

List of Figures

Figure No.	Captions	Page No.
Figure 1.1:	Ideal ABO_3 perovskite unit cell representing “A” atoms at (0, 0, 0) or (1/2, 1/2, 1/2), the “B” atoms (1/2, 1/2, 1/2) or (0, 0, 0) and “O” atoms at (0, 1/2, 1/2) or (1/2, 0, 0) positions in cubic lattice.	3
Figure 1.2:	Typical magnetic hysteresis loop (M-H) for ferromagnetic materials [after Cullity (1972)].	10
Figure 1.3:	Different types of magnetic lattice arrangements resulting in different type (A, C, G and E-type) antiferromagnetic ordering [drawn using the convention of Wollen et al. (1955)].	11
Figure 1.4:	Schematic presentation of saturation magnetization (M_s or σ_s) and the inverse magnetic susceptibility (χ^{-1}) for diamagnetic, paramagnetic, ferromagnetic antiferromagnetic and ferrimagnetic substances [after Cullity et al. (2008)].	13
Figure 1.5:	Schematic representation of Bathe-Slater curve, here, ‘a’ is the atomic radius and r is the radius of its 3d orbital where electrons are present [after Cullity (1972)].	15
Figure 1.6:	The coefficient of RKKY versus the inter-atomic distance r [after Rutheman et al. (1954)].	16
Figure 1.7:	Schematic representation of (a) DE interaction among Mn^{4+} and Mn^{3+} cations and (b) SE interaction among Mn^{3+} and Mn^{3+} cations through O^{2-} anion [Zener (1951)].	18
Figure 1.8:	Crystal-field splitting of the five-fold degenerate atomic 3d levels into higher e_g (doubly degenerate) and lower t_{2g} (triply degenerate) levels. The JT distortion of the octahedron of MnO_6 further lifts each-degeneracy [after Tokura (2006)].	19
Figure 1.9:	(a) Diagram showing charge ordering of Mn^{4+} and Mn^{3+} cations in a mixed-valence manganite ($R_{1-x}A_xMnO_3$) with $x = 0.5$, (b) Orbital ordering of the $d_{3z^2-r^2}$ orbitals of Mn^{3+} with $x = 0$, (c) collective charge and orbital orderings for $x = 0.5$ [after Rao et al. (2000)].	22
Figure 1.10:	Colossal magnetoresistance (CMR) behavior for the $La_{2/3}Ca_{1/3}MnO_3$ single crystal [after Tokura (2006)].	24
Figure 1.11:	GMR materials are prepared from alternate layers of	26

magnetic and non-magnetic metals having the thickness in nanometers scale; (a) antiferromagnetic and (b) ferromagnetic spin arrangement [drawn using the convention of Binasch et al. (1989)].

