SUMMARY

Investigations embodied in this thesis entitled "**Studies on Solid Phase Hetero Cross-Coupling Reactions Leading to Synthesis of Aryl Amines and Their Applications**" are primarily concerned with studies directed towards the development of solid-surface-mediated C–N coupling reactions for the synthesis of aryl amines and to find their applications. The thesis has been divided into three parts: **Part–I**, **Part–II** and **Part–III**. First two parts (**Part–I & II**) describe development of palladium-catalyzed C–N bond-forming reactions mediated on KF-alumina surface, which ultimately lead to general procedures for the conversion of halopyridines and haloaromatics into corresponding amino derivatives. Further application of this dry media reaction has been employed successfully and selectively in case of di- and tribromobenzenes leading to the synthesis of polyanilines. The work described in **Part–III** is of exploratory nature and includes an attempt to prepare the metal complexes using the amino pyridines as ligand, prepared from bromopyridines.

Part–I: Palladium-Catalyzed Amination of Halopyridines Mediated on KF-Alumina Surface

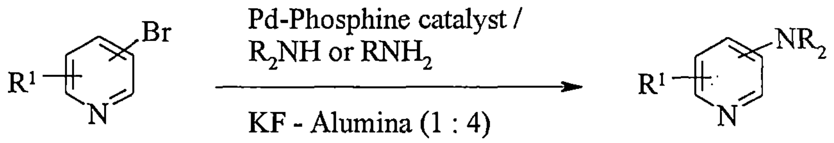
This part starts with a brief introduction on the *N*-heteroaromatic compounds with at least one amino substituents, which are of diverse applications in biological chemistry as well as in industries. The preparative methods for aminopyridines including metal-catalyzed coupling reactions, known in the literature, have been delineated briefly highlighting their merits and demerits.

Over the last decades, the palladium-catalyzed amination of haloaromatics, developed independently by Buchwald and Hartwig, has become an extremely important method to prepare amino benzenes and amino heteroaromatics. Several other groups have reported their studies on developments and applications of this methodology. Among several aspects of this simple procedure, one of the major drawbacks includes use of a strong base, sodium *tert*-butoxide, which greatly limits its applications with base-sensitive functionalities.

In this part (**Part–I**), we have described the development of a convenient and efficient heterogeneous method for C–N coupling by palladium-catalyzed amination of

bromopyridines on KF-alumina surface, thus negating the use of strong base such as, sodium *tert*-butoxide. The reaction conditions are optimized with reference to catalytic system, solvents and the surface (Scheme 1). This method represents a significant improvement and useful extension relative to Buchwald's procedure using the strong base. An account of this work has been published in *Tetrahedron Lett.* **2002**, *43*(44), pp. 7967-7969.

Scheme 1



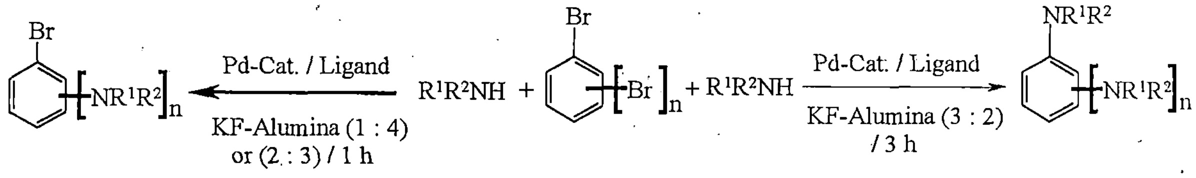
Pd-sources: $PdCl_2$; $Pd_2(dba)_3$, $Pd(OAc)_2$, $Pd(acac)_2$; $Pd[PPh_3]_4$

Phosphine: P(*o*-tolyl)$_3$; DPPF; BINAP

Part–II: Design and Synthesis of Ligands Based on Aromatic Bis-Amines

This part (**Part–II**) of this dissertation deals with studies on further extension of this procedure to the halobenzenes. Although the KF-alumina surface worked efficiently with halopyridines, it was presumed that its basicity might not be enough in the case of halobenzenes. Through a series of experimentation, we have been able to optimize the conditions for amination of halobenzenes mediated on a surface of KF-alumina. Further, the Buchwald-Hartwig aminations of dihalobenzenes are often associated with several byproducts. We envisaged that the Buchwald-Hartwig C–N couplings should be studied with polyhalobenzenes to extend the scope and the amelioration of the various parameters of this amination process. This part delineates our observations, which finally constitute not only a mild and efficient procedure for amination of aromatic bromides on a solvent-free surface of KF-alumina but also provide an expedient route for selective amination of polyhaloaromatics (Scheme 2). *A manuscript comprising preliminary account of this observation is under process of preparation and submission.*

