Summary and Future scope

Summary

Based on the works reported in the thesis, the works can be divided basically into two major parts. The first part consisting chapter 2 and chapter 3 mainly described synthesis, characterization and applications of cellulose supported Cu and Pd NPs respectively. Cu and Pd NPs have been generated into the nanopores of bio-polymer cellulose and characterized using modern analytical instruments like UV-visible spectroscopy, FTIR, powder XRD, SEM, TEM, HRTEM etc. From the analysis, it was confirmed the generation of Cu(0)/Cu$_2$O(I) NPs and Pd (0) NPs on cellulose template respectively. Cu(0)/Cu$_2$O(I) NPs on cellulose template were synthesized by chemical reduction method (Section 2.1, Chapter 2) and Pd(0) NPs on cellulose were synthesized by biogenic method (Section 3.1, Chapter 3).

The synthesized cellulose supported Cu(0)/Cu$_2$O(I) NPs were evaluated as a heterogeneous catalyst for the development of different synthetic methodologies like deprotection of oximes, imines and azines to carbonyls (Section 2.2, Chapter 2), oxidation of alcohols to carbonyls with special reference to oxidation of HMF to DFF (Section 2.3 & 2.4, Chapter 2), protodecarboxylation and oxidative decarboxylation of different aromatic acids (Section 2.5, Chapter 2), and *ipso*-decarboxylative nitration of different aromatic acids (Section 2.6, Chapter 2). Protodecarboxylation of benzoic acids and vinyl carboxylic acids leads to corresponding arenes and alkenes respectively. Oxidative decarboxylation and protodecarboxylation of phenylacetic acids leads to the aldehydes and alkyl benzenes.
respectively. *Ipso* nitro-decarboxylation of aromatic α, β-unsaturated carboxylic acids and benzoic acids leads to (E)-nitroloefins and nitrobenzenes respectively.

Cellulose supported Pd(0) NPs have been synthesized by biogenic method using hearth wood extract of *Artocarpus lakoocha* Roxb (Section 3.1, Chapter 3). Synthesized Pd(0) NPs were found as a versatile heterogeneous catalyst for the Heck and Suzuki coupling reaction in water (Section 3.2, Chapter 3). Isolation and characterization of active bioreductant, oxyresveratrol present in hearth wood extract of *Artocarpus lakoocha* Roxb has also been discussed in section 3.1, chapter 3. Oxyresveratrol is a potent therapeutic agents in human health, e.g. tyrosinase inhibitor, antioxidant, antiglycation, free radical scavenger, neuroprotection etc.

On the other hand, the second part consisting chapter 4 mainly discussed on the green synthesis of 16-Dehydropregnenolone acetate (16-DPA) and Methyl Ricinoleate (MR). The most important steroidal drugs intermediate 16-DPA, synthesized from diosgenin in a cost effective and greener way has been discussed in section 4.1, chapter 4. Green organocatalytic process for production of MR from castor oil has been discussed in section 4.2, chapter 4 of the thesis. MR is a privileged chemical of promising worldwide applications such as hydraulic fluid, perfumery chemicals, gear oil, cutting oil, dispersing agent, anti rusting agent, plasticizer etc. because of remarkably lower viscosity, higher cetane number and lower cloud and pour point properties.

Most of the works reported in this thesis are developed under microwave irradiation so as to make the methodologies “**Green**” both from energy, time and environmental point
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of view. Methodologies that are reported in section 2.2, 2.3, 2.5 and 3.2 are developed under microwave irradiation.

The introductory chapter, chapter 1 describes the basic, history and importance of nanoscience and nanotechnology. It also gives a brief description of various types, innovation properties, different synthetic routes and potential applications of nanomaterials. This chapter also deals with the importance of supports/stabilizers for nanoparticles synthesis with special emphasis on cellulose as a metal nanoparticles support. Significances of microwave assisted reactions, green chemistry principles and importance of specialty chemicals like 16-DPA and MR are discussed briefly in this chapter. Literature on Cu and Pd catalysed reactions are also outlined concisely. Finally aims and objectives of the thesis are discussed.

Future scope

There are high scopes for scientific research particularly, proper control over size and morphology of nanoparticles during synthesis, high selectivity in reaction etc. Some of the future scopes of investigations are highlighted below:

✓ The cellulose used in these works is purchased from Sigma Aldrich, USA. Future scope is there for isolation, purification and characterization of cellulose from different plant sources like bamboo, rice straw, cotton etc.

✓ Depending upon the different porosity of the cellulose templates obtained from different renewable plant resources, various shape and size of novel nanoparticles could be synthesized and stabilized. Hence future scope is there for synthesis and
characterization of metal nanoparticles using different cellulose templates and to investigate their catalytic activities.

✓ Agro-waste is a huge source of cellulose. Agricultural waste material such as rice, wheat, rice straw and husk represent an abundant, inexpensive and readily available source of renewable lingo-cellulose biomass. Agricultural crops can provide a new range of platform of chemicals that may be used as intermediates; hence there is a need to focus chemical research in this area.

✓ It is high time to expand basic research on the chemical transformation of renewable feedstock to achieve substitution processes and products.

✓ In view of the above, it has become a prime need to develop Catalysts and Catalysis processes which can meet the requirement of the country as well as of the world and such development of efficient and most selective catalysts are only possible through innovative research leading to Nanostructured based catalysts.