- Figure 1.12:** Magnetic phase diagrams for $\text{Nd}_{1-x}\text{Ba}_x\text{MnO}_3$ manganites series. F = ferromagnet, A = weak ferromagnet, ACl = antiferromagnetic clusters, FCl = ferromagnetic clusters [after Troyanchuk et al. (1999)]. **28**
- Figure 1.13:** The magnetic phase diagram along with electrical behavior for polycrystalline samples of two $\text{Nd}_{1-x}\text{Ba}_x\text{MnO}_{3-\delta}$ manganites. Solid symbols show the sample prepared in the air, and that synthesized in a reducing medium, by hollow symbols. AI = AFM semiconductor, FI = FM semiconductor, FM = FM metal and PI = PM semiconductor [after Trukhanov et al. (2002)]. **29**
- Figure 1.14:** RT powder XRD patterns of NBMO-30 NPs having particle size 20, 25 and 41 nm. The inset shows the Rietveld fit of XRD data of the sample having particle size 33 nm [after Roy et al. (2008)]. **31**
- Figure 1.15:** The temperature dependence of ZFC and FC dc magnetizations of NBMO-30 NPs. The inset shows plots between dM/dT and T [after Roy et al. (2008)]. **32**
- Figure 1.16:** Field dependent magnetization of NBMO-30 NPs with 20 nm size measured at various temperatures ($25 \text{ K} \leq T \leq 250 \text{ K}$). Top inset displays the virgin $M(H)$ plots, and the bottom inset shows the unsaturation of magnetization at 5 K [after Roy et al. (2008)]. **33**
- Figure 1.17:** Temperature dependent (a) real $\chi'(T)$ and (b) imaginary part $\chi''(T)$ of ac-susceptibility for NBMO-30 sample with a particle size of 20 nm measured at 4 Oe ac field for different frequencies. The inset of (b) demonstrates the $\log(\tau)$ vs. $\log[(T_f - T_g)/T_g]$ plot with the best linear fit [after Roy et al. (2008)]. **34**
- Figure 1.18:** Magnetic field dependent variation in MR for NPs of NBMO-30 with the particle size (a) 20 nm and (b) 25 nm measured at different temperatures [after Roy et al. (2008)]. **35**
- Figure 1.19:** Unit-cell parameters of $\text{La}_{1-x}\text{Ba}_x\text{MnO}_3$ for $0 \leq x \leq 0.5$ [T = tetragonal, R = rhombohedral, C = cubic] (after Ju et al. (2000)). **36**
- Figure 1.20:** The magnetic phase diagram of LBMO as a function of Ba^{2+} -ion doping concentration (x) and temperature (T) [FI **37**

	= FM insulator, FM = FM metal, and FMP = FM multiphase (after Ju et al. (2000))].	
Figure 1.21:	The doping concentration dependence of the saturation magnetization M_s for LBMO obtained at $T = 5$ K. T = tetragonal, R = rhombohedral, C = cubic and U = unidentified phase [after Ju et al. (2000)].	38
Figure 1.22:	(a) Magnetic entropy change as a function of temperature and (b) the RCP values as a function of applied magnetic field for LBMO-40 manganite [after Hussain et al. (2016)].	39
Figure 1.23:	RT XRD patterns for the LSMTO ($0 \leq x \leq 0.5$) thin films on LaAlO_3 (LAO) substrates. The Bragg's peaks indicated by letter "s" correspond to the substrates. Inset (a) displays the zoomed XRD patterns between $2\theta = 45^\circ - 50^\circ$ of the films, and the inset (b) indicates variation in lattice constant vs. Ti^{4+} content [after Zhu et al. (2006)].	41
Figure 1.24:	The magnetic field dependent magnetic hysteresis of LSMTO films at room temperature [after Zhu et al. (2006)].	42
Figure 1.25:	Temperature dependence of MR at different fields (0.5 T and 3 T) of LSMTO films for (a) $x = 0$, (b) $x = 0.05$, (c) $x = 0.1$ and (d) $x = 0.3$ [after Zhu et al. (2006)].	43
Figure 1.26:	Structural parameters (lattice parameters and average bond length between Mn/Ti-O) acquired from the Rietveld analysis of the XRD profiles as a function of the doping concentration of Ti^{4+} -ion (x) for $\text{La}_{0.67}\text{Ba}_{0.33}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0 \leq x \leq 0.3$) manganites [after Gasmi et al. (2009)].	44
Figure 1.27:	Compositions dependence of the magnetization recorded at a constant magnetic field $H = 500$ Oe as a function of temperature for $\text{La}_{0.67}\text{Ba}_{0.33}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0 \leq x \leq 0.3$) perovskites [after Gasmi et al. (2009)].	45
Figure 1.28:	Magnetic field dependence of magnetization measured at 50 K for $\text{La}_{0.67}\text{Ba}_{0.33}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0 \leq x \leq 0.3$) manganites [after Gasmi et al. (2009)].	45
Figure 1.29:	Temperature dependent of $M_s(T)$ and $\chi_0^{-1}(T)$ data for $\text{La}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with (a) $x = 0.05$, (b) $x = 0.1$ [after Ho et al. (2016)].	47
Figure 1.30:	Temperature dependent magnetization for $\text{La}_{0.46}\text{Sr}_{0.54}\text{Mn}_{1-x}\text{Cr}_x\text{O}_3$ ($0 \leq x \leq 0.08$) manganites measured at $H = 50$ Gauss under ZFC and FC conditions [after Dho et al. (2002)].	49

