

Table of Contents

CERTIFICATE.....	III
DECLARATIONS BY THE CANDIDATE	V
CERTIFICATE BY THE SUPERVISOR.....	V
COPYRIGHT TRANSFER CERTIFICATE	VII
ACKNOWLEDGEMENTS	IX
TABLE OF CONTENTS	XIII
LIST OF FIGURES	XVII
LIST OF TABLES	XXI
PREFACE.....	XXIII
CHAPTER 1 INTRODUCTION.....	1-1
1.1 PEROVSKITES: STRUCTURAL DIVERSITY	1-3
1.2 RUDDLESDEN D POPPER (RP) OXIDE PHASE	1-6
1.2.1 <i>Crystal Structure</i>	1-9
1.2.2 <i>Oxygen Stoichiometry and Carrier Concentration</i>	1-12
1.2.3 <i>Electrical Properties</i>	1-16
1.2.4 <i>Applications</i>	1-18
1.3 PERMITTIVITY (E) AND PERMEABILITY (M)	1-20
1.4 NEGATIVE PERMITTIVITY MATERIALS.....	1-21
1.4.1 <i>Metamaterials</i>	1-22
1.4.2 <i>Composites</i>	1-24
1.5 THEORETICAL MODELS.....	1-28
1.5.1 <i>Drude Model</i>	1-29
1.5.2 <i>Lorentz Oscillator Model</i>	1-30
1.5.3 <i>Drude-Lorentz model</i>	1-33
1.6 MOTIVATION OF THE WORK	1-34
CHAPTER 2 MATERIALS PREPARATION AND CHARACTERISATIONS.....	2-39
2.1 MATERIALS PREPARATION AND CHARACTERISATIONS	2-41

2.2 MATERIALS SYNTHESIS	2-42
2.2.1 <i>Selection of raw materials</i>	2-42
2.2.2 <i>Weighing of raw materials</i>	2-43
2.2.3 <i>Mixing of raw materials using ball mill</i>	2-43
2.2.4 <i>Calcination of Mixtures</i>	2-46
2.2.5 <i>Granulation or Palettization</i>	2-47
2.2.6 <i>Sintering of Pellets</i>	2-47
2.3 CHARACTERIZATION	2-48
2.3.1 <i>X-ray diffraction analysis</i>	2-48
2.3.2 <i>Field Emission Scanning Electron Microscope (FESEM)</i>	2-60
2.3.3 <i>Fourier Transform Infrared Spectroscopy (FTIR)</i>	2-62
2.3.4 <i>X-Ray Photoelectron Spectroscopy (XPS)</i>	2-63
2.3.5 <i>Ultra-Violet Visible Near Infra-Red (UV-Vis-NIR) Spectroscopy</i>	2-66
2.3.6 <i>Alternating Current (AC) Electrical data analysis</i>	2-68
CHAPTER 3 SYNTHESIS AND CHARACTERISATION OF SR₂MNO₄.....	3-71
3.1 INTRODUCTION	3-73
3.2 EXPERIMENTAL.....	3-74
3.3 RESULTS AND DISCUSSIONS.....	3-75
3.3.1 <i>Phase Analysis and Structural Characterization</i>	3-76
3.3.2 <i>FTIR Spectroscopic Studies</i>	3-81
3.3.3 <i>Microstructural Studies</i>	3-82
3.3.4 <i>UV-Visible Spectroscopic Studies</i>	3-83
3.3.5 <i>XPS Analysis</i>	3-85
3.4 ELECTRICAL STUDIES	3-86
3.4.1 <i>AC conductivity</i>	3-86
3.4.2 <i>Modulus and Impedance Spectroscopic Analysis</i>	3-96
3.5 CONCLUSIONS.....	3-97
CHAPTER 4 SYNTHESIS AND CHARACTERISATION OF LA_xSR_{2-x}MNO₄.....	4-99
4.1 INTRODUCTION	4-101
4.2 EXPERIMENTAL.....	4-103
4.3 RESULTS AND DISCUSSION.....	4-104
4.3.1 <i>Crystal Structure</i>	4-104

4.3.2	<i>Microstructural characterization</i>	4-110
4.3.3	<i>X-Ray Photoelectron Spectroscopy Analysis</i>	4-111
4.3.4	<i>Negative Permittivity Behaviour</i>	4-113
4.4	CONCLUSIONS.....	4-121

CHAPTER 5 SYNTHESIS AND CHARACTERISATION OF SR₂MN_{1-x}SN_xO₄.... 5-123

5.1	INTRODUCTION	5-125
5.2	EXPERIMENTAL.....	5-127
5.3	RESULTS AND DISCUSSION.....	5-128
5.3.1	<i>Phase and Crystal structure analysis</i>	5-128
5.3.2	<i>Microstructural characterization</i>	5-132
5.3.3	<i>Negative Permittivity</i>	5-134
5.3.4	<i>XPS Analysis</i>	5-141
5.3.5	<i>UV-Vis-NIR Spectroscopy</i>	5-144
5.4	CONCLUSIONS.....	5-146

CHAPTER 6 SYNTHESIS AND CHARACTERISATION OF SR₂MN_{1-x}NB_xO₄ ... 6-147

6.1	INTRODUCTION	6-149
6.2	EXPERIMENTAL.....	6-151
6.3	RESULTS AND DISCUSSION.....	6-152
6.3.1	<i>Phase analysis and Crystal structure</i>	6-152
6.3.2	<i>Microstructural characterization</i>	6-158
6.3.3	<i>X-Ray Photoelectron Spectroscopy Analysis</i>	6-158
6.3.4	<i>Negative Permittivity</i>	6-161
6.4	CONCLUSIONS.....	6-170

CHAPTER 7 CONCLUSIONS AND FUTURE SCOPE 7-173

7.1	SUMMARY AND CONCLUSIONS.....	7-175
7.2	FUTURE SCOPE.....	7-176

CHAPTER 8 BIBLIOGRAPHY 8-179