Group : Homogeneous Catalysis and Biomimetic Synthesis
Project : **Synthesis and catalysis of cationic Ru-diphosphine complexes**
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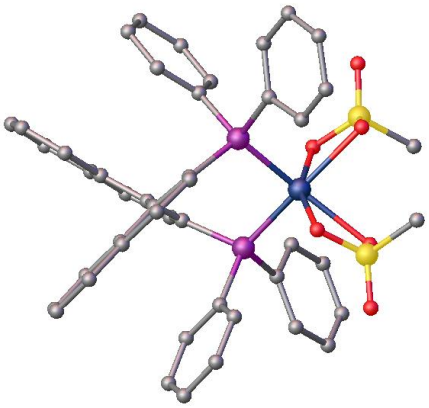
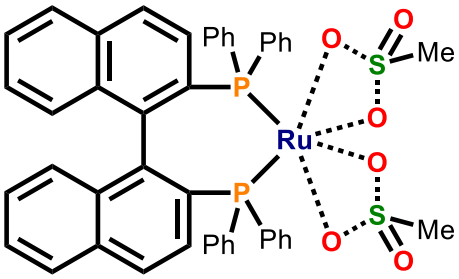
Keywords. Transition Metal Complexes, Homogeneous Catalysis

Introduction. This thesis project will focus on the preparation of cationic Binap-ruthenium complexes and their applications in catalysis. Since the first introduction of the Binap ligand by the Noyori group in 1980,[1] metal-Binap complexes were used in various asymmetric reactions, including C-C, C-N, and C-Si bond formations.[2] Recently, we synthesized a new Ru-complex, $Ru(Binap)(OMs)_2$, and its structure has been confirmed by X-Ray diffraction. $Ru(Binap)(OMs)_2$ can act as a Lewis acid due to the weakly coordinating mesylate anion, and thus it is expected to find applications in asymmetric Lewis acid catalysis.

Goal. In this thesis project, we plan to investigate the synthetic routes to $Ru(Binap)(OMs)_2$ and other novel cationic Ru-diphosphine complexes, e.g., $Ru(dppf)(OTs)_2$ and $Ru(Binap)(OTf)_2$, from readily-available Ru(II) precursors. Next, the ability of obtained complexes to catalyze various organic transformations will be studied (including alkenes isomerization,[2] hydroacylation,[3] hydrosilylation[4] and hydroamination[5]). Reaction conditions of catalytic reactions will be optimized. In the meantime, the reactivity of Ru-complexes will be investigated to acquire an in-depth understanding of catalytic reactions.





$Ru(Binap)(OMs)_2$

Novel cationic Ru-BINAP complex

Reactivity? Synthesis of Derivatives? Applications in Catalysis?

Topics to be studied. The project will combine inorganic synthesis of ruthenium complexes and development of catalytic organic reactions. The progress include the synthesis and characterization of cationic Ru-diphosphine complexes, set up and analysis of catalytic reactions, reactions monitoring and optimization.

Techniques to be used. This work will primarily involve techniques of organometallic chemistry, including operation under an inert atmosphere using Schlenk-line and/or glove box, monitoring reactions by TLC, NMR, and GC-MS techniques, isolation of air-sensitive products, crystallization, column chromatography, etc. For students interested in this thesis project, the experience in a synthetic organic laboratory is a prerequisite.

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