

SYNLETT Spotlight 128

Magnesium Bis(monoperoxyphthalate) Hexahydrate (MMPP)

Compiled by Manuel Alcarazo Velasco



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

M. Alcarazo was born in Alcalá de Guadaíra, Seville in 1978. He received his degree in chemistry at the University of Seville in 2000. He then joined Dr. J. M. Lassaletta's research group, where he is conducting his PhD research in the areas of asymmetric synthesis and catalysis. His present research interests are the design, synthesis, and applications of new chiral N-heterocyclic carbenes prepared from hydrazines, and the use of chiral bishydrazones as N,N ligands in asymmetric catalysis.

Instituto de Investigaciones Químicas (CSIC-USE), Américo Vespucio s/n, 41092-Sevilla, Spain
E-mail: malcarazo@iiq.csic.es

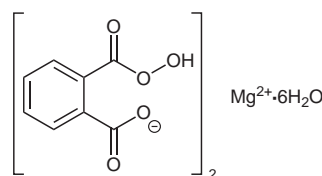
Introduction

Magnesium bis(monoperoxyphthalate) hexahydrate (MMPP) is a commercially available, inexpensive, and relatively stable reagent suitable for the oxidation of a variety of organic substrates. It is easy and safe to handle, even in large-scale reactions. MMPP has been used for the oxidation under mild conditions of a wide range of compounds including alkenes, ketones, sulfides, sulfoxides, hydrazones and hydrazides, and is thus one of the most attractive peroxyacids for this type of reaction.

Besides stability and safety advantages, there are additional practical aspects to this reagent: (1) since it is water-soluble, excess MMPP or the resulting magnesium bis(phthalate) can be removed from the reaction mixture by a simple aqueous work-up; and (2) it can be used in buff-

ered solutions, thus the range of functional groups that tolerates the reaction conditions is increased.

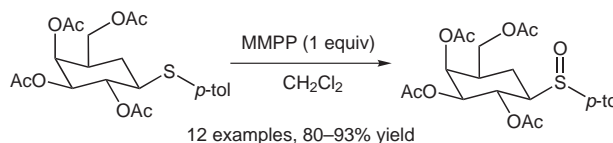
The most evident disadvantage of the reagent is also related to its solubility: since it is a salt, it has low solubility in the most common non-polar solvents. Recently, however, the use of a solid-phase-supported version of the reagent on silica gel has been successfully applied to overcome this limitation in some particular cases.¹



Abstracts

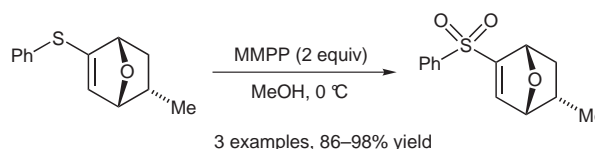
(A) Oxidation of sulfides to sulfoxides:

Sulfides are cleanly transformed into the corresponding sulfoxides in good yields when MMPP (1 equiv) is used as oxidant. The yields using this reagent are better than those obtained using typical oxidants such as oxone or sodium periodate. Moreover, no overoxidation to the sulfone is observed when the correct stoichiometry is used.²



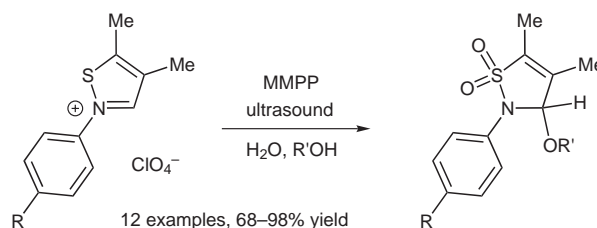
(B) Oxidation of sulfides to sulfones:

Alternatively, when an excess of MMPP (2 equiv) is used in the oxidation of sulfides, the corresponding sulfones are formed in good yields.³



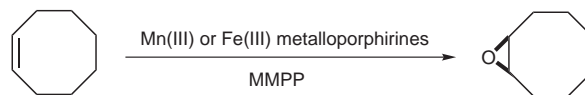
(C) Oxidation of isothiazolium salts to sultams:

The ultrasound-stimulated oxidation of isothiazolium salts with MMPP in EtOH or H₂O affords 3-alkoxy or 3-hydroxysultams in high yields.⁴



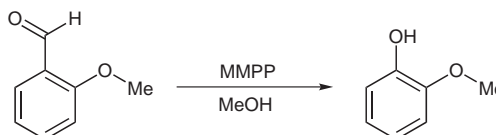
(D) Epoxidation of alkenes:

MMPP is also used as the oxygen source for the epoxidation of linear or cyclic olefins, using pernitrated porphyrin ligands for transition-metal catalysts. Mn(III) derivatives are preferred metalloporphyrins for the epoxidation of linear olefins, while Mn(III) or Fe(III) derivatives are the reagents of choice for cyclic olefins.⁵