Figure 1.31:	(a) The temperature dependent variation of the ac magnetic susceptibility recorded at various frequencies for $\text{La}_{0.46}\text{Sr}_{0.54}\text{Mn}_{0.98}\text{Cr}_{0.02}\text{O}_3$ manganite collected at $H_{ac} = 10$ G. The inset displays the best linear fits of the $\chi'(T)$ and $\chi''(T)$ data. (b) Magnetic phase diagram between temperature and Cr-doping concentration (x) for $\text{La}_{0.46}\text{Sr}_{0.54}\text{Mn}_{1-x}\text{Cr}_x\text{O}_3$ manganites [after Dho et al. (2002)].	50
Figure 1.32:	Magnetic phase diagram for $\text{La}_{0.7}\text{Sr}_{0.3}\text{Mn}_{1-x}\text{Co}_x\text{O}_3$ perovskites, where, P = PM phase; FMM = metallic FM phase; FMI = insulating FM phase; AFC + FMC = ion-ordered phase consisting of AFM and FM clusters; and SG = spin glass [after Troyanchuk et al. (2017)].	51
Figure 1.33:	Field dependence of the magnetization for $\text{La}_{0.7}\text{Sr}_{0.3}\text{Mn}_{1-x}\text{Co}_x\text{O}_3$ perovskites at $T = 10$ K [after Troyanchuk et al. (2017)].	52
Figure 2.1:	Schematic diagram of process for the synthesis of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0.0 \leq x \leq 0.50$) perovskite manganites.	67
Figure 2.2:	The room temperature XRD patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{MnO}_3$ manganite calcined at various temperatures.	68
Figure 2.3:	The room temperature XRD patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0.0 \leq x \leq 0.50$) perovskite manganites prepared at optimized temperatures	68
Figure 2.4:	(a) XRD pattern and its (b) Rietveld fit for NBMO-30 calcined at 1200°C . (c) Variation of crystallite size and lattice strain with calcination temperature. (d) Variation in unit cell volume with crystallite size.	69
Figure 2.5:	Room temperature XRD patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganite with $x = 0.10$ calcined at several temperatures from 800 to 1100°C .	70
Figure 2.6:	Schematic presentation of process for the synthesis of $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0.0 \leq x \leq 0.20$) perovskite manganites.	74
Figure 2.7:	Room temperature XRD patterns of $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ with $x = 0, 0.02, 0.04, 0.06, 0.08$ and 0.20 calcined at 1300°C temperature.	75
Figure 2.8:	(a) Rietveld fit for XRD pattern of $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ with $x = 0$ calcined at 1300°C temperature. (b) Variation in unit cell volume for $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ as a function of Ti^{4+} -doping concentration (x).	75

