

2nd Annual
Donald S. Matteson
Symposium

October 3rd 2009
Pullman, WA



World Class. Face to Face.

Symposium Schedule

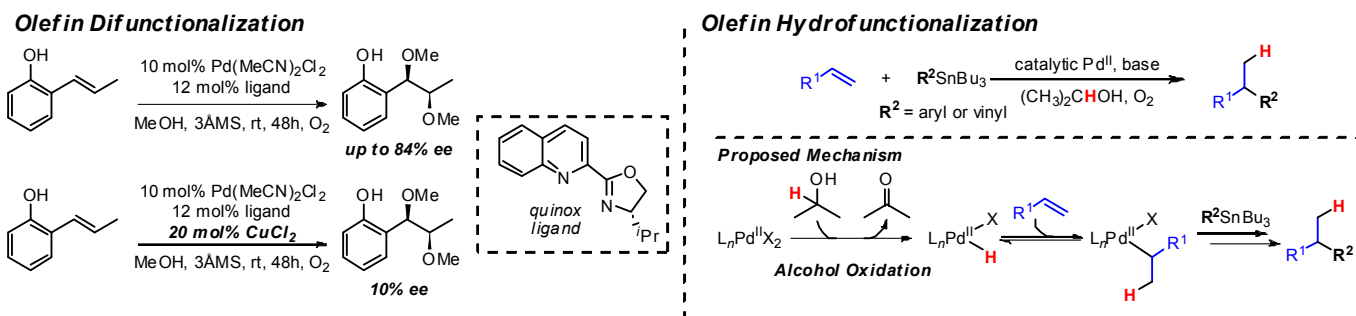
8:00 am – 8:30 am	Continental Breakfast
8:30 am – 8:40 am	Jeff Jones - Introductory Remarks
8:40 am – 9:40 am	Matthew Sigman (University of Utah) “Palladium-Catalyzed Oxidation Reactions for Organic Synthesis”
9:40 am – 10:40 am	F. Dean Toste (University of California, Berkeley) “Reactivity Driven Discovery of Gold(I)-Catalyzed Reaction for Organic Synthesis”
10:40 am – 10:55 am	Coffee Break
10:55 am – 11:55 am	Viresh Rawal (University of Chicago) “Enantioselective Catalysis Using Chiral Hydrogen Bond Donors”
Noon – 1:30 pm	Lunch & Poster Session
1:30 pm – 2:30 pm	Amir Hoveyda (Boston College) “A New Class of Fluxional Chiral Catalysts for Olefin Metathesis. Inspired by Total Synthesis, Identified through Theory”
2:30 pm – 2:45 pm	Coffee Break
2:45 pm – 3:45 pm	Robert Grubbs (California Institute of Technology) “The Synthesis of Large and Small Molecules Using Olefin Metathesis Catalysts”
3:45 pm – 4:30 pm	Don Matteson – Closing Talk
4:30 pm – 4:45 pm	Phil Garner – Concluding Remarks
4:45 pm – 6:30 pm	Beer & Wine Social and Poster Session
6:30 pm – 8:30 pm	Banquet

Abstracts

Matt Sigman

Title: Palladium-Catalyzed Oxidation Reactions for Organic Synthesis

Abstract: The development of catalytic oxidations using practical terminal oxidants such as molecular oxygen represents a central challenge in catalysis. Critical to the development of such catalysts with practical potential is a fundamental understanding of the mechanistic features which lead to a robust and selective catalytic system. Within this regard, our group has focused on the development of new Pd(II)-catalysts for various oxidation reactions wherein mechanistic analysis has played a vital role in catalyst design. This presentation will focus on our recent efforts in developing novel Pd(II)-catalyzed alkene functionalization reactions, which are coupled to the reduction of dioxygen and peroxide oxidants.



F. Dean Toste

Title: Reactivity Driven Discovery of Gold(I)-Catalyzed Reaction for Organic Synthesis

Abstract: This lecture will emphasize a reactivity driven approach to development of cationic phosphinegold(I) complexes as catalysts for cycloisomerization, rearrangement, cycloaddition and addition reactions. Thus, particular attention will be devoted to the mechanistic hypotheses that form the basis for our discovery of gold-catalyzed transformations.

