

Science of Synthesis: Houben-Weyl Methods of Molecular Transformations Vol. 47b

Alkenes

Bearbeitet von
Armin de Meijere, Kati M. Aitken, Mark S. Baird, Pauline Chiu, R. Alan Aitken

1. Auflage 2009. Buch. XXII, 670 S. Hardcover
ISBN 978 3 13 147291 5
Format (B x L): 17 x 24 cm
Gewicht: 1660 g

[Weitere Fachgebiete > Chemie, Biowissenschaften, Agrarwissenschaften > Analytische Chemie > Organische Chemie](#)

schnell und portofrei erhältlich bei

The logo for beck-shop.de features the text 'beck-shop.de' in a bold, red, sans-serif font. Above the 'i' in 'shop' are three red dots of increasing size. Below the main text, 'DIE FACHBUCHHANDLUNG' is written in a smaller, red, all-caps, sans-serif font.

beck-shop.de
DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung beck-shop.de ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

Volume 47b: Alkenes

	Preface	V
	Volume Editor's Preface	VII
	Table of Contents	IX
47.1	Product Class 1: Alkenes	
47.1.3	Synthesis by Pericyclic Reactions	
47.1.3.1	Diels–Alder Reactions F. Fringuelli, O. Piermatti, F. Pizzo, and L. Vaccaro	561
47.1.3.2	Ene Reactions P. Chiu and S. K. Lam	737
47.1.3.3	Synthesis by Electrocyclic Reactions J.-M. Lu, L.-X. Shao, and M. Shi	755
47.1.4	Synthesis by Elimination Reactions R. R. Kostikov, A. F. Khlebnikov, and V. V. Sokolov	771
47.1.5	Synthesis from Alkynes by Addition Reactions	
47.1.5.1	[2+2]-Cycloaddition Reactions V. V. Razin	883
47.1.5.2	Hydrogenation Reactions K.-M. Roy	897
47.1.5.3	Hydrometalation and Subsequent Coupling Reactions E. Negishi and G. Wang	909
47.1.5.4	Carbometalation and Subsequent Coupling Reactions E. Negishi and G. Wang	971
47.1.6	Synthesis from Arenes and Polyenes by Addition Reactions R. A. Aitken and K. M. Aitken	1017
47.1.7	Synthesis by Isomerization M. Yus and F. Foubelo	1067
47.1.8	Synthesis from Other Alkenes without Isomerization M. Yus and F. Foubelo	1095

47.2	Product Class 2: Cyclopropenes	
	M. S. Baird	1111
47.3	Product Class 3: Nonconjugated Di-, Tri-, and Oligoenes	
	K.-M. Roy	1135
	Keyword Index	1157
	Author Index	1195
	Abbreviations	1225

Table of Contents

47.1	Product Class 1: Alkenes	
47.1.3	Synthesis by Pericyclic Reactions	
47.1.3.1	Diels–Alder Reactions F. Fringuelli, O. Piermatti, F. Pizzo, and L. Vaccaro	
47.1.3.1	Diels–Alder Reactions	561
47.1.3.1.1	Thermal Diels–Alder Reactions	579
47.1.3.1.1.1	Method 1: Reactions of Carbonyl Dienophiles	579
47.1.3.1.1.1.1	Variation 1: Synthesis of Cyclohexenecarbaldehydes	579
47.1.3.1.1.1.2	Variation 2: Synthesis of Acetylcyclohexenes	585
47.1.3.1.1.1.3	Variation 3: Synthesis of Cyclohexenecarboxylic Acids and Alkyl Cyclohexenecarboxylates	591
47.1.3.1.1.1.4	Variation 4: Synthesis of Dialkyl Cyclohexenedicarboxylates	597
47.1.3.1.1.1.5	Variation 5: Synthesis of Cyclohexenecarboxylic Acids, Cyclohexene- carbonyl Chlorides, Cyclohexenecarboxamides, and Cyclohexenyl Silyl Ketones	601
47.1.3.1.1.1.6	Variation 6: Synthesis of Cyclohexenes Fused to Carbo- and Heterocycles	604
47.1.3.1.1.1.7	Variation 7: Synthesis of Bridged Cyclohexenes	619
47.1.3.1.1.2	Method 2: Reactions of Other Vinyl Dienophiles	631
47.1.3.1.1.2.1	Variation 1: Synthesis of Nitrocyclohexenes	631
47.1.3.1.1.2.2	Variation 2: Synthesis of Cyclohexenylboranes	634
47.1.3.1.1.2.3	Variation 3: Synthesis of Cyclohexenecarbonitriles	638
47.1.3.1.1.2.4	Variation 4: Synthesis of Cyclohex-3-enyl Phenyl Sulfones	641
47.1.3.1.1.2.5	Variation 5: Synthesis of (Hydroxyalkyl)cyclohexenes	644
47.1.3.1.1.2.6	Variation 6: Synthesis of Cyclohexenes from Unusual Dienophiles	648
47.1.3.1.1.3	Method 3: Synthesis of Cyclohexenyl-Substituted Fischer Carbene Complexes	651
47.1.3.1.1.4	Method 4: Synthetic Applications of Diels–Alder Reactions	655
47.1.3.1.2	Catalyzed Diels–Alder Reactions in Conventional Organic Media	660
47.1.3.1.2.1	Method 1: Reactions Using Classic Lewis Acid Catalysts	662
47.1.3.1.2.2	Method 2: Reactions Using Chiral Lewis Acid Catalysts	671
47.1.3.1.2.3	Method 3: Reactions Using Brønsted Acid Catalysts	675
47.1.3.1.2.4	Method 4: Reactions Using Chiral Organocatalysts	679
47.1.3.1.2.5	Method 5: Lewis Acid Catalyzed Diels–Alder Reactions of Chiral Dienophiles or Dienes	682
47.1.3.1.2.5.1	Variation 1: With Chiral Dienophiles	682
47.1.3.1.2.5.2	Variation 2: With Chiral Dienes	687

