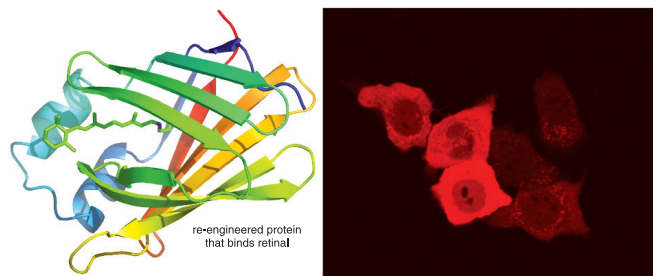


The research interests of our lab can be subdivided into the three main areas of **Bioorganic Chemistry**, **Synthetic Chemistry**, and **Organic Spectroscopy**.

Our **Bioorganic Chemistry** efforts are geared towards elucidation of the interaction of bioactive compounds with receptors and proteins. We rely heavily on de novo protein design and mimicry of natural systems to better understand how certain biological processes occur. As an example, we have initiated research into designing protein mimics of rhodopsin, the protein responsible for vision, which can bind retinal as a protonated Schiff base [PSB] (same binding mode as in rhodopsin). These protein mimics are used to investigate



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Synthetic and Bioorganic Chemistry and Organic Spectroscopy

PROFESSOR

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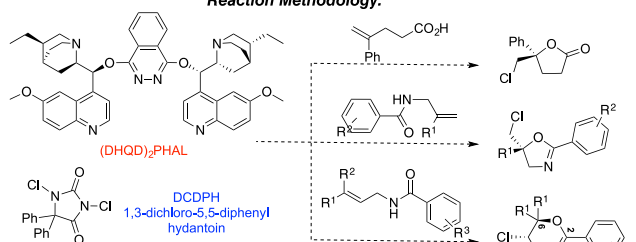
Postdoctoral Fellow, 1995-98,

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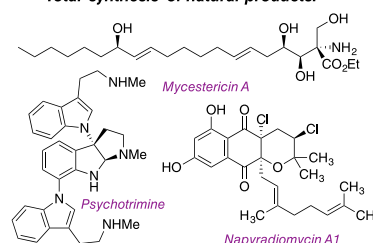
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Reaction Methodology:



Total synthesis of natural products:



the wavelength regulation mechanism that enables color vision. Currently we are exploring the potential to use our engineered proteins as colorimetric and fluorescent proteins for cellular tagging and intracellular pH sensors.

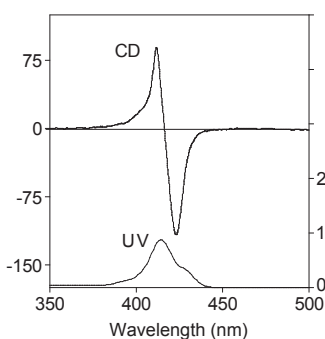
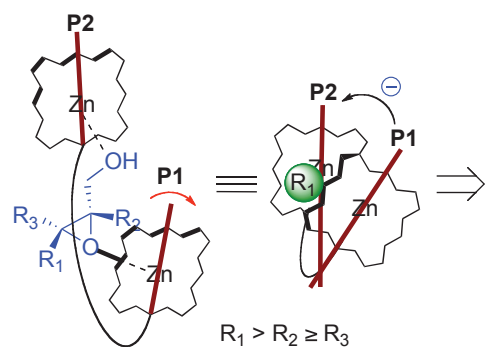
Our **Synthetic Chemistry** program is generally focused on the development of new reactions that utilize simple organic molecules and through designed manipulations lead to more complex systems. In most cases, our methodologies lead to the production of heterocycles with regio- and stereocontrol. These transformations are then highlighted in total syntheses of natural products that exhibit interesting biological activities. Recently we have reported the catalytic asymmetric chlorolactonization of alkenoic

acids and unsaturated amides to furnish chiral heterocycles. These reactions are catalyzed by (DHQD)₂PHAL in combination with various N-chlorinated hydantoins as the terminal

chloronium sources. Halofunctionalization of different compounds, understanding the mechanism of these transformations and the details of enantioselections are currently under investigation.

In the area of **Organic Spectroscopy**, we are interested in developing host/guest systems that can be used in the absolute stereochemical determination of chiral compounds. We accomplish this through the design and synthesis of chromophoric receptors, which upon binding with the chiral compound function as reporters of chirality. We rely heavily on Circular Dichroism (CD) as the tool for observing the host/guest interactions between the chiral compounds and the receptors. In particular, we will take advantage of the excitonic coupling between independently conjugated

chromophores that make up the receptors to establish non-empirical guidelines for the absolute stereochemical determination of asymmetric centers. ☘



SELECTED PUBLICATIONS

Nucleophile-Assisted Alkene Activation: Olefins Alone are Often Incompetent, Ashtekar, K. D.; Veticatt, M.; Yousefi, R.; Jackson, J. E.; Borhan, B., *J. Am. Chem. Soc.* **2016**, *138*(26), 8114-8119.

Highly Stereoselective Intermolecular Haloetherification and Haloesterification of Allyl Amide, Soltanzadeh, B.; Jaganathan, A.; Staples, R. J.; Borhan, B., *Angew. Chem. Int. Ed. Engl.* **2015**, *54*, 9517-9522.

Sensing Remote Chirality: Stereochemical Determination of beta-, gamma-, and delta-Chiral Carboxylic Acids, Tanasova, M.; Anyika, M.; Borhan, B., *Angew. Chem. Int. Ed. Engl.* **2015**, *54*, 4274-4278.

"Turn-On" Protein Fluorescence: In Situ Formation of Cyanine Dyes, Yapici, I.; Lee, K. S. S.; Berbasova, T.; Nosrati, M.; Jia, X.; Vasileiou, C.; Santos, E. M.; Geiger, J. H.; Borhan, B., *J. Am. Chem. Soc.* **2015**, *137*, 1073-1080.

A New Tool to Guide Halofunctionalization reactions: The Halenium Affinity (HaIA) Scale, Ashtekar, K. D.; Marzijarani Salehi, N.; Jaganathan, A.; Holmes, D.; Jackson, J. E.; Borhan, B., *J. Am. Chem. Soc.* **2014**, *136*, 13355-13362.

Point-to-Axial Chirality Transfer—A New Probe for "Sensing" the Absolute Configurations of Monoamines, Anyika, M.; Gholami, H.; Ashtekar, K. D.; Acho, R.; Borhan, B., *J. Am. Chem. Soc.* **2014**, *136*, 550-553.

Rational Design of a Colorimetric pH Sensor from a Soluble Retinoic Acid Chaperone, Berbasova, T.; Nosrati, M.; Vasileiou, C.; Wang, W.; Lee, K. S. S.; Yapici, I.; Borhan, B., *J. Am. Chem. Soc.* **2013**, *135*, 16111-16119.

Tuning the Electronic Absorption of Protein-Embedded All-trans-Retinal, Wang, W.; Nossou, Z.; Berbasova, T.; Watson, C. T.; Yapici, I.; Lee, K. S. S.; Vasileiou, C.; Geiger, J. H.; Borhan, B., *Science* **2012**, *338*, 1340-1343.