Electronic and structural studies of transition metal oxides

A Thesis

submitted

by

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Declaration by the Research Guide

This is to certify that the thesis entitled "**Electronic and structural studies of transition metal oxides**", submitted by Mr. Navneet Singh to the Indian Institute of Technology Mandi for the award of the degree of Doctor of Philosophy is a bonafide record of research work carried out by him under my supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

In keeping with the general practice of reporting scientific observation, due acknowledgements have been made wherever the work described is based on the findings of other investigators.

I.I.T. Mandi (H.P.) Research Guide
Date:

Declaration by the Research Scholar

This is to certify that the thesis entitled "**Electronic and structural studies of transition metal oxides**", submitted by me to the Indian Institute of Technology Mandi for the award of the degree of Doctor of Philosophy is a bonafide record of research work carried out by me under the supervision of Dr. Bindu Radhamany. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

In keeping with the general practice of reporting scientific observation, due acknowledgements have been made wherever the work described is based on the findings of other investigators.

I.I.T. Mandi (H.P.)
Date:

Signature of Research Scholar

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Affectionately

Dedicated

To

My

Loving family

Abstract

Interest in transition metal oxides has revived since the discovery of high T_c-superconductivity and colossal magnetoresistance. The observations of intrinsic inhomogenities in these systems have revolutionized the understanding of the complex phase diagram. The present thesis is focused on two different classes of materials namely perovskite based $La_{0.2}Sr_{0.8}MnO_3$ and quasi one dimensional Sr_3NiRhO_6 compounds. The thesis is aimed at understanding the fundamental issues associated with both class of compounds using synchrotron based high resolution x-ray diffraction technique, inverse photoemission technique and synchrotron based x-ray absorption spectroscopy.

Our results show that $La_{0.2}Sr_{0.8}MnO_3$ is structurally inhomogeneous in the nanometer scale for a wide temperature region which is an intrinsic property of the system. The coexisting phases are tetragonal which is orbital ordered, insulating and cubic which is charge ordered. From the results, it appears the possibility of metallicity associated with the cubic charge ordered state. In the insulating phase, we observed unusually an increased intensity at around the Fermi level in the low temperature inverse photoemission spectra. This puzzling behaviour is attributed to the shift in the chemical potential towards the conduction band and localisation of disorder induced states closer to the conduction band.

In the case of quasi one dimensional, Sr_3NiRhO_6 compound, using Ni and Sr K-edge synchrotron x-ray absorption spectroscopy, we have observed common behaviours associated with iso-structural compounds. There occurs onset of intra-chain and inter- chain magnetic interactions at temperatures much above the transition temperature and also the role played by direct *d-d* hybridization is less significant in determining the magnetic interactions.

The thesis is structured into 6 chapters. The first chapter gives details about the basic physics that is required to understand the materials under study. The chapter 2 deals with the details of the experimental techniques and computational tool that have been used for the data analysis. Chapters 3&4 discuss the results of the temperature dependent high resolution x-ray diffraction experiments and inverse photoemission experiments carried out on $La_{0.2}Sr_{0.8}MnO_3$. Chapter 5 discusses the results of the temperature dependent x-ray absorption experiments carried out on quasi one dimensional Sr_3NiRhO_6 compound. In Chapter 6, we summaries the results and discuss the future studies that can be done on the systems that have been studied in the thesis.

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