47.1.3.1.2.6	Method 6:	Reactions Using Heterogeneous Catalysts	689
47.1.3.1.3		Diels–Alder Reactions in Unconventional Media	694
47.1.3.1.3.1	Method 1:	Reactions in Water	694
47.1.3.1.3.1.1	Variation 1:	Without a Catalyst	694
47.1.3.1.3.1.2	Variation 2:	With a Lewis Acid Catalyst	697
47.1.3.1.3.1.3	Variation 3:	With Organocatalysts	700
47.1.3.1.3.1.4	Variation 4:	In Supercritical Water	701
47.1.3.1.3.1.5	Variation 5:	In Pseudo-Biological Systems or Promoted by Biocatalysts	702
47.1.3.1.3.2	Method 2:	Reactions in Nonaqueous Solvents and Their Salt Solutions	704
47.1.3.1.3.3	Method 3:	Reactions in Ionic Liquids	707
47.1.3.1.4		Diels–Alder Reactions Induced by Other Physical Means	712
47.1.3.1.4.1	Method 1:	Diels–Alder Reactions Promoted by Microwave Irradiation	712
47.1.3.1.4.2	Method 2:	Diels–Alder Reactions Promoted by High Pressure	715
47.1.3.1.4.3	Method 3:	Ultrasound-Assisted Diels–Alder Reactions	719
47.1.3.1.4.4	Method 4:	Photoinduced Diels–Alder Reactions	722
47.1.3.2	Ene Reactions P. Chiu and S. K. Lam		
47.1.3.2	Ene Reactions		737
47.1.3.2.1	Method 1:	Thermal Ene Reactions	739
47.1.3.2.1.1	Variation 1:	Intermolecular Ene Reactions	739
47.1.3.2.1.2	Variation 2:	Reactions of 1,n-Dienes	740
47.1.3.2.2	Method 2:	Metallo-Ene Reactions of Allylmetal Species	743
47.1.3.2.2.1	Variation 1:	Reactions Using Alkenes as Enophiles, Followed by Protonolysis	743
47.1.3.2.2.2	Variation 2:	Reactions Using Vinylmetals as Enophiles, Followed by Protonolysis	746
47.1.3.2.3	Method 3:	Metal-Catalyzed Metallo-Ene Reactions	747
47.1.3.2.3.1	Variation 1:	Palladium-Catalyzed Metallo-Ene Reactions Terminated by Transmetalation and Protonation	747
47.1.3.2.3.2	Variation 2:	Palladium-Catalyzed Metallo-Ene Reactions Terminated by Hydride Capture	748
47.1.3.2.4	Method 4:	Metal-Catalyzed Rearrangements	749
47.1.3.2.5	Method 5:	Retro-Ene Reactions of All-Carbon Ene Adducts	750
47.1.3.2.5.1	Variation 1:	Reactions of Homoallylic Alcohols	750
47.1.3.2.5.2	Variation 2:	Reactions of Allyldiazenes	750
47.1.3.2.5.3	Variation 3:	Reactions of Alk-2-enesulfinic Acid Derivatives	751

