"Development of Copper and Cobalt-Catalyzed Electrophilic C–H Amination Reactions"

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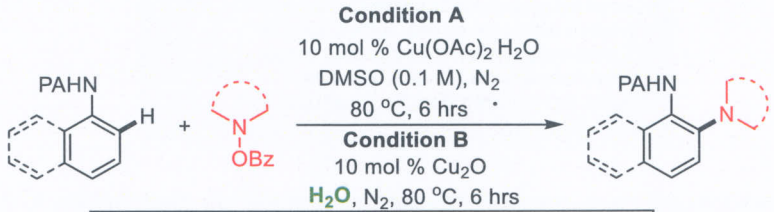
N-heterocycles as well as acyclic amines having either C(sp^2)–N or C(sp^3)–N bonds are privileged structural motifs found in many biologically and pharmaceutically important compounds. So, development of efficient methodologies for the construction of C-N bonds are in high demand. In this direction C-H amination using non-prefunctionalised substrates offered many advantages over the C-N cross-coupling reactions. However, C-H amination with free nucleophilic amines carries many limitations including harsh reaction conditions and high catalyst loading probably due to inhibition by the free amines. Using a new strategy called electrophilic amination with umpolung concept i.e. the reversal of polarity of the reacting N-centre by attaching electron withdrawing atoms or groups, many problems associated with nucleophilic amines is solved in large number of cases. Amination with the electrophilic amines can be carried out at much milder conditions and another important fact is that as they can act as mild oxidant, use of strong external metallic or non-metallic oxidants can be omitted. However, expensive 2nd and 3rd row metals such as Rh, Ir, Pd, Ru have been dominated the field of C-H aminations using these electrophilic amines. So, development of methods based on earth-abundant 3d transition metals are still in demand. The major objective of this research work is to develop efficient protocols for the synthesis of *N*-heterocycles as well as aminated products using low-cost copper and cobalt catalysts.

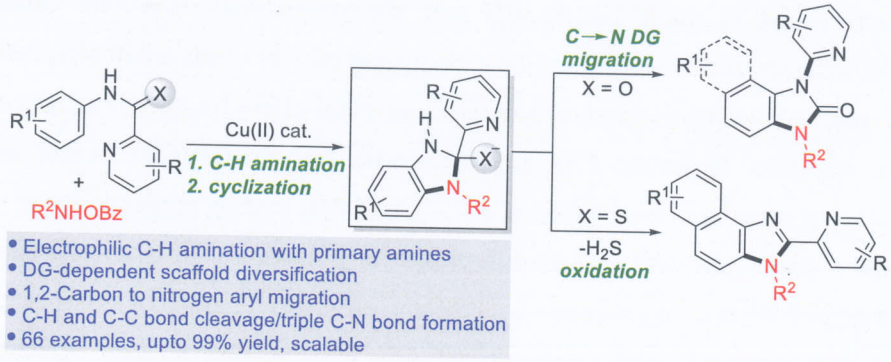
We have development, a practical copper-catalyzed, 2-picolinamide directed *ortho*-C–H amination of anilines with benzoyl protected hydroxylamines has been disclosed that proceeds smoothly without any external stoichiometric oxidant or additives affording a broad range of substrates scope (**Scheme 1**). This electrophilic C–H amination also proceeds smoothly in water under slightly modified reaction conditions.



Scheme 1. Copper-catalyzed electrophilic *ortho* C(sp^2)–H amination of aryl amines

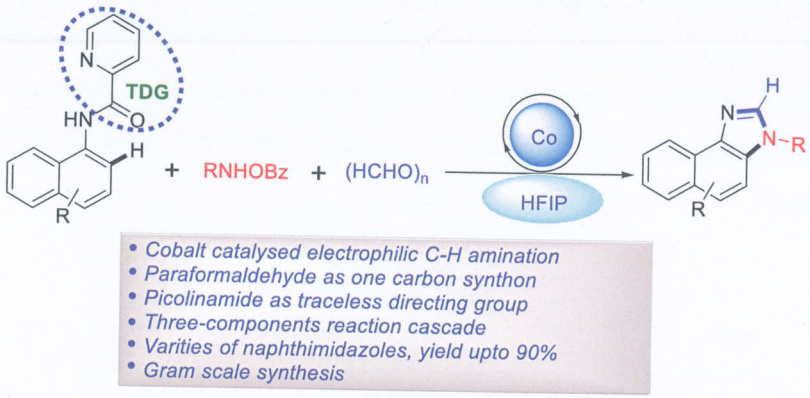
We have also successfully developed an efficient protocol for the synthesis of benzimidazolones and benzimidazoles. The benzimidazolones are obtained by a a copper-catalyzed

electrophilic *ortho*-C–H amination of protected naphthylamines with primary *N*-(benzoyloxy)amines, cyclization with the pendant amide and carbon to nitrogen 1,2-directing group migration cascade (**Scheme 2**). On the other hand, the reaction cascade was altered by subtle tuning of the directing group from picolinamide to thiopicolinamide furnishing 2-heteroaryl-imidazoles via the extrusion of H_2S.



Scheme 2. Directing group switch in copper-catalyzed electrophilic C–H amination and migratory annulation cascade to synthesize benzimidazolone/benzimidazole

We have also developed a concise and efficient method for the synthesis of valuable naphthimidazole derivatives via cobalt catalyzed three-component coupling reaction (**Scheme 3**). The reaction proceeds through cobalt catalysed electrophilic *ortho* C-H amination/cyclisation cascade with *O*-benzoloxy primary amines using paraformaldehyde as one carbon synthon. Picolinamide DG has been utilised as a trace-less directing group.



Scheme 3. Cobalt-catalyzed three-component reaction cascade *via* electrophilic C-H amination using paraformaldehyde for the synthesis of napthimidazoles

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