Synopsis of the Thesis Entitled

Novel materials for remediation of some selected pollutants from aqueous solutions

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By

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An adequate safe and accessible water supply is an important global issue and a challenge to be addressed in the new millennium. Dyes, nitrophenols and fluoride are two such pollutants that are of environmental concern globally. The dyes used in the textile industry are those with the worst impact worldwide. The sources of fluoride in water are mostly geogenic, although important contributions also come from industrial activities and coal burning. Excessive fluoride has adverse effect on human health such as it causes dental, skeletal and nonskeletal fluorosis. Phenol and phenolic derivatives are released from many industries such as pharmaceutical, petroleum and petrochemical, pesticides, plastic, paper and other manufacturers. About 17-20 % of industrial waste water contains ~70 toxic chemicals originate solely from dyeing. Dye effluent from textile industries cause very harmful effect on Environment, plant species, human beings, aquatic animals. Among this the methylene blue causes dizziness, headache, fever, anemia, nausea, vomiting, irritation of mouth, oesophagus and stomach.

To reduce the potential adverse effects of pollutants on the environment their removal at trace levels in aqueous solutions and removal from industrial effluents are the challenges facing the world today. Consequently, the development of effective remediation techniques for the removal of such pollutants has become the focus of environmental research. It is also important to develop simple and reliable methods for their determination in environmental water samples.

Many techniques including adsorption, biological treatment, chemical oxidation, catalytic reduction / degradation as well as photochemical degradation have been applied for the removal of these pollutants from aqueous solution. Amongst these techniques, adsorption is considered one of the most attractive and effective technologies due to its operational simplicity, effectiveness, low energy requirements and low cost. Biochar based adsorbents have been found to be of higher efficiency toward adsorption of pollutants as compared with the conventional adsorbents.

Furthermore, an important method to remove nitrophenols from industrial waste water is to carry out their reduction to aminophenols. Aminophenols are one of the important starting materials in the synthesis of many industrial dyes, pharmaceuticals and some biologically active compounds. Aminophenols are also used as corrosion inhibitor in paints and as anti-corrosion lubricant in fuels. Many methods are available for the reduction of nitrophenols to aminophenols such as electrolytic reduction, metal/acid reduction, homogenous and heterogeneous catalytic hydrogenation, photo reduction, etc. Among the various methods, the use of $NaBH_4$ as reducing

agent has proved to be a promising method as it is milder and thermally stable chemical hydride. Reduction reactions using $NaBH_4$ have been known to accelerate in the presence of suitable catalysts such as transition metals. Silver nanoparticles are of high interest in catalysis. The high catalytic activity partially originates from their large specific surface area owing to their small sizes. Interaction of unprotected small particles will, however lead to agglomeration or aggregation from the cohesive surface energy. In addition, the soluble/dispersible nanocatalysts suffer from problems associated with the separation, recovery, and instability at high temperatures. These general problems can be overcome by using a framework to support the nanoparticles, which keeps them separated and also makes them recyclable. Carbon-based materials, polymers, and mesoporous silica have been used as supports for metal nanocatalysts.

The thesis entitled "***Novel materials for remediation of some selected pollutants from aqueous solutions***" consists of **seven** chapters.

