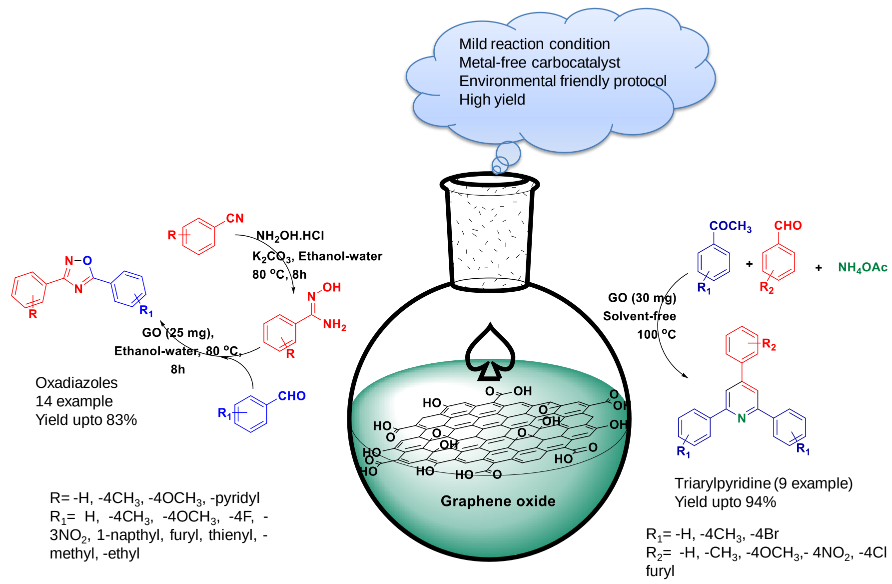
Abstract

The present thesis entitled "**ORGANIC TRANSFORMATIONS USING NOVEL CATALYTIC SYSTEM**" focused on the application of graphene oxide (GO) and its derivatives in organic synthesis. Graphene oxide and its derivatives are emerging as a new class of metal-free, inexpensive, environmentally friendly, heterogeneous carbocatalyst. GO can easily be derived from the abundant and inexpensive natural source graphite. The current active research area replaces environmentally hazardous Lewis solid acid catalyst and liquid Bronsted catalyst with heterogeneous solid catalyst. GO has been featured as a thin 2D layer with several oxygen-containing functional groups which attracted much attention in the field of the heterogeneous catalytic system. There is a huge application of GO in different fields of fuel cells, nanocomposite material, electronic devices, and catalytic support. In this thesis, we have focused on the applicability of graphene oxide and graphene-based materials in an organic reaction. The thesis is mainly divided into three chapters and each chapter is further divided as given below.

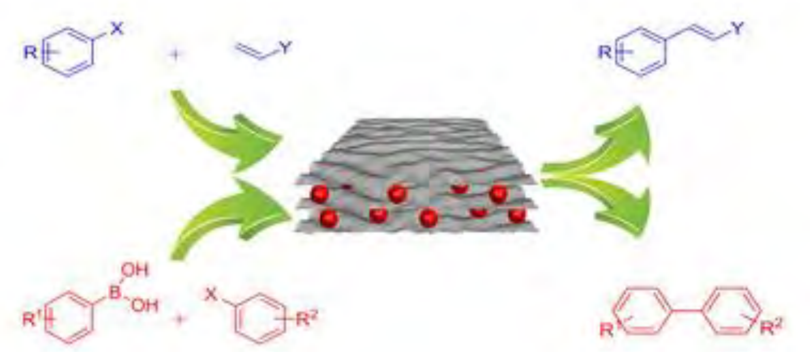
Chapter I is divided into three parts **Section A** shows a brief introduction on carbonaceous nanomaterial graphene and the development of its functionalized form graphene oxide. These carbonaceous nanomaterials are mainly heterogeneous and show activity like homogeneous one. Many research works have been published on these carbocatalysts owing to their affordability, sustainability, and high thermal and chemical stability. The use of graphene oxide (GO) and it's derivative as an outlook for green sustainable catalysis has been discussed in this chapter.

Section B represents the one-pot multicomponent synthesis of 3,5-disubstituted 1,2,4-oxadiazoles using robust solid acid catalyst graphene oxide (GO). GO plays a dual role of an oxidizing agent and solid acid catalyst for synthesizing 1,2,4-oxadiazole scaffolds with diverse functionality. The use of this carbocatalyst facilitates the synthesis of oxadiazoles under the benign condition without any undesired by-product. A plausible mechanism is proposed based on few controlled experiments and gives a clean strategy to synthesize a wide variety of oxadiazoles.



