

UNIVERSITI TEKNOLOGI MARA

**REVIEW OF STRUCTURAL AND MAGNETIC
PROPERTIES IN SUBSTITUTED CHARGE ORDERED
MONOVALENT AND DIVALENT DOPED
MANGANITES**

NURUL NAJWA BINTI ABD AZIZ

**BACHELOR OF SCIENCE (Hons.) PHYSIC
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA**

AUGUST 2022

Author's Declaration

I declare that the work in this thesis was completed in accordance with the regulations of University Teknologi MARA. It is original and the results of my own work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Nurul Najwa Binti Abd Aziz
Student ID : 2019291634
Programme : AS203 – Bachelor of Science (Hons.) Physics
Faculty : Faculty of Applied Science
Title : Review of Structural and Magnetic Properties in Substituted
Charge Ordered Monovalent and Divalent Doped Manganites

Signature of Student :

Date : August 2022

Table of Content

Abstract	1
Introduction	2
Methodology	4
Structural Characterization.....	7
Magnetic properties.....	12
Application of Manganites.....	17
Conclusion.....	18
GANTT-CHART	19
References	20

Review of Structural and Magnetic Properties in Substituted Charge Ordered Monovalent and Divalent Doped Manganites

Nurul Najwa, Rozilah Rajmi

Faculty of Applied Science, University Teknologi MARA, Cawangan Perlis, Arau Perlis
02600, Malaysia.

Abstract

Perovskite manganites refer to a family of manganese compounds with a general composition of $AMnO_3$, where $A = La, Bi, Nd, Pr$, which crystallize in the perovskite structure named. This paper provides an overview of the state of the art in studies on fabrication, structural characterization, magnetic properties, and applications of monovalent and divalent doped charge ordered manganite. A throughout understanding of the effect of K^+ and Ba^{2+} substitution at A site while Cr^{3+} and Ni^{2+} substitution at B site in monovalent-doped and divalent-doped charge ordered manganite on magnetic properties. Firstly, a review begins with a brief introduction to the history of research and unusual findings in charge ordered manganite. In the second part, the different methods used for the fabrication of charge ordered manganite are summarized. Next, in the third part is the structural characterization of A site and B site are examined in more depth. Following that, the magnetic properties of A site and B site substitution on monovalent and divalent charge ordered manganites are reviewed more detail in fourth part. Based on previous studies, it has been proposed that the disorder induced by doping at both site and the magnetic exchange interaction between both site with doped ions play a key role in explaining the magnetic properties. In addition, the potential applications of charge ordered manganite are highlighted in the following parts. Finally, this review concludes with some perspectives and challenges for future research of charge ordered manganite. As conclusion, this review is more focused on structural and magnetic properties in substituted charge ordered monovalent and divalent doped manganites.

Keyword: Perovskite manganite, Charge ordered manganite, Fabrication methods, Structural characterization, Magnetic properties, A site and B-sites substitution.

Introduction

Perovskite manganites with general formula, $R_{1-x}A_xMnO_3$ where R is trivalent rare earth ion (La, Nd, Pr, Bi) and A is divalent (Ca, Sr, Ba) or it can be monovalent (Ag, Na, Li) (Razali et al., 2018). Half-doped perovskite manganese oxide has been thoroughly studied because of it exhibit a broad range of structural, electric, and magnetic properties, which are widely investigated and studied since the discovery of the colossal magnetoresistance (CMR) effect (Arifin et al., 2018; Razali et al., 2018; Yadav et al., 2012).

In addition, studies on this rare earth manganite have revealed that the CMR effect normally associated with a double exchange mechanism (DE) which involves interaction between pairs of Mn^{3+} and Mn^{4+} ions in monovalent and divalent compound (Asmira et al., 2018). The DE interaction, between Mn^{3+} and Mn^{4+} ion cannot be explained alone the behaviours observed in these systems. So, that's why it also has been suggested to be related with Jahn Teller (JT) and charge ordered (CO) (Coey et al., 1999; Elyana et al., 2018; Hébert et al., 2002). CO have gained considerable interest due to insulating and antiferromagnetic (AFM) behaviors which being exposed to external disturbances such as magnetic fields, doping levels, and changes in the ratio of Mn^{3+}/Mn^{4+} (Rao et al., 1998; Rozilah et al., 2019; Trabelsi, 2018).

Basically, the divalent CO concentration that has been reviewed is equal to 0.5 which at this state, the value of concentration Mn^{3+} and Mn^{4+} are equally same such as $Nd_{0.5}Ca_{0.5}MnO_3$ (Shamsuddin et al., 2013) and $Sm_{0.5}Ca_{0.5}MnO_3$ (H. Wang et al., 2020). Meanwhile for monovalent CO have concentration equal to 0.75 that gives the value of concentration Mn^{3+} and Mn^{4+} also has the same amount such as $La_{0.75}Ag_{0.25}MnO_3$ (Varshney et al., 2014) and $Pr_{0.75}Na_{0.25}MnO_3$ (Rozilah et al., 2017). The CO phenomenon is associated with interactions between charges, lattice, and degrees of orbital freedom whose amplitudes strongly depend on the size and ratio of the A site and B site (Yadav et al., 2009). The lattice, JT distortion and orbital ordering in the manganites are occurs at various of doping levels (Varshney et al., 2014). The doping concentration is the main factors that could affecting their physical properties (Y. Wang et al., 2021). It also along with electric and magnetic field-induced transitions (Lalitha et al., 2018). The basic idea behind stabilizing the state of CO in manganite is the competition between DE, super exchange (SE) (Smari et al., 2014; Swain & Gorige, 2019; Yadav et al., 2009), and AFM transition (Liu et al., 2006). It is between core