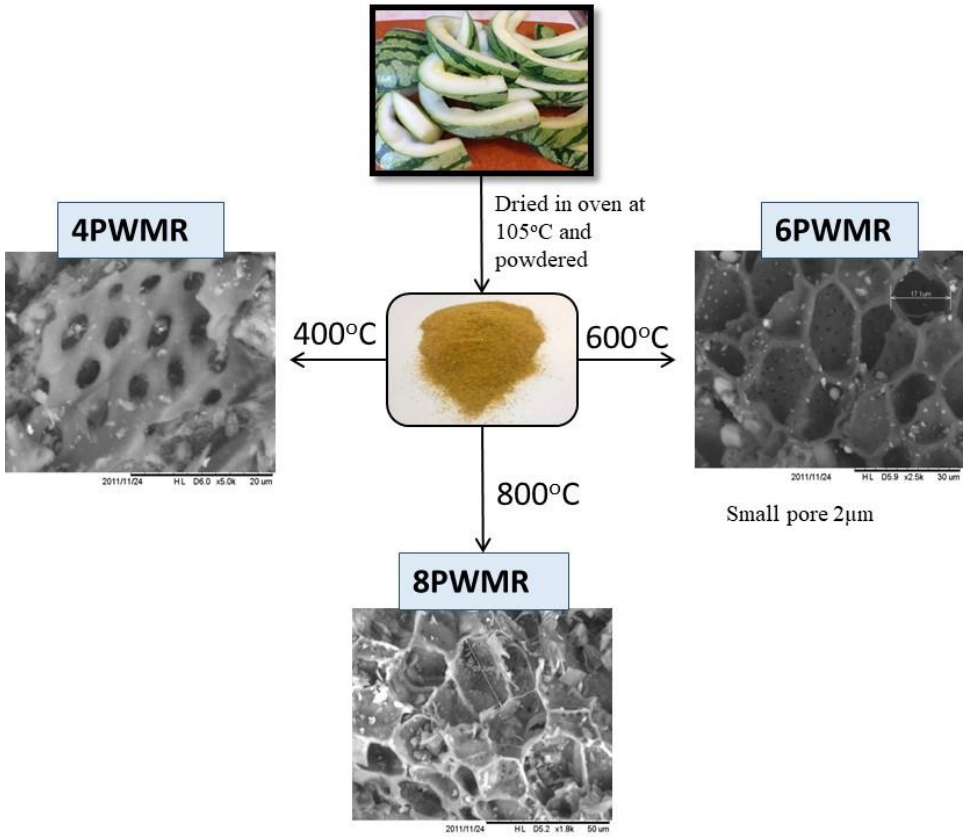
First chapter presents: i) an introduction to fluoride and dyes as contaminates in water ii) detailed review of the different technologies for the removal of these contaminants from water; (ii) adsorption process with mechanism and factors affecting adsorption; (iii) characteristics of various adsorbents with fluoride and dye removal as well as (vii) desorption and adsorbent regeneration

The objectives of present research are listed

Objectives of present research work

- To develop biochar from watermelon rind powder for the adsorption of fluoride and methylene blue dye
- To evaluate the removal of fluoride using cholate, guar-gum based gels and hydrotalcite
- To synthesize silver nanoparticle based MMOFCs and evaluate its potential for reduction of nitro derivatives

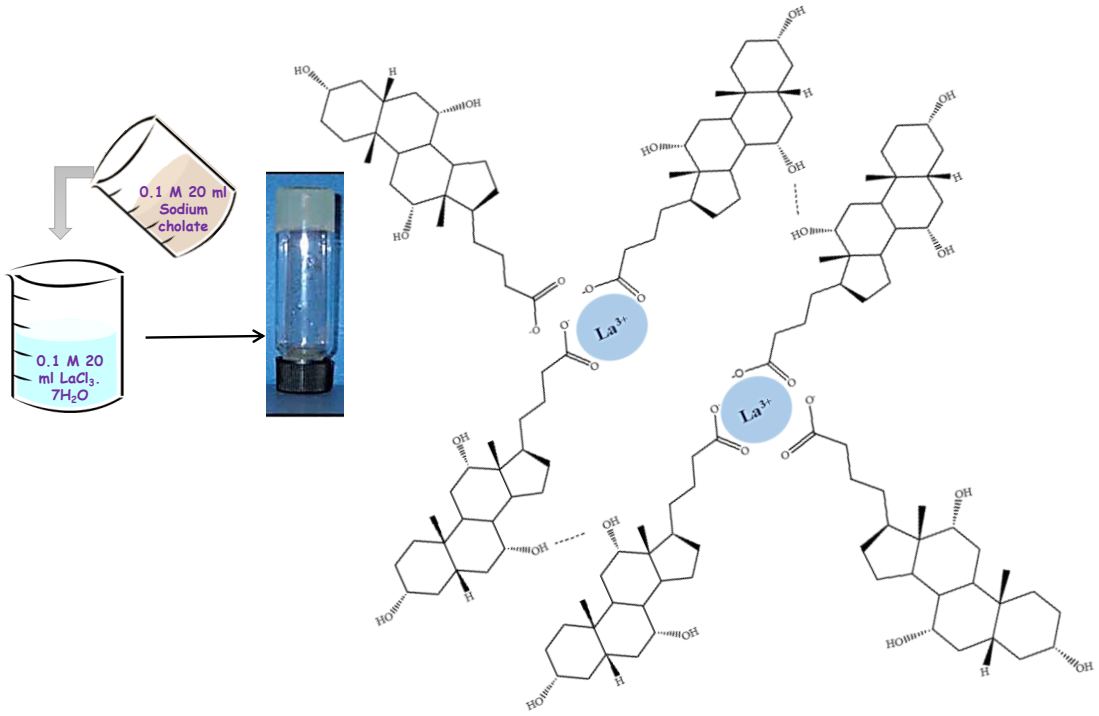
The second chapter (**Biochar from *Citrullus Lanatus*: Preparation, Characterization, and Adsorptive Potential**) describes the details of the synthesis of biochar from watermelon shell powder.



