Abstracts

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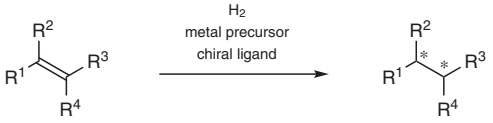
1.1.1 Homogeneous Reduction of Alkenes

X. Tan, H. Lv, and X. Zhang

This chapter is focused on recent progress in the asymmetric hydrogenation of substituted alkenes, and the application of this methodology in the construction of a variety of chiral centers. The asymmetric hydrogenation of nonfunctionalized alkenes, α,β-unsaturated carbonyl compounds, enamides, enols, and other heteroatom-substituted alkenes is covered.



Keywords: alkenes · alkanes · olefins · transition-metal catalysis · asymmetric hydrogenation · phosphorus ligands · homogeneous catalysis · reduction · rhodium · iridium · ruthenium

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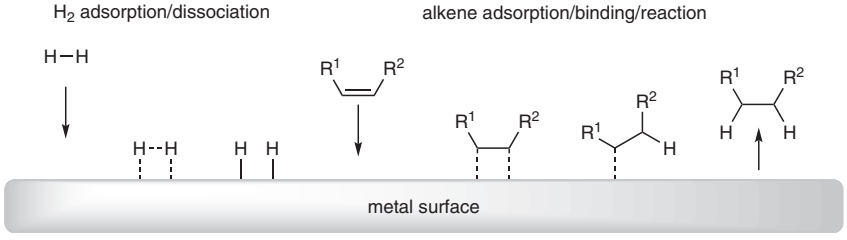
1.1.2 Reduction of Alkenes Using Nanoparticle Catalysis

R. Hudson and A. Moores

The transformation of alkenes to alkanes via hydrogenation represents a cornerstone of synthetic chemistry. Herein are outlined methods for alkene hydrogenations and transfer hydrogenations catalyzed by supported or unsupported palladium-, nickel-, iridium-, and iron-based nanoparticles.



Keywords: alkenes · alkanes · olefins · nanostructures · carbon–carbon double bonds · catalysis · hydrogenation · reduction · palladium catalysts · nickel catalysts · iridium catalysts · iron catalysts · heterogeneous catalysis

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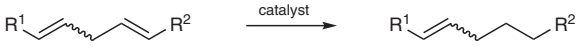
1.2 Partial Reduction of Polyenes

F. Zaccheria and N. Ravasio

The selective hydrogenation of polyenes represents an important transformation in organic synthesis and requires a proper design and choice of the catalyst used for C=C bond hydrogenation, as well as careful tuning of the reaction conditions. This chapter illustrates some selected examples of partial reduction of polyenes via both homogeneous and heterogeneous catalysis, including hydrogenation of terpenes, cyclic dienes, and vegetable oils, to obtain products and intermediates useful for the chemical industry.



Keywords: cyclooctadienes · dienes · fatty acid esters · geraniol · limonenes · polyenes · selective hydrogenation · reduction · palladium catalysts · platinum catalysts · ruthenium catalysts · rhodium catalysts

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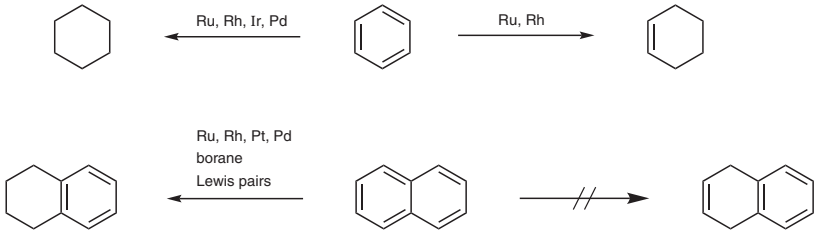
1.3 Reduction of Arenes

X. Dai and F. Shi

The group VIII metals, boranes, and Lewis pairs can catalyze the reduction of arenes to afford cycloalkanes. Cycloalkenes, as the intermediate product in the reduction of arenes, can also be generated by the partial reduction of arenes in the presence of ruthenium- and rhodium-based catalysts, but the selective partial reduction of polycyclic arenes to cycloalkenes still remains a challenge.