47.1.3.3	Synthesis by Electrocyclic Reactions J.-M. Lu, L.-X. Shao, and M. Shi	
47.1.3.3	Synthesis by Electrocyclic Reactions	755
47.1.3.3.1	Method 1: Rearrangement of 4π -Electron Systems	755
47.1.3.3.1.1	Variation 1: Rearrangement of Acyclic 1,3-Dienes	755
47.1.3.3.1.2	Variation 2: Rearrangement of Cyclic 1,3-Dienes	756
47.1.3.3.1.3	Variation 3: Rearrangement of 1,2-Dimethylene-Substituted Cycloalkanes	758
47.1.3.3.1.4	Variation 4: Rearrangement of 1,2-Dimethylene-Substituted Heterocycles	759
47.1.3.3.2	Method 2: Rearrangement of 2π -Electron Systems	760
47.1.3.3.2.1	Variation 1: Solvolysis of Chlorocyclopropanes	760
47.1.3.3.2.2	Variation 2: Solvolysis of Cyclopropyl 4-Toluenesulfonates	762
47.1.3.3.3	Method 3: Cope Rearrangement	763
47.1.3.3.3.1	Variation 1: Rearrangement of Acyclic 1,5-Dienes	763
47.1.3.3.3.2	Variation 2: Rearrangement of Cyclic 1,5-Dienes	765
47.1.3.3.3.3	Variation 3: Rearrangement of 1,2-Divinylcycloalkanes	766
47.1.4	Synthesis by Elimination Reactions R. R. Kostikov, A. F. Khlebnikov, and V. V. Sokolov	
47.1.4	Synthesis by Elimination Reactions	771
47.1.4.1	Method 1: Synthesis by Decarbonylative Elimination	771
47.1.4.1.1	Variation 1: Oxidative Decarboxylation of Carboxylic Acids	771
47.1.4.1.2	Variation 2: Oxidative Decarboxylation of Acid Anhydrides	772
47.1.4.1.3	Variation 3: Decarbonylation of Acid Halides and Aldehydes	773
47.1.4.1.4	Variation 4: Decarbonylative Reactions of β,γ -Unsaturated Acids	773
47.1.4.1.5	Variation 5: Decarbonylative Elimination from β -Halo- and β -Hydroxycarboxylic Acids	774
47.1.4.1.6	Variation 6: Fragmentation of β -Lactones	776
47.1.4.1.7	Variation 7: Fragmentation of 1,3-Diketones	777
47.1.4.1.8	Variation 8: Grob Fragmentation	778
47.1.4.2	Method 2: Oxidative Decarboxylation of Dicarboxylic Acid Derivatives	778
47.1.4.2.1	Variation 1: Oxidative Decarboxylation of 1,2-Dicarboxylic Acid Derivatives	778
47.1.4.2.2	Variation 2: Oxidative Decarboxylation of 1,3-Dicarboxylic Acids	780
47.1.4.3	Method 3: Base-Catalyzed and Solvolytic HX Elimination	780
47.1.4.3.1	Variation 1: Elimination from Alkyl Halides	780
47.1.4.3.2	Variation 2: Elimination from Ethers and Sulfides	788
47.1.4.3.3	Variation 3: Elimination from Metal Alkoxides	790
47.1.4.3.4	Variation 4: Elimination from Ammonium Salts	792
47.1.4.3.5	Variation 5: Elimination from Sulfonium Salts	794
47.1.4.3.6	Variation 6: Solvolytic and Base-Catalyzed Elimination from 4-Toluenesulfonates and Other Sulfonates	795
47.1.4.4	Method 4: Acid-Catalyzed HX Elimination	799
47.1.4.4.1	Variation 1: Acid-Catalyzed Dehydration of Alcohols	799

