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INFLUENCE OF A-SITE SUBSTITUTION ON STRUCTURAL, ELECTRICAL RESISTIVITY AND MAGNETIC PROPERTIES IN La-BASED MANGANITE SYSTEM: A REVIEW

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Influence of A-site substitution on Structural, Electrical Resistivity and Magnetic Properties in La-based manganite system: A review

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Abstract

Perovskite manganite has received attention and been studied extensively for its characteristics and application in technology nowadays. Thus, a throughout understanding of the influence of A-site substitution on electrical resistivity and magnetic properties in La-based manganite has been discussed in this work. This paper provides an overview of current research on the fabrication, structural characterization, and physical properties of perovskite manganite at A-site substitution. Our review begins with a brief overview of the research history and significant findings in the La-based manganite system. In the next section, several methods for fabricating some samples that contain La-based are summarized. Furthermore, structural characterization and multifunctional properties of A-site substitution in La-based manganite system are discussed in detail. Then, the effect of A-site substitution on electrical resistivity and magnetic properties on manganite are reviewed. Finally, potential applications of A-site substitution in La-based manganite are highlighted in the sectors of magnetic sensor, magnetic refrigeration, and photonic devices.

Keywords: *Manganite, A-site substitution, Fabrication methods, Structural characterization, Electrical and magnetic properties*

Introduction

Manganites are materials that are comprised of manganese and have become a popular topic of study in last few years (Zeydi et al., 2019). The general formula of perovskite-type manganite is $RE_{1-x}A_xMnO_3(ABO_3)$ (Cheng et al., 2019; Pandya et al., 2017), where RE represents a trivalent rare earth element (La^{3+}, Sm^{3+}, Nd^{3+}, Pr^{3+}, etc.) and A stands for divalent alkali earth element (Ba^{2+}, Ca^{2+}, Sr^{2+}, Pb^{2+}, etc.) (Denbri et al., 2021; Xia et al., 2018). In this paper, we have focused on La-based as a rare earth element, and the formula became $La_{1-x}A_xMnO_3$. In recent years, ABO_3 type perovskite manganites got so much attention because of the development of colossal magnetoresistance on their materials (Alresheedi et al., 2020; Walha & Dhahri, 2017; Zeydi et al., 2019) and have a wide range of features, particularly their magnetic structures, phase separation (Fan, Xie, Yang, et al., 2019), charge ordering phenomena (Elyana et al., 2018; Trabelsi, 2018), metal-insulator transition (MI) (Fan, Xie, Zhu, et al., 2019), etc. that allowed scientists to reconsider the investigation of such materials (Mohamed, 2017). Some of these features result from interactions such as double exchange (DE) between Mn^{3+} and Mn^{4+} (Asmira et al., 2018a; Zhao et al., 2017a), which favor the ferromagnetic metallic (FMM) state and Jahn-Teller interaction with Mn^{3+} ions and favor the paramagnetic insulating (PMI) state (Rozilah et al., 2017). However, $La_{1-x}A_xMnO_3$ manganite has promising applications in a variety of fields, including magnetic storage, magnetic sensor, magnetic refrigeration, spin-valve device, photonic devices, and bolometer infrared (IR) detector, due to its extreme sensitivity to external pressure, magnetic field, temperature, light, and electricity (Liu et al., 2019; Zhao et al., 2017b).

Before going further, we studied the basic knowledge of tolerance factor in manganite system since it is very important term in this paper which is to indicate the degree of lattice matching between the A-O layer and its neighboring B-O layers, which reflects the degree of distortion. In order to verify the structural stability of the sample, tolerance factor (τ) was be calculated as, $\tau = (\langle r_A \rangle + \langle r_o \rangle)/\sqrt{2}\,(\langle r_B \rangle + \langle r_o \rangle)$ where $\langle r_A \rangle$, $\langle r_B \rangle$ and $\langle r_o \rangle$ are the ionic radii of A, B, and O site atoms in ABO_3, respectively (Asmira et al., 2018b; Modi et al., 2017; Rozilah et al., 2019; Tozri & Dhahri, 2019; Zarifi et al., 2017). A cubic perovskite structure is formed at value near to unity ($\tau \approx 1$), which corresponds to minimal deformation and a well-aligned Mn^{3+}-O-Mn^{4+} link. Because of the increasing distortion, a decrease in τ indicated an increase in mismatch between the A-O and B-O layers (Rozilah et al., 2017).