Jul 16, 2009 10:00 AM EB1, Rm 2018	**Professor Kookheon Char** Seoul National University

Functional Multilayer Thin Film Platforms Based on the Layer-by-Layer Deposition

Functional polymer thin films have recently received much attention due to many important potential applications such as nanolithography and nanopatterning for nanodevices, biologically relevant surfaces for sensors and drug delivery, and photonic or electronic devices. In this presentation, the formation and principles of functional multilayer thin films prepared by layer-by-layer (LbL) deposition, employing various intermolecular forces, will be reviewed.

As the first example, highly nanoporous films composed of two different BCMs through the LbL assembly were prepared on substrates. The films thus prepared show tunable optical properties along with strong antireflective properties with light transmission above 99%.
This kind of LbL deposition with nano-objects allows us to mimic products in nature such as Lotus leaves and nacres. Considering the wide range of application areas for LbL multilayers, the approaches taken in the present study are likely to open up new possibilities for devices with multifunctional properties.

Jul 27, 2009 2:00 PM EB1, Rm 2018	**Professor Abraham (Avi) Marmur** Technion – Israel Institute of Technology

Non-Wettable (Lotus) Surfaces

Many plant leaves, notably of the Lotus flower, use a self-cleaning mechanism based on complete non-wettability by water (“super-hydrophobicity”) of the leaf surface. This long known effect has recently become a goal for biomimetics.

The principles governing this effect are explained and demonstrated. The mechanism of non-wettability of a surface towards water drops in air has been extended to underwater systems. The conditions for underwater non-wettability are explained and discussed. In addition, there is much interest in non-wettability by liquids in general.

It is theoretically shown how a super-hygrophobic surface can be made out of a hygrophilic material (the prefix hygro- means liquid, in general).

Per Dr. Genzer, Professor Marmur is one of the world leaders in the field of surface wettability.

Aug 24, 2009 10:45 AM 1011 EB1	**Dr. Richard Felder** Department of Chemical & Biomolecular Engineering

Engineering education in five years (or sooner)

Engineering education is currently in a turbulent period. Chronic industry complaints about skill deficiencies in engineering graduates in an increasingly globalized environment, government commission reports supporting those complaints, and the outcomes-based program accreditation systems in America, Europe, and elsewhere in the world all call for major transformations in the ways engineering curricula are structured, delivered, and assessed.

As might be expected, many faculty members and administrators are less than enthusiastic about proposed changes, arguing that the existing system functions well and needs no radical revision.

The ongoing debate involves four focal issues:

1. How should Science, Technology, Engineering, and Mathematics (STEM) curricula be structured?
2. How should STEM courses be taught and assessed (and what role will technology play)?
3. Who should teach?
4. How should the teachers be prepared?

This talk outlines the opposing positions on each of these issues—the traditional position, which has been the predominant approach of the past five decades, and the alternative position—and offers predictions about the probable outcomes.

Aug 31, 2009 10:45 AM 1011 EB1	**Dr. David Muddiman** Department of Chemistry - NC State

Development and Application of Chemical and Instrumental Approaches Directed at Biomarker Discovery

This presentation will detail our efforts over the past decade to integrate novel chemical and instrumental approaches with medical research.
Briefly, hybrid ionization sources will be discussed when coupled to Fourier transform mass spectrometry for tissue imaging applications, air amplifiers to improve capture efficiency of electrospray droplets at ambient pressure, and chemical approaches to improve the ionization efficiency of peptides and glycans. Our efforts are largely directed at cancer biomarker discovery although these approaches can be applied to address a diverse range of contemporary questions.

Sep 14, 2009 10:45 AM 1011 EB1	**Dr. Carol Hall** Chemical & Biomolecular Engineering

Confessions of an Ordinary Teacher - Dealing with the Big Fish

Professor Hall will describe the evolution of her attitude towards undergraduate teaching and its parallels with her attitude towards life: high points, low points, lessons learned, and the big fish.

Sep 23, 2009 10:40 AM 135 BTEC	**Dr. David James** University of Sheffield, UK

Dissecting the hierarchy of cellular processes underpinning recombinant monoclonal antibody production by mammalian cells

Despite the value and therapeutic importance of MAb products, it is still uncertain how engineered mammalian cell factories coordinate multiple dynamic cellular processes to most efficiently manufacture the product. Does control of flux from integrated recombinant gene to secreted product vary between cell lines or through manufacturing processes?

In this presentation I will discuss how we can use a continuum of understanding from molecular cell biology to MAb manufacturing performance in vitro to rationally generate improved cell-based manufacturing platforms.

