2010 PROGRAM

8:00 a.m. Registration & Continental Breakfast, Keeneland Room, W.T. Young Library
8:50 a.m. Welcome by Dr. Kumble R. Subbaswamy, Provost, University of Kentucky
9:00 a.m. Dr. Daniel Morse, University of California
"Bio-Inspired, Kinetically Controlled, Low-Temperature Nanofabrication of Semiconductor and Ferroelectric Thin Films and Nanoparticles: Unique Advantages for High-Performance Li-ion Batteries"

Biological systems fabricate high-performance materials at low temperatures and near-neutral pH with a precision of nanostructural control that exceeds the capabilities of present human engineering. We discovered the mechanism governing nanofabrication of silica in a marine sponge, and translated this mechanism to a generic new, "biologically inspired," low-temperature method for the kinetically controlled catalytic synthesis of a wide range of nanostructured semiconductor thin films and nanoparticles without using organic templates. Employing gentle catalysis at low temperature, this method preserves the intermetallic organization of bimetallic precursors that are thus incorporated into crystalline solids without phase segregation. Results include the first low-temperature synthesis of 6 nm barium titanate nanoparticles with low polydispersity, good electronic properties, and no organic contaminants. A wide range of other materials made by this low-temperature process offers unique combinations of structures and properties not readily attainable by conventional high-temperature processes; these exhibit potential advantages now under investigation for improved solar energy, high power-density and fireproof batteries, ferroelectric random access memory, infrared and piezoelectric detectors, and optoelectronic devices. Especially promising applications for high-performance Li ion and Li batteries will be discussed.

10:00 a.m. Break (refreshments available)
10:10 a.m. Dr. Joanna Aizenberg, Harvard University
"Dynamic, Bio-Inspired Nanofur"

Responsive behavior, which is intrinsic to natural systems is becoming a key requirement for advanced artificial materials and devices, presenting a substantial scientific and engineering challenge. I will present new dynamic actuation systems that mimic biological "hairy" structures at the nanoscale. This synthetic "nanofur" can be put in motion by the "muscle" of a specially-designed hydrogel. The movement of the nanohairs can be tuned to yield a variety of elaborate reversibly actuated patterns, self-assembling into previously unseen structures with uniform, periodic features, and controlled handedness. The actuation is fast, reversible, reproducible, and robust. These reconfigurable nanostructures may have exciting applications in actuators, microfluidics, artificial muscles, release systems, and in "smart" materials with controlled pattern formation, reversible switching of the wetting behavior, and tunable photonic properties.

11:10 a.m. Poster Session, Gallery, Young Library
12:30 p.m. Lunch
2:00 p.m. Dr. Chad Mirkin, Northwestern University
"Programming Materials Synthesis with DNA: Applications in Biology and Medicine"

Chemists have a desire to construct materials atom-by-atom and molecule-by-molecule, and through the development of modern polymer chemistry, coordination chemistry, and crystal engineering. They have become moderately proficient at realizing target structure. Some researchers draw the analogy between atoms and nanoparticles, yet as chemists, we are just beginning to realize the nanoparticle equivalents of molecules and extended materials. One of the fundamental challenges facing nanotechnology researchers in this area is the development of a method to programmably assemble these nanoparticles into complex 1-, 2-, and 3-dimensional structures. The ability to create these nanoscale architectures would provide a means to increase sensitivity, speed, and functionality in electronic, therapeutic, and diagnostic devices relative to current benchmarks, as achieving such a feat would allow for the synthesis of designer materials, wherein the physical properties of a material could be predicted and controlled *a priori*. Our group has taken the initial steps towards this goal and developed a means of creating tailorable assembly environments using DNA-nanoparticle conjugates. These nanobioconjugates combine the discrete plasmon resonances of gold nanoparticles with the synthetically controllable and highly selective recognition properties of DNA, making them both useful nanoscale building blocks and beneficial materials in their own right. This talk will focus on the history of these conjugates, as well as recent advances and potential applications of both the conjugates and their assemblies in medical research, gene regulation, therapeutics, and diagnostics.

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Thirty-Sixth Annual
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Chemistry & Molecular Biology

established by M. Benton Naff
in memory of Anna S. Naff

Bio-Inspired Nanomaterials

SPEAKERS

Daniel E. Morse
Joanna Aizenberg
Chad A. Mirkin

Friday, April 23, 2010

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