Contents

Pre	reface			IX
1.	Self-healing Polymers and Composites			
	1.1	Introd	luction	1
	1.2	Types	of Healing Techniques	2
		1.2.1	Healing by Using Crack Filling	
			Technique	2
		1.2.2	Diffusion	5
		1.2.3	Bond Reformation	5
			Virgin Property Strengthening	8
	1.3		us Self-healing Polymers and Composites	9
	1.4		usions	23
	Refer	ences		24
2.	Ionic	Liquid	s and Poly(ionic liquid)s Based	
	Coatings			31
	2.1	Introd	luction	31
	2.2			33
		2.2.1	Poly(ionic liquid)s Based Protective	
			Coatings	33
		2.2.2	Poly(ionic liquid)s Based Sorbent	
			Coatings	35
		2.2.3	Other Functional Coatings Based on	
			PILs	37
	2.3	Ionic Liquids Based Coatings		39
		2.3.1	Ionic Liquids Based Coatings for	
			Titanium	39
		2.3.2	1 0 11	41
		2.3.3	1 0	43
		2.3.4	Ionic Liquids Based Coatings for	
			Aluminum	44
		2.3.5	1 0	
			Magnesium Alloy	45
		2.3.6	Other Functional Coatings Based on ILs	47
	2.4		Liquids Based Electrodeposited Al	48
		Coatir	8	
		2.4.1	Coatings for Steel	49
		2.4.2	Coatings for Copper	50
		2.4.3	Coatings for Gold	50

		2.4.4	Coatings for Magnesium Alloy	51	
		2.4.5	Coatings for Neodymium Iron Boron		
			(NdFeB) Magnet	51	
		2.4.6	Coatings for Other Purposes	52	
	2.5	Conclu	isions	54	
	Refer	ences		54	
3.	Terna	ary Cu/	ZnO/Graphene Nanocomposites with		
	Photocatalytic Activity for Methylene Blue Dye				
	Degradation under Visible Light				
	3.1	Introduction			
	3.2	Experimental		69	
		3.2.1	Materials	69	
		3.2.2	Synthesis of Graphite Oxide (GO)	70	
		3.2.3			
			Nanocomposites	70	
		3.2.4	Characterization	70	
		3.2.5	Photocatalytic Studies	71	
	3.3	5			
	3.4	Conclusions			
	Refer	ences		85	
4.	Smart Textiles: Synthesis and Properties				
	4.1	Introduction		91	
	4.2	Materials Used for Generating Smart Textiles			
	4.3	5			
	4.4	Conclusions			
	Refer	rences			
5.	Shap	e Memo	ory Polymers and Polymer Composites	115	
	5.1	Introd	uction	115	
	5.2	SMPs and SMPCs Based on Polyurethane		116	
		5.2.1	Polyurethane Based SMPs	116	
		5.2.2	Shape Memory Polyurethane		
			Composites with Graphene	121	
		5.2.3	SMPCs of PU with Carbon Nanotubes	123	
		5.2.4	Other PU based SMPCs	127	
	5.3	SMPs	and SMPCs Based on Epoxy	128	
		5.3.1	Epoxy Based SMPs	128	
		5.3.2	Shape Memory Epoxy Polymer		
			Composites	131	

Contents

6.

5.4	SMPs	and SMPCs Based on Polylactide	134	
	5.4.1		134	
	5.4.2	Shape Memory Polylactide Composites	135	
5.5	SMPs	and SMPCs Based on Polycaprolactone	137	
	5.5.1	Polycaprolactone Based SMPs	137	
	5.5.2			
		Composites	138	
5.6	Acryla	ites Based SMPs and SMPCs	140	
5.7	Styrene Based SMPs and SMPCs			
5.8	SMPs and SMPCs Based on Other Polymers			
	5.8.1	SMPs	143	
	5.8.2	SMPCs	145	
5.9	Conclu	usions	148	
Refer	ences		148	
Energ	gy Stora	age Devices	167	
6.1		luction	167	
6.2	Super	capacitors	169	
	6.2.1	Graphene Based Supercapacitors	169	
	6.2.2	Activated Carbon Based		
		Supercapacitors	174	
	6.2.3	Metal Based Supercapacitors	177	
	6.2.4	5 1 1	184	
6.3	Lithiu	m-Ion Batteries (LIBs)	188	
	6.3.1	Silicon Based LIB Anodes	188	
	6.3.2		191	
	6.3.3		192	
	6.3.4		194	
	6.3.5	Graphene Based LIB Anodes	196	
	6.3.6	Other Carbonaceous Materials Based		
		LIB Anodes	199	
6.4	Sodiu	m-Ion Batteries (SIBs)	200	
	6.4.1	Graphene Based SIB Electrodes	200	
	6.4.2	Other Carbonaceous Materials Based		
		SIB Electrodes	201	
	6.4.3	Metal Based SIB Electrodes	203	
6.5	Lithiu	m-Sulfur Batteries (LSBs)	203	
	6.5.1	Graphene Based LSB Electrodes	203	
	6.5.2	Carbon Nanotubes Based LSB Elec-	204	
		trodes		

		6.5.3	Other Carbonaceous Materials Based			
			LSB Electrodes	205		
		6.5.4	Polymers Based LSB Electrodes	206		
	6.6	Conclu	usions	206		
	References			206		
7.	Bio-Inspired Nanomaterials			239		
	7.1					
	7.2	Bio-Inspired Gold Nanomaterials				
	7.3	Bio-Inspired Silver Nanomaterials				
	7.4	Bio-Inspired Palladium Nanomaterials				
	7.5	Bio-Inspired Iron Oxide Nanomaterials				
	7.6	Bio-Inspired Zinc Oxide Nanomaterials				
	7.7	•				
	7.8	•				
	7.9	-				
	7.10	Bio-Inspired Nanomaterials Based on Other				
		Metal Oxides		264		
	7.11	Bio-Inspired Silica Based Nanomaterials				
	7.12	1				
	7.13	Other Bio-Inspired Carbonaceous				
			naterials	271		
	7.14	Bio-Inspired Polymer Nanomaterials				
	7.15	Conclusions				
	Refer	rences				
8.	Schiz	ophylla	an for Enhanced Oil Recovery	311		
	8.1	Introduction		311		
	8.2	Synthesis		312		
	8.3	•				
	8.4	Properties		315		
		8.4.1	Concentrated Solution Behavior	315		
		8.4.2	Gelation Behavior	318		
		8.4.3	Interfacial Properties	322		
		8.4.4	Dilute Solution Properties	323		
	8.5	Application in Enhanced Oil Recovery		324		
	8.6			328		
	8.7	Conclusions				
	References			331		