INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Auxiliary-Assisted C-H Functionalization: Exploring the Realm of C-C and C-Heteroatom Bond Formation

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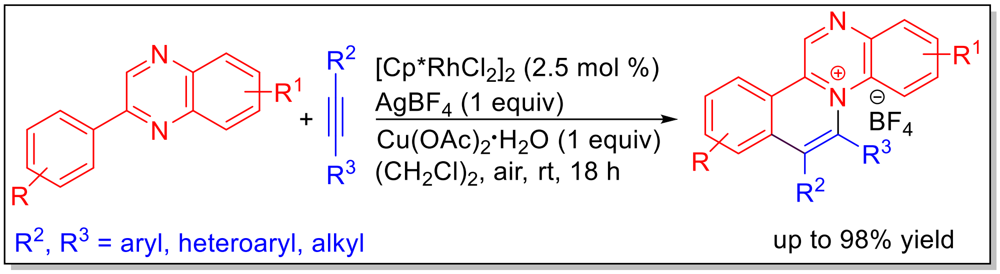
SHORT ABSTRACT

The thesis is segmented into four chapters. The initial chapter delineates a Rh-Catalyzed Tandem C-C/C-N bond formation of quinoxalines with alkynes leading to heterocyclic ammonium salts. The second chapter explores the Pd-Catalyzed sp^3 C-H alkoxycarbonylation of 8-methylquinolines using $Mo(CO)_6$ as a CO surrogate. The third chapter showcases the Rh-catalyzed alkenylation of aryl 2-pyridyl ethers with vinyl acetate *via* sp^2 C-H activation. Lastly, the fourth chapter delves into on Ru-catalyzed site selective acetoxylation of aryl 2-pyridyl ethers exploiting vinyl acetate as acetoxylating agent.

Chapter I. Rh-Catalyzed Tandem C-C/C-N Bond Formation of Quinoxalines with Alkynes Leading to Heterocyclic Ammonium Salts

The quaternary ammonium salts with substitutions hold significant importance as they are commonly found in numerous natural products displaying diverse bioactivities. The conventional methods for synthesizing these salts often face challenges related to the need for pre-functionalized substrate precursors, harsh reaction conditions, and a restricted substrate scope. The increasing demand for quaternary ammonium salts in pharmaceutical and materials sciences has propelled the active exploration of synthetic routes in recent research endeavors. The present chapter describes an efficient Rh-catalyzed oxidative coupling of quinoxalines with alkynes *via* a tandem C-H activation and *N*-annulation to provide a diverse variety of quaternary ammonium salts at room temperature (Scheme 1). The mild reaction conditions, substrate scope and functional group diversity are the salient practical features.



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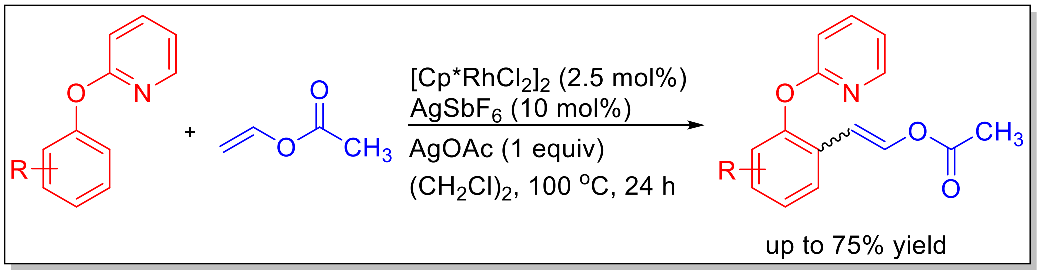
Scheme 1. Rh(III)-Catalyzed Tandem C-C/C-N Bond formation of Quinoxalines

Chapter II. Pd-Catalyzed sp^3 C-H Alkoxycarbonylation of 8-methylquinolines using Mo(CO)$_6$ as a CO Surrogate