Sep 24, 2009 **9:00 AM** **EB1, Room 1010**	**Dr. Andrew Teplyakov** University of Delaware

Tuning the chemical properties of thin film surfaces: From solid inorganic films to biosensors

Thin films are needed in many practical devices. The chemical control over the properties of thin film surfaces becomes ever increasing problem, especially for the miniaturized devices. This talk will give two very different examples of chemical surface modification of thin films. The chemical properties of titanium nitride-carbide (TiNC) and titanium nitride (TiN) films deposited on silicon show that the surface reactivity of nitride-based films can be modified precisely and reversibly by controlling the surface elemental composition. These materials are used as diffusion barrier films and therefore understanding their surface chemistry is key for controlling further deposition steps during interconnect metallization.
The ability to control the reactivity of a deposited film offers unique opportunities in designing chemical modification schemes for a successful deposition onto these barrier films. A very different example will focus on the potential of coupling biomolecules with electronic elements. The problem is that so far very few actual devices with a practical function have been built based on such interfaces.
We have developed the chemical path to produce and demonstrated the stability of interface of biological molecules, such as DNA, with semiconductor surfaces for bioelectronic sensing applications. Based on the interfacing shape-restricted DNA molecules with silicon, we propose a very sensitive DNA-FET biosensor: */nano/DNA-JUGFET*.

Sep 28, 2009 **10:40 AM** **EB1, Room 1011**	**Dr. David Carroll** Wake Forest University

Advances in Organic Device Design: from light collection to light emission

Advances in our understanding of conjugated polymer-nanophase composite systems have recently led to dramatic improvements in organic device performance. In organic photovoltaics and in organic light emitting diode technologies, the addition of an engineered nanophase to control charge transfer and transport within the active layers, can enhance performance, increase lifetimes, and improve processability.
The key to successful implementation of nanocomposites in device structures is the overall control of morphology of the nanophase. As we have shown, nanophase "texturing" can double the performance of planar bulk heterojunction organic photovoltaics, raising the external conversion efficiency from ~3% to nearly 6% (for the P3HT:PCBM system).
More recently we have shown that applying these same nonequilibrium thermodynamic techniques to create meso-scale structure can be applied to OLEDs yielding a more than 60% increase in overall device efficiency and drastically altering device lifetime.
In this talk a detailed survey of our work in nanophase-polymer interactions and their device implications will be described. Though some examples from inorganic nanophases will be presented, the majority of the conversation will center on nanocarbon allotropes.

Oct 12, 2009 10:40 AM 1011 EB1	**Dr. David Ensor** Research Triangle Institute

Aerosol Filtration

The filtration of aerosols or small particles from air is widely applied in our society. Applications range from protection of people and equipment from damaging particles, collection of industrially produced products, to environmental protection.

A fundamental quest has always been the development of filters with the ability to remove particles with minimum energy or pressure drop requirements. Secondary issues include: 1) understanding the change of filter performance as particles are collected and 2) making matrices that are sufficiently robust to withstand fabrication and use. Interestingly, no matter what configuration of filtration scheme is used, the collection efficiency as a function of particle size has the same general curve with a minimum efficiency in the 0.07 to 0.3 µm particle diameter range depending on the feature size of the collector and the gas face velocity.

The dominant collection mechanisms are diffusion, interception and impaction. Electrostatics can significantly enhance filter collection. Recently, questions have been raised about the ability of filters to capture nanoparticles.

The potential of lowered efficiency of nanoparticles was raised by the possibility of thermal rebound and some errorneous data presented at an international meeting. Recent academic data indicates that thermal rebound is not a consideration unless the particles are smaller than 2nm.

Measurement of filter performance with aerosols for development and product control is very simple in concept but tends to be dictated by the application of the filter. Aerosol filter theory will be discussed and illustrated by examples of filter performance data.

Oct 19, 2009 10:40 AM EB1, Room 1011	**Dr. Thom LaBean** Duke University

Programmable Molecular Self-Assembling for Nanoelectronics and Nanomedicine

Self-assembly is used on multiple length scales in the construction of natural biological materials systems. Taking inspiration from biology, we have created a variety of artificial molecular self-assemblies at the nanometer scale.

Using nucleic acids, peptides, and proteins, we have created organized materials with increasingly complex patterns, shapes, and dynamics. In what could be characterized as programmable artificial biomineralization, these novel biomolecular matrices are being employed as scaffolds and templates for the directed-assembly of nano-scale objects including metals, quantum dots, and other inorganics and organics.

The exciting, novel properties of these materials lend themselves to promising applications in nanofabrication and biomedicine.

