Chad A. Mirkin

Dr. Chad Mirkin is a nanoscience expert known for his development of nanoparticle-based biodetection schemes, the invention of Dip-Pen Nanolithography, and contributions to supramolecular chemistry.

He is the author of numerous manuscripts and patents and applications, and the founder of two companies, Nanosphere and NanoInk. He is listed as one of the top 10 most cited chemists in the world, and is the top most cited nanomedicine researcher in the world.

Dr. Mirkin has been recognized for his accomplishments with over 50 national and international awards. He is a Member of the National Academy of Engineering and a Fellow of the American Association for the Advancement of Science. Dr. Mirkin has served on the Editorial Advisory Boards of over twenty scholarly journals. He is the founding editor of the journal *Small*, one of the premier international nanotechnology journals, and he has coauthored two bestselling books on nanobiotechnology.

Dr. Mirkin holds a B.S. degree from Dickinson College and a Ph.D. degree in chemistry from the Pennsylvania State University. He was an NSF Postdoctoral Fellow at the Massachusetts Institute of Technology prior to becoming a chemistry professor at Northwestern University.

DNA Rules: Materials Synthesis, Biodiagnostics, and Intracellular Gene Regulation

Monday, May 4, 3:00 pm, NCB 117

Over the past decade, we have developed methods for modifying nanoparticles with oligonucleotides and explored how they can be used as designer constructs for preparing highly ordered, highly functional materials. Over the course of these studies, we have discovered many unusual fundamental properties that make these materials particularly useful in biodiagnostics and intracellular gene regulation.

This seminar will focus on the rules that govern the use of these conjugates and sequence specific crystallization, high selectivity and sensitivity nucleic acid and protein detection, and "antisense" therapy. Specifically, we will introduce the concept of the "antisense particle", as well as similarly functionalized siRNA particles, which exhibit a range of unique properties that make them very well-suited for gene regulation. In particular, the particles are highly resistant to nuclease digestion, have high and tailorable binding constants for target mRNA, and exhibit high entry efficiency into multiple cell types. Further, we can tailor the chemistry on the nanoparticle surface, and thus control the particles' binding strength to complementary target sequences, ultimately demonstrating that changing the binding strength or surface chemistries offers a means to control the degree of protein expression.

Anisotropic Nanostructures: Building Valency into Nanoparticles

Tuesday, May 5, 3:00 pm, NCB 117

In ancient times, the spectacularly vibrant hues of colloids of noble metal particles evoked intrigue and mystery to the degree that a red "potion" of gold was heralded as an Elixer of Life. Over the past century, as modern instrumentation to study these brilliantly colored metals has developed, most research has focused on spherical nanocrystals.

Anisotropic, i.e. nonspherical, noble metal structures present many opportunities from a nanotechnology and materials development standpoint due to their highly size and shape dependent properties. Recently, we developed high yield methods to synthesize noble metal triangular nanoprisms. The controllable syntheses of gold and silver nanoprisms are both seed-mediated, with silver prism formation proceeding through a plasmon-driven pathway, and gold prism formation being afforded thermally.

Colloidal gold and silver triangular nanoprisms are optically and morphologically tunable anisotropic, biocompatible inorganic nanostructures whose functionality can be spatially addressed, which gives them great potential in overcoming some of the current challenges of building valency, i.e. the site-specific ligand environment on the surface of a nanoscrystal. Similar challenges that faced inorganic chemists over a century ago in constructing a controllable ligand environment around a metal center now face nanochemists in controlling the valency of nanoparticles. A question such as, "How can one selectively place an oligonucleotide on one side of a nanocrystal and an antibody on the other side?" is analogous to the question of, "How can one place two amine groups *cis* to each other on a square planar platinum(II) center as opposed to *trans*?" The ability to create multivalent nanoparticles could lead to fundamental breakthroughs in nanoscale assembly, optical, electronic, and drug- and gene-delivery applications, just as ligand sphere control has allowed for countless breakthroughs in inorganic, bioinorganic and materials chemistry.

A Coordination Chemistry Approach to Supramolecular Enzyme Mimics

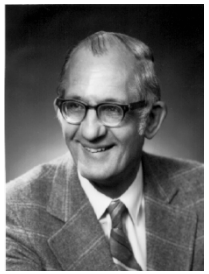
Wednesday, May 6, 10:30 am, NCB 117

Through the use of enzymes and related structures, Nature takes a complex, integrated approach to regulating cellular activities such as signal cascades, molecular transport, and catalysis. These critical functions are performed using information storage and retrieval processes that make use of molecular recognition.