The fabricated biochars (i.e. 4PWMR, 6PWMR, 8PWMR) have been characterised by SEM (Scanning electron microscope), FTIR (Fourier transform infrared) spectroscopy , XRD (X-ray Diffraction) , BET surface area analysis, XPS (X-Ray photoelectron spectroscopy), TGA (Thermogravimetric analysis) etc. and have been applied for the removal of Fluoride and Methylene Blue

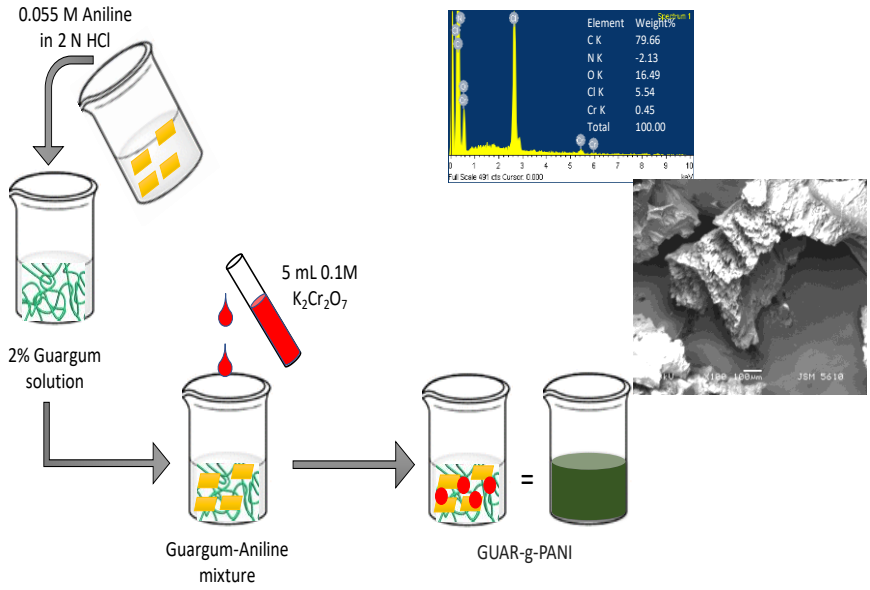
The conditions for their removal have been optimised and the mechanism of their removal has been studied using different isotherm and kinetic models. The adsorbents were also tested for their recyclability and their adsorption potential was compared with other adsorbents reported from literature.The adsorbents have been applied to real water and synthetic effluents.

The third chapter discusses the synthesis of lanthanum cholate and its potential to remediation of fluoride. The same have been characterised by SEM (Scanning electron microscope), FTIR (Fourier transform infrared) spectroscopy , XRD (X-ray Diffraction) , BET surface area analysis, XPS (X-Ray photoelectron spectroscopy), TGA (Thermogravimetric analysis) etc.

