Nanostructured materials including transition metal oxides have received significant interest in various advanced fields of science and technology. In order to produce new materials with improved activities, nanotechnology has been developing numerous methods to manipulate materials at the atomic level. In other word, the synthesis and characterization of nanomaterials continue to remain a thrust area of material science and chemistry.

The present thesis is concerned mainly with the synthesis and application of a few nanostructured 3d transition metal oxides. In addition to the synthesis, systematic investigations have been carried out to study the structural, electronic, magnetic and luminescence properties of the synthesized materials. These materials have been characterized by various physical techniques such as XRD, SEM, TEM, N2-sorption technique, UV-vis, IR and Raman spectroscopic techniques. Attempts have also been made to explore these nanostructured oxides as catalysts in several important reactions under heterogeneous condition.

The work embodied in this thesis has been divided into six chapters. Each chapter has its own introduction, results and discussion section, conclusion, experimental section and literature references.

The first chapter comprising of “General Introduction” gives an overview of nanomaterials. This ropes in the history of nanoscience and nanotechnology, preparative methods, characterization techniques and applications of nanomaterials including metal oxides. The aims and objectives of the present thesis have been outlined at the end of this chapter. The second chapter deals with the fabrication of CuO nanoparticles and their use in the catalytic epoxidation of styrene. The third chapter includes the synthesis of nanostructured iron(III) oxides with different phases and morphologies via a precursor method and studies on their magnetic properties. The fourth chapter discusses yet another facile method to synthesize of iron(III) oxide nanoparticles with different phases using ferric chloride as an iron source. The catalytic utility of these oxide nanoparticles in the
epoxidation of styrene also has been discussed in this chapter. In the fifth chapter, fabrication of Co$_3$O$_4$ and mesoporous silica (SBA-15 or MCM-48) supported Co$_3$O$_4$ have been discussed. Particulate gold has also been supported on Co$_3$O$_4$ and on SBA-15 along with cobalt oxide. SBA-15 supported composite materials have been examined both in the catalytic hydrogenation of cinnamaldehyde and epoxidation of styrene. Finally, in the last chapter (sixth chapter), we discussed the synthesis and characterization of both NiO and ZnO nanoparticles under different conditions. The catalytic application of NiO in the oxidation of limonene and the luminescence properties of ZnO samples have been discussed in this chapter.

Due acknowledgements have been made wherever the work described in the present thesis is based on the earlier findings of other researchers. Any omission might have occurred by error of judgment is regretted.

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