

The Pauson–Khand Reaction

The Pauson–Khand reaction is a versatile metal-mediated cyclisation affording a cyclopentene in one step from an alkene and an alkyne in the presence of a carbon monoxide source. Developed in the 1970s by Pauson and Khand at the University of Strathclyde in Glasgow, the original procedure involves heating a dicobalt hexacarbonyl alkyne complex with an alkene to effect the cyclization, while newer methods are catalytic and employ other transition metals such as Rh, Ir, Ru, and Ni. Although a number of reviews exist, this book edited by Ramon Rios Torres, is the first comprehensive treatise on the Pauson–Khand reaction and is a much needed complement to existing literature.

The first chapter gives an introduction to the reaction and some of the historical background, and discusses important aspects such as the regioselectivity, stoichiometric versus catalytic processes, inter- and intramolecular reactions, and the use of promoters. Chapter 2 delves more deeply into the mechanism, looking at the individual steps of the cobalt-mediated transformation and reporting on more recent computational studies aiming at a deeper understanding of the mechanism and the regioselectivity.

Chapter 3 covers the more general aspects of the Pauson–Khand reaction including catalytic versions using cobalt complexes. The following three chapters deal with the asymmetric Pauson–Khand reaction, starting with the chiral pool approach and moving on to chiral auxiliaries, promoters and ligands. Chapter 7 then discusses catalytic methods using other transition metals than cobalt. A nice feature here is a table that summarizes the catalysts and reaction conditions used in each case. Tandem reactions are also mentioned briefly. Another chapter deals with heterogeneous catalysis. Lacking here is the mention of which catalyst has been used for the results shown in each table. This is confusing as the reader is continuously obliged to refer to the text for clarification. Apart from this omission, the chapter is a useful complement to the earlier sections on homogeneous catalysis, and may be of special interest to researchers in this area.

Many natural products contain five-membered rings and it is thus not surprising that the Pauson–Khand reaction has been extensively exploited in total synthesis. One chapter is devoted entirely to such applications and also includes other target molecules such as annulenes. Unfortunately, some of the schemes have been reduced in size to the

extent of being difficult to read, but the chapter itself is likely to interest a wide range of readers. The final chapter discusses alternatives to the Pauson–Khand reaction for preparing cyclopentenones, with a focus on cycloadditions involving other transition metals. This is a very nice supplement to the earlier chapters, enabling comparison of different methods.

There is overlap of content between some chapters, but this not really a problem as these topics are discussed from different angles depending on the focus of the chapter. However, it is mildly annoying to find the general definition of a Pauson–Khand reaction repeated at the start of several chapters, and this could perhaps have been rectified in the editing process. A standardized format for the references in each chapter would also have been desirable. Apart from this mild criticism, the layout is pleasing, with many schemes and figures to facilitate understanding, and few typographical errors. Chapters covering the hetero-Pauson–Khand reaction, as well as unusual substrates such as allenes, could have been of interest, but overall the book covers the main aspects of the reaction in a well-disposed way.

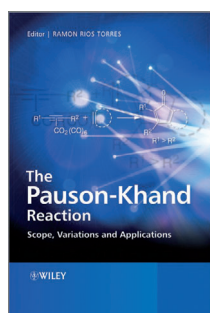
Although much development of the Pauson–Khand reaction has taken place in recent years, with the advent of catalytic methods, alternative carbon monoxide sources, and asymmetric reactions, this [2+2+1] reaction can nevertheless be challenging with certain substrates. In particular the intermolecular reaction does not always provide satisfactory yields unless reactive alkenes are used. In addition, the area of asymmetric Pauson–Khand reactions is as yet limited in scope. There is thus still a need to improve efficiency and selectivity in this versatile cyclization, and for this purpose the book is timely and a useful starting point.

The book is most likely to attract readers already working within the area of organometallic chemistry, but several of the chapters may be of interest to researchers in other fields, i.e., natural product chemistry, heterogeneous catalysis, and asymmetric synthesis. The starting chapter is suitable for a first year graduate student and gives an easily digestible introduction to the Pauson–Khand reaction, while other chapters may be more challenging reading for a novice. Overall the book provides a useful and detailed insight into the Pauson–Khand reaction, and will most likely be of interest to a wide range of readers.

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