47.1.4.4.2	Variation 2:	Dehydration of Alcohols Using Lewis Acids and Heterogeneous Catalysts	803
47.1.4.4.3	Variation 3:	Dehydration of Alcohols with Other Systems	807
47.1.4.5	Method 5:	Pyrolytic HX Elimination	812
47.1.4.5.1	Variation 1:	Pyrolysis of Alkyl Halides	812
47.1.4.5.2	Variation 2:	Pyrolysis of Esters	813
47.1.4.5.3	Variation 3:	Pyrolysis of Xanthates, Thiocarbamates, Thiophosphates, Arenesulfonates, Sulfamates, and Sulfuranes	816
47.1.4.5.4	Variation 4:	Cope Elimination from <i>N</i> -Oxides	821
47.1.4.5.5	Variation 5:	Thermolytic Elimination from Ammonium Hydroxides	824
47.1.4.5.6	Variation 6:	Thermolytic Elimination from Phosphonium Salts	825
47.1.4.5.7	Variation 7:	Thermolytic Elimination from Alkyl Selenoxides	826
47.1.4.5.8	Variation 8:	Thermolytic Dehydration of Alcohols in Dimethyl Sulfoxide or Hexamethylphosphoric Triamide	827
47.1.4.6	Method 6:	Reductive Elimination from Halohydrins and Their Esters or Ethers	829
47.1.4.6.1	Variation 1:	Dehalogenation of Vicinal Dihalides	829
47.1.4.6.2	Variation 2:	Elimination from Halohydrins	832
47.1.4.6.3	Variation 3:	Elimination from Halohydrin Esters	833
47.1.4.6.4	Variation 4:	Elimination from Halohydrin Ethers	834
47.1.4.6.5	Variation 5:	Elimination from <i>vic</i> -Diols	836
47.1.4.6.6	Variation 6:	Elimination from <i>vic</i> -Diol Disulfonates	838
47.1.4.7	Method 7:	Reductive Elimination of X_2 from Fragments of the Type CX_2-CH_2	840
47.1.4.7.1	Variation 1:	Dehalogenation of Geminal Dihalides	840
47.1.4.7.2	Variation 2:	Elimination of Nitrogen from Diazo Compounds	841
47.1.4.8	Method 8:	Reductive Extrusions from Three- to Five-Membered Heterocycles	841
47.1.4.8.1	Variation 1:	From Oxiranes	841
47.1.4.8.2	Variation 2:	From Thiiranes and Thiirane 1,1-Dioxides	844
47.1.4.8.3	Variation 3:	Ramberg–Bäcklund Reaction	847
47.1.4.8.4	Variation 4:	From Aziridines	848
47.1.4.8.5	Variation 5:	From 1,3-Dioxolane- and 1,3-Dithiolane-2-thiones	849
47.1.4.8.6	Variation 6:	From 2-Alkoxy- and 2-(Dimethylamino)-1,3-dioxolanes ...	851
47.1.4.9	Method 9:	Reactions of Ketone (Arylsulfonyl)hydrazones	853
47.1.4.9.1	Variation 1:	The Bamford–Stevens Reaction	854
47.1.4.9.2	Variation 2:	The Shapiro Reaction	860
47.1.4.9.3	Variation 3:	Sequential Transformations Based on the Shapiro Reaction	866
47.1.4.10	Method 10:	Dehydrogenation of CH_2-CH_2 Fragments	871

47.1.5	Synthesis from Alkynes by Addition Reactions		
47.1.5.1	[2+2]-Cycloaddition Reactions V. V. Razin		
47.1.5.1	[2+2]-Cycloaddition Reactions	.....	883
47.1.5.1.1	Method 1: Photochemical and Microwave-Assisted Reactions	.....	883
47.1.5.1.1.1	Variation 1: From Diphenylacetylene	.....	883
47.1.5.1.1.2	Variation 2: From Diynes, Triynes, and Vinylacetylene	.....	884
47.1.5.1.1.3	Variation 3: Intramolecular Reactions	.....	886
47.1.5.1.2	Method 2: Thermocatalytic Reactions	.....	887
47.1.5.1.2.1	Variation 1: Lewis Acid Catalyzed [2+2] Cycloadditions	.....	887
47.1.5.1.2.2	Variation 2: Reactions Catalyzed by Nickel, Ruthenium, and Cobalt Complexes	.....	888
47.1.5.1.2.3	Variation 3: Zirconocene-Catalyzed Cyclobutene Formation	.....	892
47.1.5.2	Hydrogenation Reactions K.-M. Roy		
47.1.5.2	Hydrogenation Reactions	.....	897
47.1.5.2.1	Method 1: Catalytic Hydrogenation	.....	897
47.1.5.2.2	Method 2: Chemical Reduction	.....	899
47.1.5.2.2.1	Variation 1: Reduction with Metals	.....	899
47.1.5.2.2.2	Variation 2: Reduction by Hydrometalation–Protodemetalation	.....	902
47.1.5.3	Hydrometalation and Subsequent Coupling Reactions E. Negishi and G. Wang		
47.1.5.3	Hydrometalation and Subsequent Coupling Reactions	.....	909
47.1.5.3.1	Method 1: <i>syn</i> -Hydrometalation Reactions of Alkynes Producing <i>E</i> - β -Mono-, <i>syn</i> - α,β -Di-, and <i>anti</i> - α,β -Disubstituted Alkenylmetals	.....	918
47.1.5.3.1.1	Variation 1: <i>syn</i> -Hydrometalation of Alkynes Involving Group 1, 2, 11, and 12 Metals	.....	918
47.1.5.3.1.2	Variation 2: Hydroboration of Alkynes	.....	919
47.1.5.3.1.3	Variation 3: Substitution of Boron in the Hydroboration Products with Hydrogen and Heteroatoms	.....	921
47.1.5.3.1.4	Variation 4: C–C Bond-Forming Reactions That Are Unique to Organoboranes	.....	923
47.1.5.3.1.5	Variation 5: Hydroalumination and Hydrozirconation of Alkynes	.....	925
47.1.5.3.1.6	Variation 6: Substitution of the Metal in Alkenylaluminum and Alkenylzirconium Compounds with Hydrogen or Deuterium, Halogens, Other Heteroatoms, Metals, and Carbon	.....	929
47.1.5.3.2	Method 2: <i>anti</i> -Hydrometalation Reactions of Alkynes Producing <i>Z</i> - β -Mono- and <i>anti</i> - α,β -Disubstituted Alkenylmetals	.....	932
47.1.5.3.2.1	Variation 1: <i>anti</i> -Hydroalumination of Alkynes with Hydroaluminates	..	932

