

Fine Chemicals through
Heterogeneous Catalysis

Roger Arthur Sheldon, Herman van Bekkum

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Preface

The subject of this book is the application of heterogeneous catalysis in organic synthesis with emphasis on transformations of relevance to fine chemicals manufacture. Both gas and liquid phase reactions are included although the latter are more numerous, analogous to fine chemicals manufacture where substrates and products often have low volatility and/or thermal stability, necessitating operation in the liquid phase. The subject is divided on the basis of the major types of catalytic conversions employed in organic synthesis: acid and base catalysis, hydrogenation and dehydrogenation, oxidation and C-C bond formation.

Heterogeneous catalysis has a long history, dating back to the early studies of alcohol dehydration over alumina and alcohol oxidation over platinum metal in the nineteenth century. Another milestone was the discovery, by the organic chemists Sabatier and Senderens, of catalytic hydrogenations at the beginning of the twentieth century. The high potential of catalysts as „molecular marriage brokers and divorce lawyers“ gradually became apparent and, following the advent of petrochemicals in the nineteen twenties, heterogeneous catalysis by solid acids and supported metals was widely applied in oil refining and petrochemicals. In contrast, fine chemicals manufacture was dominated by synthetic organic chemists who adhered to „stoichiometric“ methodologies. But „times are a changing“. The pressure of environmental legislation has, in the last decade, provided an important stimulus for the development of clean, catalytic methodologies. And heterogeneous catalysts have the added benefit of ease of separation and reuse.

This book is directed towards chemists engaged in organic synthesis, and catalysis, both in industrial and academic laboratories, who are concerned with research and development as well as education. Our primary aim is to cultivate a deeper understanding and, hence, promote a greater utilization of heterogeneous catalysis in organic synthesis. To this end, an international group of recognized authorities in the field of heterogeneous catalysis has been gathered together.

A general introduction to the subject is followed by a discussion of basic principles regarding types of catalyst and their preparation and characterization and types of catalytic reactors. Chapter 3 deals with the different types of solid acids. In the following chapters (4-6) various (solid) acid-catalyzed transforma-

tions are reviewed, *e. g.* aromatic substitutions and rearrangements and isomerizations. Solid base-catalyzed processes, *e. g.* aldol and related condensations are discussed in Chapter 7. Subsequent chapters deal with catalytic hydrogenation and dehydrogenation (Chapter 8), catalytic oxidation (Chapter 9) and catalytic C-C bond formation (Chapter 10), culminating in a future outlook (Chapter 11).

Each chapter contains an extensive bibliography covering the principal literature through the end of 1999.

Finally, the editors would like to express their sincere thanks to their friends and colleagues who have contributed such fine chapters to this book. We gratefully acknowledge the invaluable assistance of Mrs. Mieke van der Kooij in coordinating the traffic of manuscripts between contributors, editors and publisher. We also thank Wim Jongeleen for the cover illustration. Finally, we thank Dr. Anette Eckerle and Dr. Roland Kessinger of Wiley-VCH for their help in preparing this book.

Summer 2000

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Contents

1	Introduction	1
1.1	What are Fine Chemicals?	1
1.2	The Environmental Factor	2
1.3	The Development of Organic Synthesis and Catalysis	3
1.4	Why Heterogeneous Catalysis?	4
1.5	Types of Catalysts and Reactions	5
1.5.1	Solid-Acid Catalysis	5
1.5.2	Solid-Base Catalysis	6
1.5.3	Catalytic Hydrogenation	6
1.5.4	Catalytic Oxidations	6
1.5.5	Catalytic C–C Bond Formation	7
1.6	Alternative Approaches	8
1.7	Heterogeneous Catalysis in Multi-step Synthesis: Vanillin	8
2	Basic Principles/General	13
2.1	General Considerations and Types of Catalyst	13
2.1.1	Introduction	13
2.1.2	Catalytically Active Surface Area	14
2.1.3	Reactors Employed in the Fine-chemical Industry	14
2.1.4	Slurry-phase Catalysts	16
2.1.5	Fixed-bed Catalysts	18
2.1.6	Integration of the Catalyst and the Reactor	18
2.1.7	Solid Catalysts Employed in the Fine-chemical Industry	19
2.1.8	Metal Catalysts	19
2.1.9	Solid-Acid Catalysts	24
2.2	Preparation of Solid Catalysts	26
2.2.1	Demands on Solid Catalysts	26
2.2.2	Preparation Procedures [2]	28
2.2.3	Conclusions	33
2.3	Characterization of Solid Catalysts	35
2.3.1	Total Surface Area and Pore-size Distribution	36
2.3.2	Catalytically Active Surface Area Per Unit Weight of Catalyst	39