- Figure 3.1:** The scanning electron microscopic (SEM) images of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ perovskite manganites for (a) $x = 0$, (b) $x = 0.05$, (c) $x = 0.10$, (d) $x = 0.15$, (e) $x = 0.20$, (f) $x = 0.25$ and (g) $x = 0.30$. **82**
- Figure 3.2:** The energy dispersive X-ray spectroscopy (EDS) spectra of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites for (a) $x = 0$, (b) $x = 0.05$, (c) $x = 0.10$, (d) $x = 0.15$, (e) $x = 0.20$, (f) $x = 0.25$ and (g) $x = 0.30$. **84**
- Figure 3.3:** Room temperature X-ray diffraction patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ for $x = 0, 0.05, 0.10, 0.15, 0.20, 0.25$ and 0.30 . **87**
- Figure 3.4:** Rietveld fits for the XRD patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ compounds using orthorhombic *Imma* space group (a) $x = 0$, (b) 0.05 , (c) 0.10 , (d) 0.15 , (e) 0.20 , (f) 0.25 and coexistence of tetragonal *I4/mcm* and *P4mm* space groups (g) 0.30 . **89**
- Figure 3.5:** Variation of (a) lattice parameters and (b) unit cell volume with Ti^{4+} -ions doping concentration (x) for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ with $0 \leq x \leq 0.30$. Here, a_o , b_o , and c_o correspond to the lattice parameters for orthorhombic structure and a_T , b_T , and c_T for tetragonal structure. **90**
- Figure 3.6:** Ball and stick models for (a) *Imma* ($x < 0.30$), (b) *I4/mcm* ($x = 0.30$) and (c) *P4mm* ($x = 0.30$) space groups. **91**
- Figure 3.7:** (a) Temperature dependence of χ_{ZFC} (close symbol) and χ_{FC} (open symbol) for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ compounds with $0 \leq x \leq 0.30$. (b) dM/dT curves as a function of T for $x = 0, 0.05$ and 0.10 . (c) Exponential variation of T_C as a function of doping concentration of Ti^{4+} -ion. Inset shows low-temperature zoomed view of $\chi_{ZFC/FC}$ for $x = 0.20, 0.25$ & 0.30 . (d) Temperature dependent variation in irreversible magnetization. **95**
- Figure 3.8:** (a) and (c) Temperature dependent inverse dc susceptibility of NBMT0 manganites with $0 \leq x \leq 0.30$. The dots indicate the experiment data while solid lines indicate the linear fit. (b) Variation of experimental value of $\mu_{\text{eff}}^{\text{exp}}$ (μ_B) as a function of Ti-doping content for NBMT0 with $0 \leq x \leq 0.30$. **97**
- Figure 3.9:** (a-c) Magnetic hysteresis curves for NBMT0 manganites with $0 \leq x \leq 0.30$ at different temperatures. Inset shows low-field zoomed view of $M(H)$ curves. Variation of (d-e) experimental and (f) theoretical saturation moments with doping concentration of Ti^{4+} -ion. **101**

- Figure 3.10:** Isothermal Arrott's plots (M^2 vs. H/M) for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with (a) $x = 0$, (b) $x = 0.05$, (c) $x = 0.10$, (d) $x = 0.15$, (e) $x = 0.20$, (f) $x = 0.25$ and (g) $x = 0.30$. **105**
- Figure 3.11:** Temperature dependence of (a-d) real component $\chi'(T)$ and (e-h) imaginary part of ac-susceptibility $\chi''(T)$ for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ compounds with $x = 0, 0.10, 0.20$ and 0.30 measured during cooling for ac magnetic field amplitude at different frequencies. Insets of the left channel show the low-temperature view of real part $\chi'(T)$ of ac-susceptibility. **108**
- Figure 4.1:** HR-SEM micrographs of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites for (a-b) $x = 0.40$ and (c-d) $x = 0.50$ taken into two different regions. The energy dispersive X-ray spectroscopy (EDS) spectra of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ for (e-f) $x = 0.40$ and (g-h) $x = 0.50$ showing presence of elements in nominal compositions. **116**
- Figure 4.2:** (a) Room temperature XRD patterns for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganite with $x = 0.50$ calcined at $1200, 1300$ and 1350°C in the 2θ range 20° - 120° ; the asterisk (*) show the impurity peaks of BaMnO_3 and Mn_3O_4 . (b) Room temperature XRD patterns for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with $x = 0.40$ and 0.50 calcined at 1350°C . The inset of (b) shows selected XRD profile between 39° - 41° showing that peak(s) $(112)_B/(200)_B$ shifting towards lower angle side and peak $(110)_T$ towards higher angle side. **118**
- Figure 4.3:** Rietveld fits for the XRD patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ compounds, (a) $x = 0.40$ and (b) 0.50 . Dots indicate the experimental data and the calculated data is the continuous curve, overlapping them. The lowest curve shows the difference between experimental and calculated XRD patterns. The vertical bars indicate the expected Bragg's reflection positions. The upper vertical bars indicate the Bragg's position for $I4/mcm$, while lower for $P4mm$. (c) and (d) Ball and Stick models for the unit cell of $I4/mcm$ and $P4mm$ space groups for the sample with $x = 0.40$, respectively. **120**
- Figure 4.4:** Structural phase diagram for $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($0 \leq x \leq 0.50$) manganites. **121**
- Figure 4.5:** (a) The temperature dependence of zero field cooled M_{ZFC} and field cooled M_{FC} magnetization of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ ($x = 0.40, 0.50$). Inset to (a) shows zoomed view of $M(T)$ curves at low-temperatures for $x =$ **123**

