

Contents

	<i>page</i>
<i>Abstract</i>	ii
<i>Acknowledgements</i>	v
<i>Contents</i>	vii
<i>List of Figures</i>	ix
<i>List of Tables</i>	xii
<i>List of Symbols</i>	xiii
<i>List of Abbreviations</i>	xv
Chapter 1: Introduction to Memories	
1.1 Classification of Memories	1
1.1.1 Volatile Memories	2
1.1.2 Non-volatile Memories	2
1.2 Emerging Non-volatile Memories	4
1.2.1 Ferroelectric Memories (FeRAM)	4
1.2.2 Spin-torque Transfer Magnetic Memories (STT-MRAM)	5
1.2.3 Phase Change Memories (PCRAM)	6
1.2.4 Resistive Random Access Memories (RRAM)	7
1.3 Research Focus and Thesis Organization	8
Chapter 2: Resistive Random Access Memories	
2.1 Resistive Switching & RRAM	11
2.1.1 Resistive Switching Phenomenon & its Types	11
2.1.1.1 Unipolar Resistive Switching	13
2.1.1.2 Bipolar Resistive Switching	14
2.1.1.3 Threshold switching	15
2.2 Valance Change RRAM (VCRAM)	16
2.3 Conductive Bridge RRAM (CBRAM)	17
2.4 RRAM Device Structures	18
2.5 Performance Parameters of RRAM Devices	19
2.5.1 Endurance	19
2.5.2 Retention Time	20
2.5.3 Switching Speed and Power Consumption	21
2.5.4 Variability	22
2.5.5 Scalability	22
2.6 Current Status	23
Chapter 3: Fabrication and Characterization Techniques	
3.1 Atomic Layer Deposition (ALD)	27
3.2 Spin Coating	28
3.3 Physical Vapor Deposition	29
3.4 Surface Profiling	30
3.5 Atomic Force Microscopy	31
3.6 Scanning Electron Microscopy	32
3.7 Ultra-Violet and Visible Absorption Spectroscopy	33
3.8 Fourier-transform infrared spectroscopy	33
3.9 RAMAN Spectroscopy	34
3.10 Electrical Characterization & Parameter Extraction	35
Chapter 4: Multi-temperature ALD Scheme for Enhanced Reliability	
4.1 Introduction	39
4.2 Multi-Temperature Deposition Scheme	40
4.3 Experiments	41
4.4 Electrical Characterization of RRAM Devices	42
4.5 Conclusions	47

Chapter 5: Metal Oxide/Polymer Hybrid Bilayer Devices	
5.1 Introduction to Hybrid RRAM	49
5.2 Device Fabrication	50
5.3 Results and Discussions	50
5.3.1 Film Characterization	50
5.3.2 Switching Performance and Reliability	50
5.3.3 Conduction & Switching Mechanism	52
5.4 Conclusions	54
Chapter 6: Polymer:2-D Material Composite for High Performance Flexible Devices:	
Part-I	
6.1 Graphene Oxide Composites for RRAMs	57
6.2 Fabrication of Flexible RRAMs	58
6.3 Results and Discussions	59
6.3.1 PVP:GO Film and Material Characterization	59
6.3.2 Electrical Performance of Flexible RRAMs	61
6.3.3 Flexibility Testing of RRAMs	64
6.4 Conclusion	68
Chapter 7: Polymer:2-D Material Composite for High Performance Flexible Devices:	
Part-II	
7.1 Introduction	69
7.2 Preparation of PVP:MoS ₂ Composite and Device Fabrication	70
7.3 Film and Electrical Characterization of Flexible RRAMs	70
7.3.1 PVP:MoS ₂ Film and Material Characterization	70
7.3.2 Electrical Characterization and performance testing	71
7.3.3 Flexibility Study under Various Strain Conditions	74
7.4 Conclusion	77
Chapter 8: Conclusion and Future Scope	
8.1 Summary	79
8.2 Conclusions	81
8.3 Future Scope	81
References	83