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Miller Institute News

Miller Fellow Focus: Matthew Francis
Deadline To Note


More information for each program is available on the Miller Institute website: http://socrates.berkeley.edu/~4mibrs

All materials are due in the Miller Institute office by 4:00 pm of deadline.
Matt Francis' research involves the development of new methods in synthetic chemistry and the application of diversity-based strategies to problems that lie at the interfaces between chemistry, biology, and material science.

One of Matt's interests is the development of new catalytic reactions involving transition metal ions. A key component of many catalytic systems is an organic ligand that binds to a metal center and controls its reactive properties. By carefully designing these ligands, the reactivity of the metal can be turned to produce a desired reaction product, and this approach has afforded many selective and efficient reactions for organic synthesis. However, the factors controlling this reactivity are interrelated and poorly understood, and as a result the discovery of new catalytic reactions frequently involves a time consuming and empirical optimization process.

In the last decade, combinatorial chemistry has emerged as a powerful method for the exploration of multivariate chemical problems. The key to this approach is the generation of a large collection, or library, of diverse molecules using efficient synthetic methods. The library of molecules is then subjected to a carefully designed screening process that can identify the members that possess desired properties. In the context of small molecule libraries, this process has been used to accelerate the identification of new pharmaceutical compounds and to explore the structural features associated with receptor-ligand interactions. It was envisaged that combinatorial approaches could be similarly useful as a tool for rapid catalyst discovery and optimization.

In order to accomplish this, Matt developed new synthetic techniques that allowed a library of 5,760 metal-ligand complexes to be synthesized in an efficient manner. The complexes were prepared attached to small polystyrene beads (~100 um in size) and varied in terms of the metal ion identity, ligand structure, and counter ions--variables known to have a strong influence on catalytic activity. Furthermore, an efficient screening process was developed in order to ascertain which of the complex-bearing beads produced the desired products for a given reaction. The identification of the associated structures led to the discovery of new catalytic systems for the epoxidation of unfunctionalized olefins with hydrogen peroxide, a reaction potentially useful for the synthesis of pharmaceutical compounds. The new catalytic systems possessed little if any resemblance to
Continued from page 1

Miller Fellow Focus: Matthew Francis

previously known speciation systems, thus validating the power of the method for the discovery of new reactivity.

One of Matt’s research areas at UC Berkeley employs a diversity-based approach for the development of new carrier molecules for targeted drug delivery. The beneficial effects of most pharmaceutical compounds arise from their interactions with a limited number of cell types; however, most drug molecules possess the ability to readily traverse cell membranes, and thus can gain access to most of the cells in the patient’s body. The exposure of the drugs to inappropriate cell types frequently leads to side effects, toxicity, and premature degradation of the pharmaceutical compounds.

A potential improvement to this situation could be achieved by molecules to polymeric carriers that possess a high molecular weight. Once attached to the carrier, the drug molecules can no longer freely diffuse into inappropriate cell types, and thus are much less toxic in circulation. By incorporating small molecule targeting moieties on the polymer, the carriers can then be directed to specific tissue types, such as solid tumors. Once the carriers have reached these targets, they can enter cells via endocytosis, and the release of the free drug molecules can be triggered using linkers that degrade in the endosomal and lysosomal vesicles. Thus, the drug molecules are delivered only to the targeted cells.

The early stages of this research have focused on the development of well-defined polymers that possess the biocompatibility necessary for these applications. From these studies, non-toxic, water-soluble polymers have been identified and converted into carriers for the highly toxic anticancer drug doxorubicin. Furthermore, a modular synthetic approach has been developed that allows these polymers to be prepared with a variety of molecular weights and architectures. Current efforts are underway to explore the effects of these parameters on the pharmacokinetics and biodistribution of these materials, as well as the incorporation of tissue-specific targeting mechanisms.

In Matt’s free time, he and his wife, Jennifer enjoy backpacking and other outdoor activities, watching movies, and drinking gun mariins with friends. This fall he has been searching for academic positions, and this spring he will be learning Kung Fu with Miller Fellow Tom Junor.

“In the last decade, combinatorial chemistry has emerged as a powerful method for the exploration of multivariate chemical problems”

News Flash! Miller Fellow Adam Summers will be writing a monthly column for Natural History magazine. The column will focus on biomechanics. After having his research featured in two columns during the past year the editor offered Adam the opportunity to be the regular columnist, providing 10 columns per year to the magazine. Watch for his first contribution to appear in the May 2001 issue.
Visiting Miller Professorships

The Executive Committee and Advisory Board of the Miller Institute have granted awards to the following Visiting Miller Professors. Terms range from fourteen days to one semester during the 2001-2002 academic year. Additional awards for next year will be made in March. The deadline for nominations is February 12.