The development of these reactions stemmed from the hypothesis that the strong relativistic effects¹ governing the electronic structure of gold render it unique among the electrophilic late transition metals, and, specifically, that it may stabilize cationic intermediates in the course of Au(I)-catalyzed reactions. Thus, a number of reactions which proceed by mechanisms in which gold(I) serves to activate π -bonds towards nucleophilic addition² and in some cases to donate electron density back into an electron deficient cationic intermediate in the form of a gold(I)-carbenoid³ will be presented.

In addition, strategies towards developing gold(I) complexes for enantioselective catalysis will be presented. This will include the application of dinuclear chiral bisphosphine digold(I) complexes⁴ and

chiral counterions⁵ to induce enantioselectivity. The application of these complexes as catalysts for enantioselective olefin cyclopropanation, additions to allenes, rearrangement and cycloaddition reactions will be discussed.

References

- [1] Gorin, D. J.; Toste, F. D. *Nature*. 446 (2007) 395.
- [2] Shapiro, N. D.; Toste, F. D. *Proc. Natl. Acad. Sci. USA* 105 (2008) 2779.
- [3] Benitez, D.; Shapiro, N. D.; Tkatchouk, E.; Wang, Y.; Goddard III, W. A.; Toste, F. D. *Nature Chem.* **2009**, *1*, 482.
- [3] LaLonde, R. L.; Sherry, B. D.; Kang, E. J.; Toste, F. D. *J. Am. Chem. Soc.* 129 (2007) 2452.
- [4] Hamilton, G. A.; Kang, E. J.; Blázquez, M. M.; Toste, F. D. *Science* 317 (2007) 496.

Viresh Rawal

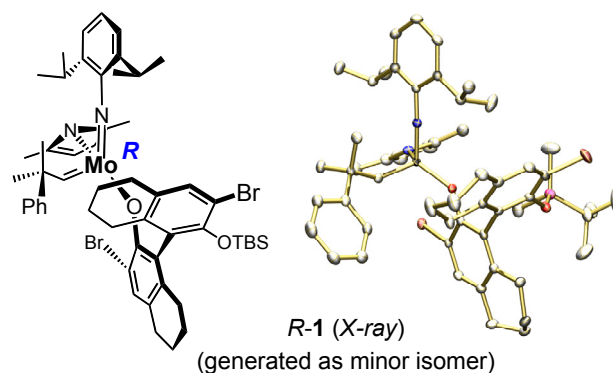
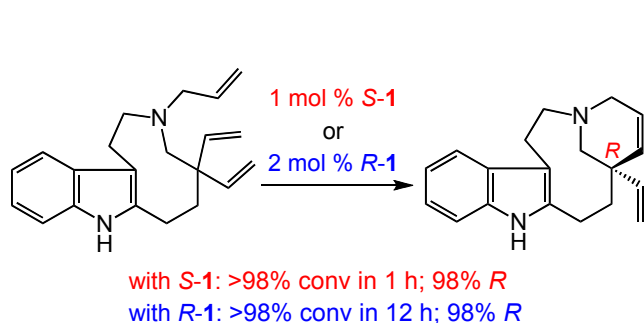
Title: Enantioselective Catalysis Using Chiral Hydrogen Bond Donors

Abstract: The bare hydrogen atom—a proton—functioning in the Bronsted-Lowry sense, is the most commonly used catalyst for promoting chemical reactions. In contrast, the Lewis acid property of the hydrogen atom, most evident in hydrogen bonds, has been little utilized for catalysis. Indeed, in contemporary organic synthesis, especially for asymmetric reactions, the notion of Lewis acid catalysis has become synonymous with metal-based catalysis. Hydrogen bonds, while of central importance for the organization and function of large biomolecules, have played, at best, a minor role in the promotion of chemical reactions. This situation changed about five years ago, with reports of non-enzyme based hydrogen bond donor molecules that functioned as effective catalysts for enantioselective reactions. In this presentation I will summarize our work on the rapidly developing field of catalysis.

