CONTENTS

ACKNOWLEDGEMENT i
SYNOPSIS iii
LIST OF FIGURES vii
LIST OF TABLES xi

CHAPTER 1 INTRODUCTION 1
1.1 Nanotechnology and its different aspects 1
   1.1.1 Carbon based nanomaterials 2
   1.1.2 Ceramic nanoparticles 3
   1.1.3 Magnetic nanoparticles 3
   1.1.4 Metal nanoparticles 4
   1.1.5 Semiconductor nanoparticles 4
1.2 Some elementary ideas about semiconductors 5
   1.2.1 Effective mass of an electron in semiconductors 7
   1.2.2 Quantum confinement effect in semiconductors 7
   1.2.3 Electron in a one dimensional potential well: a simple case of Quantum confinement 8
1.3 A new step towards magnetic semiconductors 9
1.4 Potential spintronic devices based on dilute magnetic semiconductors 12
   1.4.1 Spin-LED 14
   1.4.2 Spin FET 14
1.5 General magnetic interactions in matters 15
   1.5.1 Diamagnetism and Paramagnetism 16
   1.5.2 Ferromagnetism 17
   1.5.3 Superparamagnetism 19
   1.5.4 Antiferromagnetism and Ferrimagnetism 21
1.6 scope of the thesis 22
References 24

CHAPTER 2 EXPERIMENTAL TECHNIQUES 29
CHAPTER 3  CHARACTERIZATION OF DEFECTS IN ZnO NANOCRYSTALS

3.1 Introduction 54
3.2 Experimental details 56
3.3 Results and discussion 56
  3.3.1 XRD analysis 56
  3.3.2 Photoluminescence 58
    3.3.2.1 Photoluminescence quantum efficiency (PLQE) 59
  3.3.3 Positron annihilation studies 62
    3.3.3.1 Doppler broadening studies 62
CHAPTER 4 OPTICAL, HYPERFINE AND MAGNETIC BEHAVIOUR OF Fe-DOPED ZnO NANOCRYSTALS

4.1 Introduction 73
4.2 Experimental details 75
4.3 Results and discussion 77
   4.3.1 Structural studies 77
   4.3.2 Optical studies 81
   4.3.3 Magnetization studies 85
   4.3.4 Mössbauer studies 86
   4.3.5 Positron annihilation studies 88
4.4 Conclusion 90
References 91

CHAPTER 5 STRUCTURAL, OPTICAL AND MAGNETIC CHARACTERIZATIONS OF Fe-DOPED SnO₂ NANOCRYSTALLINE SAMPLES

5.1 Introduction 94
5.2 Experimental 95
5.3 Results and discussions 95
   5.3.1 Structural studies 96
   5.3.2 Optical analysis 97
   5.3.3 Mössbauer studies 99
   5.3.4 Magnetization studies 101
5.4 Conclusion 107
References 109
CHAPTER 6 MICROSTRUCTURAL AND MAGNETIC CHARACTERIZATION OF Fe-DOPED NiO NANOCRYSTALLINE SAMPLES

6.1 Introduction 111
6.2 Experimental 113
6.3 Results and discussions 114
   6.3.1 Structural analysis 114
   6.3.2 Magnetization studies 118
      6.3.2.1 Dc-susceptibility measurements 118
      6.3.2.2 Ac-susceptibility measurements 120
      6.3.2.3 M-H measurements 122
6.4 Conclusion 131
References 132

CHAPTER 7 SUMMARY AND FUTURE SCOPE 135

List of publications 139