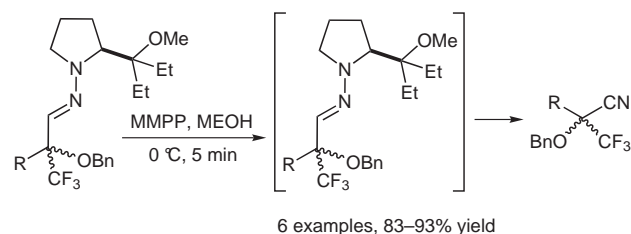


(E) Transformation of aromatic aldehydes to phenols:

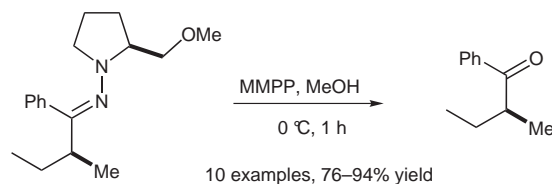
Most aromatic aldehydes are oxidized to the corresponding carboxylic acids. However, it was recently reported that *ortho*- and *para*-methoxybenzaldehydes are transformed to the analogous phenols using MMPP as the oxidant.⁶

(F) Oxidative conversion of aldehyde *N,N*-dialkylhydrazones to nitriles:

The transformation of aldehyde *N,N*-dialkylhydrazones into nitriles has been accomplished using different procedures, but the conditions required are often harsh, like hyperbasic or strongly oxidative media. The use of MMPP allows this transformation in high yield, even for densely functionalized hydrazones containing, for example, protected carbohydrate moieties.⁷

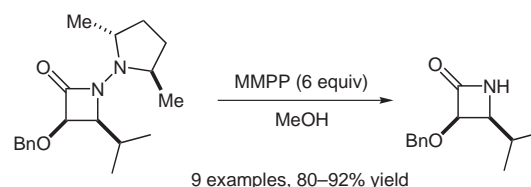
(G) Oxidative cleavage of ketone *N,N*-dialkylhydrazones to ketones:

When ketone *N,N*-dialkylhydrazones are used as substrates for the above reaction, ketones are obtained instead of nitriles. The reaction is again high yielding and chemoselective, and proceeds without racemization.⁸



(H) Oxidative deamination of tertiary hydrazides:

The N–N bond cleavage of tertiary hydrazides by MMPP is applied to the deamination of substrates such as *N*-dialkylamino β -lactams under mild conditions. This methodology is not only an efficient solution where other deprotecting methodologies fail, but appears to be the only procedure suitable for substrates that carry functionalities sensitive to reductive conditions.⁹



References

- (1) Ali, M. H.; Stevens, W. C. *Synthesis* **1997**, 764.
- (2) Chen, M.; Patkar, L. N.; Lin, C. C. *J. Org. Chem.* **2004**, *69*, 2884.
- (3) (a) Arjona, O.; Menchaca, R.; Plumet, J. *Tetrahedron* **2001**, *57*, 6751. (b) Arjona, O.; Menchaca, R.; Plumet, J. *J. Org. Chem.* **2001**, *66*, 2400.
- (4) Taubert, K.; Siegemund, A.; Einfeld, A.; Baumann, S.; Sieler, J.; Schulze, B. *Synthesis* **2003**, *14*, 2265.
- (5) (a) Haber, J.; Iwanejko, R.; Poltowicz, J.; Battioni, P.; Mansuy, D. *J. Mol. Catal. A: Chem.* **2000**, *152*, 111. (b) Haber, J.; Iwanejko, R.; Poltowicz, J.; Battioni, P.; Mansuy, D. *J. Mol. Catal. A: Chem.* **2000**, *152*, 117.
- (6) Heaney, H.; Newbold, A. *Tetrahedron Lett.* **2001**, *42*, 6607.
- (7) (a) Fernández, R.; Gasch, C.; Lassaletta, J. M.; Llera, J. M.; Vázquez, J. *Tetrahedron Lett.* **1993**, *34*, 141. (b) Pareja, C.; Martín-Zamora, E.; Fernández, R.; Lassaletta, J. M. *J. Org. Chem.* **1999**, *64*, 8846. (c) Díez, E.; Fernández, F.; Gasch, C.; Lassaletta, J. M.; Llera, J. M.; Martín-Zamora, E.; Vázquez, J. *J. Org. Chem.* **1997**, *62*, 5144.
- (8) Enders, D.; Plant, A. *Synlett* **1990**, 725.
- (9) Fernández, R.; Ferrete, A.; Llera, J. M.; Magriz, A.; Martín-Zamora, E.; Díez, E.; Lassaletta, J. M. *Chem. Eur. J.* **2004**, *10*, 737.