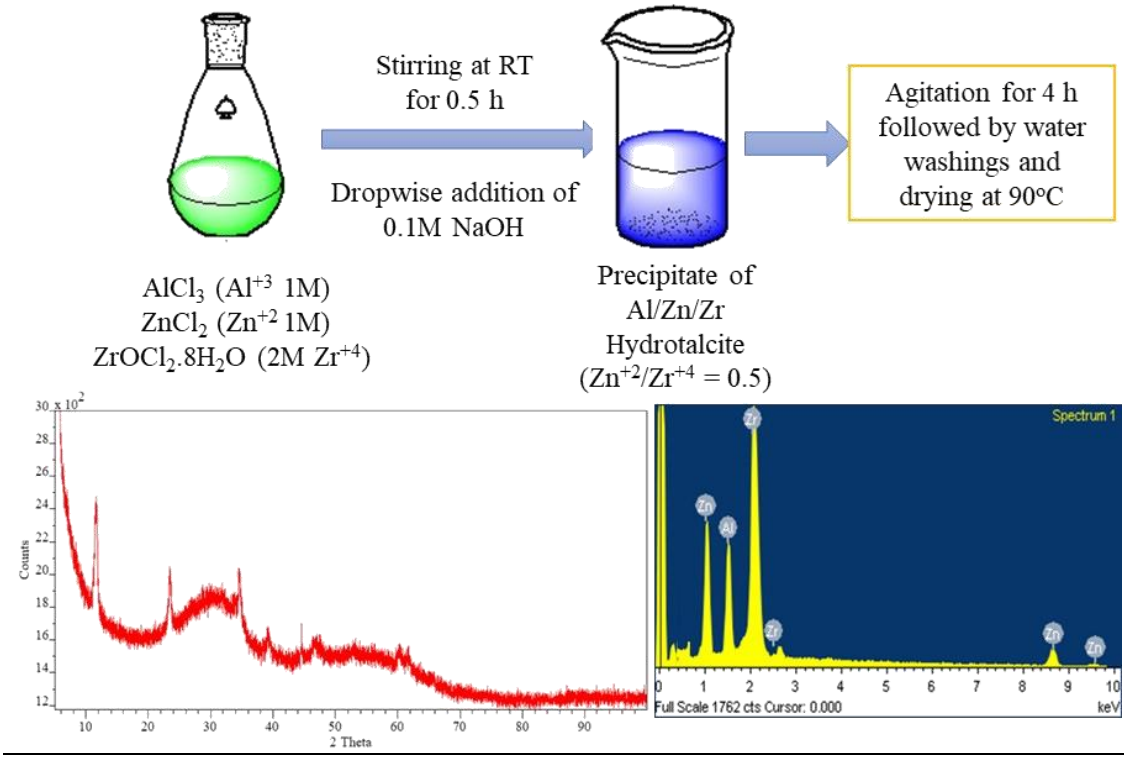


The conditions for their removal using lanthanum cholate have been optimised and the mechanism of their removal has been studied using different isotherm and kinetic models. The adsorbents were also tested for their recyclability and their adsorption potential was compared with other adsorbents reported from literature.

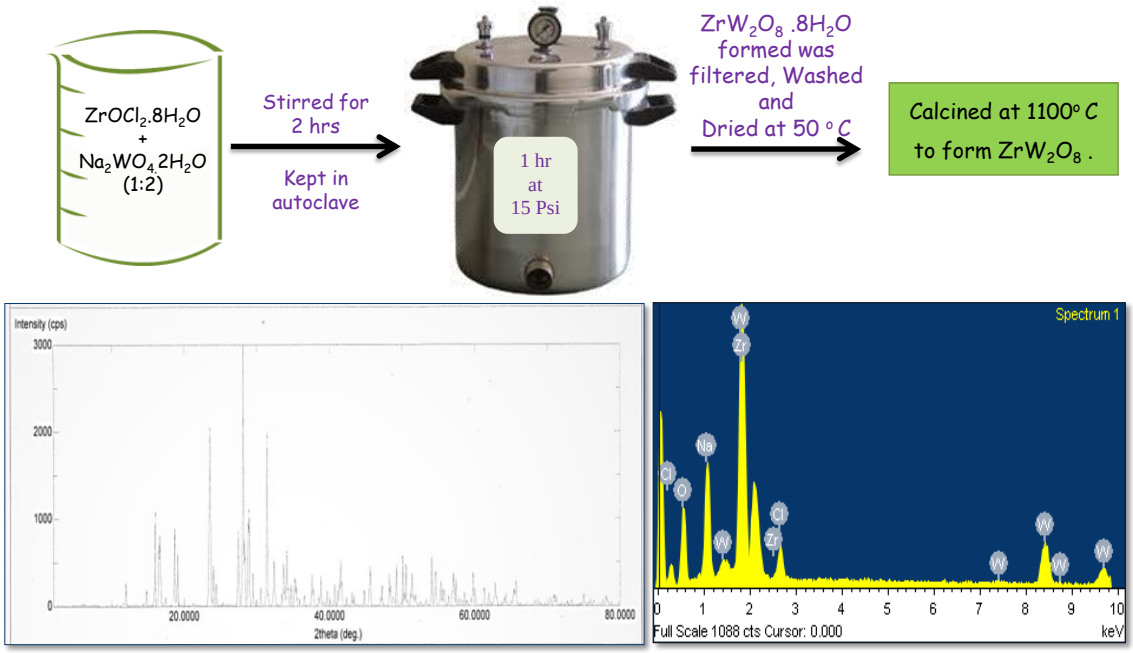
The chapter also briefs the Synthesis and characterization of polyaniline-guargum gel composites and investigation of its potential applications. The GG-PANI hydrogel was prepared by using Cr (VI) as an oxidant. The hydrogels are prepared using the different composition of the Guargum and $K_2Cr_2O_7$ concentration. The hydrogel formed by taking 0.055 M aniline, 2% w/v 50 mL Guargum solution is stiff in nature. The hydrogel was characterised by EDS-SEM (Scanning electron microscope), FTIR (Fourier transform infrared) spectroscopy, TGA, Zeta potential.