- 0.40. (b) The difference between M_{FC} magnetization and M_{ZFC} as a function of temperature. Inset shows the temperature dependence of derivative dM_{ZFC}/dT curves for $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ ($x = 0.40, 0.50$).
- Figure 4.6:** (a) and (b) Temperature dependence of dc inverse susceptibility of $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ ($x = 0.40, 0.50$) in ZFC mode showing PM-FM phase transition near T_C . The straight line Curie-Weiss fit to experimental data is shown in (a) while (b) shows fits using power law. **125**
- Figure 4.7:** (a) The field dependence of magnetization $M(H)$ of $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ ($x = 0.40, 0.50$) in ZFC mode at 10 K in the magnetic field of $-60 \text{ kOe} \leq H \leq +60 \text{ kOe}$. The inset of (a) shows the enlarged view of $M(H)$ curves. (b) Isothermal Arrott's plots (M^2 vs. H/M). Inset of (b) shows the enlarged view of M^2 vs. H/M curves. **127**
- Figure 4.8:** Temperature dependence of in-phase part ac susceptibility $\chi'_{ac}(T)$ of $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ for (a) $x = 0.40$ and (b) $x = 0.50$ measured during cooling with ac field at 100 Hz and 700 Hz. The respective insets show the enlarged view of $\chi'_{ac}(T)$ of ac susceptibility. The temperature dependence of out of phase part ac susceptibility $\chi''_{ac}(T)$ of $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ for (c) $x = 0.40$ and (d) $x = 0.50$ measured during cooling with ac field at 100 Hz and 700 Hz. The respective insets show the enlarged view of $\chi''_{ac}(T)$ of ac susceptibility. **129**
- Figure 4.9:** Variation of temperature dependent resistivity (a-b) and conductivity (c-d) for $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ perovskites with $x = 0.40$ and $x = 0.50$, respectively. **130**
- Figure 4.10:** Variation of frequency dependent dielectric constant (a-b) and dielectric loss (c-d) for $Nd_{0.7}Ba_{0.3}Mn_{1-x}Ti_xO_3$ manganites with $x = 0.40$ and $x = 0.50$, respectively. Inset of (a) shows artifact due to high conductivity losses giving negative dielectric constant for $x = 0.40$. **132**
- Figure 5.1:** (a) Room temperature XRD patterns of $Nd_{0.7}Ba_{0.3}Mn_{0.9}Ti_{0.1}O_3$ manganite calcined at various temperatures ($\# = BaMnO_3$; $* = Mn_3O_4$). (b) Variation in unit cell volume as a function of particle size. **139**
- Figure 5.2:** The Rietveld fits between observed and calculated XRD patterns for (a) C8, (b) C9, (c) C10 and (d) C11 samples of NBMTO-10 manganite. **140**
- Figure 5.3:** Williamson-Hall plots for the samples (a) C8, (b) C9, (c) C10, and (d) C11. Variation in (e) crystallite and particle sizes estimated using D-S & W-H methods and HRSEM **143**

micrographs and (f) lattice strain, as a function of calcination temperature.