Taking our inspiration from Nature, we have applied a synthetic methodology for the preparation of flexible supramolecular complexes developed by our group, known as the Weak-Link Approach, for the design of unique bioinspired metallomacrocyclic structures. Recently, we have demonstrated that this approach is a powerful tool for the synthesis of novel supramolecular catalysts in which the reactivity of the catalytic structure can be regulated allosterically. It is this ability to regulate reactivity in situ that has enabled the use of these complexes as sensors for the detection of small-molecule analytes and also for the molecular recognition of chiral carboxylic acid-based substrates.

Another aspect of our research is focused on the design of a highly modular approach for the preparation of unique coordination chemistry-based micro- and nanostructures, which form upon the simple addition of an initiation solvent to a precursor solution of metal ions and metalloligands. The carboxylate-functionalized metalloligand monomers are connected via metal coordination to give an infinite coordination polymer particle. Interestingly, the particle size can be tailored by controlling the rate of addition of the initiation solvent, while the optical properties of the particles can be tailored by varying the metals and metalloligands used. In addition, the porous nature of the particles allows for facile post-synthetic modification of their chemical composition via ion exchange of the constituent metal ions, with minimal change particle size.

Fred L.M. Pattison



Born in Scotland, where he received his early education, he attended the University of Cambridge in 1941 for undergraduate work in Natural Sciences, followed by a Ph.D. in Organic Chemistry. After spending a year at Dalhousie University as Lecturer, he joined Western as Assistant Professor in 1948.

Fred established a Ph.D. program in the department, and his research on biologically active organic fluorine compounds produced many scientific papers, garnered the award of an Sc.D. by the University of Cambridge, and resulted in the publication of a book, *Toxic Aliphatic Fluorine Compounds*. In 1959, he became Professor and Head of the Department, and he presided over the expansion of the department and its move to new facilities.

In 1965, Fred decided on a career change, and at the age of 42, he enrolled at Western as a first-year medical student. After completing his M.D. four years later, he interned at St. Joseph's Hospital in London and served for a year as resident in the Family Practice Program. As well, he was enrolled in a diploma course in venereology at the University of Liverpool. During 1971-73, Fred followed up a long-standing interest in the people of Canada's North by working with the International Grenfell Association. He provided solo medical care to about 6,000 people scattered along 120 miles of the Atlantic coast of Newfoundland.

Fred returned to London in 1973, when he joined Western's student health service, holding the position of Director at his formal retirement in 1988. During the same period he was clinical assistant professor in the Faculty of Medicine, giving instruction in venereology, and director of the Middlesex-London Sexually Transmitted Disease Clinic.

On his retirement, Fred was able to resume his connection with the Chemistry Department with the rank of Professor Emeritus. In view of Fred's long service and many contributions to chemistry and medicine at Western, it is entirely fitting that the department dedicate a lecture series bearing his name.

Lecture Schedule

DNA Rules: Materials Synthesis, Biodiagnostics, and Intracellular Gene Regulation
Monday, May 4, 3:00 pm, NCB 117

Anisotropic Nanostructures: Building Valency into Nanoparticles
Tuesday, May 5, 3:00 pm, NCB 117

A Coordination Chemistry Approach to Supramolecular Enzyme Mimics
Wednesday, May 6, 10:30 am, NCB 117

Light Snacks and Refreshments will be served 15 minutes prior to each lecture.

Contact Information

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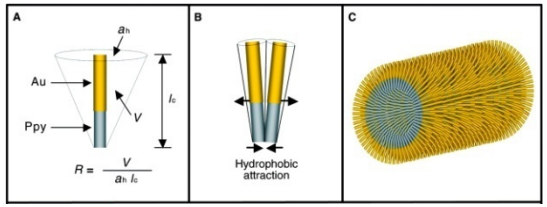
Fred Pattison Senior Lectureships

1992	Sir Derek Barton, Texas A & M University
1993	Barry Trost, Stanford University
1995	Stephen J. Benkovic, Penn State University
1996	Steven V. Ley, University of Cambridge
1997	Anthony J. Kirby, University of Cambridge
1998	Larry E. Overman, Univ. of California, Irvine
1999	Sir Fraser Stoddart, Northwestern University
2000	Dennis Curran, University of Pittsburgh
2001	Joseph Lambert, Northwestern University
2002	Anthony Barrett, Imperial College
2003	Richard Wolfenden, UNC Chapel Hill
2004	Victor Snieckus, Queen's University
2005	Lutz F. Tietze, Georg-August University, Göttingen
2006	Juan C. (Tito) Scaiano, University of Ottawa
2007	François Diederich, ETH Zürich
2008	Erik J. Sorensen, Princeton University

The Department of Chemistry
presents the
2009 Fred Pattison Senior Lecturer

Chad A. Mirkin

George B. Rathmann Professor of Chemistry
Professor of Chemical and Biological Engineering
Professor of Biomedical Engineering
Professor of Materials Science and Engineering
Professor of Medicine
Director, International Institute for Nanotechnology
Northwestern University



A three-part lecture series
May 4–6, 2009
North Campus Building

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