**Department of Chemical Engineering**

**Seminar Schedule**

**Directed Self-assembly of Nanomaterials for Sensing and DNA Delivery**

Guangzhao Mao

Professor and ChE and Materials Science Chair; Wayne State University

**Abstract**

We engineer nanomaterials based on molecular self-assembly principles for gas sensing as well as drug/gene delivery applications. These materials include nanoparticle carriers for targeted drug delivery in spinal cord injury and cancer therapies, organic nanowires for electrochemical sensing, and bioreducible polymer coatings for sequential DNA delivery. The first part of the talk will focus on seed-mediated nucleation of organic crystals and its application towards scalable manufacturing of nanowire sensors. Nanowires are widely recognized as the next generation building block for ultrasensitive and ultrafast chemical detection. Despite the research progress very few nanowire sensors have reached the market due to their manufacturing complexity. We are exploring a simple, low-cost electrocrystallization method to deposit nanowires from a solution droplet at room temperature directly on electronic substrates. The nanowires are grown by seed-mediated electrocrystallization using nanoparticles as nucleation seeds. The size of the nanoparticle seed limits the width of the organic crystals and promotes nanowire formation. The second part of the talk will focus on bioreducible layer-by-layer (LbL) films for sequential DNA delivery. The LbL technique is based on alternating adsorption of anionic and cationic polymers on substrates. Despite extensive knowledge on LbL assembly mechanism and internal structure, several important questions remain with respect to LbL film disassembly, for example, the timing and structure of the released species, and how these factors can be designed to facilitate sequential DNA delivery. Bioreducible LbL films have advantages over other types of biodegradable films in their ability to utilize cellular exofacial redox activity for film disassembly. However, the films tend to degrade randomly and in bulk. We have found that by mixing a non-bioreducible polycation with the bioreducible polycation during film assembly it is possible to change film disassembly from bulk to surface degradation, reduce released DNA particle size, and prolong the release process.

**Bio**

The primary research focus of Prof. Guangzhao Mao is the self-assembly of nanoscale building blocks ranging from nanoparticles, nanorods, molecular aggregates, lipid bilayers, and polymeric chains. Self-assembly takes the bottom-up approach to nanotechnology, which is complementary to the top-down approach of the lithographical methods. One of the major hurdles in nanoscale manufacturing is the assembly and connection of various functional elements, such as nanoparticle quantum dots. Prof. Mao is working on a general scheme to create inter-element connections and their interface to the macroscopic electrodes. For example, nanorod linkers have been prefabricated onto nanoparticle quantum dots by nanoparticle-induced nucleation. Self-assembled bilayer patterns have been used as molecular templates for the synthesis of semiconductor nanorod arrays. The nanoscale confinement effect on molecular aggregation, nucleation, and crystallization has been exploited for the making of nanoscale organic/inorganic hybrid thin films and devices. Prof. Mao's other research interests include gene and drug delivery, biomolecular interactions, and biomembranes. The self-assembled structures, patterns, and the self-assembly process are characterized at the molecular scale and in situ by atomic force microscopy and single-molecular force spectroscopy.

**Seminar**

**Monday, December 4, 2017**

**3:00 Pm**

**Livermore 101**