2.3.3	Extent of Reduction of Metal Catalysts	41
2.3.4	Solid-acid Catalysts	42
2.3.5	Dispersion of Active Component(s) Over the Support	42
2.3.6	Conclusions	43
2.4	Reactors	45
2.4.1	Introduction	45
2.4.2	Three-phase Catalytic Reactions (G-L-S)	46
2.4.3	Characteristics of Three-phase Catalytic Reactors for Fine-chemicals Production	47
2.4.3.1	Reactors with Moving Catalyst	48
2.4.3.2	Reactors with a Fixed Bed of Catalyst	49
2.4.3.3	Comparison-Reactor Choice	50
2.4.4	Design Aspects of Stirred Tank Batch Reactor	53
2.4.5	Scale-up of Stirred-Tank Batch Reactors-Runaway Reactions . .	56
3	Solid-acid Catalysts-General	61
3.1	Acidic Clays	61
3.1.1	Introduction	61
3.1.2	Structure	62
3.1.3	Main Properties and Catalytic Applications	63
3.1.4	Pillared Interlayer Clays (PILC)	71
3.1.5	Conclusions	76
3.2	Zeolites as Catalysts	80
3.2.1	Introduction	80
3.2.2	Acid Zeolites	83
3.2.2.1	Framework Composition	83
3.2.2.2	Extra-framework Composition	84
3.2.3	Basicity in Zeolites	85
3.2.3.1	Basic Zeolites-Framework Composition	85
3.2.3.2	Basic Zeolites-Extra-framework Composition	86
3.2.4	Redox Molecular Sieves	86
3.2.4.1	Oxidation Sites in Framework Positions	86
3.2.4.2	Oxidation Sites in Extra-framework Positions	88
3.2.5	Conclusions	88
3.3	Sulfonated Polysiloxanes	92
3.3.1	Motivation and Expected Advantages	92
3.3.2	Synthetic Approaches	92
3.3.2.1	Grafting of Silanes to Silica	93
3.3.2.2	Copolycondensation and Sol-Gel Processing	94
3.3.2.3	Sulfonation of Arylsiloxanes	94
3.3.2.4	Oxidation of Sulfur-functionalized Siloxanes	95
3.3.3	Characterization of the Polysiloxanes	95
3.3.3.1	General	95
3.3.3.2	Analytical Determination of Capacity	96
3.3.3.3	NMR Spectroscopy	96
3.3.3.4	Thermal Stability	98

3.3.4	Applications and Reactions	98
3.3.5	Summary	99
3.4	Silica-occluded Heteropolyacids	100
3.4.1	Introduction	100
3.4.2	Preparation of Silica-occluded Heteropolyacid	101
3.4.3	Liquid-phase Organic Reactions over Silica-occluded $H_3PW_{12}O_{40}$	102
3.4.3.1	Hydrolysis of Ethyl Acetate	102
3.4.3.2	Hydration of Isobutene	103
3.4.3.3	Alkylation of Phenol	103
3.5	Hybrid Sulfonated Mesoporous Systems	106
3.5.1	Amorphous Solid Sulfonic Acids	106
3.5.1.1	Organic Resin-Silica Composites	106
3.5.1.2	Modification of Silica via Si-C Bonds	107
3.5.1.3	Sol-Gel Preparation	109
3.5.2	Ordered Sulfonic Acid Catalysts	109
3.5.2.1	Immobilization of Sulfonic Acids via Grafting and Coating	110
3.5.2.2	Sol-Gel Synthesis with Structure-directing Agents	112
3.5.2.3	Organic Catalysis with Ordered Solid Sulfonic Acids	113
3.6	The Use of Nafion and Nafion-Silica Composites in Solid Acid Catalysis	116
3.6.1	Introduction	116
3.6.2	The Ion-exchange Resin Nafion	116
3.6.3	Nafion in Catalysis	117
3.6.4	Nafion-Silica Composites	117
3.6.5	Nafion-Silica Composites in Catalysis	118
3.6.5.1	Friedel-Crafts Alkylation	118
3.6.5.2	Friedel-Crafts Acylation	118
3.6.5.3	Fries Rearrangement	119
3.6.5.4	Dimerization of α -Methylstyrene	119
3.6.5.5	Esterification Reactions	119
3.6.6	Conclusions	120
4	Solid-acid Catalysts-Aromatic Substitution	123
4.1	Nitration of Aromatic Compounds	123
4.1.1	Introduction	123
4.1.2	Reaction Mechanism	123
4.1.3	Commercial Manufacture of Nitroaromatic Compounds	124
4.1.4	Solid-acid-based Nitration	125
4.1.5	Liquid-phase Reactions	126
4.1.6	Vapor-phase Reactions	128
4.1.7	Conclusion	130
4.2	Halogenation over Solid Catalysts	133
4.2.1	Introduction	133
4.2.2	Halogenation and Halogenating Agents	134
4.2.3	Halogenation over Solid Catalysts	135