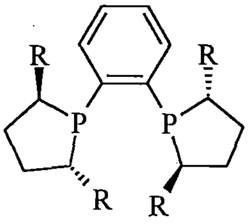
Scheme 2



n = 0; Br = NR^1R^2

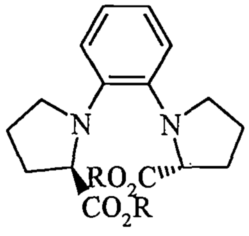
n = 0, 1, 2; R^1 = H or alkyl, aryl; R^2 = Alkyl
Pd-Cat. / Ligand = Pd_2dba_3 - BINAP or $Pd(OAc)_2$ - BINAP

Bis-amination products could be important since compounds of the type (1) or (2) are analogous to corresponding bis-phosphine derivatives (**1**; Me-Duphos), which have found wide applications in ligand chemistry and metal-catalyzed asymmetric synthesis. Our objective was also directed towards developing a simple procedure for the synthesis of aromatic bis-amines with the hope that its optically pure form might be prepared in the near future. Compounds (**2** & **3**) have been designed and synthetic attempts have been depicted in this part.



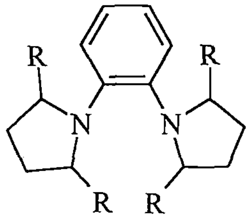
(1)

R = Me; Methyl-Duphos



2 a; R = Me

2 b; R = CH_2Ph



3 a; R = H

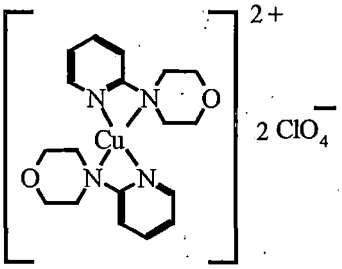
3 b; R = Me

Part III: Transition Metal Complexes of 2-Pyridyl Amino Derivatives: Synthesis of Copper-Complexes and their Characterization

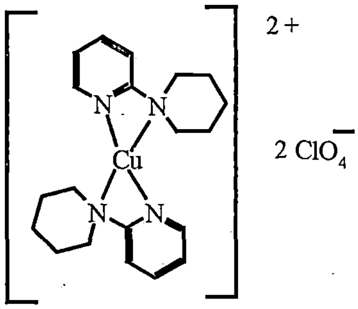
This part of this dissertation delineates studies on preparing some metal complexes coordinated with 2-amino pyridines derivatives that were prepared in this work.

The chemistry of copper (II) carboxylate complexes, especially with N-donor ligands, has been extensively studied over the past few decades. Certain complexes have shown properties important for application in diverse areas such as pharmaceuticals, fungicides, catalysts, gas occlusion compounds, and solvent extraction process. Moreover, the attention of, bioinorganic chemists has been directed towards the synthesis and characterization of new copper (II) carboxylates with *N*-donor ligands to model the active sites in metallozymes

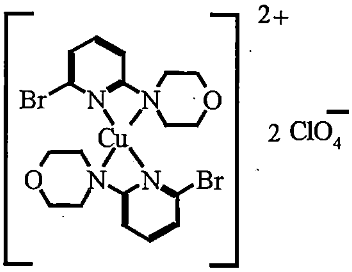
In view of enormous applications of *bis*-Cu complexes derived from 2-pyridyl amines and other metal complexes from 2-pyridyl thiols, we undertook preparation of some new complexes derived from 2-morpholinopyridine (**4**), 2-piperidinopyridine (**5**), 6-bromo-2-morpholinopyridine (**6**) and 5-bromo-2-morpholinopyridine (**7**).



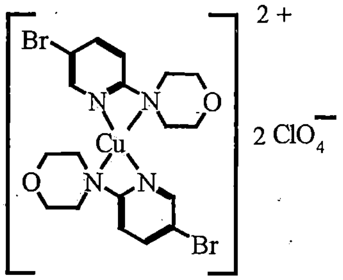
(4)



(5)



(6)



(7)

All the complexes (**4-7**) have been characterized by their spectral data (IR and UV-VIS spectra) only. The given structures (**4-7**) have been proposed on the basis of spectral and literature data. Further characterizations by preparing their suitable crystals are, however, necessary to conclude about their structures and would be undertaken as a part of further studies.