- Figure 5.4:** HR-SEM micrographs for NBMTO-10 manganite calcined at (a) 800°C, (b) 900°C, (c) 1000°C and (d) 1100°C. **144**
- Figure 5.5:** The EDS spectra for NBMTO-10 manganite calcined at (a) 800°C, (b) 900°C, (c) 1000°C, and (d) 1100°C. **145**
- Figure 5.6:** (a) Temperature dependence of magnetization curves and (b) dM/dT plots for NBMTO-10 manganite calcined at various temperatures. (c) Variation of Curie temperature (T_C) as a function of calcination temperature. (d) Temperature-dependent inverse dc molar susceptibility for NBMTO-10 manganite. **147**
- Figure 5.7:** (a-d) Inverse of magnetic dc susceptibility for C8, C9, C10 and C11 samples of NBMTO-10 manganite. The straight line fits for the two different linear regions were done by using Curie-Weiss law. **149**
- Figure 5.8:** Ordering of the spins in (a) Griffith's phase region ($T_C \leq T \leq T_G$) and (b) below FM transition ($T \leq T_C$). **150**
- Figure 5.9:** (a) Temperature dependent inverse dc susceptibility for C8 sample and (b) log-log plot between $\chi^{-1}(T)$ and reduced temperature (t) for C8 to estimate critical exponent λ_{GP} . **151**
- Figure 5.10:** (a) Magnetic hysteresis loops for C8, C9, C10 and C11 at 10 K. Variation in (b) M_s and M_{max} at 60 kOe and (c) saturation moment at 10 K as a function of particle size. (d) Arrott's plots for C8, C9, C10 and C11 samples at 10 K. **153**
- Figure 5.11:** Temperature-dependent real part (a)-(d) and imaginary part (e)-(h) of ac susceptibility for the samples C8, C9, C10, and C11 measured at different frequencies, respectively. **156**
- Figure 5.12:** Variation in freezing temperature as a function of frequency for (a) C8, (b) C9, (c) C10 and (d) C11. (e) A plot between $\log_{10}f$ and T_f for NBMTO-10. (f) Variation in the value of T_f at zero frequency ($f = 0$) with respect to calcination temperature. **158**
- Figure 5.13:** Temperature dependent XRD profiles for bulk sample of NBMTO-10 manganite measured at various temperatures. Selected Bragg's peaks for (c) (101), (d) (121), and (220) reflections corresponding to orthorhombic cell. **159**

Figure 5.14:	Rietveld fits for the XRD patterns of $\text{Nd}_{0.7}\text{Ba}_{0.3}\text{Mn}_{0.9}\text{Ti}_{0.1}\text{O}_3$ manganite measured at (a) 300 K and (b) 1300 K. (c) Variation in unit cell volume as a function of temperature.	160
Figure 6.1:	(a) RT powder XRD patterns for LBMO-40 manganites calcined at 900 and 1300°C temperatures. (b) A representative W-H plot for the nano sample of LBMO-40 manganite. Rietveld fits for (c) nano and (d) bulk samples of LBMO-40 manganite.	166
Figure 6.2:	(a-b) MnO_6 octahedra for nano and bulk LBMO-40 manganite showing Mn-O bond lengths for each, respectively. (c) Schematic Ball and Stick unit cell for LBMO-40 manganite.	167
Figure 6.3:	(a-b) High resolution scanning electron microscopy (HR-SEM) images and (c-d) Energy dispersive X-ray spectroscopy (EDS) spectra for nano and bulk samples of $\text{La}_{0.6}\text{Ba}_{0.4}\text{MnO}_3$ manganites, respectively.	168
Figure 6.4:	(a) Temperature dependence ZFC and FC magnetization curves, (b) dM_{ZFC}/dT vs. T plots and (c) variation of irreversible magnetization as a function of temperature for nano and bulk samples of LBMO-40 manganite. Inset of (c) indicates zoomed view of the irreversible magnetization near T_C .	171
Figure 6.5:	(a) & (c) Variation of inverse dc molar susceptibility as a function of temperature for nano and bulk samples of LBMO-40, in which dots display experimental data while straight lines show CW fits at higher temperatures. (b) & (d) $\log_{10}t$ versus $\log_{10}\chi^{-1}$ plot for the nano sample of LBMO-40 manganite.	173
Figure 6.6:	(a-b) Field dependence of magnetization $M(H)$ curves and (c-d) isothermal magnetic hysteresis loops for nano and bulk samples of LBMO-40 manganite measured at 10 and 300 K temperatures. Insets of (c-d) show the low field zoomed view of the hysteresis loops.	178
Figure 6.7:	(a-b) Isothermal Arrott's plots M^2 vs. H/M for nano and bulk samples of LBMO-40 manganite, respectively.	180
Figure 6.8:	Temperature dependence of (a-b) real part and (c-d) imaginary part of ac susceptibility for nanocrystalline and bulk LBMO-40 samples, respectively measured at various frequencies.	181
Figure 7.1:	The SEM micrographs for $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with x = (a) 0.02, (b) 0.04, (c) 0.06 and (d)	186

