

## Contents

	<b>page</b>
Abstract	V
Acknowledgements	viii
Contents	X
List of Figures	xiii
List of Tables	xvii
List of Symbols	xix
List of Abbreviations	xxi
	<b>Page</b>
<b>Chapter 1: INTRODUCTION</b>	
<b>1.1 Semiconductor Data Storage Devices</b>	1
1.1.1 Present Memory Technology	2
1.1.2 Next-Generation Memory Technologies	4
<b>1.2 Resistive Random-Access Memory (RRAM)</b>	6
1.2.1 Fundamental Conduction Mechanisms in RRAM	7
1.2.2 Switching mechanism in RRAM	9
1.2.3 Neuromorphic Applications of RRAM	11
❖ Learning Rules in Neuromorphic Devices	12
1.2.4 Oxide Based RRAM	12
1.2.5 Organic Molecule Based RRAM	13
1.2.6 Quantum Dots Based RRAM	15
<b>1.3 Literature Survey and Motivation of Current Work:</b>	16
<b>1.4 Objective of the Thesis:</b>	19
<b>1.5 Thesis Organization:</b>	19
<b>Chapter 2: Experimental Techniques and Instrumentations</b>	
<b>2.1 Synthesis of QDs and Device Fabrication</b>	22
2.1.1 Synthesis Method of Colloidal QDS	22
2.1.2 Device Fabrication	23
<b>2.2 Materials Characterization Techniques</b>	24
2.2.1 X-ray Diffraction (XRD)	24
2.2.2 X-ray Photoelectron Spectroscopy (XPS)	25
2.2.3 Scanning Electron Microscopy (SEM)	26
2.2.4 Transmission Electron Microscopy (TEM)	28
2.2.5 Atomic Force Microscopy (AFM)	29
2.2.6 Scanning Tunnelling Microscopy and Spectroscopy (STM)	30
2.2.7 UV-Visible Spectroscopy	32
2.2.8 Fluorescence Spectroscopy (FL)	33

2.2. 9	Fourier Transformed Infrared Spectroscopy (FTIR)	34
2.2. 10	Cyclic Voltammetry (CV)	35
2.2. 11	Electrical Characterization Setup	36

### **Chapter 3: Composition and Surface Morphology Invariant High On-Off Ratio from an Organic Memristor**

<b>3.1</b>	<b>Introduction</b>	38
<b>3.2</b>	<b>Experimental Section</b>	39
3.2.1	Device fabrication	39
3.2.2	Characterizations	40
<b>3.3</b>	<b>Results and Discussions</b>	40
3.3.1	Optical Characterization	40
3.3.2	Surface morphology study	41
3.3.3	Electrical Characterization	43
<b>3.4</b>	<b>Conclusion</b>	49

### **Chapter 4: Charge Trapped CdS Quantum Dots Embedded Polymer Matrix for High Speed and Low Power Memristor**

<b>4.1</b>	<b>Introduction</b>	51
<b>4.2</b>	<b>Experimental Details</b>	52
4.2. 1	Required chemicals	52
4.2. 2	Synthesis procedure	52
4.2. 3	Characterization of CdS QDs	53
4.2. 4	Device fabrication	54
<b>4.3</b>	<b>Results and Discussions</b>	54
4.3. 1	Material characterizations	54
4.3. 2	Surface morphology study	57
4.3. 3	Electrical characterizations	58
4.3. 4	Insight of the switching mechanism	61
<b>4.4</b>	<b>Conclusion</b>	62

### **Chapter 5: Non-volatile Memristor-Based Artificial Synaptic Behavior of Redox-Active Organic Composite**

<b>5.1</b>	<b>Introduction</b>	64
<b>5.2</b>	<b>Experimental Details</b>	65
5.2.1	Device Fabrication	65
5.2.2	Characterizations	66
5.2.3	Theoretical Methodolog	66
<b>5.3</b>	<b>Results and Discussions</b>	66
<b>5.4</b>	<b>Conclusion</b>	76

### **Chapter 6: Neuromorphic Synaptic Behavior of Single Quantum Dot Through Scanning Tunnelling Microscopy: Effect of Ion Transport**

<b>6.1</b>	<b>Introduction</b>	78
<b>6.2</b>	<b>Experimental details</b>	79
6.2.1	Required Chemicals	79

6.2.2	Synthesis of AgInS <sub>2</sub> QDs	79
6.2.3	Characterization of QDs	80
6.2.4	Device Fabrication	81
6.2.5	Theoretical Calculation details	81
6.3	<b>Results and Discussions</b>	81
6.4	<b>Conclusion</b>	92

## **Chapter 7: Summary and Conclusions**

7.1	<b>Summary</b>	93
7.2	<b>Conclusion</b>	94
7.3	<b>Future scope in this field</b>	95

	<b>List of publications</b>	96
--	-----------------------------	----

## **Reference**