Astronomy
Prof. Donald Ekers, Australia National Telescope Facility
Prof. Jonathan Lunine, University of Arizona

Chemistry
Prof. Mehran Kardar, MIT (also in Physics)
Prof. Mats Larson, Stockholm University

Earth & Planetary Science
Prof. Philippe Lognonne, University Paris VII and Institut de Physique du Globe de Paris

Mathematics
Prof. Barry McCoy, Institute for Theoretical Physics, New York University

Physics
Prof. Charles Thorn, University of Florida
Prof. Dale Van Haren, University of Illinois

Statistics/EECS
Prof. Peter Bartlett, Australian National University

Miller Professorships

The Executive Committee and Advisory Board of the Miller Institute have granted awards to the following Miller Professors. Terms are either one or two semesters during the 2001-2002 academic year.

Chemistry
Professor Paul Alivisatos
Professor Martin Head-Gordon

Computer Science
Professor Jitendra Malik

Earth & Planetary Science
Professor Walter Alvarez

Economics
Professor Christina Shannon

Integrative Biology
Professor Mary Power

Mathematics
Professor Craig Evans

Materials Science & Engineering
Professor Eugene Haller

Molecular & Cell Biology
Professor Terry Machen

Physics
Professor Kam-Biu Luk
Professor Paul Richards

~Please Post~
Selected Recent Publications

Former Miller Fellow Ryosuke Motani wrote an article, "Rulers of the Jurassic Seas" which was featured on the cover of Scientific American, December 2000.


Miller Professor Costas Grigoropoulos wrote a paper during his term (Fall 1999) with the Miller Institute: "Excimer Laser-Induced Temperature Field in Melting and Resolidification of Silicon Thin Films", with M. Hatano, S. Moon and K. Suzuki, Journal of Applied Physics, Vol. 87, pp. 36-43.

Awards & Honors

Manuel Cardona, Visiting Miller Professor (Spring '00), of the Max Planck Institute for Solid State Research in Stuttgart won the Mott Medal and Prize in recognition of his broad and important contributions to the detailed understanding of the optical and electronic properties of solids.

Ewine van Dishoeck of the Leiden Observatory in The Netherlands and Visiting Miller Professor (Fall '00), has been awarded the Spinoza Prize, the most prestigious award in Dutch academia.

Former Miller Fellows Dana Longcope ('93-'95) of Montana State University and Jonas Peters ('98-'99) of The California Institute of Technology were named by President Clinton as recipients of the fifth annual Presidential Early Career Awards for Scientists and Engineers (PECASE). This is the highest honor bestowed by the United States government on young professionals at the outset of their independent research careers. These awards, established by President Clinton in February 1996, embody the high priority the Administration places on producing outstanding scientists and engineers ready to contribute to all sectors of the economy. Eight Federal departments and agencies join together annually to nominate the most meritorious young scientists and engineers who will broadly advance the science and technology that will be of the greatest benefit to fulfilling the agencies' missions.

Chang-Lin Tien of the Department of Mechanical Engineering at the University of California, Berkeley, was named the Distinguished Alumnus for 2000 by Tau Beta Pi, the engineering honor society. Professor Tien was recognized for his leadership as an educator, committed to expanding opportunities for all, and for serving as a role model and inspiration to young students around the world. Dr. Tien was a Miller Professor in 1967-68.

Obituaries

Former Miller Professor ('71-'72) Lucien LeCam of the Department of Statistics, passed away April 2000 at the Doctor's Medical Center in San Pablo. He was 75.

Former Executive Director (1984-87) and Miller Professor ('68-'69) Robert Ornduff of the Department of Integrative Biology, passed away on September 22, 2000 at Alta Bates Medical Center in Berkeley. He was 68.

Former Miller Professor ('60-'66 and '67-'68) John Reynolds of the Department of Physics, passed away on November 4, 2000 at his home in Berkeley. He was 77.

Former Miller Professor ('65-'66) Sherwood Washburn of the Department of Anthropology passed away April 2000 at Alta Bates Medical Center in Berkeley. He was 88.

Former Miller Professor ('60-'61) Edmund Laitone of the Department of Mechanical Engineering, passed away on December 18, 2000 at his home in El Cerrito. He was 85.