0.08.

- Figure 7.2:** Electron Dispersive X-ray spectroscopy (EDS) spectrum for $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with $x =$ (a) 0.02, (b) 0.04, (c) 0.06 and (d) 0.08. **187**
- Figure 7.3:** (a) RT X-ray diffraction patterns, (b) Bragg's reflection (110) for LBMTO manganites with $x = 0.02, 0.04, 0.06$ and 0.08 and (c) Variation of lattice constant and unit cell volume as a function of Ti-doping concentration (x). **189**
- Figure 7.4:** Rietveld fits for Ti-doped LBMTO manganites with (a) $x = 0.02$, (b) 0.04 , (c) 0.06 and (d) 0.08 . **191**
- Figure 7.5:** MnO_6 octahedra showing bond-length Mn-O for LBMTO manganites with (a) $x = 0.02$ and (b) $x = 0.08$. **191**
- Figure 7.6:** Temperature dependence of (a) ZFC and FC magnetizations curves, (b) irreversible magnetization and (c) dM/dT vs. T plots for LBMTO manganites with $x = 0.02, 0.04, 0.06$ and 0.08 . (d) Variation in T_C as a function of Ti^{4+} -ion concentration. **194**
- Figure 7.7:** (a) Temperature dependence of inverse molar susceptibility (b) Variation of experimental and theoretical effective PM moments for LBMTO manganites with nominal compositions $x = 0.02, 0.04, 0.06$ and 0.08 . (c) Inverse molar susceptibility for LBMTO with $x = 0.08$. (d) log-log plot between reduced temperature (t) and inverse molar susceptibility for LBMTO manganite with $x = 0.08$. **197**
- Figure 7.8:** Field dependent magnetic hysteresis curves measured at (a) 10 K and (b) 300 K (c) Field dependent magnetization curves at 10 K (d) Variation of theoretical and experimental saturation moment as a function of Ti-doping concentration (x), for LBMTO manganites. **199**
- Figure 7.9:** Arrott's plots M^2 versus H/M for LBMTO manganites measured at (a) 10 K and (b) 300 K. Inset of (a) shows zoomed view of Arrott's plots at 10 K. Insets (Ib) and (IIb) show zoomed view of Arrott's plots for $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with $x = 0.04$ and 0.06 . **202**
- Figure 7.10:** Temperature and frequency dependence of ac magnetic susceptibility real part (left panel) for $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with $x =$ (a) 0.02, (b) 0.04, (c) 0.06 and (d) 0.08 and imaginary part (right panel) for $\text{La}_{0.6}\text{Ba}_{0.4}\text{Mn}_{1-x}\text{Ti}_x\text{O}_3$ manganites with nominal compositions $x =$ (e) 0.02, (f) 0.04, (g) 0.06 and (h) 0.08. **203**