The exploration of C-O bond formation holds pivotal importance in organic synthesis, given the widespread presence of this structural element in a multitude of biologically and pharmaceutically significant molecules. Recent focus on atom-efficient processes and green chemistry has elevated transition-metal-catalyzed direct C-H activation as a leading protocol in modern synthetic chemistry. This method has significantly prospered in constructing site-selective C-C and C-heteroatom bonds. Regioselective functionalization of sp^3 C-H bonds faces significant challenges due to the absence of π-bonds and the high bond dissociation energy associated with them. Due to the remarkable significance of quinolines in alkaloids and medicinal science, their functionalization has garnered considerable attention in the field of synthetic chemistry. In this chapter, we present a Pd(II)-catalyzed three-component sp^3 C-H alkoxycarbonylation of 8-methylquinoline (8-MQ) derivatives, utilizing Mo(CO)$_6$ as a bench stable, non-toxic alternate for CO (Scheme 2). The selectivity, functional group tolerance and late-stage natural product mutations are the important practical features.

Chapter III. Site-Selective Rh-Catalyzed Alkenylation of Aryl 2-Pyridyl Ethers with Vinyl Acetate

Direct C-H functionalization catalyzed by transition metals has revolutionized the transformation of basic compounds into intricate molecules, fostering structural diversity and enhancing atom efficiency. Olefins, a prevalent functional group, can undergo straightforward modifications to create complex organic molecules. The unique reactivity of olefins emphasizes the significance of alkene functionalization in the realm of organic synthesis. In recent times, diverse transition metal catalysts, including Pd, Rh, Ru, Ir, and Co, have been employed for akenylation reaction. Nonetheless, most current techniques are limited to activated alkenes such as acrylates, enones, and styrenes. However, achieving direct sp^2 C-H functionalization in electron-rich alkenes remains uncommon, despite being a highly sought-after goal. This chapter elucidates a method for site selective alkenylation of aryl 2-pyridyl ethers utilizing vinyl acetate as alkenylating agent using Rh(III)-catalysis (Scheme 3). The site-selectivity, utilization of unactivated alkene and mechanistic investigations are salient features of the protocol.



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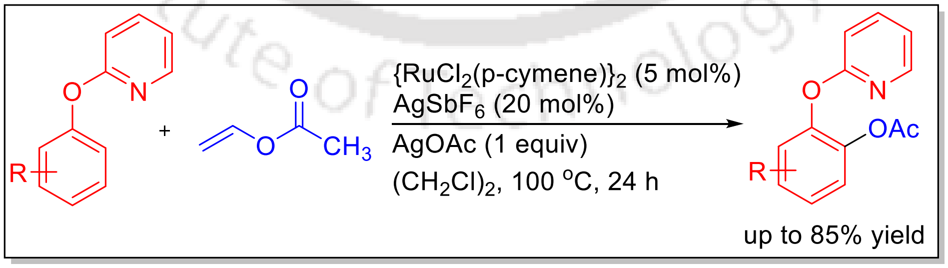
Scheme 3. Rh-Catalyzed Alkenylation of Aryl 2-Pyridyl Ethers with Vinyl Acetate

Chapter IV. Ru-Catalyzed *ortho*-Selective Acetoxylation of Aryl 2-Pyridyl Ethers exploiting Vinyl Acetate as an Acetoxylating Agent

Establishing C-C and C-O bonds is a fundamental goal in the field of synthetic organic chemistry. Significantly, heterocycles containing nitrogen and oxygen serve as crucial structural motifs, prominently contributing to a diverse range of biologically active natural compounds and synthetic pharmaceuticals. Given the contemporary focus on atom-economical procedures and a green chemistry approach, transition-metal-catalyzed direct C-H activation has emerged as a reliable protocol at the forefront of current synthetic chemistry. In recent times, the remarkable growth of transition metal-catalyzed C-H bond functionalization has been evident, primarily attributed to the convenient accessibility of C-H bonds. Within the array of C-H functionalization reactions, considerable attention has been devoted to transition metal catalyzed C-O bond formation reaction although restricted to employment of hypervalent iodine reagents along with $Cu(OAc)_2$. This chapter outlines a Ru-catalyzed site-selective oxygenation of aryl 2-pyridyl ethers employing vinyl acetate as the acetoxylating agent (Scheme 4). Aryl 2-pyridyl ethers with versatilefunctional groups are well tolerated the reaction protocol and the suggested mechanism has been supported by a combination of experimental mechanistic inquiries and DFT calculations.



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Scheme 4. Ru-Catalyzed *ortho*-Selective Acetoxylation of Aryl 2-Pyridyl Ethers.