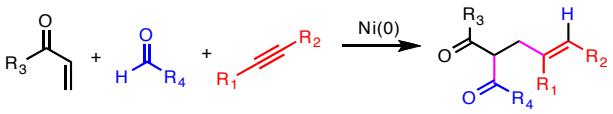
University of Michigan

DEPARTMENT OF CHEMISTRY

ORGANIC CHEMISTRY

Graduate Program

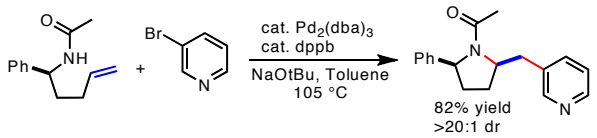
Michigan offers a diverse selection of research opportunities in Organic Chemistry with particular strengths in Organometallic Chemistry, Organic Synthesis, Bioorganic Chemistry, and Organic Materials. Our innovative research rotation program allows students to explore a range of exciting possibilities before choosing an advisor. Specific research projects in each area are highlighted below.



Nickel-catalyzed coupling of an aldehyde, alkyne and enone via redox isomerization (Montgomery).

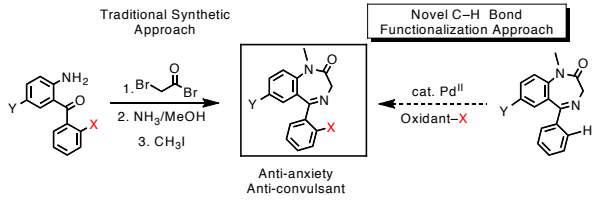
Organometallic Chemistry

Transition-metal mediated bond formation can be a versatile and efficient transformation in any organic synthesis. At Michigan, several research groups are focused on the use of transition metals in reaction discovery, synthetic methodology development, mechanistic chemistry, and complex molecule synthesis. Highlights of ongoing research projects include: (1) Developing new transition-metal catalyzed reactions for the stereoselective synthesis of saturated heterocycles such as tetrahydrofurans and pyrrolidines. (2) Discovering methods to transform inert carbon-hydrogen bonds into



Palladium-catalyzed reaction of an γ-amino olefin and an aryl bromide (Wolfe).

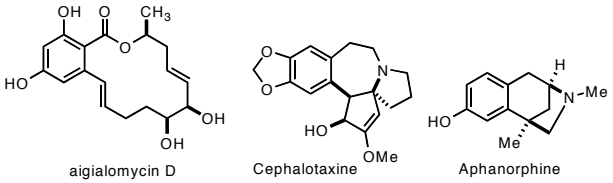
new functional groups. (3) Developing novel routes for functionalizing readily available organic building blocks such as alkenes and alkynes. (4) Exploring the reductive coupling of aldehydes and alkynes or enones and alkynes. Recent studies have demonstrated strategies involving redox isomerization to avoid the use of reducing agents in processes of this type. (5) The discovery of new glycosylation methods and their application in collaborative projects involving enzymatic C-H oxidation reactions.



Palladium-catalyzed C-H functionalization of an arene (Sanford).

Organic Synthesis

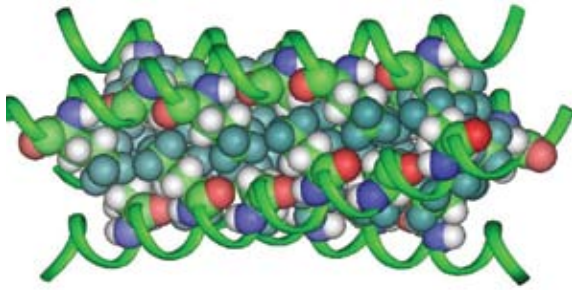
Designing efficient synthetic routes to complex organic molecules remains a challenge. At Michigan, several research groups are working on total syntheses using methods developed in their labs. Recent synthetic targets include aigialomycin D, cephalotaxine, and aphanorphine.



aigialomycin D | Cephalotaxine | Aphanorphine

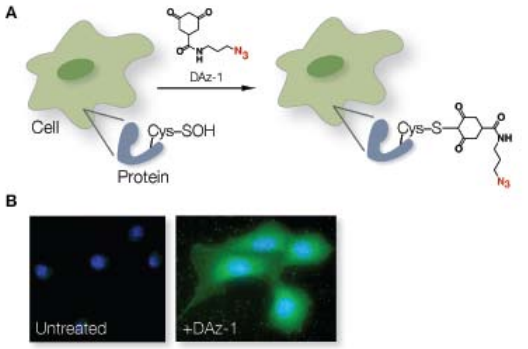
Bioorganic Chemistry

Research efforts in Bioorganic Chemistry at Michigan focuses on applying chemical principles, particularly those of organic chemistry, to solve problems in human health. Highlights of ongoing research projects include: (1) Developing strategies for reprogramming gene expression using small molecules, both natural products and 'designer' molecules. These molecules are being used as mechanistic probes of eukaryotic transcription as well as prototypes for transcription-targeted therapeutics for diseases ranging from diabetes to cancer. (2) Identifying novel molecular targets and small molecules for the



Fluorinated amino acids can be used to make super-stable "Teflon" proteins; here the interior of a small protein is packed with the fluorous amino acid hexafluoroleucine (Marsh).

