and a look into the future. L.S. Schadler**

*The NSF Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures* (www.nano.rpi.edu) was founded in September 2001 at Rensselaer Polytechnic Institute (RPI), in collaboration with the University of Illinois at Urbana-Champaign (UIUC), and Los Alamos National Laboratory (LANL). Our Nanoscale Science and Engineering Center (NSEC) continues to address the fundamental scientific issues underlying the design and synthesis of nanostructured materials, assemblies, and devices with dramatically improved capabilities for many industrial and biotechnological applications.

Our key accomplishments have been:
(1) Fundamentally changing the way the community looks at polymer nanocomposites and gels, taking them from essentially separate scientific research disciplines and integrating them into areas that inform one another to a conceptually integrated whole – nanocomposites – that spans the nanoparticle concentration range in polymers from dilute to concentrated. Powerful combinations of theory, computation and experiment have lead to biphasic inks that can be used to write 3D structures with spatial features at the nanoscale. Unique control over nanoparticle surface chemistries have lead to improved fundamental understanding of the thermodynamics controlling the morphology and rheology of nanofilled polymers, and to the use of engineered nanoparticle composites in a range of industrial applications.

(2) Fundamentally changing the way the community understands biomolecule-nanomaterial hierarchical assemblies and their resulting composites, not only in terms of our ability to construct new functional hybrid materials with practical applications in energy, environment, and biomedical fields, but also to chart a clear path forward to create a wide range of heretofore unrealized opportunities for new materials, new devices, and new systems in the future. For example, surfaces and bulk materials are being generated that are endowed with bio-nano hybrids that will one day enable safe and sustainable healthcare and food processing environments.

(3) Introducing an innovative and sustainable style of STEM stealth education (www.molecularium.com) that combines large-scale molecular dynamics simulations with entertaining animation to bring the public into the world of atoms and molecules and teach them some of the science they need to help them understand the increasingly complex and critical decisions that our world needs to make to solve the 21$^{st}$ Century Grand Challenges.

Importantly, based on our NSEC's research progress and success over the past ten years on polymer nanocomposites and nanostructured biomolecule composites, we can see clearly how these two broad areas can now be integrated to create a new larger world of hierarchical hybrid material systems. The next challenge is to understand the processing science and manufacturing routes that can preserve the integrity of the nanomaterial system and its biomolecule structure and function in a commercially viable manufacturing environment. As a result, it will be possible to begin to integrate biomolecular and nanoscale science and engineering with hierarchical materials processing and manufacturing to enable the design, manufacture, and commercial adoption of robust, scalable, and affordable material systems with hybrid biological and non-biological functionalities.