47.1.5.3.2.2	Variation 2:	Other <i>anti</i> -Hydrometalation Reactions of Alkynes	933
47.1.5.3.2.3	Variation 3:	Useful Alternatives to <i>anti</i> -Hydrometalation of Alkynes ...	933
47.1.5.3.3	Method 3:	Palladium-Catalyzed Cross-Coupling Reactions of Alkenylmetals or Alkenyl Electrophiles Prepared by Alkyne Hydrometalation	935
47.1.5.3.3.1	Variation 1:	1,2-Disubstituted <i>E</i> -Alkenes via β -Monosubstituted <i>E</i> -Alkenyl Derivatives	937
47.1.5.3.3.2	Variation 2:	1,2-Disubstituted <i>E</i> -Alkenes via β -Monosubstituted <i>E</i> -Alkenyl Derivatives Preparable by Methods Other Than Hydrometalation	950
47.1.5.3.3.3	Variation 3:	1,2-Disubstituted <i>Z</i> -Alkenes via β -Monosubstituted <i>Z</i> -Alkenyl Derivatives Preparable by Alkyne Hydrometalation, Ethyne Carbocupration, and Other Methods	953
47.1.5.3.3.4	Variation 4:	Trisubstituted Alkenes via <i>syn</i> - α,β -Disubstituted Alkenyl Derivatives Preparable by Alkyne <i>syn</i> -Hydrometalation and Other Methods	957
47.1.5.3.3.5	Variation 5:	Trisubstituted Alkenes via <i>anti</i> - α,β -Disubstituted Alkenyl Derivatives Prepared by Alkyne <i>syn</i> - or <i>anti</i> -Hydrometalation and Other Methods Not Involving Elementometalation ...	962
47.1.5.4	Carbometalation and Subsequent Coupling Reactions E. Negishi and G. Wang		
47.1.5.4	Carbometalation and Subsequent Coupling Reactions		971
47.1.5.4.1	Method 1:	Syntheses of Trisubstituted Alkenes via Zirconium-Catalyzed <i>syn</i> -Carboalumination of Alkynes	978
47.1.5.4.2	Method 2:	Syntheses of Trisubstituted Alkenes by Carbocupration of Alkynes	998
47.1.5.4.2.1	Variation 1:	<i>syn</i> -Carbocupration of Alkynes	998
47.1.5.4.2.2	Variation 2:	Copper-Catalyzed <i>anti</i> -Carbomagnesiation of Propargyl Alcohols	1002
47.1.5.4.3	Method 3:	Synthesis of Trisubstituted Alkenes via <i>syn</i> -Haloboration of Alkynes	1003
47.1.5.4.4	Method 4:	Synthesis of Trisubstituted Alkenes via β,β -Disubstituted Alkenyl Derivatives Prepared by Miscellaneous Other Methods	1007
47.1.5.4.5	Method 5:	Synthesis of Tetrasubstituted Alkenes via Trisubstituted Alkenyl Derivatives	1010
47.1.6	Synthesis from Arenes and Polyenes by Addition Reactions R. A. Aitken and K. M. Aitken		
47.1.6	Synthesis from Arenes and Polyenes by Addition Reactions		1017
47.1.6.1	Synthesis from Arenes		1017
47.1.6.1.1	Method 1:	Reduction by Metals in Liquid Ammonia	1017
47.1.6.1.1.1	Variation 1:	Reduction by Lithium and Added Ethanol	1017
47.1.6.1.1.2	Variation 2:	Reduction by Sodium and Added Ethanol	1018
47.1.6.1.1.3	Variation 3:	Reduction by Potassium and Added <i>tert</i> -Butyl Alcohol	1018

