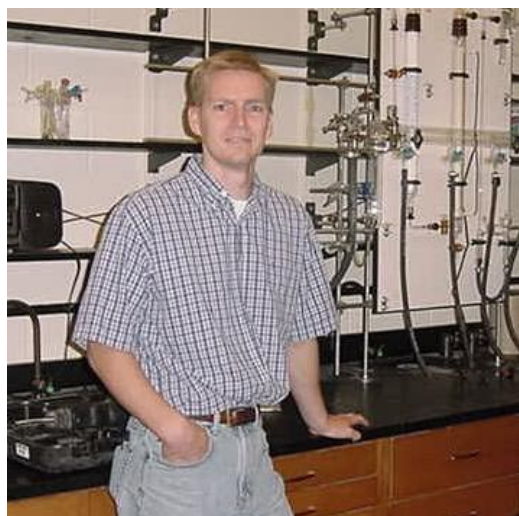


## Don Krogstad



*Donald A. Krogstad joined the faculty at Concordia College in 2002. He received a B.S. from the University of Wisconsin-Stevens Point (1992) and a Ph.D. from the University of Minnesota (1996) under Louis H. Pignolet. After this, he taught at the University of the South in Sewanee, TN from 1996 to 2000 and at Minnesota State University Moorhead from 2000 to 2002. Krogstad was awarded Petroleum Research Fund grants in 1998 and 2001 for his work in the field of Green Chemistry.*

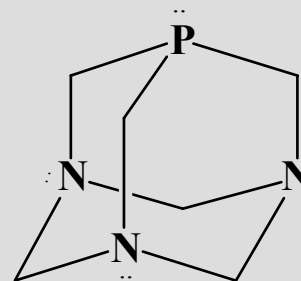
**Research Interests:** Due to increasing environmental concerns and waste disposal costs, the chemical, pharmaceutical, and petroleum industries have started to examine and implement “green” laboratory practices and processes. Green Chemistry involves the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. This is important because it protects the environment, individuals that work in the lab, and the citizens who live near a laboratory, plant, or disposal site. “Green” activities have ranged from the utilization of new catalysts to the development of synthetic pathways which use alternative reaction conditions and solvents. An attractive combination of these ideals is aqueous, biphasic catalysis.

In aqueous, biphasic catalysis, a transition metal complex is dissolved and employed in water, while the substrate is immersed in an immiscible organic media. This methodology is superior to traditional catalytic reactions in organic media because it minimizes the use of a potentially hazardous solvent while allowing for the simple phase separation of metal free, organic products and intact catalyst.

Our group is interested in better understanding the mechanistic steps that are involved in aqueous and biphasic catalysis. This involves synthesizing transition metal complexes that are ligated by 1,3,5-triaza-7-phosphaadamantane (PTA) and other water soluble phosphines and studying their abilities to catalyze inter- and intramolecular hydroamination reactions.

### Selected Publications:

- D.A. Krogstad, J.A. Klitzke, H.A. Williams, S.B. Owens, J.A. Halfen and V.G. Young, Jr. “Intramolecular Hydroamination of Aminoalkynes in Aqueous Media Catalyzed by Palladium and Platinum 1,3,5-Triaza-7-phosphaadamantane (PTA) Complexes” (submitted).
- D.A. Krogstad; J.A. Halfen; T. J. Terry; and V. G. Young, Jr. “Synthesis and Characterization of Iridium 1,3,5-Triaza-7-phosphaadamantane (PTA) Complexes” *Inorg. Chem.* **40**, 463 (2001).



PTA

# Research Projects

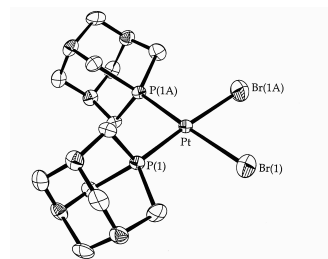
## Overview

With growing industrial needs to minimize cost and comply with environmental regulations there is a push to use water as a solvent. For this to occur, there needs to be a better understanding of transition metal catalysis in the aqueous phase. Unfortunately, many previous studies were hindered by substrate solubility in water. Therefore, we use water-soluble aminoalkynes to examine transition metal catalyzed hydroamination reactions in water and organic solvents. This is the first study to examine a catalytic process in both aqueous and organic solvents with the same catalysts. The results produce both a qualitative and quantitative comparison of solvents leading to a better understanding of the utility of water as a catalytic medium. Rate comparisons of the metals and ligands in the complexes lead to a rational design for new water-soluble catalysts.

## Synthesis and characterization of water-soluble complexes

Transition metal complexes are prepared by combining a metal ion with an atom or group of atoms called a ligand. For the complex to be water-soluble, the ligand(s) must be ionic or polar. The ligands that our group primarily uses are phosphines that contain amine, alcohol, or sulfonate functionalities. One such phosphine is 1,3,5-triaza-7-phosphaadamantane (PTA). See Figure on the previous page.

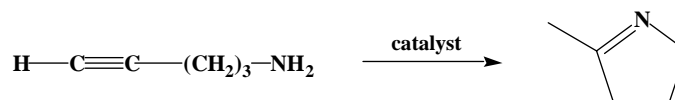
At the present time, our group is studying reactions that are catalyzed by Pd, Pt, Ir, and Rh. For this to continue, we need to prepare more molecules with different and, hopefully, enhanced properties. Due to the fact that most transition metals and their complexes are susceptible to oxidation, many of our reactions are run under an inert atmosphere of N<sub>2</sub> or Ar. This involves the use of a glove box or vacuum line. Once a molecule is prepared it is characterized by <sup>1</sup>H and <sup>31</sup>P NMR, IR, mass spectrometry, elemental analysis and X-ray crystallography. An X-ray structure of a molecule from our lab is shown to the right.



Therefore, you may have the opportunity to prepare molecules that have *never* been made before while utilizing the spectroscopic skills that you have developed in other courses.

## Catalytic Hydroamination

In order to probe the catalytic abilities of the molecules prepared in the lab, and hence to better understand catalysis in water, our group uses the intramolecular hydroamination of 4-pentyn-1-amine as a model reaction.



The intramolecular hydroamination is being used as a model reaction for three reasons. 1) C-N bond formation is of fundamental importance in organic chemistry. 2) The aminoalkyne is soluble in water *and* organic solvents. Substrate solubility in water is often problematic, and the hydrogen bonding capability of the amine removes this difficulty. 3) The conversion is easily followed by comparing the relative peak areas of 4-pentyn-1-amine and 2-methyl-1-pyrroline in the <sup>1</sup>H NMR

Therefore, this project relies heavily on NMR. This will involve preparing the samples under a N<sub>2</sub> atmosphere at Concordia and following the catalytic progression with the NMR at Minnesota State University Moorhead. This is not a problem, however, because the NMR may be programmed to analyze the sample at specified time intervals even when no one is present.

