Contents

		page
Abstract		i
Acknowledgements		iii
Contents		v
List of Figures		vii
List of Tables		xi
List of Abbreviations		xiii
Chapter 1: Introduction		
1.1	Challenges Associated with Current Memory Technologies	2
1.2	Classification of Memories	3
	1.2.1 Volatile Memories	3
	1.2.2 Non-volatile Memories	3
1.3	Emerging Non-volatile Memory Technologies	4
	1.3.1 Ferroelectric Random Access Memory (FeRAM)	5
	1.3.2 Spin-torque Transfer Magnetic Random Access Memory (STT-MRAM)	6
	1.3.3 Phase Change Random Access Memory (PCRAM)	7
	1.3.4 Resistive Random Access Memory (RRAM)	8
1.4	Resistive Switching Devices	9
	1.4.1 Write Once Read Many (WORM) Resistive Switching	10
	1.4.2 Resistive Random Access Memory	11
1.5	Classification of RRAM	12
	1.5.1 Based on the Polarity of Switching Operation	13
	1.5.2 Based on Switching Mechanism	14
1.6	Resistive Switching Device Structure	16
1.7	Performance Parameters for Resistive Switching Devices	17
1.8	Thesis Outline	20
Chapter 2: Material Synthesis, Device Fabrication and Characterization Techniques		
2.1	Introduction	23
2.2	Solid-State Synthesis of Perovskite Oxides	23
2.3	*Device Fabrication Techniques*	24
	2.3.1 RF Sputtering	24
	2.3.2 Thermal Evaporation	26
2.4	*Ion Irradiation*	28
	2.4.1 Low-Energy Ion Beam Irradiation	29
	2.4.2 Pelletron for Swift Heavy Ion Irradiation	29
2.5	*Characterization Techniques*	31
	2.5.1 X-ray Diffraction (XRD)	31
	2.5.2 Ultra-Violet and Visible Diffuse Reflectance Spectroscopy (UV-Vis DRS)	33
	2.5.3 Atomic Force Microscopy (AFM)	34
	2.5.4 Field Emission Scanning Electron Microscopy (FESEM)	35
	2.5.5 Raman Spectroscopy	37
	2.5.6 Surface Profiler	38
2.6	Electrical Characterization	38
Chapter 3: Amorphous BaTiO3 Thin Film-Based Write Once Read Many Memories		
3.1	Introduction	41
3.2	Synthesis and Characterization of $BaTIO_3$ Powder	42
3.3	Thickness Dependent WORM performance of am-BTO Thin Films	45
	3.3.1 Device Fabrication and Memory Characteristics of am-BTO Thin Films	46
3.4	*Temperature Dependent WORM Performance of am-BTO Thin Films*	51
	3.4.1 WORM Performance for Different Deposition Temperatures	53
3.5	*Conclusions*	58

Chapter 4: Radiation Stability Analysis of Amorphous $BaTiO_3$ Thin Film-Based Memory Devices

4.1 Introduction 59
4.2 Thin Film Deposition and Irradiation Details 60
4.3 Thin Film Characterizations 61
4.4 Resistive Switching Characterizations 62
4.5 Conclusions 65

Chapter 5: Radiation Hard Resistive Switching Performance of $SrTiO_3$ Thin Film-Based Resistive Switching Devices

5.1 Introduction 67
5.2 Synthesis and Characterization of $SrTiO_3$ Powder and Target Preparation 68
5.3 Deposition of $SrTiO_3$ thin films and Au^{9+} Ions Irradiation 69
5.4 Thin Film Characterization 70
5.5 RRAM Characteristics 70
5.6 Conclusions 74

Chapter 6: $LaFeO_3$ Thin Film-Based Resistive Switching Devices for Neuromorphic Computing

6.1 Introduction 75
6.2 Synthesis and Characterization of $LaFeO_3$ Powder and Target Preparation 76
6.3 Growth of $LaFeO_3$ thin films using RF magnetron sputtering 78
6.4 *Morphological Characterizations* 78
6.5 RRAM Characteristics of $LaFeO_3$ Thin Films 79
6.6 Conclusion 85

Chapter 7: Effect of Ar^{+6} ions on the Memory Performance of $LAFeO_3$ Thin Film Resistive Switching Devices

7.1 Introduction 87
7.2 Experimental Details 88
7.3 Thin Film Characterization 88
7.4 Electrical Characterizations 89
7.5 Conclusions 94

Chapter 8: Conclusions and Future Work

8.1 Conclusions 97
8.2 Future Work 98

Publications 99
References 101