

CONTENTS

<i>Preface</i>	ix
1. Single Spin Coherence in Semiconductors	1
Maiken H. Mikkelsen, Roberto C. Myers, Gregory D. Fuchs, and David D. Awschalom	
1. Introduction	2
2. Single Electron Spins in Quantum Dots	3
3. Few Magnetic Spins in Quantum Wells	18
4. Single Spins in Diamond	27
References	41
2. Theory of Spin–Orbit Effects in Semiconductors	45
Jairo Sinova and A. H. MacDonald	
1. Introduction	46
2. The Relativistic Origins of Spin–Orbit Coupling	48
3. Band Structure of Semiconductors: Effective $\mathbf{k} \cdot \mathbf{p}$ Hamiltonians	51
4. SHE and AHE	61
5. Topological Berry's Phases in Spin–Orbit Coupled Systems: ACE	79
References	85
3. Fermi Level Effects on Mn Incorporation in III-Mn-V Ferromagnetic Semiconductors	89
K. M. Yu, T. Wojtowicz, W. Walukiewicz, X. Liu, and J. K. Furdyna	
1. Introduction	90
2. Sample Preparation and Characterization	93
3. Effects of Mn Location on the Electronic and Magnetic Properties	98
4. Concluding Remarks	125
Acknowledgments	130
References	130

4. Transport Properties of Ferromagnetic Semiconductors	135
T. Jungwirth, B. L. Gallagher, and J. Wunderlich	
1. Introduction	135
2. Basic Transport Characteristics	138
3. Extraordinary Magnetotransport	167
4. Summary	199
Acknowledgments	200
References	200
5. Spintronic Properties of Ferromagnetic Semiconductors	207
F. Matsukura, D. Chiba, and H. Ohno	
1. Introduction	207
2. Spin-Injection and Detection of Spin-Polarization	209
3. Magnetic Tunnel Junction	212
4. Magnetic DW	218
5. Electric-Field Control of Ferromagnetism	228
6. Optical Control of Ferromagnetism	231
7. Summary	234
Acknowledgments	235
References	235
6. Spintronic Nanodevices	241
C. Gould, G. Schmidt, and L. W. Molenkamp	
1. Introduction	241
2. Tunneling Anisotropic Magnetoresistance	244
3. Multi-TAMR Structures	248
4. Volatile and Nonvolatile Operation	250
5. Correlated Effects	252
6. Portability	259
7. Nanodevices	260
8. Lateral Nanoconstrictions	260
9. Current-Assisted Manipulation	264
10. Local Lithographic Anisotropy Control	268
11. Magnetic Characterization of Nanobars	269
12. Transport Characterization of Nanobars	271
13. Anisotropic Strain Relaxation	274
14. Memory Device Using Local Anisotropy Control	277
15. Device Operation	278
16. Magnetic States	279

17. Origin of the Resistance Signal	280
18. Conclusion and Outlook	283
Acknowledgments	284
References	284
7. Quantum Structures of II–VI Diluted Magnetic Semiconductors	287
J. Cibert, L. Besombes, D. Ferrand, and H. Mariette	
1. Magnetic and Electric Impurities in II–VI Nanostructures	287
2. Carrier-Induced Ferromagnetism in 2D DMSs	291
3. 0D Systems	298
4. Transport in Quantum II–VI DMS Structures	316
5. Summary	320
References	320
8. Magnetic Impurities in Wide Band-gap III–V Semiconductors	325
Agnieszka Wolos and Maria Kaminska	
1. Introduction	326
2. Diluted Magnetic Semiconductors	330
3. Nature of Mn Impurity in III–V Semiconductors	334
4. Magnetic Interactions in III–V DMSs with Mn	352
5. GaN-Based DMSs	357
6. Internal Reference Rule for Transition Metal Ions—Case of GaN	361
7. Summary and Conclusions	362
Acknowledgments	364
References	364
9. Exchange Interactions and Nanoscale Phase Separations in Magnetically Doped Semiconductors	371
Tomasz Dietl	
1. Introduction	372
2. Substitutional Transition Metal Impurities in Semiconductors	375
3. Origin of Exchange Interactions between Carriers and Localized Spins	381
4. Effects of sp–d(f) Exchange Interactions	382
5. Exchange Interactions between Effective Mass Carriers	392
6. Models of Ferromagnetic Spin–Spin Interactions in Semiconductors	397
7. p–d Zener Model of Carrier-Mediated Ferromagnetism	399
8. Effects of Disorder and Localization on Carrier-Mediated Ferromagnetism	407
9. Effects of Nonrandom Distribution of Magnetic ions	416

10. Is Ferromagnetism Possible in Semiconductors with no Magnetic Elements?	422
11. Summary	423
Acknowledgments	425
References	425
10. Computational Nano-Materials Design for the Wide Band-Gap and High-T_C Semiconductor Spintronics	433
Hiroshi Katayama-Yoshida, Kazunori Sato, Tetsuya Fukushima, Masayuki Toyoda, Hidetoshi Kizaki, and An van Dinh	
1. Introduction	433
2. Magnetic Mechanism, T_C , and Unified Physical Picture	436
3. Spinodal Nano-Decomposition and Nano-Spintronics Applications	444
4. New Class of Oxide Spintronics without a 3d TM	450
5. Conclusion	452
Acknowledgments	452
References	452
11. Properties and Functionalities of MnAs/III-V Hybrid and Composite Structures	455
Masaaki Tanaka, Masafumi Yokoyama, Pham Nam Hai, and Shinobu Ohya	
1. Introduction	455
2. Fabrication and Structure of GaAs:MnAs Nano-Particles	456
3. Large Magnetoresistance at Room Temperature	458
4. Spin Dependent Tunneling Transport Properties in III-V Based Heterostructures Containing GaAs:MnAs	463
5. Properties of Zinc-Blende Type and NiAs-Type MnAs Nano-particles	471
6. Magneto-Optical Device Applications	478
Acknowledgments	483
References	484
<i>Index</i>	487
<i>Contents of Volumes in This Series</i>	499
<i>See Color Plate Section in the back of this book</i>	