
Contents

PREFACE	xi
CHAPTER 1. TRENDS IN DYE PHOTSENSITIZED RADICAL POLYMERIZATION REACTIONS	1
Jacques LALEVÉE and Jean-Pierre FOUASSIER	
1.1. Introduction.	1
1.2. A brief overview of dye-based PISs	6
1.2.1. Dye one-component systems	6
1.2.2. Dye two-component systems	7
1.2.3. Dye three-component systems	10
1.3. A discussion on specific or recent developments in dye-based photoinitiating systems	12
1.3.1. Dyes for use with polychromatic visible lights	14
1.3.2. Dyes for blue, green and red laser light-induced polymerizations.	16
1.3.3. Dyes as part of PISs in the medical area	18
1.3.4. Dyes in controlled radical photopolymerization reactions.	19
1.3.5. Photoinitiation under soft irradiation conditions: novel three-component systems	19
1.3.6. Dyes with red-shifted absorptions and high molar extinction coefficients	22
1.3.7. Performances of novel three-component PISs in low-viscosity matrices under LEDs/laser diodes and low-intensity household devices.	23
1.3.8. Recoverable dyes: the concept of photoinitiator catalysts	25
1.3.9. Metal-based dyes: recent perspectives	26
1.3.10. Dyes under sunlight exposure.	27

1.3.11. Dye-based PISs as a source of mediator radicals: application to FRPCP	27
1.3.12. Dyes exhibiting a dual radical/cationic behavior: application to concomitant radical/cationic photopolymerizations.	28
1.3.13. Dyes in thiol-ene photopolymerizations.	29
1.3.14. Dyes for the manufacture of photopolymerizable panchromatic films.	29
1.3.15. Dyes for polymerization of in situ nanoparticle containing films.	30
1.4. Dye-based photoinitiating systems: properties, efficiency and reactivity	31
1.5. Trends and perspectives	32
1.6. Bibliography	34
CHAPTER 2. SENSITIZATION OF CATIONIC PHOTOPOLYMERIZATIONS	45
James CRIVELLO	
2.1. Introduction.	45
2.2. Photosensitization of onium salts	48
2.3. Synthesis of long wavelength absorbing photoinitiators	50
2.4. Photosensitization of onium salt cationic photoinitiators	51
2.5. Early dye sensitization studies.	55
2.6. Polynuclear aromatic hydrocarbons and their derivatives.	56
2.7. Phenothiazine photosensitizers	60
2.8. Carbazole photosensitizers.	62
2.9. Thioxanthone photosensitizers	63
2.10. Curcumin as a photosensitizer	64
2.11. Quinoxaline photosensitizers.	65
2.12. Miscellaneous electron-transfer photosensitizers	66
2.13. Free-radical-promoted photosensitization	66
2.14. Conclusions	70
2.15. Bibliography	71
CHAPTER 3. CONTROLLED PHOTOPOLYMERIZATION AND NOVEL ARCHITECTURES	81
Sean DORAN, Omer Suat TASKIN, Mehmet Atilla TASDELEN and Yusuf YAĞCI	
3.1. Introduction.	81
3.2. Photoinitiated controlled radical polymerizations	84
3.2.1. Photoiniferter	84
3.2.2. Photoinitiated nitroxide-mediated radical polymerization	87
3.2.3. Photoinitiated atom transfer radical polymerization	89

3.2.4. Photoinitiated RAFT polymerization	97
3.3. Photoinitiated living ionic polymerization.	102
3.3.1. Living cationic photopolymerization	102
3.3.2. Living anionic photopolymerization.	106
3.4. Acknowledgments	108
3.5. Bibliography	109
CHAPTER 4. APPLIED PHOTOCHEMISTRY IN DENTAL MATERIALS: FROM BEGINNINGS TO STATE OF THE ART	123
Joachim E. KLEE, Maximilian MAIER and Christoph P. FIK	
4.1. Photoinitiated free radical polymerization.	123
4.1.1. Introduction: from ultraviolet to visible light curing	123
4.1.2. The camphorquinone/amine system	124
4.1.3. Acyl phosphine oxides.	127
4.1.4. Various other photoinitiator systems	129
4.2. Cationic photopolymerization	133
4.3. Conclusion	134
4.4. Bibliography	134
CHAPTER 5. PHOTOINITIATED CROSS-LINKING IN OLEDs: AN EFFICIENT TOOL FOR ADDRESSING THE SOLUTION-PROCESSED DEVICES ELABORATION AND STABILITY ISSUES	139
Frédéric DUMUR and Didier GIGMES	
5.1. Introduction.	139
5.2. Cross-linking of light-emitting materials	141
5.2.1. Polymer-based light-emitting materials	141
5.2.2. Small-molecule-based light-emitting materials	154
5.3. Cross-linking of charge-transport materials.	157
5.3.1. Polymer-based hole-transport materials.	157
5.3.2. Polymer-based electron-transport/injection materials.	165
5.3.3. Small-molecule-based hole-transport materials	167
5.4. Conclusion	169
5.5. Bibliography	170
CHAPTER 6. POLYMERS AS LIGHT-HARVESTING DYES IN DYE-SENSITIZED SOLAR CELLS	183
Thanh-Tuân BUI, Xavier SALLENAVE and Fabrice GOUBARD	
6.1. Introduction.	183
6.2. Characterization of DSSC devices	185
6.3. Poly(3-thiophenylacetic acid)-based polymers	188

