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Book Review

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N-heterocyclic carbenes in synthesis

Wiley-VCH, 2006,
304 pp; price €139.00
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N-heterocyclic carbenes (NHCs) have been increasingly used over the last decade for a range of purposes, ranging from their use as ligands for transition metals to their direct applications as organocatalysts. This treatise, edited by Steven Nolan, provides an outline and discussion of the work carried out within this area to date. The book is made up of 12 chapters, with diverse topics ranging from cross coupling reactions mediated by Pd–NHC complexes to complexes for olefin metathesis and organocatalysis. The length and style of each of the chapters differs markedly, ranging from specialist reviews of a certain reaction type of metal complex to broad overviews of an area within the field, and in this way will be a useful addition as a reference text to practicing chemists or newcomers to the area. The only real drawback with this book, which covers the field to the beginning of 2006, is that many advances within this research area (notably within the area of organocatalysis) have been made since this time; this merely reflects the importance and growth within this field and emphasizes the need for reference books of this type.

Chapter 1 details a highly instructive and comprehensive account of NHC-Ru complexes for olefin metathesis and covers mechanistic detail, asymmetry and immobilization. Chapter 2 covers the remainder of the NHC–Ru complex field, detailing hydrogenation, hydrosilyation and transfer hydrogenation processes before looking at tandem reaction processes both involving and excluding metathesis reactions. In Chapter 3, Nolan and Scott cover a number of cross-coupling reactions catalysed by Pd^0 and Pd^{II}–NHC complexes, while in Chapter 4 the ability of Pd–NHC complexes to act as catalysts in telomerization and aryl amination reactions is discussed in great detail. Chapter 3 is perhaps slightly too concise and not comprehensive although still instructive, while Chapter 4 is perhaps guilty of expressing too much detail for these industrially important applications. The following two chapters, dealing with metal mediated oxidations using NHCs and the hydrosilylation of alkenes by Pt^0 complexes, cover reactivity, mechanism and structure of the catalysts used in these specialized areas. In Chapter 5, Schultz and Sigman provide a clear and authoritative account of NHC catalysed oxidation procedures with a range of metals, while the mechanistic detail in Chapter 6 details the intricacies of the hydrosilylation reaction to the non-specialist. In Chapter 7 Louie gives a great overview of the area of Ni–NHC mediated catalysis, covering a range of areas ranging from rearrangements to cycloaddition chemistry and reductive couplings. Chapter 8 is especially useful for readers interested in the development of chiral NHCs for asymmetric catalysis, as it contains a detailed breakdown of the many structural classes of chiral NHC that have been used in the literature and their uses for a range of different applications including asymmetric hydrogenation, 1,4 addition, hydrosilylation and olefin metathesis. In Chapter 9, Crabtree and Rivera introduce and detail the synthetic strategies used for the preparation of chelate and pincer NHC complexes to date, while in Chapter 10 the preparation and uses of iridium based NHC complexes for applications in hydrogenation are discussed. Chapter 11 is devoted to the uses of Cu, Ag and Au–NHC complexes in catalysis and emphasizes the important place that Ag–NHC complexes have as carbene delivery agents within this field. Chapter 12 concentrates upon the development of NHCs as organic catalysts and comments upon their use in Benzoin, Stetter or homoenolate reactions, but focuses mainly upon their use as transesterification agents with applications in ring opening polymerization. Although useful, this chapter is not comprehensive and does not reflect the current state of the art, which has made considerable progress within the last few years.

In conclusion, this book is an important addition to the area of NHC chemistry, giving a general overview of the vast array of chemistry supported by NHCs and will be a useful reference for both specialist and non-specialist chemists working within this discipline.

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