

Contents

Preface	XI
1. Polymer Nanocomposites for Gas Barrier and Packaging Applications	1
1.1 Introduction	1
1.2 Gas Barrier and Packaging Applications	4
1.2.1 Graphene/Polymer Nanocomposites	4
1.2.2 Carbon Nanotubes (CNTs)/Polymer Nanocomposites	13
1.2.3 Clay/Polymer Nanocomposites	15
1.2.4 SiO ₂ /Polymer Nanocomposites	22
1.2.5 ZnO/Polymer Nanocomposites	24
1.3 Summary and Outlook	25
References	26
2. Polymer Nanocomposites for Electromagnetic Interference (EMI) Shielding	35
2.1 Introduction	35
2.2 Polymer/Carbon Nanotubes Nanocomposites	37
2.2.1 Poly(vinylidene fluoride) (PVDF)/Carbon Nanotubes Nanocomposites	37
2.2.2 Polyethylene/Carbon Nanotubes Nanocomposites	39
2.2.3 Polypropylene/Carbon Nanotubes Nanocomposites	39
2.2.4 Polystyrene/Carbon Nanotubes Nanocomposites	40
2.2.5 Poly(methyl methacrylate)/Carbon Nanotubes Nanocomposites	41
2.2.6 Polycarbonate/Carbon Nanotubes Nanocomposites	41
2.2.7 Polyurethane/Carbon Nanotubes Nanocomposites	41
2.2.8 Polylactide/Carbon Nanotubes Nanocomposites	42
2.2.9 Polycaprolactone/Carbon Nanotubes Nanocomposites	42
2.2.10 Epoxy/Carbon Nanotubes Nanocomposites	43

2.2.11	Elastomer/Carbon Nanotubes Nanocomposites	44
2.2.12	Copolymer/Carbon Nanotubes Nanocomposites	45
2.2.13	Other Polymer/Carbon Nanotubes Nanocomposites	45
2.3	Polymer/Graphene Nanocomposites	46
2.3.1	PS/Graphene Nanocomposites	46
2.3.2	PMMA/Graphene Nanocomposites	48
2.3.3	PC/Graphene Nanocomposites	48
2.3.4	Polyurethane/Graphene Nanocomposites	49
2.3.5	Polyaniline/Graphene Nanocomposites	50
2.3.6	Epoxy/Graphene Nanocomposites	51
2.3.7	Other Polymer/Graphene Nanocomposites	51
2.4	Polymer/Carbon Nanofibers Nanocomposites	53
2.5	Polymer/Carbon Black Nanocomposites	55
2.6	Polymer/Carbonaceous Hybrid Filler Nanocomposites	55
2.7	Polymer/Metal Nanomaterials Nanocomposites	57
2.7.1	PVDF/ Metal Nanomaterials Nanocomposites	57
2.7.2	Polypyrrole/Metal Nanomaterials Nanocomposites	58
2.7.3	Polyurethane/Metal Nanomaterials Nanocomposites	59
2.7.4	Poly(vinyl chloride) (PVC)/Metal Nanomaterials Nanocomposites	59
2.7.5	Other Polymer/Metal Nanomaterials Nanocomposites	60
2.8	Conclusions	62
	References	62
3.	Polymer Nanocomposites for Automotive Applications	77
3.1	Introduction	77
3.2	Polymer Nanocomposites for Automotive Tires	78
3.2.1	Styrene Butadiene Rubber (SBR) Nanocomposites	79

3.2.2	Natural Rubber Nanocomposites	82
3.2.3	Butyl Rubber Nanocomposites	87
3.2.4	Other Elastomer Nanocomposites	88
3.3	Polymer Nanocomposites for Automotive Tire Inner Tubes	90
3.4	Polymer Nanocomposites for Automotive Coatings	91
3.4.1	Acrylic/Melamine Nanocomposite Coatings	92
3.4.2	Polyurethane Nanocomposite Coatings	92
3.4.3	Acrylic Nanocomposite Coatings	94
3.4.4	Polyester Nanocomposite Coatings	95
3.5	Polymer Nanocomposites for Automotive Polymer Electrolyte Membrane Fuel Cells	96
3.6	Polypropylene (PP) Nanocomposites for Automotive Applications	100
3.7	Poly(lactic acid) (PLA) Nanocomposites for Automotive Applications	100
3.8	Conclusions	102
	References	102
4.	Polymer Nanocomposites for Wastewater Treatment	117
4.1	Introduction	117
4.2	Different Polymer Nanocomposites and Application for Wastewater Treatment	119
4.2.1	Graphene Based Polymer Nanocomposites	119
4.2.2	CNT Based Polymer Nanocomposites	126
4.2.3	Clay Based Polymer Nanocomposites	128
4.2.4	Metal Oxide Based Polymer Nanocomposites	135
4.3	Conclusions	138
	References	139
5.	Polymer Nanocomposites for Building and Construction	147
5.1	Introduction	147
5.2	Polymer Nanocomposite Modified Cementitious Materials	148
5.3	Polymer Nanocomposites Based Polymer	

	Concrete	150
5.4	Polymer Nanocomposites Based Concrete Coatings	151
5.5	Polymer Nanocomposites Based Stone and Monument Coatings	152
5.6	Polymer Nanocomposite Based Anti-Corrosion Coatings	154
5.7	Polymer Nanocomposites Based Flame Retardant Coatings	158
5.8	Polymer Nanocomposites Based Adhesives	159
5.9	Polymer Nanocomposites Modified Asphalt	163
5.10	Polymer Nanocomposites Based Wood Coatings and Adhesives	168
	5.10.1 Wood Coatings	168
	5.10.2 Wood Adhesives	170
5.11	Polymer Nanocomposites for Sound Insulation	172
5.12	Polymer Nanocomposites for Electrical and Thermal Insulation	173
5.13	Other Applications	174
5.14	Conclusions	175
	References	175
6.	Polymer Nanocomposites for Electronics Applications	191
6.1	Introduction	191
6.2	Electronics Applications of Various Polymer Nanocomposites	192
	6.2.1 Graphene Based Polymer Nanocomposites	192
	6.2.2 CNTs Based Polymer Nanocomposites	199
	6.2.3 CNFs Based Polymer Nanocomposites	209
	6.2.4 ZnO Based Polymer Nanocomposites	212
6.3	Summary	214
	References	215
7.	Polymers and Polymer Nanocomposites for Tissue Engineering and Artificial Joints	225
7.1	Introduction	225
7.2	Polymeric Materials for Tissue Engineering	225
	7.2.1 Polymeric Hydrogels	227
	7.2.2 Polymer Nanofibers	232

7.2.3	Conducting Polymers	235
7.2.4	Other Polymer Composites and Blends	236
7.3	Artificial Joints	240
7.3.1	UHMWPE	242
7.3.2	PVA Hydrogels Based Materials	250
7.4	Conclusions	252
	References	252
8.	Polymer Nanocomposites for Aerospace Applications	269
8.1	Introduction	269
8.2	Development of Polymer Nanocomposites for Aerospace Applications	269
8.3	Conclusions	276
	References	277
9.	Polymer Nanocomposites for Sensing Applications	287
9.1	Introduction	287
9.2	Conducting Polymer Nanocomposites for Sensing	288
9.3	Development of Different Sensors	289
9.3.1	Gas Sensors	289
9.3.2	Biosensors	293
9.3.3	Humidity Sensors	297
9.3.4	Liquid Sensing	300
9.4	Conclusions	301
	References	302
	Index	315