Keywords: reduction · arenes · cycloalkanes · cycloalkenes · partial reduction · total reduction · hydrogenation

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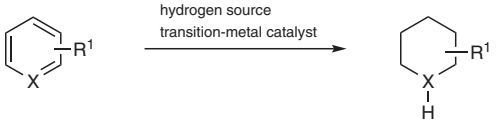
1.4 Reduction of Hetarenes

Z.-P. Chen and Y.-G. Zhou

The reduction of hetarenes provides a practical and efficient route to the corresponding saturated or partially saturated heterocycles, which are important structural motifs in many biologically active reagents and synthetic drugs. In the past decades, this approach has been extensively developed and it now represents a very powerful tool in organic synthesis. This chapter provides an overview of the reduction of hetarenes. Both heterogeneous and homogeneous catalysis approaches involving hydrogenations and transfer hydrogenations with transition-metal catalysts are discussed. Moreover, enantioselective approaches are also covered.



Keywords: hetarenes · heterocycles · transition-metal catalysts · heterogeneous catalysis · homogeneous catalysis · asymmetric catalysis · hydrogenation · transfer hydrogenation · reduction

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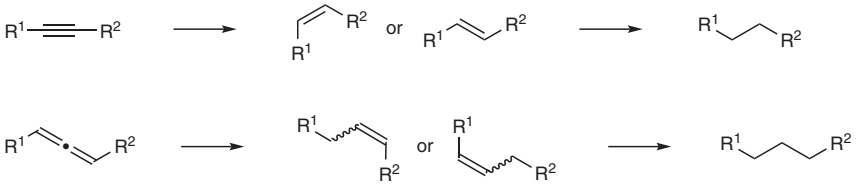
1.5 Catalytic Reduction of Alkynes and Allenes

W. Bonrath, J. A. Medlock, and M.-A. Müller

Catalytic reductions are one of the most important transformations in the chemical industry. In the field of alkyne and allene reduction, the most widely used method is hydrogenation. Numerous processes have been developed and implemented in the fine chemical and pharmaceutical industries for the production of a wide variety of alkenes and alkanes. This review provides an overview of the best (selective) reduction methods, from the use of the classic supported transition metal catalysts (e.g., the Lindlar catalyst) to more recently developed homogeneous catalysts which show alternative reactivity and selectivity, including preferential formation of *E*-alkenes.



Keywords: alkynes · alkenes · allenes · alkanes · hydrogenation · semi-hydrogenation · transfer hydrogenation · reduction · metal catalysts · Lindlar catalyst

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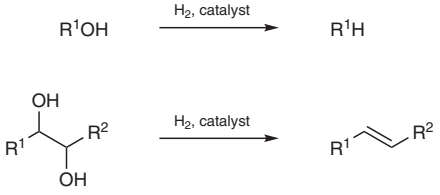
1.6 Catalytic Reduction of Phenols, Alcohols, and Diols

S. Tin and J. G. de Vries

The catalytic deoxygenation of organic molecules has attracted a lot of attention in recent years because of interest in the use of biomass-derived fuels and chemicals. The raw materials used may contain up to 50 wt% of oxygen. In this chapter, some practical methods for the selective catalytic hydrodeoxygenation of phenols and alcohols to give arenes and alkanes, respectively, and the deoxydehydration of diols using hydrogen gas or transfer-hydrogenation methods are described.



