ABSTRACT

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Thesis Title: **Exploring Transition Metals (Co, Cu, Rh & Ir) for the Construction of C–C and C–Heteroatom Bonds *via* C–H Activation Strategy: Expeditious Synthesis of Densely Functionalized Heterocyclic Architectures**

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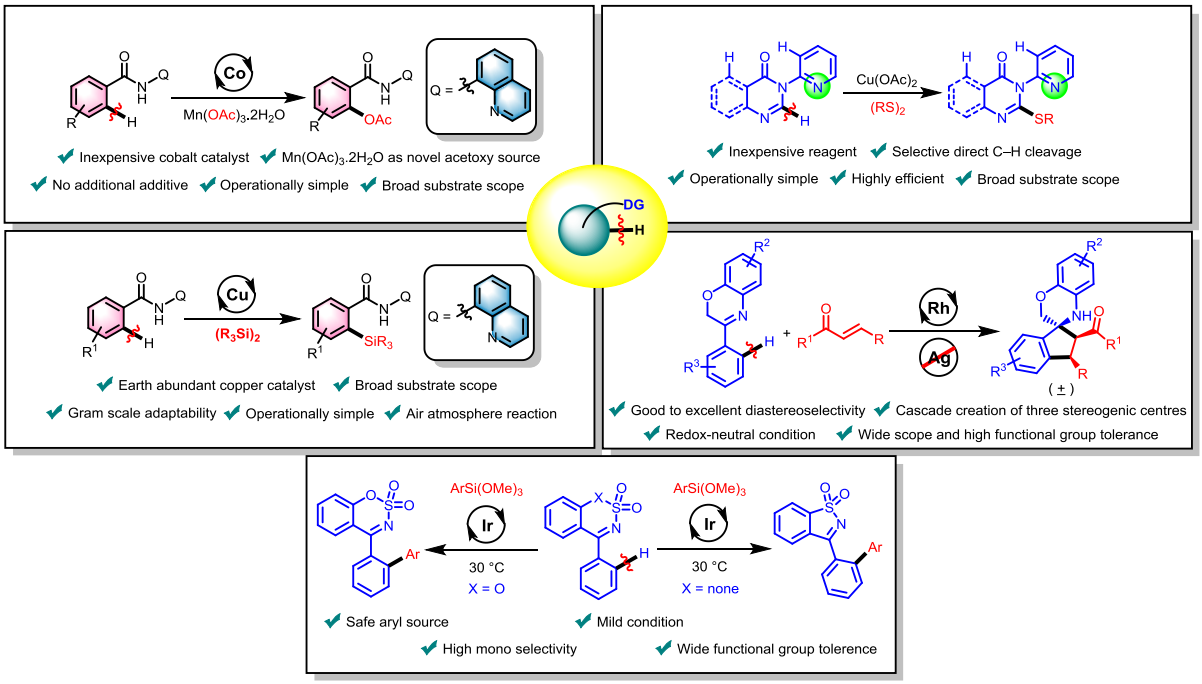
C–C and C–Heteroatom bond formation via transition metal (TM) catalysis is indispensable in modern organic chemistry. This strategy allows for the selective and efficient synthesis of organic compounds, which are otherwise only accessible via stringent multi-step synthetic routes. To realize this goal, the most efficient and strategically sought-after procedure would be the transition metal-catalyzed direct activation of C–H bonds, ubiquitous in most organic frameworks. This step and atom economical strategy has gained tremendous attention over the past few decades making it an inherently more sustainable approach over traditional methods which require pre-functionalized starting materials and harsh reaction conditions. Our group is actively involved in this area of research with an aim to develop new catalytic systems and methodologies using transition metals for C–H activation/functionalization reactions, by which novel and densely functionalized heterocyclic architectures can be synthesized having potential biological activity.



Scheme 1. Abstract of the thesis work.

Our focus has been on both first-row transition metals (Co, Cu), owing to their earth abundance and cost-effective nature, and also second- and third-row transition metals (Rh, Ir) because of their minimal requirement and altogether different reactivity. 8-aminoquinoline tethered aromatic amides, quinazolinones, benzoxazines, sulfonyl ketimines and their derivatives are considered to be privileged pharmacophores in organic and medicinal chemistry. Therefore, the selective functionalization of these scaffolds holds enormous importance. This thesis describes the development of several methodologies for the direct and selective functionalization of relatively inert C–H bonds employing transition metal-catalyzed C–H activation technique to synthesize densely functionalized molecules of the above scaffolds (Scheme 1). Use of diverse directing groups (DGs) has also been explored in this regard.

Functional groups like the acetoxy, thioether and silyl moieties are extremely important in synthetic organic chemistry, since their incorporation in organic molecules lead to compounds with diversified biological activities, synthetic abilities, and form key components in many fields of science, *viz.* pharmaceutical, material science, polymer industries, among others, and are also present in a plethora of natural products and drug candidates. In this regard, we have developed three different C–Heteroatom bond forming methodologies for the selective installation of these functionalities in molecules using the help of first-row transition metal-catalyzed C–H activation. A cobalt-catalyzed acetoxylation reaction of arylamides using $Mn(OAc)_3.H_2O$ as a novel acetoxy source and a copper-catalyzed silylation of similar scaffolds using disilanes as organosilicon source have been demonstrated for the first time with the aid of 8-aminoquinoline bidentate auxiliary. Also, a copper-promoted sulfenylation of quinazolinones and pyrimidinones has been described using disulfides as thio group source.

We have again developed two C–C bond forming methods for their selective and efficient construction harnessing second-row and third-row transition metal-catalyzed C–H activation. Indanyl amine and 1,4-benzoxazine systems are biologically and synthetically important fragments possessing a broad application in synthetic organic chemistry. In this context, we have demonstrated a rhodium-catalyzed regio- and stereoselective [3+2]-spiroannulation of benzoxazines with chalcones generating multi-substituted spiro-indanamines under redox-neutral conditions. The strategy leads to the one-pot synthesis of novel spirocycles with three continuous stereogenic centers in excellent yields and high diastereoselectivity. Considering the immense importance of biaryl motifs in varied fields of science, we have also developed an iridium-catalyzed direct *ortho* arylation reaction of cyclic *N*-sulfonyl ketimines using environmentally benign arylsiloxanes as a cheap and readily available aryl source for the quick and efficient synthesis of biaryl frameworks under ambient reaction conditions.

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