47.1.6.1.1.4	Variation 4:	Reduction by Calcium	1018
47.1.6.1.2	Method 2:	Reduction by Lithium and Alkylamines	1019
47.1.6.1.2.1	Variation 1:	Reduction in Methylamine or Ethylamine	1019
47.1.6.1.2.2	Variation 2:	Reduction in Ethylenediamine	1019
47.1.6.1.2.3	Variation 3:	Reduction in Mixed-Amine Systems	1019
47.1.6.1.3	Method 3:	Electrochemical Reduction in Methylamine	1020
47.1.6.1.4	Method 4:	Reduction by Sodium and <i>tert</i> -Butyl Alcohol	1020
47.1.6.2	Synthesis from 1,2-Dienes (Allen es)	.....	1020
47.1.6.2.1	Method 1:	Reduction by Addition of Hydrogen	1020
47.1.6.2.1.1	Variation 1:	Catalytic Hydrogenation	1020
47.1.6.2.1.2	Variation 2:	Transfer Hydrogenation Using Ammonium Formate	1022
47.1.6.2.1.3	Variation 3:	Reduction by Lithium or Sodium in Liquid Ammonia	1022
47.1.6.2.1.4	Variation 4:	Reduction by Sodium and Ethanol	1022
47.1.6.2.1.5	Variation 5:	Reduction by the Zinc–Copper Couple	1023
47.1.6.2.1.6	Variation 6:	Reduction by Diimide	1023
47.1.6.2.1.7	Variation 7:	Reduction by Red Phosphorus and Hydriodic Acid	1023
47.1.6.2.1.8	Variation 8:	Reduction by Borane	1024
47.1.6.2.1.9	Variation 9:	Reduction by Aluminum Hydrides	1024
47.1.6.2.1.10	Variation 10:	Reduction by Baker’s Yeast	1024
47.1.6.2.1.11	Variation 11:	Miscellaneous Variations	1024
47.1.6.2.2	Method 2:	Synthesis by Hydrocarbonation (Addition of Carbon and Hydrogen)	1024
47.1.6.2.2.1	Variation 1:	Hydrocarbonation Using a Grignard Reagent	1025
47.1.6.2.2.2	Variation 2:	Hydrocarbonation Using Arylboronates	1025
47.1.6.2.2.3	Variation 3:	Hydrocarbonation Using Stabilized Carbanions	1025
47.1.6.2.2.4	Variation 4:	Hydrocarbonation by Hydrozirconation Followed by Zinc-Mediated Claisen Rearrangement	1026
47.1.6.2.2.5	Variation 5:	Hydrocarbonation by Reductive Coupling to Carbonyl Compounds	1027
47.1.6.3	Synthesis from 1,3-Dienes or Fully Conjugated Polyenes	.....	1028
47.1.6.3.1	Synthesis by Addition of Hydrogen	.....	1028
47.1.6.3.1.1	Method 1:	Catalytic Hydrogenation	1028
47.1.6.3.1.1.1	Variation 1:	Hydrogenation Using Chromium or Molybdenum Catalysts	1028
47.1.6.3.1.1.2	Variation 2:	Hydrogenation Using Nickel Catalysts	1029
47.1.6.3.1.1.3	Variation 3:	Hydrogenation Using Palladium Catalysts	1030
47.1.6.3.1.1.4	Variation 4:	Hydrogenation Using Platinum Catalysts	1031
47.1.6.3.1.1.5	Variation 5:	Hydrogenation Using Other Metal Catalysts	1032
47.1.6.3.1.2	Method 2:	Dissolving Metal Reduction	1033
47.1.6.3.1.2.1	Variation 1:	Reduction by Lithium and Ammonia	1033
47.1.6.3.1.2.2	Variation 2:	Reduction by Sodium and Ammonia	1033
47.1.6.3.1.2.3	Variation 3:	Reduction by Sodium Amalgam	1034
47.1.6.3.1.2.4	Variation 4:	Reduction by Sodium and an Alcohol	1035
47.1.6.3.1.2.5	Variation 5:	Reduction by Magnesium	1036
47.1.6.3.1.2.6	Variation 6:	Reduction by Aluminum Amalgam	1036
47.1.6.3.1.2.7	Variation 7:	Reduction by Zinc and Acetic Acid	1036