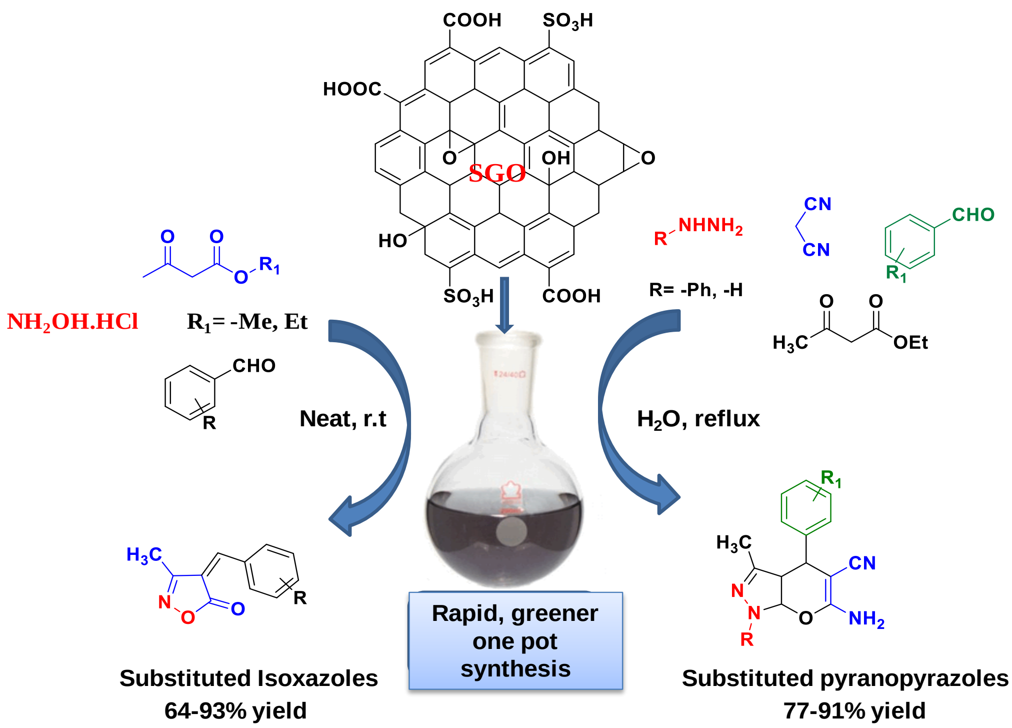
In **Section C** from the same chapter the synthesis of 2,4,6-triarypyridines from benzaldehydes, acetophenones, and ammonium acetate in presence of graphene oxide (GO) as a solid acid catalyst has been described. The oxygen-containing acidic groups in GO have a profound role in catalyzing the synthesis of 2,4,6-triarypyridine derivatives with good to excellent yield.

Chapter II is divided into two sections; **Section A** provides a generalized view of heterogeneous palladium (Pd) catalyzed C-C cross-coupling reaction in water. With growing interest in green chemistry, solid-supported ligand-free heterogeneous catalysts are in demand. The solid supports mostly include activated carbon, polymer, zeolites, mesoporous carbon, silica, alumina, titania. In recent years, graphene oxide (GO) has attracted much consideration as solid catalyst support for organic reaction owing to its large surface area and easy recovery after the reaction. The addition of polymer on GO significantly increases the mechanical and thermal stability of the composite. The necessity of new solid support automatically comes which allows high thermal stability, easy recovery and this led the chemists to find out the new one.



Section B from the same chapter deals with a ligand-free protocol for SuzukiMiyaura and Mizoroki-Heck C-C cross-coupling reaction using low palladium loaded graphene oxide-polymer (GO-PMMA-Pd) composite catalyst. Water has been selected as the medium instead of hazardous solvents like DMF, NMP, DMA,etc considering the environmental concern. GO-PMMA composite enhances the thermal stability of the support and Pd NPs are immobilized in between the layers of this solid composite. This solid supported Pd catalyst was characterized by HRTEM, ICP-AES, PXRD, TGA, XPS, and FT-IR .

In the end, **Chapter III** is divided into two sections. **Section A** describes sulfonated graphene oxide (SGO) catalyzed one-pot synthesis of 3-methyl-4-(hetero) arylmethylene isoxazole-5(4*H*)-ones. This novel methodology involves a greener, radiation, and metal-free approach for synthesizing isoxazoles with a broad range of substrate applicability. The prepared catalyst SGO was characterized by HR-TEM, FEG-SEM, FT-IR, powder XRD analysis, and recyclable upto 5th run without a remarkable drop in its catalytic activity.



Section B represents the catalytic performance of SGO for the one-pot four-component synthesis of 1,4-dihydropyrano[2,3-c] pyrazoles with excellent yield. The use of SGO as a catalyst seems to be more fascinating due to its high surface area, easy recovery, higher reusability, excellent acidic property and holds great potential for an acid-catalyzed synthesis of pyranopyrazoles.