The fourth chapter are divided into two portions, the first describes synthesis and characterization of Al/Zr/Zn hydrotalcite (Zn^{+2}/Zr^{+4} = 0.5). The synthesized hydrotalcite was used for the fluoride remediation.

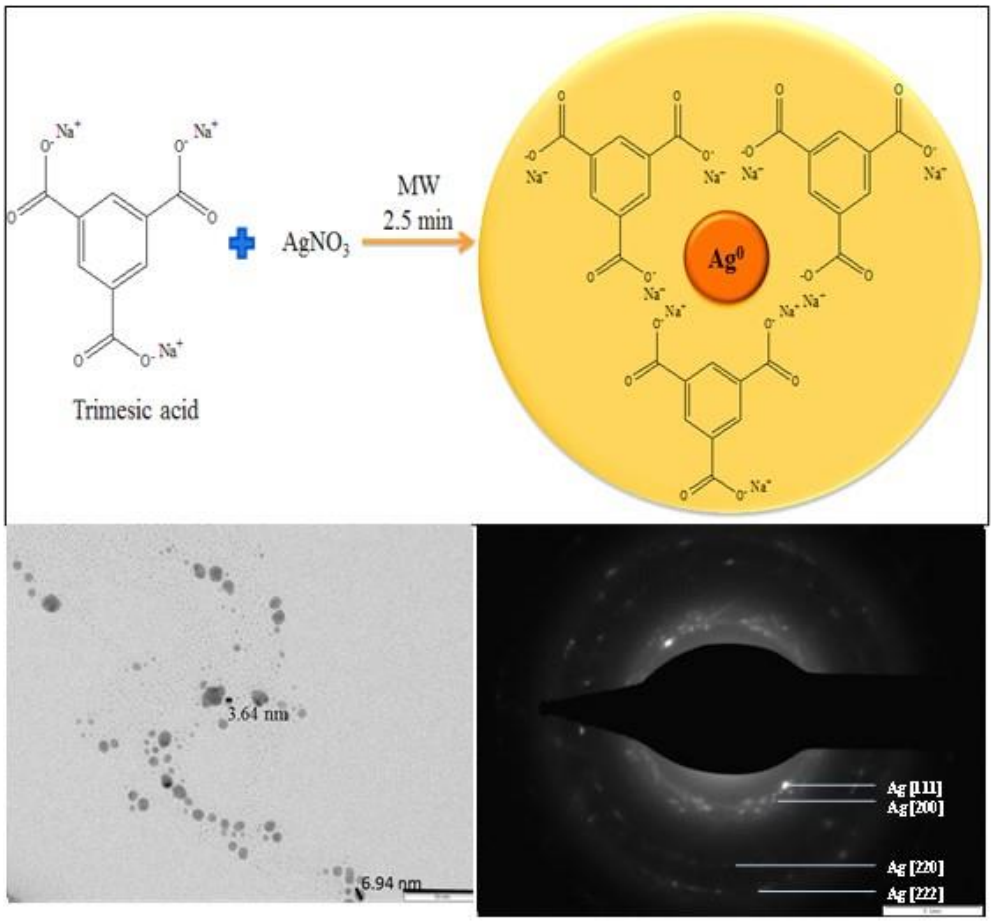


The second portion of this chapter describes the synthesis of zirconium tungstate. The ZrW have been characterised by EDS-SEM (Scanning electron microscope), FTIR (Fourier transform infrared) spectroscopy , XRD (X-ray Diffraction), TGA (Thermogravimetric analysis) etc.