47.1.6.3.1.3	Method 3:	Reduction by Sodium Borohydride with Iodine or Disodium Tetracyanonickelate	1037
47.1.6.3.1.4	Method 4:	Reduction by Diisobutylaluminum Hydride	1037
47.1.6.3.1.5	Method 5:	Reduction by Platinum-Catalyzed Hydrosilylation	1038
47.1.6.3.1.6	Method 6:	Reduction by Diimide	1038
47.1.6.3.1.7	Method 7:	Reduction by Sodium Dithionite	1039
47.1.6.3.1.8	Method 8:	Reduction by Zirconocene and Hydrochloric Acid	1040
47.1.6.3.1.9	Method 9:	Reduction by Vanadium(II) and Pyrocatechol	1040
47.1.6.3.1.10	Method 10:	Reduction by Samarium and Water	1040
47.1.6.3.1.11	Method 11:	Electrochemical Reduction	1041
47.1.6.3.1.12	Method 12:	Reduction by Nicotinamide Adenine Dinucleotide Model Dihydropyridines	1041
47.1.6.3.1.13	Method 13:	Reduction by Yeasts	1041
47.1.6.3.2	Synthesis by Hydrocarbonation (Addition of Carbon and Hydrogen)		1042
47.1.6.3.2.1	Method 1:	Hydrocarbonation Using Alkylolithium Reagents	1042
47.1.6.3.2.2	Method 2:	Hydrocarbonation Using Alkylsodium Reagents	1043
47.1.6.3.2.3	Method 3:	Hydrocarbonation Using Organometallic Reagents	1044
47.1.6.3.2.4	Method 4:	Hydrocarbonation Using Nitroalkane Anions	1046
47.1.6.3.2.5	Method 5:	Hydrocarbonation Using Stabilized Carbanions	1047
47.1.6.3.2.6	Method 6:	Hydrocarbonation by Reductive Coupling to Carbonyl Compounds, Imines, or Alkenes	1049
47.1.6.3.3	Synthesis by Carbonation (Formation of Two C—C Bonds)		1051
47.1.6.3.3.1	Method 1:	Carbonation Using an Alkyl- or Aryllithium and a Haloalkane	1051
47.1.6.3.3.2	Method 2:	Carbonation Using a Grignard Reagent Followed by Carbon Dioxide	1051
47.1.6.3.3.3	Method 3:	Carbonation Using a Nickel-Catalyst with Trimethylborane or Dimethylzinc and an Aldehyde	1052
47.1.6.3.3.4	Method 4:	Carbonation Using an Alkylcopper Reagent Followed by a Carbonyl or Haloalkane Electrophile	1052
47.1.6.3.3.5	Method 5:	Carbonation Using an Acyl(carbonyl)cobalt Reagent and a Stabilized Carbanion	1053
47.1.6.3.4	Addition Across Two Molecules of a 1,3-Diene		1054
47.1.6.3.4.1	Method 1:	Hydrocarbonation Using Nitroalkane Anions	1054
47.1.6.3.4.2	Method 2:	Hydrocarbonation Using Stabilized Carbanions	1055
47.1.6.3.4.3	Method 3:	Hydrocarbonation Using Reductive Coupling to Imines and Alkenes	1055
47.1.6.3.4.4	Method 4:	Carbonation Using Alkyl Radicals	1055
47.1.6.3.4.5	Method 5:	Addition of Ammonia and Amines	1056
47.1.6.3.4.6	Method 6:	Addition of Alcohols, Phenols, or Carboxylic Acids	1056
47.1.6.3.4.7	Method 7:	Addition of Arenesulfinic Acids	1057
47.1.6.4	Synthesis from 1,4-Dienes, 1,5-Dienes, or Higher Dienes		1057
47.1.6.4.1	Method 1:	Catalytic Hydrogenation	1057
47.1.6.4.1.1	Variation 1:	Hydrogenation Using Nickel Catalysts	1057
47.1.6.4.1.2	Variation 2:	Hydrogenation Using Palladium Catalysts	1058

47.1.6.4.1.3	Variation 3:	Hydrogenation Using Platinum Catalysts	1058
47.1.6.4.1.4	Variation 4:	Hydrogenation Using Other Metal Catalysts	1059
47.1.6.4.2	Method 2:	Reduction by Magnesium	1060
47.1.6.4.3	Method 3:	Reduction by Diimide	1060
47.1.6.4.4	Method 4:	Reduction by Sodium Hydrazide/Hydrazine	1061
47.1.6.4.5	Method 5:	Reduction by Nicotinamide Adenine Dinucleotide Model Dihydropyridines	1061

47.1.7 **Synthesis by Isomerization**

M. Yus and F. Foubelo

47.1.7	Synthesis by Isomerization	1067
47.1.7.1	Method 1: Rearrangement from Terminal to Internal Alkenes	1067
47.1.7.1.1	Variation 1: Using Ruthenium Complexes	1067
47.1.7.1.2	Variation 2: Using Rhodium Catalysts	1069
47.1.7.1.3	Variation 3: Using Palladium Complexes	1070
47.1.7.1.4	Variation 4: Using Diphenyl Disulfone	1071
47.1.7.2	Method 2: Rearrangement from Internal to Terminal Alkenes	1072
47.1.7.3	Method 3: Rearrangement of <i>Z</i> - and <i>E</i> -Alkenes	1074
47.1.7.3.1	Variation 1: Conversion of an <i>E</i> -Alkene into a <i>Z</i> -Alkene	1075
47.1.7.3.2	Variation 2: Conversion of a <i>Z</i> -Alkene into an <i>E</i> -Alkene	1076
47.1.7.4	Method 4: Allylic Rearrangement	1077
47.1.7.4.1	Variation 1: Of Alcohols and Ethers	1077
47.1.7.4.2	Variation 2: Of Esters and Imidates	1082
47.1.7.4.3	Variation 3: Of Sulfoxides, Selenoxides, Sulfones, and Related Compounds	1084
47.1.7.4.4	Variation 4: Of Azides	1086
47.1.7.5	Method 5: Rearrangement of Vinylcyclopropanes	1087
47.1.7.5.1	Variation 1: Under Thermal Conditions	1088
47.1.7.5.2	Variation 2: Under Photochemical Conditions	1088
47.1.7.5.3	Variation 3: Under Transition-Metal Catalysis	1090

