

Contents

	<i>List of Contributors</i>	page ix
	<i>Preface</i>	xi
	<i>List of Abbreviations</i>	xiii
1	Magnetism, Magnetic Materials, and Nanoparticles	1
	Adrian Ionescu, Justin Llandro, and Kurt R. A. Ziebeck	
	1.1 Introduction	1
	1.2 Fundamental Concepts	2
	1.3 Magnetization Processes	16
	1.4 Magnetic Measurements	30
	1.5 Structural Analysis	45
	Sample Problems	46
2	Preparation of Magnetic Nanoparticles for Applications in Biomedicine	52
	Pedro Tartaj, Sabino Veintemillas-Verdaguer, Teresita Gonzalez-Carreño, and Carlos J. Serna	
	2.1 Introduction	52
	2.2 Fundamentals of Solution Routes and Some Interesting Examples	53
	2.3 Nanocomposites from Solution Routes	58
	2.4 Gas and Solid Routes	61
	2.5 Conclusions and Perspectives	63
	Sample Problems	63
3	Magnetic Nanoparticle Functionalization	68
	Justin J. Palfreyman	
	3.1 Gold-Coated Particles	68
	3.2 Coupling to Epoxides	79
	3.3 Quantification	85
	Sample Problems	88

vi	Contents	
4	Manipulation	91
	4.1 A Survey of Tweezers for the Manipulation of Micro/Nanoentities Donglei Fan and Chia-Ling Chien	91
	4.2 Magnetic Drug Delivery Thomas Schneider and Urs O. Häfeli	112
	Sample Problems	134
5	Modeling the In-Flow Capture of Magnetic Nanoparticles	151
	Bart Hallmark, Nicholas J. Darton, and Daniel Pearce	
	5.1 Introduction	151
	5.2 Physical Mechanisms Underlying Nanoparticle Capture	151
	5.3 Concluding Comments	168
	Sample Problems	168
6	Sensing Magnetic Nanoparticles	172
	6.1 Hall Effect Biosensors Adarsh Sandhu and Paul Southern	172
	6.2 Spin Valve and Tunnel Magnetoresistance Sensors Susana Cardoso de Freitas, Simon Knudde, Filipe A. Cardoso, and Paulo P. Freitas	181
	6.3 Magnetoimpedance Biosensors Galina V. Kuryandskaya	206
	Sample Problems	221
7	Magnetic Nanoparticles for Magnetic Resonance Imaging Contrast Agents	228
	Nohyun Lee and Taeghwan Hyeon	
	7.1 Introduction	228
	7.2 Basic MRI Principles and Properties of MNPs	230
	7.3 Control of MR Relaxivity of MNPs	236
	7.4 Toxicity of MNPs	245
	7.5 Conclusion	246
	Sample Problems	246
8	Magnetotactic Bacteria and Magnetosomes	251
	Dennis A. Bazylinski and Denis Trubitsyn	
	8.1 Introduction and History	251
	8.2 Magnetotactic Bacteria: Diversity, Phylogeny, and Physiology	252
	8.3 The Bacterial Magnetosome: Composition, Size, Arrangement, and Morphology	255
	8.4 Function of Magnetosomes: Magneto-Aerotaxis	257
	8.5 Genomics of Magnetotactic Bacteria	260

8.6	Biom mineralization of Magnetosomes	262
8.7	Mass Culture of Magnetotactic Bacteria and Purification of Magnetosomes	265
8.8	Applications of Magnetotactic Bacteria and Magnetosomes	267
8.9	Concluding Remarks and Future Directions of Research	270
	Sample Problems	271
	<i>Appendix</i>	285
	<i>Index</i>	287