6.4. Phenylenevinylene-based polymers	194
6.5. Triphenylamine-based polymer	195
6.6. Fluorene-based polymers.	196
6.7. Dye polymers with acceptor–donor structure.	197
6.8. Polymer containing metal complexes	199
6.9. Conclusion	205
6.10. Bibliography	206
CHAPTER 7. NIR-DYES FOR PHOTOPOLYMERS AND LASER DRYING IN THE GRAPHIC INDUSTRY	213
Bernd STREHMEL, Thomas BRÖMME, Christian SCHMITZ, Knut REINER, Steffen ERNST and Dietmar KEIL	
7.1. Introduction.	213
7.2. Computer to plate systems	216
7.2.1. Technical remarks	216
7.2.2. Photochemical aspects of photoinitiation using NIR lasers	218
7.2.3. Importance of thermal deactivation	230
7.2.4. Contrast materials and color on demand	232
7.2.5. Sensitivity	236
7.3. Laser-drying and offset-printing	239
7.3.1. Principle of laser-drying.	239
7.3.2. Chemical systems.	241
7.4. Conclusions and outlook	243
7.5. Acknowledgments.	244
7.6. Bibliography	244
CHAPTER 8. DYES AND PHOTOPOLYMERS	251
Yue QI and John T. SHERIDAN	
8.1. Photopolymer	251
8.2. Dye study of the photopolymer materials	260
8.3. Conclusion	271
8.4. Bibliography	272
CHAPTER 9. ADVANCED STRATEGIES FOR SPATIALLY RESOLVED SURFACE DESIGN VIA PHOTOCHEMICAL METHODS	279
Anja S. GOLDMANN, Guillaume DELAITTRE, Jan O. MUELLER and Christopher BARNER-KOWOLLIK	
9.1. Introduction.	279
9.2. Inorganic surfaces	282
9.3. Bio and bioinspired surfaces.	296

9.4. Cross-linking	309
9.5. Conclusion	314
9.6. Bibliography	315
CHAPTER 10. PHOTOSYNTHESIZED HIGH-PERFORMANCE BIOMATERIALS	327
Julien BABINOT, Estelle RENARD, Valérie LANGLOIS and Davy-Louis VERSACE	
10.1. Introduction	327
10.2. Surface photografting methodology	329
10.2.1. Photoinduced “grafting-from” method	329
10.2.2. Benzophenone and derivatives	329
10.2.3. Ketones and derivatives	331
10.2.4. Photo-oxidation process	333
10.2.5. Photoiniferters for living/controlled surface photografting	334
10.2.6. Triarylsulfonium salts	335
10.3. Photoinduced “grafting-to” procedure	337
10.3.1. Aryl azides chemistry.	337
10.3.2. Anthraquinone-derived monomers	337
10.4. Achievements and biomedical applications of the photosynthesized materials	339
10.4.1. Achievements	339
10.4.2. Stimuli-responsive materials	341
10.4.3. Modification of membranes	343
10.4.4. Biomedical applications	344
10.4.5. Enzymes and proteins immobilization.	347
10.4.6. Cell adhesion and compatibility	348
10.5. Conclusion	350
10.6. Bibliography	350
CHAPTER 11. LIGHT-CURED LUMINESCENT COATINGS FOR PHOTOVOLTAIC DEVICES	361
Federico BELLA, Gianmarco GRIFFINI, Roberta BONGIOVANNI and Stefano TURRI	
11.1. Photovoltaics: technology, devices and spectral management	361
11.1.1. Energy demand and photovoltaic converters	361
11.1.2. Spectral management for photovoltaics: principles, materials and applications	364

11.2. Photocurable luminescent downshifting layers and dye-sensitized solar cells.	371
11.3. Luminescent solar concentrators.	378
11.4. Bibliography	385
CHAPTER 12. POLYMERS WITH PHOTOINDUCED SELF-HEALING PROPERTIES	393
Julien POLY	
12.1. Introduction	393
12.2. Healing based on photo-reversible cycloadditions	395
12.3. Healing based on photoinduced homolytic dissociations of covalent bonds.	399
12.4. Photoinduced healing in supramolecular polymers and related systems	408
12.5. Healing based on photothermally induced phase transitions or photo-isomerizations	413
12.6. Conclusion and perspectives	416
12.7. Bibliography	418
LIST OF AUTHORS	423
INDEX	427