SYNLETT Spotlight 181

Synthetic Applications of Oxone®

Compiled by Wei He

This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research

Wei He was born in Shaanxi, P. R. of China. She studied organic chemistry at Northwest University, Xi'an, P. R. of China, where she obtained her B.Sc. (1994) and M.Sc. (1999). She is currently pursuing her Ph.D. under the supervision of Prof. Sheng Yong Zhang at the School of Pharmacy, Fourth Military Medical University, Xi'an, P. R. of China. Her research interests include asymmetric catalysis, new synthetic methods for green chemistry and bioactive natural product synthesis.

Department of Chemistry, School of Pharmacy, Fourth Military Medical University, Xi'an 710032, P. R. of China
E-mail: hewei_chem@yahoo.com.cn

Introduction

Oxone® consists of $2\text{KHSO}_5 \cdot \text{KHSO}_4 \cdot \text{K}_2\text{SO}_4$; its active component is potassium peroxymonosulfate (KHSO_5), a powerful oxidizing agent in synthetic organic chemistry which has proved to be a versatile reagent for various organic transformations. Oxone® is commercially available and can be used immediately. Apart from its well-known applications as oxidizing agent in some transformations reviewed by Narsaiah,¹ it has found a number of other

applications in synthetic chemistry in recent years, such as deprotection of functional groups, functional-group transformations, and cleavage of linker molecules from solid support. It has also shown wide potential in chiral ketone-catalysed asymmetric epoxidation of alkenes² leading to a variety of natural product skeletons, where its unique regioselective properties gave excellent results for the preparation of key intermediates.

Abstracts

(A) Oxidation of aldehydes to acids and esters:

B. Borhan and coworkers³ reported a highly efficient, mild and simple protocol for the oxidation of aldehydes to carboxylic acids using Oxone® as the sole oxidant. Direct conversion of aldehydes to their corresponding esters in alcoholic solvents was also reported, which was proved to be a valuable alternative to traditional metal-mediated oxidations.

(B) Oxidation of alkyl amines to nitroxides and hydroxylamines:

Secondary amines were oxidized to the corresponding nitroxides with Oxone® in aqueous buffered solution at 0 °C and yields of 75–93% can be obtained for different substrates.⁴ When Oxone® is supported on silica or alumina, primary and secondary amines can also be oxidized selectively to hydroxylamines in either the presence or absence of a solvent.⁵

(C) Oxidation of aromatic amines to nitro- or nitrosoarenes:

Apart from oxidation to nitro compounds with Oxone® in 5–20% aqueous acetone and buffered sodium bicarbonate,⁶ aromatic amines can also be oxidized to nitrosoarenes in CH_2Cl_2 – H_2O in good to excellent yields.⁷

(D) *Oxidative cleavage of 1,3-dicarbonyls and alkynes to carboxylic acids:*

Using Oxone® as oxidizing agent, 1,3-dicarbonyls were transformed to carboxylic acids in good yield.⁸ Also alkynes were transformed to carboxylic acids with ruthenium-catalyzed Oxone® oxidative cleavage.⁹

(E) *Oxidation of unactivated C–H bonds:*

D. Yang and coworkers¹⁰ have reported the intramolecular oxidation of unactivated C–H bonds by dioxiranes generated in situ. This method has been applied successfully for the construction of novel tetrahydropyran derivatives.

(F) *Selective halogenation reaction:*

When using NaX combined with Oxone®, selective halogenation could be carried out effectively in some flavanones.¹¹

(G) *Deprotection of tert-butyldimethylsilyl ethers:*

G. Sabitha et al.¹² have reported an approach for the cleavage of *tert*-butyldimethylsilyl ethers by Oxone® in 50% aqueous methanol at room temperature. This method enables one to deprotect *tert*-butyldimethylsilyl ethers to yield primary alcohols in the presence of *tert*-butyldimethylsilyl ethers of secondary and tertiary alcohols and phenols, which could tolerate a wide variety of other functional groups. The silyl ethers of phenols were also deprotected after longer reaction times.

(H) *Cleavage methodology for solid-phase synthesis:*

E. Petricci¹³ et al. have developed an original and highly efficient Oxone® cleavage methodology for the solid-phase synthesis of substituted uracils.

References

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