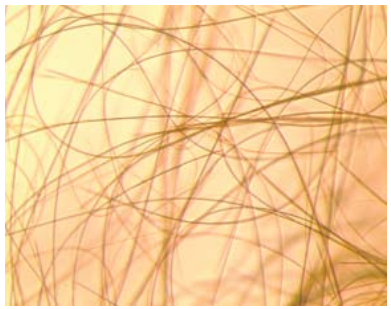
treatment of autoimmune diseases and cancer. (3) Developing and applying chemical tools to study the role of oxidants as signaling molecules and the biological basis of aging. (4) Elucidating catalytic mechanisms and essential active site features of metalloenzymes and ribozymes, including protein farnesyltransferase, UDP-3-O-acyl-GlcNAC deacetylase, histone deacetylase and ribonuclease P. These studies should enhance our ability to design potent inhibitors of these enzymes useful for the treatment of cancer or bacterial infections. (5) Exploring the interface between biological macromolecules and materials chemistry through the de-novo design of extensively fluorinated "Teflon" proteins. Such proteins exhibit useful new properties such as increased thermal stability, resistance to unfolding in organic solvents, and resistance to degradation by proteases.



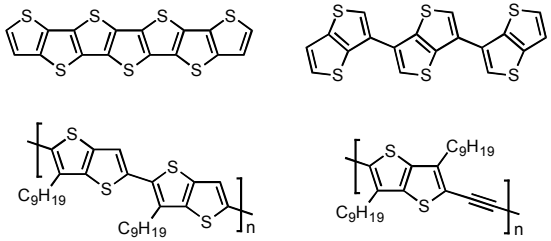
Detecting redox-regulated proteins in living cells. (A) Sulfenic acid post-translational modifications are selectively detected via the cell-permeable probe DAz-1. (B) Visualization of protein sulfenic acids in MEF cells treated with DAz-1 (right) or untreated (left) (Carroll).

Organic Materials

Organic Materials research at Michigan is focused on creating functional properties through synthetic modifications to polymers and small-molecules. Highlights of ongoing research projects include: (1) Developing techniques to control the process of crystallization using organic polymers as phase directors with the goal of making materials with improved function. Combinatorial materials chemistry plays a vital role in these efforts. (2) Developing novel routes for the efficient production of new members of conjugated oligomers and polymers with planar structural constraints, such as fused oligothiophenes, and studying their behavior in the solid state as it relates to important device applications such as organic thin film transistors (OTFTs). These structure types also find application in the construction of porous solids for applications ranging from gas storage to catalysis. (3) Designing new molecules that induce hydrogelation in the presence of an analyte for use in chemical and biological sensing. (4) Developing living polymerization methods for the synthesis of new conjugated polymer architectures for optoelectronic applications.



Optical microscope image of a novel small-molecule based hydrogel (McNeil).



Methodology development for the synthesis of conjugated polymers and oligomers of fused-ring thiophene compounds (Matzger).

Life in Ann Arbor

The University of Michigan offers a rich intellectual environment. Opportunities for research and collaboration in Organic Chemistry are enhanced by top-ranked programs in Medicinal Chemistry, Biochemistry, and the Life Sciences Institute.

The University is located in Ann Arbor, a small city of 110,000, combining the comfort and charm of a college town with the vivid cultural life of a large city.

Further Information

For more information about specific research interests, go to: www.umich.edu/~michchem. Please feel free to contact faculty directly:

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How to Apply

Application to the Chemistry Graduate Program at the University of Michigan is online at www.umich.edu/~michchem/graduate/

For questions regarding admission, see www.umich.edu/~michchem or contact the department by

Website:	www.umich.edu/~michchem
Email:	ChemAdmissions@umich.edu
Phone:	toll free 888-999-2436 or 734-764-7278
Fax:	734-647-4865

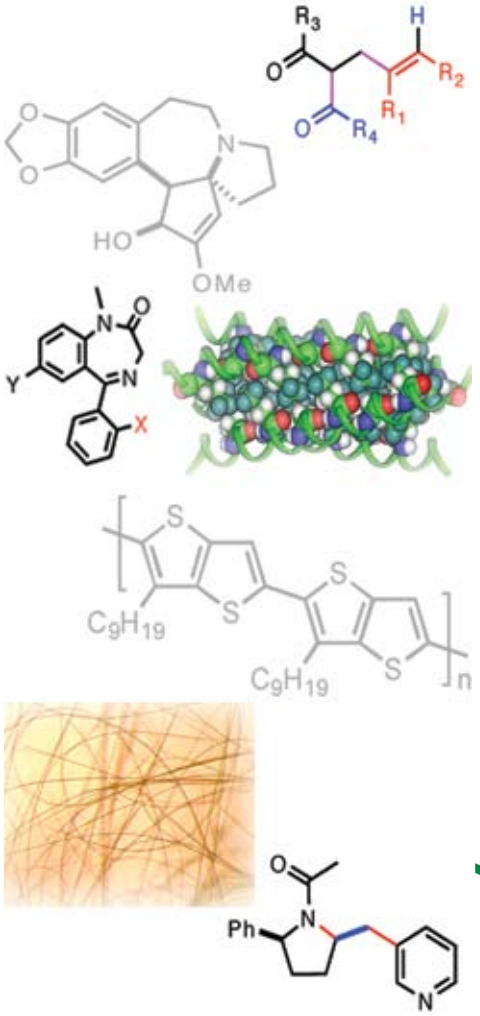
cover: Highlights of research in Organic Chemistry at Michigan.

2008

Chemistry

at the University of Michigan

Organic Chemistry



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