



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

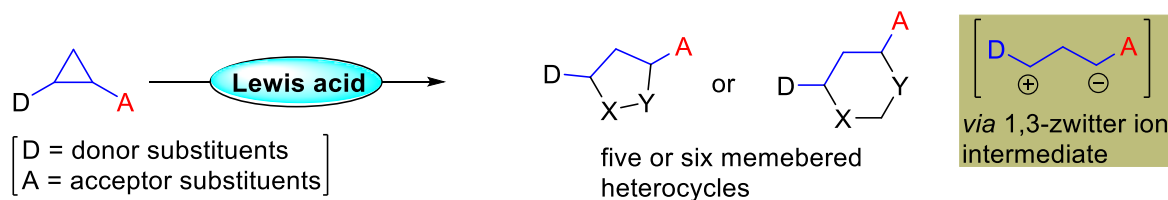
Name of the Student : **Manmath Misha**  
Roll Number : **176122051**  
Programme of Study : **Ph.D.**  
Thesis Title: **Studies Towards Stereoselective C-C/C-Heteroatom Bond Formations of Strained Rings**  
Name of Thesis Supervisor(s) : **Prof. T. Punniyamurthy**  
Thesis Submitted to the Department/ Center : **Chemistry**  
Date of completion of Thesis Viva-Voce Exam : **23-04-24**  
Key words for description of Thesis Work : Stereoselective, Atom economy, Multiple-bond forming cascade

---

**SHORT ABSTRACT**

**Chapter I. General introduction to ring opening and cyclization of D-A cyclopropanes**

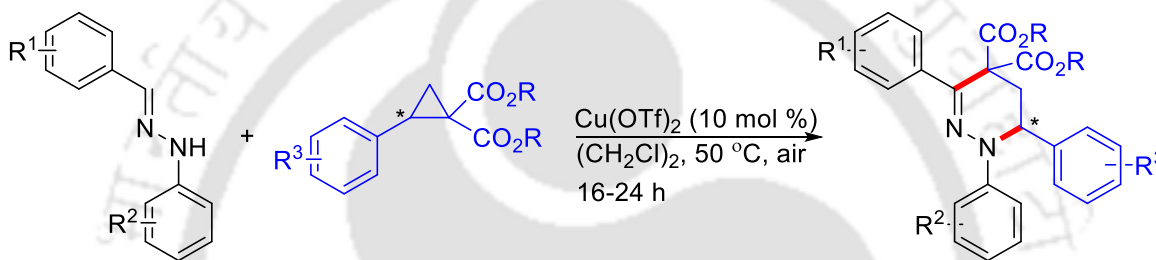
Nitrogen- and oxygen-containing heterocycles are among the most prevalent moieties found in both pharmaceutical and naturally occurring compounds. Research and development into these compounds is of high interest and of ongoing importance in organic synthesis. Recently, C-C and C-heteroatom bonds formation by ring expansion of three-membered strained ring systems, particularly in D-A cyclopropanes have provided a great synthetic space for easy access to structurally complex scaffolds. The inherent ring strain and electrophilic character made them an attractive building blocks for the selective synthesis of five, six and seven-membered heterocycles through ring-scission. In this chapter, the studies behind the background, reactivity and synthetic methodologies of ring-opening and cyclization of D-A cyclopropanes are discussed.



**Scheme 1.** Lewis acid Catalyzed Ring Opening and Cyclization of D-A Cyclopropanes

## Chapter II. Cu(II)-Catalyzed Stereospecific Synthesis of Pyridazines *via* Ring-Opening/Oxidative C(sp<sup>2</sup>)-H Alkylation of D-A Cyclopropanes With Hydrazones

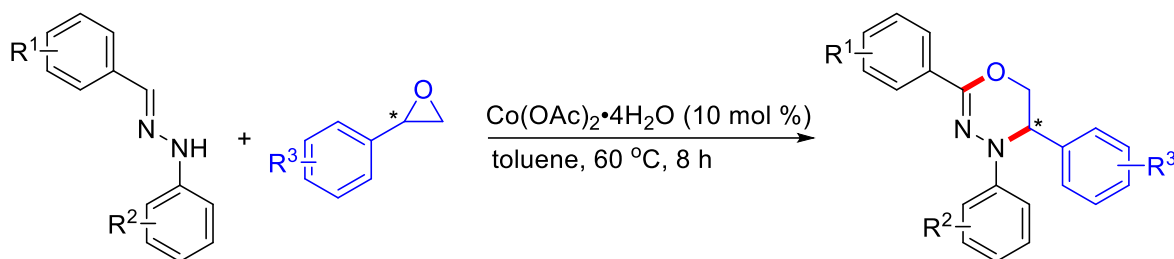
Tetrahydropyridazines and their synthetic analogues represent an imperious class of aza-heterocycles as they display unique biological properties. In this vein, a simple operational strategy could be sought out using readily available starting materials for their efficient synthesis. This chapter describes the stereospecific ring opening and an oxidative cyclization of D-A cyclopropanes with reactive hydrazones in presence of Cu(OTf)<sub>2</sub> catalyst. The method bargains an one-pot C-C and C-N bond forming strategy under mild reaction conditions (Scheme 1). Enantiopure D-A cyclopropanes were also efficiently coupled and air as the oxidant is an attractive feature.