Keywords: hydrogenolysis · hydrogenation · reduction · alcohols · diols · alkanes · alkenes

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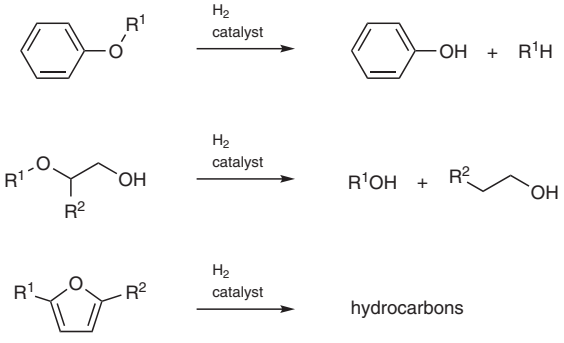
1.7 Hydrogenolysis of Ethers

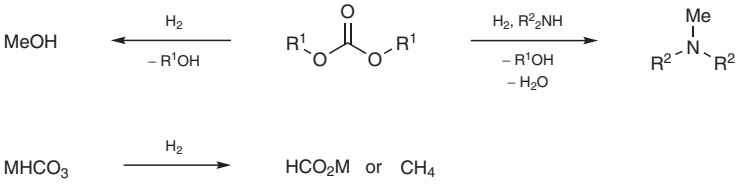
Y. Nakagawa, M. Tamura, and K. Tomishige

Selective hydrogenolysis of ethers to alcohols and hydrocarbons is becoming possible with appropriate metal catalysts. Total removal of oxygen atoms from functionalized ethers to give alkanes, especially from furan derivatives toward biofuels, is catalyzed by a combination of metal and acid.



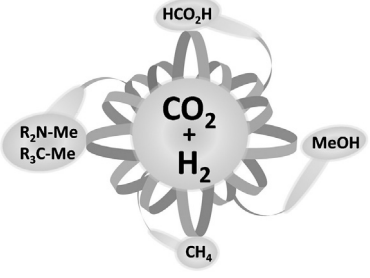
Keywords: hydrogenolysis · hydrogenation · reduction · aryl ethers · unsymmetrical ethers · cyclic ethers · furan · biomass resources · biofuels

Carbonates are basic chemicals that are widely used in both industry and academia. Their reduction under either homogeneous or heterogeneous catalytic conditions generates formates, methanol, or methane. Carbonates can also act as a C_1 building block for the reductive methylation of amines.



Keywords: reduction · hydrogenation · homogeneous catalysis · heterogeneous catalysis · carbonates · alcohols · hydrolysis · formates · methylation

Carbon dioxide is an economical, safe, and renewable C_1 source. This attractive C_1 building block is mainly used in the synthesis of organic chemicals, materials, and carbohydrates. As a feedstock to produce chemicals and fuel derivatives, carbon dioxide utilization will most certainly become an important tool in the quest for more sustainable chemistry. The atom-economical hydrogenation of carbon dioxide using dihydrogen offers a unique opportunity to achieve that goal. The main products of carbon dioxide hydrogenation or reduction fall into two categories: fuels and chemicals. The main topics discussed in this chapter are the hydrogenation of carbon dioxide to formic acid, methanol, and methane, as well as the reductive methylation of amines and C—H bonds. Both homogeneous and heterogeneous catalytic metal systems are reviewed herein.



Keywords: carbon dioxide · formic acid · formates · methanol · hydrogenation · homogeneous catalysis · heterogeneous catalysis · reductive methylation · reduction

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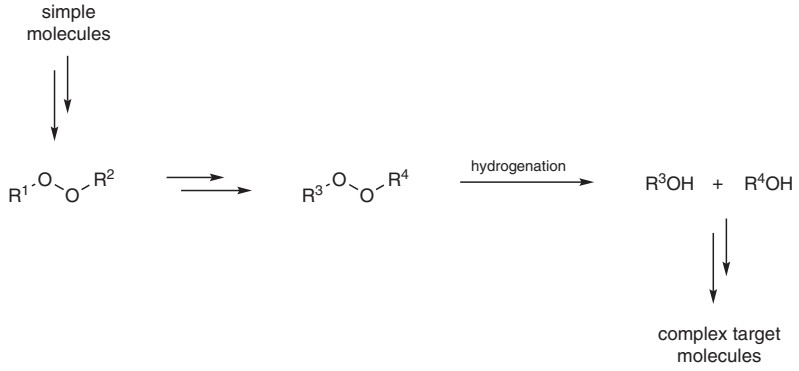
1.10 Reduction of Peroxo Compounds, Ozonides, and Molozonides