Oct 26, 2009 **10:40 AM** **EB1, Room 1011**	**Dr. Orlando Rojas** Forest Biomaterials Science and Engineering

Nanostructures cleaved from fiber self-assemblies

In this seminar work in our group related to interfacial and colloid science and advances in new applications for lignocellulose-based materials will be introduced. Natural self-assemblies and their hierarchies to construct soft materials at different length scales will be discussed.

Nanofibers that are cleaved from bulk fibers using "top-down" routes will be highlighted, with especial focus on native cellulose nanofibers and nanocrystals, both with lateral dimensions of few nm. The use of these elements to enhance surface and composite mechanical properties and the possibility of creating templates for other functional materials will be explained.

The seminar will conclude with some thoughts on principles learned from nature that could, hopefully enable the design of multilevel constructs, for example, by taking advantage of competing interactions and packing frustrations.

Nov 16, 2009 **10:40 AM** **EB1, Room 1011**	**Dr. Paul Agris** Department of Biochemistry

Nature's Chemical Engineering of RNA

RNA is for the most part a biological heteropolymer composted of four fundamental units, the nucleosides adenosine, guanosine, cytosine, and uridine. However, nature has found that these four chemistries are insufficient for the many critical functions of RNA in the synthesis of proteins, and in the control of gene expression.

Therefore, after the biopolymer has been synthesized as a transcription product of various genes, the RNA is site-selectively modified with a multitude of additional chemistries. How do these chemistries extend the structure-function relation of RNAs?

Can we predict the effect of these chemistries on RNAs that have not previously be studied?

Can we use these chemistries to design new RNAs, or DNAs, with novel structures and functions?

Nov 23, 2009 10:40 AM EB1, Room 1011	**Dr. Dan Loughlin** Environmental Protection Agency

The Climate Change Challenge: Modeling Technological Pathways for Mitigation

More than eighty percent of U.S. greenhouse gas emissions in 2007 were attributed to the combustion of fossil fuels for energy. Reducing the carbon dioxide (CO2) emissions of our energy system is thus a major and necessary facet of the climate change legislation being deliberated in Congress.

Achieving emissions reduction targets, however, will undoubtedly require a revolution in the ways that we produce, store, move and use energy. Assuming that the challenge is achievable, all technological pathways for CO2 mitigation are not equal. Pathways may differ in the degree to which they efficiently allocate precious resources and funds, their robustness under uncertainty, and their environmental implications.

The U.S. Environmental Protection Agency's Office of Research and Development is using an energy system model, MARKAL, to identify and explore alternative mitigation technology pathways. The results are providing important insights about critical technologies and fuels, as well as identifying cross-sector interactions and counter-intuitive behavior.

Nov 24, 2009 1:00 PM EB1, Room 1010	**Dr. John Rogers** University of Illinois

Materials for Stretchable Electronics

Electronic systems that involve transistors and other components on thin plastic or rubber substrates offer mechanical properties (e.g. bendability, stretchability) and other features (e.g. rugged, lightweight construction; curvilinear shapes) that cannot be achieved with conventional technologies. Examples of new device possibilities include electronic eyeball cameras and personal health monitors, where the electronics must conform to curved surfaces and flex/stretch during use.

This talk describes the use of nanomaterials in integrated circuits that offer the electronic performance of state-of-the-art, wafer-based devices but with the mechanical properties of a rubber band. We explain the materials science and mechanics of these approaches, as well as aspects of their use in various electronic systems.

Cardiac and brain monitoring devices provide examples of applications in biomedicine; hemispherical electronic eye imagers illustrate the capacity for bio-inspired device design.

Nov 30, 2009 **10:40 AM** **EB1, Room 1011**	**Dr. Rich Superfine** Department of Physics and Astronomy – UNC

Measuring and mimicking the physics of mucus clearance in the lung

The lung maintains an air/blood interface with a surface area the size of half a tennis court. This huge surface area presents a challenge to physiology to maintain a sterile environment in the presence of continual assaults from environmental pathogens.

The body is successful by secreting a layer of mucus, a viscoelastic polymeric fluid, onto the epithelial surface to trap dust and unwanted visitors. This mucus filter is then changed through the continual upward flow due to beating cilia and cough.

We are attempting to understand each aspect of this process through biophysical measurements and through the development of engineered biomimetic systems. Using a magnetic microbead assay, we have measured the force developed by individual lung cilia. To understand the response of the mucus, we measure the fluid rheology using driven microbead rheology that reveals the strain thickening behavior due to high shear rates at the surface of micro and nano sized structures. Finally, to understand the flows generated by carpets of cilia, we have engineered artificial cilia at the size scale of their biological counterparts and have observed directed flow and enhanced mixing in actuated arrays.