Amir Hoveyda

Title: A New Class of Fluxional Chiral Catalysts for Olefin Metathesis. Inspired by Total Synthesis, Identified through Theory

Abstract: Discovery of efficient catalysts is one of the most compelling objectives of modern chemistry. Chiral catalysts are particularly in high demand: they facilitate synthesis of enantiomerically enriched small-molecules that are critical to developments in medicine, biology and materials science. Especially noteworthy are catalysts that promote, with otherwise inaccessible efficiency and selectivity levels, reactions demonstrated to be of substantial utility in chemical synthesis. In this lecture, a new class of chiral catalysts, which initiate olefin metathesis with exceptional efficiency and enantioselectivity, will be presented. Such attributes arise from structural fluxionality of the catalysts and the central role that stereoelectronic factors play in the course of the catalytic cycle. The new catalysts bear a stereogenic metal center and carry only monodentate ligands; the Mo-based complexes are prepared stereoselectively and rendered enantiomerically pure by an unprecedented ligand exchange process involving an enantiomerically pure aryloxy, a class of ligands scarcely used in enantioselective catalysis. Application to synthesis of *Aspidosperma* alkaloid, quebrachamine, through an olefin metathesis reaction that cannot be promoted by any of the previously reported catalysts, demonstrates the utility and uniqueness of the new complexes.



Robert Grubbs

Title: The Synthesis of Large and Small Molecules Using Olefin Metathesis Catalysts

Abstract: Ruthenium based olefin metathesis catalysts have provided new routes to olefins that appear in a variety of structures. Their functional group tolerance and ease of use allow their application in the synthesis of multifunctional bioactive molecules.¹ The same systems are also useful for the synthesis of an array of new materials from multifunctional polymers to supramolecular systems.² Underlying these developments has been the discovery of active catalysts with controlled selectivity through the synthesis of new ligands³ that control the geometry of the intermediate carbene and metallacycle complexes.

1. "Increased Efficiency in Cross-Metathesis Reactions of Sterically-Hindered Olefins." I. C. Stewart, C. J. Douglas, and R. H. Grubbs, *Organic Lett.* **2008**, *10* (3), 441-444. "The Catalytic Asymmetric Total Synthesis of Elatol." D. E. White, I. C. Stewart, R. H. Grubbs, and B. M. Stoltz, *J. Am. Chem. Soc.* **2008**, *130*, 810-811.
2. "Cyclic Ruthenium-Alkylidene Catalysts for Ring-Expansion Metathesis Polymerization." A. J. Boydston, J. A. Kornfield, I. A. Gorodetskaya, R. H. Grubbs, *J. Am. Chem. Soc.* **2008**, *130* (38), 12775-12782. "A Direct Route to Cyclic Organic Nanostructure via Ring-Expansion Metathesis Polymerization of a Dendronized Macromonomer.: A. J. Boydston, T. W. Holcombe, D. A. Unruh, J. M. Frechet, R. H. Grubbs, *J. Amer. Chem. Soc.* **2009**, *131* (15), 5388.
3. "Olefin Metathesis Catalyst: Stabilization Effect of Backbone Substitutions of N-Heterocyclic Carbene." C. K. Chung, R. H. Grubbs, *Org. Lett.* **2008**, *10*, (13), 2693-2696, "Synthesis and Activity of Ruthenium Olefin Metathesis Catalysts Coordinated with Thiazol-2-ylidene Ligands." G. C. Vougioukalakis and R. H. Grubbs, *J. Am. Chem. Soc.* **2008**, *130* (7), 2234-2245. "Conformations of N-Heterocyclic Carbene Ligands in Ruthenium Complexes Relevant to Olefin Metathesis." I. C. Stewart, D. Benitez, D. J. O'Leary, E. Tkatchouk, M. W. Day, W. A. Goddard III, R. H. Grubbs, *J. Am. Chem. Soc.* **2009**, *131* (5), 1931-1938.

Poster Presentations

Undergraduate Students

U1 Sulfonamide inhibitors for prostate specific membrane antigen. Joseph Choi, Cliff Berkman* (Washington State University)

U2 Understanding the mechanism of action of carbonic anhydrase on heterocumulenes using synthetic models. Eric A. Standley, Bryan Diebels, Mallory E. Sullivan, Eric Brown* (Boise State University)

U3 Synthesis of aziridinomitosenes analogs for analysis of the role of the C6 and C7 electrophilic sites in DNA interstrand crosslink formation. Jeremy Daniels, Mikenna Summers, Don L. Warner* (Boise State University)

U4 Stereocontrolled organocatalytic synthesis of oxacycles. Charlotte Osborne, Hannah C. Harper, Robert A. Clarke, Craig A. Sather, Michael A. Harris, Nicholas R. Babij, Rich G. Carter, Andrew P. Duncan* (Willamette University)