47.1.8 **Synthesis from Other Alkenes without Isomerization**

M. Yus and F. Foubelo

47.1.8	Synthesis from Other Alkenes without Isomerization	1095
47.1.8.1	Method 1: Electrophilic Substitution	1095
47.1.8.1.1	Variation 1: Acylation Reactions	1095
47.1.8.1.2	Variation 2: Reactions of Vinylsilanes and Vinylstannanes	1096
47.1.8.2	Method 2: Nucleophilic Substitution	1099
47.1.8.2.1	Variation 1: Reactions with Carbon Nucleophiles	1099
47.1.8.2.2	Variation 2: Reactions with Heteroatom Nucleophiles	1100
47.1.8.3	Method 3: Alkylation of Organometallic Compounds	1102
47.1.8.3.1	Variation 1: Reactions of Organolithium Compounds	1103
47.1.8.3.2	Variation 2: Reactions of Organomagnesium Compounds	1105
47.1.8.3.3	Variation 3: Reactions of Organocopper Compounds	1107

47.2	Product Class 2: Cyclopropenes		
	M. S. Baird		
47.2	Product Class 2: Cyclopropenes		1111
47.2.1	Synthesis of Product Class 2		1111
47.2.1.1	Method 1: Synthesis by Ring Closure with Formation of Two C—C Bonds		1111
47.2.1.2	Method 2: Synthesis by Ring Closure with Formation of One C—C Bond		1113
47.2.1.2.1	Variation 1: Dehydrohalogenation of Allylic Halides		1113
47.2.1.2.2	Variation 2: Cyclizing Insertions of Methylenecarbenes (Vinylidenes) or Related Species		1114
47.2.1.2.3	Variation 3: 1,3-Elimination from Propenes		1114
47.2.1.2.4	Variation 4: By Formation of the C=C Bond		1115
47.2.1.3	Method 3: Synthesis by Ring Contraction		1115
47.2.1.4	Method 4: Synthesis by 1,2-Elimination		1116
47.2.1.4.1	Variation 1: Dehydrohalogenation		1116
47.2.1.4.2	Variation 2: Dehalogenation		1120
47.2.1.4.3	Variation 3: Dehalosilylation		1123
47.2.1.4.4	Variation 4: Dehydroxysilylation		1124
47.2.1.5	Method 5: Synthesis by Rearrangement of Methylenecyclopropanes		1125
47.2.1.6	Method 6: Synthesis from Other Cyclopropenes		1126
47.2.1.6.1	Variation 1: By Alkylation of a Carbon Nucleophile		1126
47.2.1.6.2	Variation 2: By Alkylation with an Electrophilic Reagent		1127
47.2.1.6.3	Variation 3: By Ene Reactions		1127
47.2.1.7	Method 7: Miscellaneous Methods		1130
47.3	Product Class 3: Nonconjugated Di-, Tri-, and Oligoenes		
	K.-M. Roy		
47.3	Product Class 3: Nonconjugated Di-, Tri-, and Oligoenes		1135
47.3.1	Synthesis of Product Class 3		1135
47.3.1.1	Synthesis with C—C Bond Formation		1135
47.3.1.1.1	Method 1: Wittig-Type Reactions		1135
47.3.1.1.2	Method 2: Coupling Reactions with Organometallic Compounds		1138
47.3.1.1.2.1	Variation 1: With Organomagnesium Compounds		1138
47.3.1.1.2.2	Variation 2: With Organoboron Compounds		1140
47.3.1.1.2.3	Variation 3: With Organoaluminum and Organoindium Compounds		1141
47.3.1.1.2.4	Variation 4: With Organosilicon and Organotin Compounds		1142
47.3.1.1.2.5	Variation 5: With Other Organometallic Compounds		1146
47.3.1.1.3	Method 3: Dimerization and Oligomerization Reactions		1150
47.3.1.2	Synthesis by Elimination		1150
47.3.1.2.1	Method 1: Synthesis from Cyclopropylcarbinols		1150
47.3.1.2.2	Method 2: Synthesis from Iodohydrin Derivatives		1151
47.3.1.2.3	Method 3: Hydroboration–Elimination of Enamines		1152

47.3.1.3	Synthesis by Reduction	1152
47.3.1.3.1	Method 1: Catalytic Hydrogenation	1152
47.3.1.3.2	Method 2: Chemical Reduction	1153
47.3.1.3.3	Method 3: Electrochemical Reduction	1154
 Keyword Index		1157
 Author Index		1195
 Abbreviations		1225