**Scheme 2.** Stereospecific Cu(II)-Catalyzed C-C and C-N bond formation of D-A Cyclopanes with Hydrazones

## Chapter III. Co(II)-Catalyzed Stereospecific C-N/C-O Bond Formation of Oxiranes With Hydrazones: Synthesis of Oxadiazines

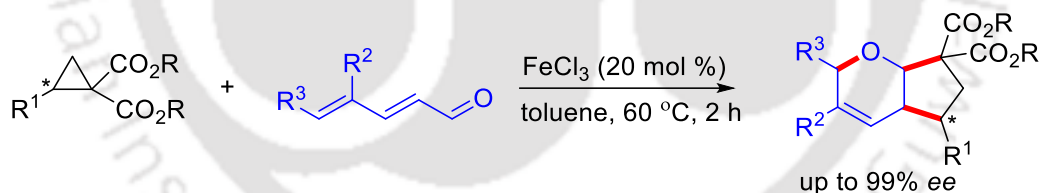
Heterocycles with three-heteroatoms are privileged structural frameworks due to their interesting biological and medicinal properties. Among them, oxadiazines are of great interests as they display diverse applications in medicinal and agricultural sciences. Epoxides are versatile building blocks and the selective cleavage of C-C and C-O bonds provide potential approach to diverse oxygen containing heterocycles. On the other hand, the Co-catalyzed annulation reactions have recently appeared as a sustainable synthetic tool as they are less-expensive and minimally toxic. This chapter demonstrates a Co(II)-catalyzed stereospecific ring opening and C-O bond forming cascade of hydrazones with reactive oxiranes. The reaction is aerobic and biologically important oxadiazines were synthesized with excellent yields and enantiopurities.



**Scheme 2.** Stereospecific Co(II)-Catalyzed C-N and C-O Bond Forming Cascade of Hydrazones with Oxiranes

#### Chapter IV. Iron(III)-catalyzed regioselective synthesis of pyrans using D-A cyclopropanes and 2,4-dienals as the coupling partners

Pyran is an important prevalent structural subunit present in a broad spectrum of natural products, such as sugars, coumarins, flavonoids and xanthenes and also are used as anti-cancer agents. Therefore, swift construction of pyrans from readily available starting materials under mild and economic conditions would be worthy rewarding task. This chapter describes the regioselective synthesis of pyrans from readily available D-A cyclopropanes with 2,4-dienals in presence of benign  $\text{FeCl}_3$ -catalyst (Scheme 3). The sequential three C-C and C-O bond forming cascade under a single operation *via* a ketene intermediate is noteworthy achievement. Enantiopure pyran derivatives were also synthesized efficiently.

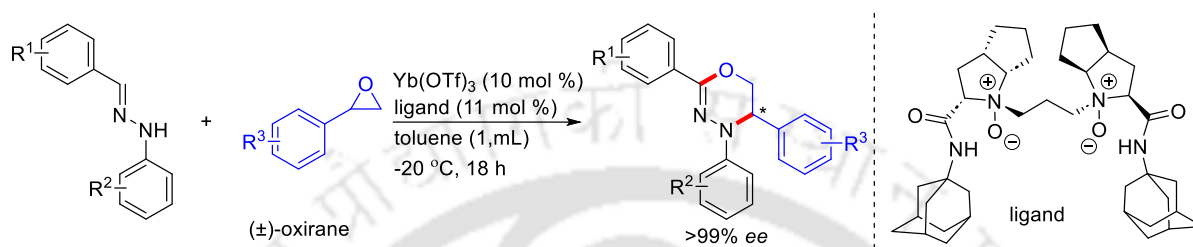


**Scheme 4.** Fe(III)-Catalyzed Sequential C-C and C-O Bond Forming Cascade of D-A Cyclopropanes With 2,4-Dienals.

#### Chapter V. Chiral Yb(III)-N,N'-Oxide Assisted Enantioselective Synthesis of Oxadiazines from Oxiranes and Hydrazones

Transition metal doped chiral ligand catalyzed enantioselective strategies plays an important role in modern asymmetric synthesis owing to their high modifiability, ease of handling, as well as their environmentally friendly nature. In this regard, N- and O-containing multidentate chiral ligands can be complexed with transition metals to synthesize stereoselective organic compounds. To worthy mention

is here, a series of C<sub>2</sub>-symmetry chiral bisoxazolines, Py-Boxes, chiral bulky salen complexes, chiral N,N-oxides as well as chiral bimetallic phosphoric acid ligands can be used for this noble aim. This chapter delivers the enantioselective synthesis of oxadiazines from racemic oxiranes with hydrazones using chiral Yb-adamantyl *N,N*-oxide complex (Scheme 4). The strategy is operationally simple and the oxadiazines were produced with excellent enantioselectivities.



**Scheme 5.** Enantioselective Synthesis of Oxadiazines.