

CONTENTS

CERTIFICATE.....	iii
DECLARATION BY THE CANDIDATE.....	v
COPY RIGHT TRANSFER CERTIFICATE.....	vii
ACKNOWLEDGEMENT.....	ix
TABLE OF CONTENTS.....	xiii
LIST OF FIGURES.....	xix
LIST OF TABLES.....	xxiii
LIST OF ABBREVIATIONS.....	xxv
LIST OF SYMBOLES.....	xxvii
PREFACE.....	xxix
CHAPTER 1 INTRODUCTION.....	1
1.1 Perovskite Oxides.....	2
1.2 Alkaline Earth Titanate Perovskites.....	3
1.3 Alkaline Earth Stannate Perovskites.....	5
1.4 Solid Solution Perovskites.....	7
1.4.1 Independent Isovalent Substitutions.....	7
1.4.2 Independent Hetro-valent Substitutions.....	7
1.4.3 Valence Compensated Substitutions.....	8
1.5 Solid Solution of BaTiO ₃ - BaSnO ₃	8
1.6 Ferroelectric Materials.....	9
1.6.1 Normal Ferroelectric.....	11
1.6.2 Diffused Phase Transition.....	12
1.6.3 Relaxor Ferroelectric.....	13
1.7 Theoretical Model to Explain Relaxor Behavior.....	16
1.8 Objectives and Scope of Present Works.....	19
CHAPTER 2 EXPERIMENTAL TECHNIQUES.....	23
2.1 Raw Materials.....	23
2.2 Synthesis of Materials.....	24

2.2.1	Powder and Ceramics of $BaTi_{1-x}Sn_xO_3$	24
2.2.2	Synthesis of Powder of Ferrite $NiFe_2O_4$	25
2.2.3	Synthesis of Powder of Multi-walled Carbon Nanotube (MW-CNTs).....	25
2.2.4	Synthesis of Ceramics of Composites and their Constituent Phases.....	36
2.2.5	Fly ash Powder.....	26
2.3	Characterization.....	28
2.3.1	Thermal Analysis (TG/DSC).....	28
2.3.2	X-Ray Diffraction (XRD).....	29
2.3.3	Density and Porosity Measurements.....	31
2.3.4	Fourier Transform Infrared (FTIR) Spectroscopy	31
2.3.5	Raman Spectroscopy.....	33
2.3.6	Transmission Electron Microscopy (TEM).....	34
2.3.7	Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS).....	35
2.3.8	Dielectric Measurements.....	37
2.3.9	Hysteresis loop.....	38
2.3.10	Impedance Measurements and AC conductivity.....	40
CHAPTER 3 SYNTHESIS AND CHARACTERIZATION OF $BaTi_{1-x}Sn_xO_3$ SYSTEM USING BARIUM CARBONATE.....		41
3.1	Introduction.....	41
3.2	Results and Discussion.....	42
3.2.1	Thermal Analysis of the Mixture of $BaCO_3$ and TiO_2	42
3.2.2	Phase Analysis and Crystal Structure.....	44
3.2.3	Fourier Transmission Infra-red (FTIR) Spectrum	49
3.2.4	Micro Structural Analysis.....	50
3.2.5	Energy dispersive x-ray (EDX) Analysis.....	51
3.2.6	Dielectric Analyses.....	52
3.3	Conclusions.....	57

CHAPTER 4 SYNTHESIS AND CHARACTERIZATION OF $BaTi_{1-x}Sn_xO_3$ SYSTEM USING BARIUM NITRATE.....59

4.1 Introduction.....	59
4.2 Results and Discussion.....	60
4.2.1 Thermal Analysis of TiO_2 and $Ba(NO_3)_2$ powder	60
4.2.2 Thermal Analysis of mixture of raw materials for BTS20.....	62
4.3 Characterization of Calcined Powders	64
4.3.1 X-ray Diffraction (XRD).....	64
4.3.2 Transmission Electron Micrographs (TEM).....	67
4.4 Characterization of Ceramics.....	68
4.4.1 X-ray Diffraction (XRD).....	68
4.4.2 Raman Spectroscopy	72
4.4.3 Fourier Transformed Infrared (FTIR) Spectroscopy	73
4.4.4 Microstructural Analysis.....	75
4.4.5 Energy Dispersive X-ray (EDX) Analysis.....	76
4.4.6 Dielectric Analysis.....	77
4.4.7 P-E loop.....	85
4.5 Conclusions.....	86

CHAPTER 5 SYNTHESIS AND CHARACTERIZATION OF COMPOSITES $BaTi_{0.85}Sn_{0.15}O_3-NiFe_2O_4$89

5.1 Introduction	89
5.2 Results and Discussion	91
5.2.1 Thermal Analysis of Mechanical Mixture of BTS and NF15.....	91
5.2.2 Phase Analysis and Crystal Structure.....	92
5.2.3 Density and Porosity Measurement	95
5.2.4 Fourier Transform Infrared (FTIR) Spectroscopy	96
5.2.5 Morphological Analysis	98
5.2.6 Energy Dispersive X-ray (EDX) Analysis.....	99
5.2.7 AC Conductivity.....	99

5.2.8 Dielectric and Ferroelectric Properties	102
5.2.9 Magnetic Properties.....	110
5.3 Conclusions.....	117

CHAPTER 6 SYNTHESIS AND CHARACTERIZATION OF COMPOSITES

BaTi_{0.85}Sn_{0.15}O₃ – CNTS.....119

6.1 Introduction	119
6.2 Results and Discussion	122
6.2.1 Thermal Analysis.....	122
6.2.2 Phase Analysis.....	125
6.2.3 Fourier Transform Infrared (FTIR) Spectroscopy	127
6.2.4 Surface Morphology Analysis.....	128
6.2.5 Energy-Dispersive X-ray (EDX) Analysis.....	131
6.2.6 Dielectric Analysis.....	133
6.2.7 AC Conductivity.....	136
6.3 Conclusions.....	140

CHAPTER 7 SYNTHESIS AND CHARACTERIZATION OF COMPOSITES

BaTi_{0.85}Sn_{0.15}O₃- FLY ASH.....141

7.1 Introduction.....	141
7.2 Results And Discussion	142
7.2.1 Thermal Analysis.....	143
7.2.2 Phase Analysis	145
7.2.3 Fourier Transform-Infrared (FTIR) Analysis.....	147
7.2.4 Scanning Electron Micrographs (SEM).....	149
7.2.5 Energy-Dispersive X-ray (EDX) Analysis.....	151
7.2.6 Dielectric Analysis.....	152
7.2.7 Electrical Conductivity.....	155
7.3 Conclusions.....	157

CHAPTER 8 SUMMARY AND CONCLUSIONS	159
8.1 General	159
8.2 Future Scope of Study.....	162
REFERENCES.....	163
LIST OF PUBLICATIONS.....	181