

HANDBOOK OF POLYMER SYNTHESIS

PART A

**EDITED BY
HANS R. KRICHELDORF**

*Institute for Technical and Macromolecular Chemistry
University of Hamburg
Hamburg, Germany*

Marcel Dekker, Inc.

New York • Basel • Hong Kong

Contents of Part A

Foreword	<i>Herman F. Mark</i>	iii
Preface		v
Contributors to Part A		xi
Contents of Part B		xiii
Contributors to Part B		xvii
Abbreviations		xix
1. Polyolefins		1
	<i>Walter Kaminsky</i>	
Introduction		1
Polyethylene		3
Polypropylene		26
Polymers of higher α -olefins		51
References		59
2. Polystyrenes and Other Aromatic Poly(vinyl compounds)		77
	<i>Oskar Nuyken</i>	
Styrene		77
Substituted styrenes		90
Vinyl arenes		102
<i>N</i> -Vinylcarbazole		105
Poly(<i>N</i> -vinylpyrrolidone)		114
Vinylpyridines		123
References		130

3. Poly(vinyl ether)s, Poly(vinyl ester)s, and Poly(vinyl halogenide)s	145
<i>Oskar Nuyken and James Crivello</i>	
Poly(vinyl ethers)s	145
Poly(vinyl acetate)	164
Poly(vinyl chloride)	172
Poly(vinyl vinyl fluoride)	182
Poly(vinylidene fluoride)	191
Poly(tetrafluoroethylene)(PTFE)	197
References	207
4. Polymers of Acrylic Acid, Methacrylic Acid, Maleic Acid, and Their Derivatives	223
<i>Oskar Nuyken and Guenter Lattermann</i>	
Acrylates and methacrylates	223
Arylamide and methacrylamide	256
Acrylic acid and methacrylic acid	268
Anhydrides and acid chlorides of acrylic and methacrylic acid	277
Acrylonitrile	280
Maleic acid and related monomers	297
References	310
5. Poly(vinyl aldehyde)s, Poly(vinyl ketone)s and Phosphorus-Containing Vinyl Polymers	337
<i>Oskar Nuyken</i>	
Poly(acrolein)	337
Polymers of crotonaldehyde and methacrolein	345
Poly(methyl vinyl ketone)	351
Polymers of α , β -unsaturated ketones	360
Phosphorus-containing vinyl polymers	368
References	374
6. Polymeric Dienes	385
<i>Walter Kaminsky</i>	
Introduction	385
Polybutadiene	386
Polyisoprene	393
Chloroprene	396
Substituted polybutadienes	398
Poly(1,3-pentadiene)s	405
Miscellaneous dienes	410
Copolymerization of dienes	416
References	420
7. Metathesis Polymerization of Cycloolefins	433
<i>Hans R. Kricheldorf</i>	
Introduction	433
Mechanistic aspects	434

Contents of Part A

ix

Polymerization of cyclic olefins	442
Polymerization of bicyclic olefins	447
Polymerization of cyclic dienes, trienes, and tetraenes	461
Heterocyclic olefins	468
Copolymerizations of cyclic olefins	469
References	472
8. Aliphatic Polyethers	481
<i>Shohei Inoue and Takuzo Aida</i>	
Introduction	481
Oxiranes	484
Oxetanes	516
Tetrahydrofuran	521
References	537
9. Aromatic Polyethers	545
<i>Hans R. Kricheldorf</i>	
Introduction	545
Polyphenylene oxides	546
Poly(ether sulfones)	561
Poly(ether ketones)	574
Various polyethers	588
Chemical modification of polyethers	597
References	609
10. Poly(acetals)	617
<i>Heiner Görrissen</i>	
Introduction	617
Polymerization of formaldehyde	618
Polymerization of higher aliphatic aldehydes	623
Polymerization of ketones	629
Polymerization of cyclic acetals	630
Polymerization of trioxane and tetroxane	633
References	640
11. Polyesters	645
<i>Zbigniew J. Jedliński</i>	
Introduction	645
Step-growth polyesterification	646
Polyester synthesis from lactones	652
Polycarbonate synthesis	666
Unsaturated polyester synthesis	671
References	678
12. Poly(urethanes) and Related Polymers	685
<i>Claus D. Eisenbach and Hartmut Nefzger</i>	
Introduction	685
Linear homo-poly(urethanes)	686
Segmented polyurethanes	708

Poly(ureas)	713
Poly(biurets)	718
Uretdione groups containing polymers	721
Poly(isocyanates)	725
Allophanates	729
Carbodiimides	730
Miscellaneous	735
References	737
13. Poly(amines) and Poly(ammonium salts)	743
<i>Donald A. Tomalia</i>	
Introduction	743
Monomer syntheses and properties	745
Alkyleneimine polymer types and topologies	752
Alkyleneimine homopolymers: topologies, properties, and polymerization mechanisms	753
Alkyleneimine copolymers: topologies, properties, and polymerization mechanisms	775
Polymer modifications	787
Poly(ammonium salts)	789
References	794
14. Polyamides	807
<i>Hikaru Sekiguchi and Bernard Coutin</i>	
Introduction	807
Thermal polycondensations	808
Low-temperature polycondensations (acyl halide methods)	828
Polycondensation using active esters and other active derivatives (active ester methods)	848
Direct polycondensation by condensing agents	865
Lactam polymerizations	876
Polymerization of <i>N</i> -carboxy- β -amino acid anhydrides and related reactions	898
Hydrogen transfer polymerization	906
Miscellaneous methods	911
References	915