U5 A rational and modular synthesis of diphenyl chlorines for the treatment of prostate cancer via photodynamic therapy. Andrew R. Henderson, Tommaso A. Vannelli* (Gonzaga University)

U6 Synthesis of substituted meso-tetraphenyl-cis- β,β' -dihydroxychlorins bearing p-trifluoromethyl benzene and a prostate cancer targeting molecule for use in photodynamic therapy. Jonathan Del Toro, John B. Nelson, Tommaso A. Vannelli* (Gonzaga University)

Graduate Students

G1 Synthesis and characterization of novel, selective nitrogen-containing ligands for metal ion separations. Cortney Hoch, G. Patrick Meier* (Washington State University)

G2 Design, synthesis, and biophysical evaluation of hydroxyproline-based nucleopeptides. Chung-Min Park, Philip Garner* (Washington State University)

G3 Detecting circulating prostate cancer tumor cells using chemoaffinity labels in flow cytometry. Lisa Wu, Tian-Cheng Liu, Amanda, Grimm, Cliff Berkman*, Bill Davis (Washington State University)

G4 Study on mechanism of substrate oxidation by aldehyde oxidase. Wenyun Ouyang, Jeff Jones* (Washington State University)

G5 New reactions of S-nitrosothiols for organic synthesis. Nelmi O. Devarie, Yvette Strampe, Ming Xian* (Washington State University)

G6 New chemistry for mapping protein S-nitrosation. Hua Wang, Jia Pan, Jiming Zhang, Ming Xian* (Washington State University)

G7 C5 Functionalized LNA M. Oestergaard, P. Kumar, B. Bharal, B. Anderson, D. Guenther, P. J. Hrdlicka* (University of Idaho)

G8 DNA Targeting using invader nucleic acids. Brooke A. Anderson, Rie L. Rathje, Patrick J. Hrdlicka* (University of Idaho)

Donald S. Matteson Biographical Sketch

Professor Matteson earned a bachelor's degree in chemistry in 1954 from the University of California, Berkeley and a doctorate in organic chemistry in 1957 from the University of Illinois, at Urbana-Champaign, where he did this thesis research with Professor Harold Snyder. Professor Matteson then worked as a research chemist at Du Pont investigating hydrocarbon pyrolysis.

He joined WSU's Department of Chemistry faculty in 1958 and attained the rank of professor in 1969. In 1966, he was the first WSU faculty member to receive an Alfred P. Sloan Foundation Research Fellowship. Throughout Professor Matteson's career, he has lectured extensively throughout Europe, Russia, India, Mexico, Canada, and Asia. He has served on the editorial advisory board of the journals *Organometallics* and *Heteroatom Chemistry*.

Although Professor Matteson's research has been broadly based, he is best known for his seminal developments in the fields of boronic ester chemistry and asymmetric synthesis. He has developed reactions that provide precise and general tools for stereoselective and asymmetric syntheses. As an example of the far-reaching impact of his research, Professor Matteson's chemistry is providing the key part of "Velcade," a new anticancer drug in clinical use for treating multiple myeloma.

He is the author of two books, co-inventor on five patents, and author or co-author of 203 technical articles. In addition, Professor Matteson has served as thesis advisor for 31 doctoral students, supervised six master's students and more than two dozen postdoctoral research associates, and sponsored numerous international visitors. Although Professor Matteson is semi-retired, he manages a vibrant research lab where he still develops methods of asymmetric synthesis.

Professor Matteson and his wife Marianna are generous donors to Washington State University supporting endowed chairs, graduate research assistanceships as well as undergraduate scholarships. He and his wife Marianna live in Moscow, Idaho and they travel extensively.

Acknowledgements

This symposium was made possible by generous contributions from

Jose and Sally Shdo
Gilead Sciences, Incorporated
Herbert and Jannette Hill
William C. Hiscox
Oliver Chen-Pu and Ling Ling Ho
Pharmacia Foundation
Philip Weintraub
Wen-bin Ho

Hoffmann-La Roche, Incorporated
Pradipta K. Jesthi
Charles W. Locuson
Thomas J. Michnick
Robert and Mary Hofsommer-Moody
Rahul Ray
Doug and Carol Campbell



World Class. Face to Face.