ELECTRICAL TRANSPORT ANALYSIS OF Cr^{3+} SUBSTITUTION AT THE Mn SITE OF DIVALENT-DOPED $La_{0.5}Ca_{0.5}Mn_{1-x}Cr_xO_3$ (x = 0, 0.03, 0.05) MANGANITE USING SCATTERING AND HOPPING MODELS

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This Final Year Project Report entitled "**Electrical transport analysis of Cr^{3+} substitution at the Mn site of divalent-doped $La_{0.5}Ca_{0.5}Mn_{1-x}Cr_xO_3$ (x = 0, 0.03, 0.05) manganite using scattering and hopping models"** was submitted by Mohammad Aidil Ikhwan Bin Zulkifli in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons) Physics, in the Faculty of Applied Science, and was approved by

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ABSTRACT

Electrical transport analysis of Cr^{3+} substitution at the Mn site of divalent-doped $La_{0.5}Ca_{0.5}Mn_{1-x}Cr_xO_3$ (x = 0, 0.03, 0.05) manganite using scattering and hopping models

The study focusses on Cr^{3+} substitution at the Mn-site of divalent-doped $La_{0.5}Ca_{0.5}Mn_{1-x}Cr_xO_3$ (x = 0, 0.03, 0.05) on the electrical transport properties. The samples were successfully synthesised by the conventional solid-state reaction method. The resistivity behaviour over a wide temperature range was studied. The electron transport mechanism in metallic region ($T<T_{MI}$) was analysed using scattering model. The experimental data in the metallic region is best fitted with the scattering models $\rho = \rho_0 + \rho_2 T^2 + \rho_{4.5} T^{4.5}$ suggested scattering involving grain boundary, electron-electron, and electron-magnon interaction. The fitted value of the parameter was observed to be decrease upon increasing Cr^{3+} content. The resistivity in metallic area was observed to be lower at higher Cr^{3+} substitutions and this may be attributed to the formation of double exchange interaction of Mn^{3+}-O-Cr^{3+} and Mn^{3+}-O-Mn^{4+}. The resistivity behaviour in the metallic region was dominated by the domain or grain boundary resistivity. In insulating region ($T>T_{MI}$), the small polaron hopping model with equation $\rho(T) = BT\, e^{\frac{E_a}{K_B T}}$ was used to analyse the electron transport mechanism. The findings show that the presence of Cr^{3+} substitution enhances the activation energy resulted from enhanced Jahn-Teller lattice distortion, causes the polarons to localise. The combined findings show the complex competition between structural and electrical parameters in Cr-substituted manganites. These findings contribute to a deeper understanding of the transport phenomena in substituted manganite and their potential in electronic and spintronic applications.

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