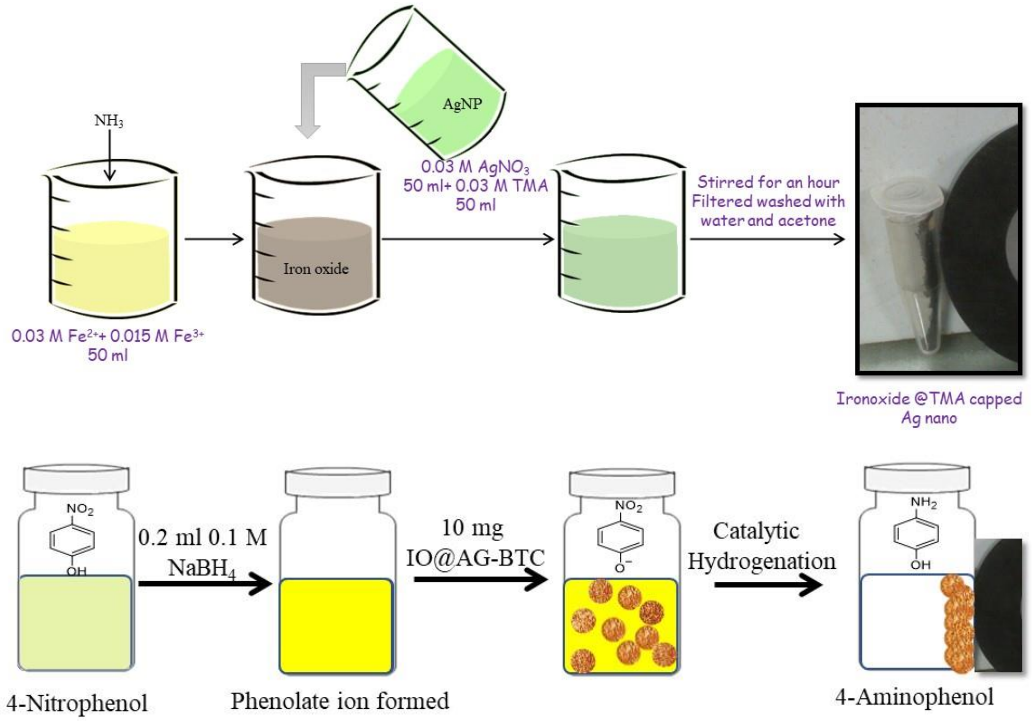
The fluoride adsorption using Hydrotalcite and the methylene blue adsorption using ZrW are carried and the experimental conditions for the same have been optimised. The mechanism of fluoride removal and methylene blue removal have been studied using different isotherm and kinetic models. The adsorption potential was compared with other adsorbents reported from literature.

The fifth chapter discusses the fabrication of Nanosilver MOFs for Catalytic Applications. Initially the Green Microwave Synthesis of Trimesic acid capped silver nanofluids is discussed. The formation of nano silver was established by using TEM (Transmission electron micrography), Raman spectroscopy, DLS (Differential light scattering).



The catalytic activity of trimesic acid capped Ag nanofluids was examined by reduction of Nitro derrivative (p-Nitroaniline, m-Nitroaniline, p-Nitrophenol) and Nitroso derrivatives (1-Nitroso-2-naphthol) into their amino derivatives using $NaBH_4$ and AgNPs. The kinetics of the catalytic reaction is studied, their rate constants were determined.

The latter part of this chapter evaluates Nano Magnetic Silver Metal Organic Framework composite as Catalyst for nitroarene reduction. The fabricated catalyst was characterized by TEM (Transmission electron micrography), Raman spectroscopy, DLS (Differential light scattering), EDS-SEM (Scanning electron microscope), FTIR (Fourier transform infrared) spectroscopy, XRD (X-ray Diffraction), VSM analysis, UV spectroscopy, Raman spectroscopy , ZPC, XPS.



The kinetics of the catalytic reaction was studied and their rate constants were determined. The recyclability of the catalysts was studied upto 9 cycle. The recycled catalyst obtained after cycle one to four each was characterized by EDS analysis**.**

The chapter six of the thesis summarizes the work presented in the thesis. Brief conclusions with future scope of the study are also included in this chapter.

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