P. Poechlauer and A. Zimmermann

Research in the field of heterogeneous catalytic hydrogenation of peroxo compounds, ozonides, and molozonides has delivered results in a diverse range of fields of organic chemistry. It has revealed details of the reaction mechanisms that take place at the catalyst surface, and has enabled further understanding of the factors governing the chemoselectivity of various catalysts. Apart from enabling yield increases in single transformations, this has also opened up opportunities to apply the introduction and subsequent hydrogenation of peroxo moieties in multistep syntheses of complex molecules. The facile introduction of the peroxide moiety via very different reactions at positions otherwise difficult to access, and its subsequent transformation in the presence of other functional groups, has allowed the design of concise synthetic pathways to complex molecules, including pharmaceuticals and natural products.



Keywords: heterogeneous catalysis · reduction · oxidation · hydrogenation · peroxides · endoperoxides · ozonolysis · alcohols

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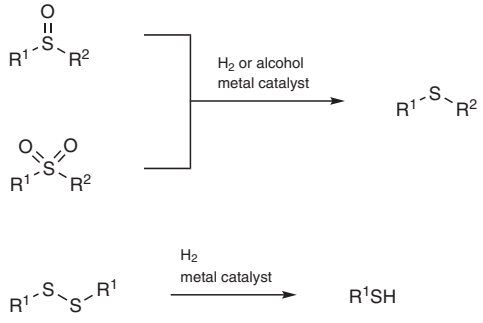
1.11 Reduction of Sulfur Compounds Using Metal Catalysts

K. Kaneda and T. Mitsudome

Homogeneous and heterogeneous metal catalysts based on molybdenum, rhenium, ruthenium, and platinum promote the reduction of sulfur compounds such as sulfoxides, sulfones, and disulfides by using alcohols or molecular hydrogen as reductants.



Keywords: reduction · hydrogenation · transfer hydrogenation · sulfides · thioethers · disulfides · sulfoxides · sulfones · thiols · deoxygenation · sulfur compounds · homogeneous catalysts · heterogeneous catalysts · green chemistry

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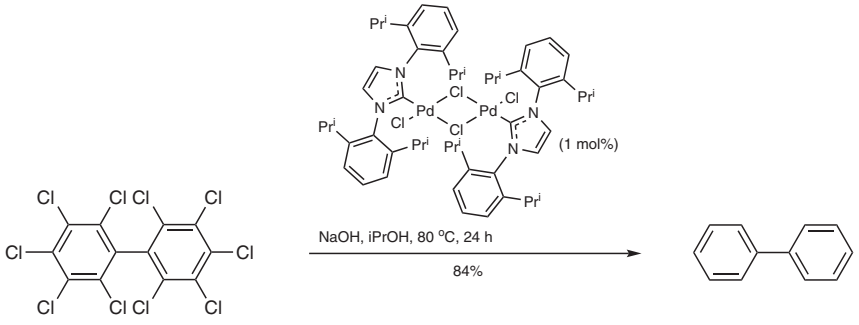
1.12 Catalytic Hydrodehalogenation Reactions

B. Ghosh and R. E. Maleczka, Jr.

Hydrodehalogenation, or reductive dehalogenation, is an important organic transformation that is often used as a detoxification process in industry. A number of methods have been employed to effect this transformation in organic synthesis. Metal-catalyzed hydrodehalogenation is among the popular methods and is typically performed with molecular hydrogen or via transfer hydrogenation from other reagents. The current review highlights development in metal-catalyzed hydrodehalogenation reactions in the last 15 years, where protocols to afford spectroscopically characterized reaction products have been established.



Keywords: dehalogenation · heterogeneous catalysis · homogeneous catalysis · reduction · haloalkanes · alkanes · haloarenes · arenes · transition-metal catalysis · photoredox catalysis